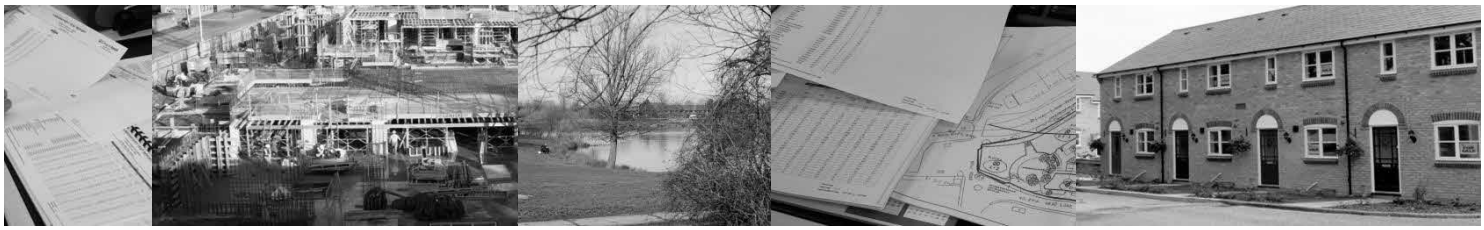

PHASE II GROUND INVESTIGATION & GENERIC RISK ASSESSMENT REPORT

Unit 12, Dencora Park, Saffron Walden, Shire Hill, Saffron Walden, CB11 3GB

Project Reference:
CON257-SAFF-001

Site Address:
Unit 12
Dencora Park
Shire Hill
Saffron Walden
CB11 3 GB

Report Date:
12 April 2024

Version Number:
Version 1.0

Customer:
Digicopy Group Holdings Limited
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Dencora Park
Shire Hill
Saffron Walden
CB11 3GB

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

Stansted Environmental Services Limited has been commissioned by Digicopy Group Holdings Limited, to undertake a Phase II Generic Risk Assessment for Unit 12, Dencora Park, Saffron Walden, Shire Hill, Saffron Walden, CB11 3GB. The site may be located by National Grid Reference TL 547382.

This Phase II Generic Risk Assessment has been prepared to assess contamination in relation to the proposed redevelopment of the site and has considered a variety of sources of information regarding the past land uses.

It is understood that the roof of the existing building is to be replaced and the building extended to provide eco-cycle storage/retail space.

Reference to the BGS website indicates that the site is underlain by the Lewes Nodular Chalk Formation and Seaford Chalk Formation. No superficial deposits are shown.

The Lewes Nodular Chalk Formation and Seaford Chalk Formation has been identified as a Principal Aquifer by the Environment Agency. The site is shown within the Total Catchment (Zone 3) of the Groundwater Source Protection Zone by the Environment Agency.

A Phase I Desk Study and Preliminary Risk Assessment for the site was carried out by SES and issued on the 8th March 2024 v1.0, project ref. CON257-SAFF-001. Significant pollutant linkages were identified associated with the site and, therefore, further works were recommended with respect to contamination.

An intrusive investigation was undertaken on the 15th of March and consisted of three dynamic window sampler boreholes to a maximum depth of 4.00m. Standpipes were inserted into selected holes for ongoing gas and groundwater monitoring. Suitable soil samples were taken and subjected to a range of contaminant testing.

The intrusive investigation encountered Made Ground to 4.00m bgl corresponding to the maximum depth drilled.

All the boreholes were dry during the subsequent monitoring visits except for WS03 where the groundwater level was measured at 3.50m bgl on the 28th March 2024.

A raft foundation or, alternatively, pile foundations are suggested for the proposed building extension.

A Design Sulphate Class of DS-1 and ACEC Class of AC-1 should be adopted for the site.

Based on the gas monitoring carried out on site during three visits in March 2024, the site may be designated as Characteristic Situation (CS) 1.

All the contaminants tested in the samples collected from the Made Ground exceeded their respective S4UL/C4SL in all instances. Therefore, 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.

In light of this, no pollutant linkages have been identified and no remediation is deemed to be necessary at the site in relation to the proposed commercial use.

This report should be submitted to the Local Authority as suitable evidence to discharge Condition 3 of the Planning Application UTT/23/3202/FUL, relating to contamination.

1. INTRODUCTION

Stansted Environmental Services Limited (SES) has been commissioned by Digicopy Group Holdings Limited, the Client, to provide a Phase II Generic Risk Assessment Report for the site at Unit 12, Dencora Park, Shire Hill, Saffron Walden, CB11 3GB.

The purpose of the investigation was to evaluate the contamination status at the site and to develop a risk assessment based on the past uses of the site and the proposed end use. In addition, geotechnical parameters have been provided to allow for foundation design.

It is understood that the roof of the existing building is to be replaced and the building extended to provide eco-cycle storage/retail space.

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/23/3202/FUL (dated 19th February 2024), is to replace asbestos roof sheeting with composite insulated steel sheeting including full length skylights each side. Single storey side extension to provide eco cycle storage/retail space.

The permission has the following condition attached:

3 *No development approved by this permission shall take place until a Phase 1 Desk Study report documenting the ground conditions of the site with regard to potential contamination has been submitted to and approved in writing by the Local Planning Authority. This report shall adhere to BS10175:2011.*

Where shown to be necessary by the Phase 1 Desk Study, a Phase 2 Site Investigation adhering to BS 10175:2011 shall submitted to and approved in writing by the Local Planning Authority.

Where shown to be necessary by the Phase 2 Site Investigation a detailed Phase 3 remediation scheme shall be submitted for approval in writing by the Local Planning Authority. This scheme shall detail measures to be taken to mitigate any risks to human health, groundwater, and the wider environment. Any works which form part of the Phase 3 scheme approved by the local authority shall be completed in full before any permitted building is occupied.

The effectiveness of any scheme shall be demonstrated to the Local Planning Authority by means of a validation report (to incorporate photographs, material

transport tickets and validation sampling), unless an alternative period is approved in writing by the Authority.

Any such validation should include responses to any unexpected contamination discovered during works.

Reason: To protect human health and the environment in accordance with Policy ENV14 of the Uttlesford District Local Plan 2005 and the NPPF.

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.

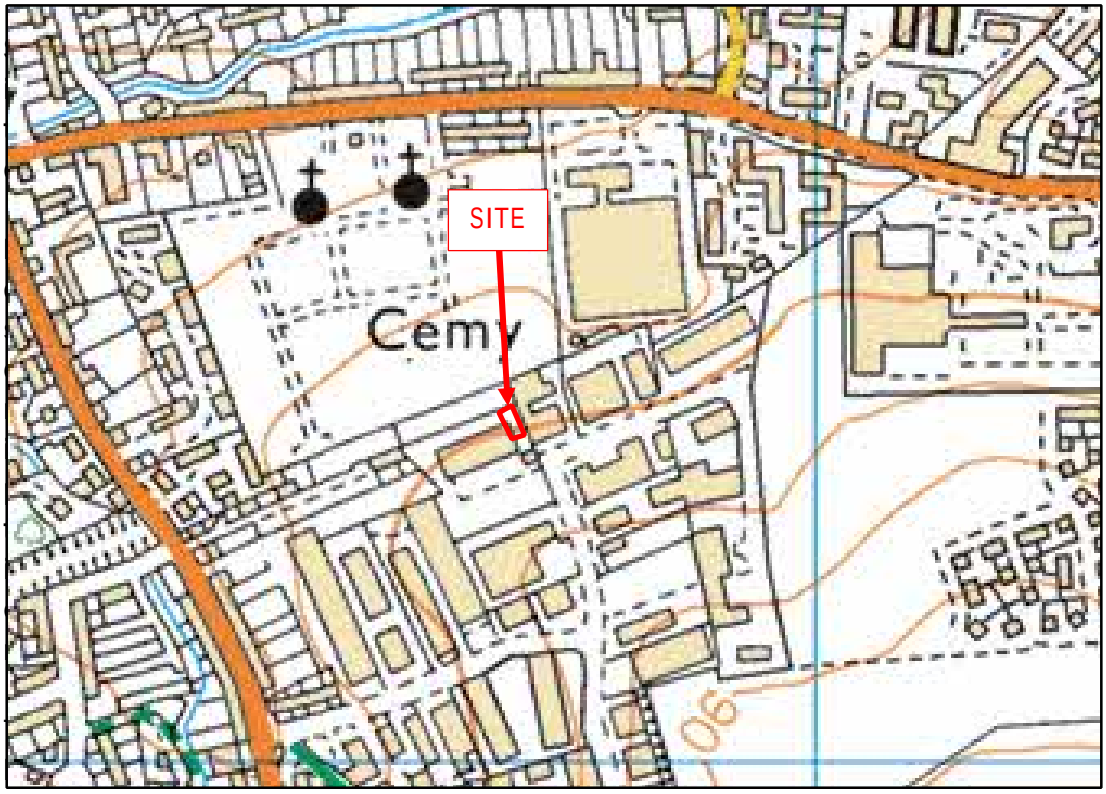
2. SITE SETTING

2.1 Site Location

The site is located at Unit 12, Dencora park, Shire Hill, Saffron Walden, CB11 3GB and may be approximated by the National Grid reference TL 547382. The site location is shown in Figure 1.

FIGURE 1: Site Location Plan

2.2



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The site is rectangular in shape, covering an area of approximately 200m^2 and is roughly level. The site is immediately bounded by The Saffron Walden Cemetery to the north, the Dencora Park to the west and other commercial and industrial units to the south and the west.

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 Lewes Nodular Chalk Formation and Seaford Chalk Formation (Undifferentiated) (White Chalk Subgroup). No superficial deposits are shown.

2.4 Hydrogeology

The Lewes Nodular Chalk Formation and Seaford Chalk Formation has been identified as a Principal Aquifer by the Environment Agency. The site is shown within the Total Catchment (Zone 3) of the Groundwater Source Protection Zone by the Environment Agency.

2.5 Proposed Development

It is understood that the roof of the existing building is to be replaced and the building extended to provide eco-cycle storage/retail space.

3. SUMMARY OF PHASE I DESK STUDY

A Phase I Desk Study and Preliminary Risk Assessment for the site was carried out by SES and issued on the 8th March 2024 v1.0, project ref. CON257-SAFF-001.

The site appeared to have been on the Saffron Walden Railway until 1970 when it was dismantled. In 1982 an extension to an existing workshop occupied part of the southern part of the site. The area to the north of the site has been used as cemetery since the first Ordnance dated 1877. The rest of the immediate surrounding of the site has been used as nurseries until 1970s and subsequently redeveloped to provide industrial units until the current time.

At the time of the walkover, the site was a small patch of grass with nettles and litter scattered around. The site was immediately bounded by Unit 12 to the south, a car park directly west from the site, a steep slope to the north ending up in the cemetery area and a building to the east. Several trees were present about 20m to the north of the site. Asbestos cement sheeting was noted on the roof of Unit 12.

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

TABLE 1: Potential sources of contamination

Location	Source	Contaminant
On-site (current)	Made ground used to backfill the site after dismantling of the railway line	Heavy metals, PAHs, TPHs, asbestos, Ground gases (e.g. carbon dioxide, methane)
On-site (current)	Asbestos cement sheeting	Asbestos
Off-site (current)	Fuel tanks about 60m to the northeast of the site.	TPHs, PAHs
Off-site (current)	Electrical substation	PCBs
Off-site (current)	Cemetery	Heavy Metals, VOCs, Ground gases (e.g. carbon dioxide, methane)
Off-site (current)	Petrol filling stations	TPHs, PAHs
Off-site (current)	Factories	TPHs, PAHs, PCBs, heavy metals, VOCs, solvents, chemical additives.
Off-site (historical)	Nurseries	Herbicides, pesticides, fertilisers
Off-site (historical)	Gas works located 240m to the northwest	PAHs, Ground gases (e.g. carbon dioxide, methane)
Off-site (historical)	Cement works	TPHs, Heavy metals, PAHs, PCBs, Ground gases (e.g. carbon monoxide, sulphur oxides)
Off-site (historical)	Timber yard about 130m west	TPH, PAHs, Chlorinated solvents
Off-site (historical)	Made ground used to backfilled chalk pits	Ground gases (e.g. carbon dioxide, methane)

There was a potential for the soil on-site to be impacted with a number of contaminants including asbestos, PAHs, PCBs and heavy metals released into the ground by the made ground used to backfill the area after the dismantling of the Saffron Walden Railway. Considering the amount of Made Ground potentially used the risk posed by them was judged to be moderate.

This Made Ground could be significantly impacted by volatile contaminants, such as petroleum hydrocarbons, or other organic materials. These have the potential to decompose in anaerobic conditions and generate hazardous ground gases including methane and carbon dioxide. The risk to human health was judged to be low.

It was considered that there was the potential for Made Ground of unknown origin to have been used to infill the chalk pits off site. This has the potential to generate ground gases. Given the time elapsed from the infilling, the distance from site the risk to human health was judged to be very low.

Corrugated asbestos cement sheets were used to cover the building on-site. Considering the overall good conditions and the amount of asbestos contained in this type of sheeting the risk posed by it was considered to be low.

Fuel tanks were present about 60m to the northeast of the site. These could be source of hydrocarbons. Considering the size of them and the distance from site, the risk posed by it was considered to be low.

Potential pesticides, herbicides and fertilizers may have migrated into the groundwater from the historical nurseries located in the area surrounding the site. Given the distance from the site, the geology of the area and the time the nurseries were dismantled the risk was judged to be very low.

A timber yard was present about 130m to the west of site in the 1970s. Considering the time passed since its closure, the redevelopment of the area and the distance from site, the risk was judged to be negligible.

Electrical substations were currently and historically present off site, given the distance from the site, the relative difficulty of the PCBs to migrate, the geology of the area and the time elapsed from the demolition, the risks were judged to be very low.

Potential TPH, heavy metals, and ground gases such as carbon monoxide and sulphur oxide could have been released by the cement works located 900m south of the site. Considering the distance from site and the geology of the area the risk was judged to be very low.

The cemetery currently present off site located about 20m northwest has the potential to release heavy metals, VOCs, ground gases (e.g. carbon dioxide, methane) into the ground. Given the geology of the area and the distance from site the risk was judged to be low to moderate.

Potential TPHs and PAHs could have been released by the petrol filling stations, the closest located 246m to the east of the site. These have the potential to migrate into the groundwater reaching the site. Considering the distance between the site and the petrol filling station and the geology of the area, the risk was considered to be very low.

Several unknown factories and works were located on and around the study site. These factories could be source of several contaminants such as TPHs, PAHs, PCBs, heavy metals, VOCs, solvents, chemical additives entering the groundwater and contaminating the site. Given the number of factories, the distance from the site and the geology of the area the risk was judged to be moderate to high.

Gas works were present 240m northwest of the site had the potential to release PAHs, Ground gases (e.g. carbon dioxide, methane) into the ground. Given the distance from site, the geology of the area, and the time passed since closing the risk was judged to be low.

There was a potential for Made Ground of unknown origin to have bene used to infill the historical chalk pits off site, the closest located 600m east. This Made Ground could be source of ground gases (e.g. methane, carbon dioxide). Considering the geology of the area, the possible amount of Made Ground used, the time elapsed since backfilling and the distance from the sources, the risk was judged to be negligible.

The risk to groundwater was considered to be moderate as the site is underlain by the Lewes Nodular Chalk Formation and Seaford Formation which is a high permeability Principal Aquifer and is likely to act as water storage.

Significant pollutant linkages were identified associated with the site and, therefore, further works were recommended with respect to contamination.

An initial Conceptual Site Model (CSM) was developed on the basis of the desk study. The CSM is used to identify potential sources, pathways and receptors (i.e. potential pollutant linkages) on site and is summarised in the table below.

TABLE 2: Outline Initial Conceptual Site Model

Potential Source	Contaminants of Concern	Via	Potential Pathways	Linkage Potentially Active?	Receptors
On-site – current and historical Made Ground Asbestos cement roof	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		N/A
		Groundwater	Direct contact/ingestion		Site users Off-site users
			Inhalation of volatiles		Site users Off-site users
			Vertical and lateral migration in permeable strata		N/A
Off-site – current Electrical substation Cement works Cemetery Fuel stations Factories Timber yard **Off-site – historical:** Gas works Chalk Pits Nurseries	PAHs, PCBs, heavy metals, TPHs, VOCs, Solvents, Chemical additives, herbicides, pesticides, fertilisers, chlorinated solvents	Groundwater	Direct contact/ingestion		Site users
			Inhalation of volatiles		Site users
		Service conduits	Direct contact/ingestion		Site users
			Inhalation of volatiles		Site users
On and off-site Made Ground / natural strata or bio-degradation of contamination Cemetery	Carbon dioxide and methane	Ground Gas	Inhalation of ground gas		Site users Off-site users
			Explosive risks		Site users Off-site users

4. SITE WORK

The site work for the current phase of development was carried out on 15th March 2024 on the basis of the practices set out in BS 10175:2001+A2:2017, BS 5930:2015+A1:2020, ISO 1997:2007. The locations of exploratory holes have been planned, where possible, in general accordance with CLR 4,

Three boreholes, designated WS01 to WS03, were sunk using dynamic sampling techniques at the positions shown on the exploratory hole plan, Appendix A. The depths of the boreholes, descriptions of strata encountered and comments on groundwater conditions are given on the exploratory holes records, Appendix B.

Representative disturbed samples were taken at the depths shown on the borehole 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.

Monitoring installations protected by a stopcock cover were installed in all the boreholes as detailed below:

TABLE 3: Standpipe Installation Details

Borehole Number	Depth to Base of Borehole m	Response Zone m	Nominal Pipe Diameter mm	Gas Valve/Lockable Cover
WS01	3.96	1.00 – 3.96	50	Yes
WS03	3.93	1.00 – 3.93	50	Yes

Gas and groundwater readings were made on three occasions between March and April 2024 the results of which are presented in Appendix C.

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 4: Summary of Ground Conditions

Strata Encountered	Depth Encountered (m bgl)		Maximum Measured Strata Thickness m
	From	To	
Made Ground	Ground Level	>4.00	4.00

5.1 Made Ground

All the exploratory holes encountered Made Ground to a depth of 4.00m bgl corresponding to the maximum depth drilled.

The Made Ground generally consisted of brown mottled white slightly sandy slightly gravelly clay/ Black mottled white sandy slightly silty very angular to angular fine to medium gravel of coal, clinker and chalk, with occasional coal ash.

The natural moisture content for the tested samples ranged from 19.2% to 30.9%.

5.2 Groundwater

No groundwater was encountered during drilling operations.

All the boreholes were dry during the subsequent monitoring visits except for WS03 where the groundwater level was measured at 3.50m bgl on the 28th March 2024.

All the results obtained during the monitoring visits are presented in Appendix C.

6. LABORATORY ANALYSIS

6.1 Geotechnical

A geotechnical laboratory testing programme was carried out to provide further information on the engineering properties of the subsoil. Samples were submitted to Geolabs Ltd while chemical analysis was undertaken by i2 Analytical. Unless stated otherwise, these tests were carried out in accordance with BS 1377 "Methods of Test for Soils for Civil Engineering Purposes." Geolabs Ltd and i2 Analytical have been accredited for specific tests as indicated below, by the United Kingdom Accreditation Service (UKAS). Individual full format reports for tests are available, if required.

Geotechnical laboratory analysis completed to date is summarised in the table below:

TABLE 5*:* Summary of Laboratory Tests

No.	Test	Laboratory	UKAS Accredited
3	Moisture Contents	Geolabs	
2	Water Soluble Sulphate & pH	I2 Analytical	

The laboratory test results for this site are presented in Appendix D.

6.2 Contamination

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 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 E.

7. GEOTECHNICAL ASSESSMENT AND RECCOMENDATIONS IN RELATION TO THE PROPOSED DESIGN

7.1 Structural Design

It is understood that the roof of the existing building is to be replaced and the building extended to provide eco cycle storage/retail space.

7.3 Preliminary Geotechnical Risk Register

The table below summarises the potential geotechnical hazards associated with the development. The table provides an assessment of whether the site is likely to be affected by the hazard and the possible consequences and engineering considerations.

TABLE 6: Geotechnical Risk Register

Hazard Description	Is hazard likely to be present / affect the site? (H / M / L?)	Comments/possible engineering requirements where hazard present
Sudden lateral/vertical changes in ground conditions	H	The ground investigation encountered only Made Ground throughout the depth of the boreholes. The main variations in ground conditions are likely to be associated with the depth and composition of the Made Ground. The White Chalk Subgroup is deemed to be present at depth.
Highly compressible/low bearing capacity soils, (including peat and soft clay)	M/H	SPT N values show the variability of the bearing capacity of the Made Ground.
Ground dissolution features/natural cavities	M/H	The site is underlain by the Lewes Nodular & Seaford Chalk Formation. This formation can be liable to dissolution.
Shrinking and swelling clays	L	The site is underlain by the Lewes Nodular & Seaford Chalk Formation. This formation is not susceptible to shrinking/swelling.
Slope stability/Retaining wall issues	L	A slope is present to the immediate north of the site. Any temporary or permanent slopes or retaining walls created as part of the development should be subject to appropriate geotechnical design based on site-specific site investigation information.
High groundwater table (including waterlogged ground)	L	Groundwater was encountered at 3.50m bgl only in one occasion during the monitoring visits Excavations beneath this depth will require groundwater exclusion and control measures. If the bearing level of traditional foundations is close to or below this level, the allowable bearing capacity of these foundations will be reduced.

Hazard Description	Is hazard likely to be present / affect the site? (H / M / L?)	Comments/possible engineering requirements where hazard present
Filled and Made Ground (including embankments)	L	Made Ground was encountered in all the intrusive holes to 4.00m bgl corresponding to the maximum depth drilled.
Obstructions (including foundations, services, basements, tunnels and adjacent sub-structures)	L/M	The site has previously been developed as reported in the Phase I PRA report, dated 8th March 2024/ Obstructions may therefore be anticipated beneath the site. Specialist construction plant may be required to remove these obstructions which should be programmed for and their location recorded and allowed for during substructure design.
Underground mining	L	There are three recorded ceased chalk pits, the closest located 620m to the east of the site (Turnip Hall Chalk Pit)
Concrete classification	L	Testing indicates that a Design Sulphate Class of up to DS1 and an Aggressive Chemical Environment for Concrete (ACEC) Classification of AC-1s should be appropriate for all buried concrete structures in the Made Ground.
Seismic Activity	L	The Eurocode 8 seismic hazard zoning maps for the UK (Musson and Sargeant, 2007) indicate that horizontal Peak Ground Acceleration (PGA) values with 10% probability of being exceeded in 50 years (475 year return period) are between 0.00g and 0.02g, which is considered very low.
NOTES: H – High Risk; M – Medium Risk; L – Low risk		

7.4 Foundation Design

Based upon average SPT N value results and the low column load expected for a cycle storage/retail space, the Made Ground is likely to provide a suitable bearing stratum and raft foundations are suggested to overcome the potential differential settlement that could occur in this stratum.

Raft foundations should be designed following the guidance suggested by the NHBC Chapter 4.4 “Raft, pile, pier and beam foundations”.

If Made Ground, is not considered suitable as a bearing layer, pile foundations should be adopted to be ending in the underlaying White Chalk Subgroup and recourse should be made to a competent piling contractor.

7.5 Floor Slabs

If raft foundations are adopted, floor slabs should be a minimum of 150mm thick including anti-crack reinforcements.

If pile foundations are adopted, considering the thickness of the Made Ground suspended floor slab should be used. A minimum ventilation void should also be provided as suggested in the NHBC Standards Chapter 5.2.

7.6 Excavations

All excavations are likely to require close sided support in the form of trench sheets or sheet piles. It should be noted that all deposits are likely to deteriorate in the presence of water and it is recommended that all proposed formations are carefully inspected and any loose pockets are removed and the formation restored with granular fill or lean mix concrete as soon as is practicable after excavation. In addition, any constructional disturbance resulting from the excavation of foundations and service trenches should be made good using suitable plant.

Groundwater has been recorded at 3.50m bgl during the monitoring campaign. It would be prudent, however, to have conventional sump pumping techniques available to control groundwater ingress. Nevertheless, it is recommended that groundwater control measures are assessed in relation to the conditions encountered at the time of excavation construction.

7.6 Pavement Design

The structural design of a road or hard standing is based on the strength of the subgrade, which is assessed from the California Bearing Ratio (CBR) scale from which the subgrade surface modulus can be estimated. Experience has shown that the measurement of the in-situ CBR value tends to give unreliable results because of the influence of the moisture content of the materials. In practice, the correlation given by the Highways Agency (design Guidance for Road Pavement Foundations, 2009), is usually more appropriate than direct determination of CBR.

The process of design given in the guidance notes requires an estimate of CBR and subgrade stiffness modulus to be made at the design stage and in-situ measurement prior to construction.

Made Ground is not normally recommended as a sub-grade for pavement construction and any hardstanding or pavements constructed directly onto the Made Ground will be done so with the risk of settlement over time such that a long term maintenance programme will be required.

The assessment assumes there to be a high water table, average construction conditions and a thin pavement construction. Any areas of soft or deleterious material in the Made Ground should be excavated and replaced with a properly compacted granular fill.

7.7 Chemical Attack on Buried Concrete

Chemical testing was carried out on a series of soil samples collected from the Made Ground in the exploratory holes. The ground investigation established that the underlying groundwater condition is likely to be classified as 'mobile'. In accordance with BRE Special Digest 1:2005 Third Edition "Concrete in Aggressive Ground", Table C2 for brownfield locations, the Design Sulphate Class and ACEC Class have been established based upon the available laboratory results.

The results of an analysis indicate water soluble sulphates ranging from 0.032g/l to 0.066g/l with pH in the range of 8.1 to 8.7. Therefore, a Design Sulphate Class of DS-1 and ACEC Class of AC-1 should be adopted.

8. GENERIC RISK ASSESSMENTS

8.1 Results of Soil Analysis

The pH of the tested soils ranged from 8.1 to 8.7 with an average of 8.4. The Soil Organic Matter (SOM) of the samples ranged from 2.0% to 3.6%. 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 7: Results of Metals Analysis

Contaminant	Number of Samples Analysed	Range of Measured Concentration (mg/kg)	Location of Maximum Concentration and Depth (m bgl)
Arsenic	3	9.4 - 9.6	WS01 at 0.35
Beryllium	3	0.47 - 0.65	WS02 at 0.20
Water Soluble Boron	3	1.2 - 3.2	WS02 at 0.20
Cadmium	3	0.4	All locations
Chromium	3	83 - 120	WS03 at 0.45
Chromium VI		All results below Limit of Detection	
Copper	3	23 - 28	WS02 at 0.20
Lead	3	51 - 60	WS02 at 0.20
Mercury	All results below Limit of Detection		
Nickel	3	23 - 56	WS03 at 0.45
Selenium		All results below Limit of Detection	
Zinc	3	76 - 170	WS02 at 0.20

Concentrations of the sixteen PAH compounds analysed are summarised below:

TABLE 8: Results of PAH Analysis

Contaminant	Number of Samples Analysed	Range of Measured Concentration (mg/kg)	Location of Maximum Concentration and Depth (m bgl)
Naphthalene	3	0.17	WS01 at 0.35
Acenaphthylene	3	0.05 - 0.06	WS02 at 0.20
Acenaphthene	3	0.2 - 1.2	WS01 at 0.35
Fluorene	3	0.14 - 0.91	WS01 at 0.35
Phenanthrene	3	0.62 - 13	WS01 at 0.35
Anthracene	3	0.17 - 3.8	WS01 at 0.35
Fluoranthene	3	1.4 - 26	WS01 at 0.35

Contaminant	Number of Samples Analysed	Range of Measured Concentration (mg/kg)	Location of Maximum Concentration and Depth (m bgl)
Pyrene	3	1.3 - 22	WS01 at 0.35
Benzo(a)anthracene	3	0.69 - 12	WS01 at 0.35
Chrysene	3	0.72 - 9.9	WS01 at 0.35
Benzo(b)fluoranthene	3	0.81 - 12	WS01 at 0.35
Benzo(k)fluoranthene	3	0.38 - 4.8	WS01 at 0.35
Benzo(a)pyrene	3	0.73 - 9.8	WS01 at 0.35
Indeno(123-cd)pyrene	3	0.3 - 4.3	WS01 at 0.35
Dibenzo(ah)anthracene	3	0.27 - 1.4	WS01 at 0.35
Benzo(ghi)perylene	3	0.36 - 5.1	WS01 at 0.35

Neither monohydric phenols nor total cyanide 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 9: Results of TPH Analysis

Contaminant	Number of Samples Analysed	Range of Measured Concentration (mg/kg)	Location of Maximum Concentration and Depth (m bgl)
TPH aromatic C_{12}-C_{16}	3	4.3 - 6.9	WS01 at 0.35
TPH aromatic C_{16}-C_{21}	3	44 - 15	WS01 at 0.35
TPH aliphatic C_{21}-C_{35}	3	24 - 14	WS01 at 0.35
TPH aromatic C_{21}-C_{35}	3	16 - 68	WS01 at 0.35
Benzene	3	All results below LoD	
Toluene	3	All results below LoD	
Ethylbenzene	3	All results below LoD	
m/p Xylene	3	All results below LoD	
o Xylene	3	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 roof of the existing building is to be replaced and the building extended to provide eco cycle storage/retail space.

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 proposed development include the construction of a cycle storage/retail space the S4ULs for 'commercial' have been adopted for this assessment.

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 F.

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

TABLE 10: Metals Statistics

Contaminant	Key statistics				S4UL* (Commercial)	
	Number of detects	Min. Value (mg/kg)	Max. Value (mg/kg)	Mean Value (mg/kg)	S4UL (mg/kg)	No. Samples exceeding assessment criteria
Arsenic	3	9.4	9.6	9.5	640	0
Beryllium	3	0.47	0.65	0.59	12	0
Water Soluble Boron	3	1.2	3.2	2.0	240000	0
Cadmium	3	0.4			190	0
Chromium III	3	83	120	95.3	8600	0
Copper	3	23	28	25	68000	0
Lead[#]	3	51	60	51	2330	0
Nickel	3	23	56	39	980	0
Zinc	3	76	170	80	730000	0

Notes to Table

** Most appropriate screening values are Sustainable 4 Use Level (S4UL) for a commercial 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, all the concentrations of heavy metals recorded by the analysis were less than the respective S4UL/C4SL in all instances and 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 11: PAH Statistics

Contaminant	Key statistics				S4UL* (Commercial)	
	Number of detects	Min. Value (mg/kg)	Max. Value (mg/kg)	Mean Value (mg/kg)	S4UL (mg/kg)	No. Samples exceeding assessment criteria
Naphthalene	1	0.17			460	0
Acenaphthylene	2	0.05	0.06	0.06	97000	0
Acenaphthene	2	0.2	1.2	0.7	97000	0
Fluorene	2	0.14	0.91	0.53	68000	0
Phenanthrene	3	0.62	13	5.3	22000	0
Anthracene	3	0.17	3.8	1.5	54000	0
Fluoranthene	3	1.4	26	10.6	23000	0
Pyrene	3	1.3	22	9.0	54000	0
Benzo(a)anthracene	3	0.69	12	5.0	170	0
Chrysene	3	0.72	9.9	4.2	350	0
Benzo(b)fluoranthene	3	0.81	12	5.1	44	0
Benzo(k)fluoranthene	3	0.38	4.8	2.1	1200	0
Benzo(a)pyrene	3	0.73	9.8	4.1	35	0
Indeno(123-cd)pyrene	3	0.3	4.3	1.8	510	0
Dibenzo(ah)anthracene	2	0.27	1.4	0.8	3.6	0
Benzo(ghi)perylene	3	0.36	5.1	2.2	4000	0

Notes to Table

** Most appropriate screening values are Sustainable 4 Use Level (S4UL) for a commercial 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 PAH determinands exceeded their relevant S4UL. It is therefore considered that there is a negligible 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 12: TPH Statistics

Contaminant	Key statistics				S4UL* (Commercial)	
	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_{12}-C_{16}	2	4.3	6.9	5.6	37000	0
TPH aromatic C_{16}-C_{21}	2	15	44	29.5	28000	0
TPH aliphatic C_{21}-C_{35}	2	14	24	19	1700000	0
TPH aromatic C_{21}-C_{35}	3	16	68	35.7	28000	0

Notes to Table

** Most appropriate screening values are Sustainable 4 Use Level (S4UL) for commercial 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.

8.2 Asbestos

None of the samples tested identified the presence of asbestos.

8.3 Generic Gas Risk Assessment

Gas monitoring visits were made on three occasions between March and April 2024 and are summarised in Appendix C.

As the monitoring data shows, methane concentrations were recorded up to 0.01% with carbon dioxide concentrations in the range from 0.08% v/v to 1.92%. Oxygen levels did not vary significantly from atmospheric values.

Flow rates were recorded over a three minute period during the return monitoring visits. The maximum of the three minute average flows was recorded up to at less than 0.2l/hr.

Details of generic ground gas risk assessments are given in Appendix G.

BS8485:2015+A1:2019 has introduced borehole hazardous gas flow rate Q_{hg}. The Q_{hg}, in l/hr, should be calculated for each monitoring location and each monitoring event for each hazardous gas. The values for Q_{hg} for each monitoring visit are given in the Results of Gas Monitoring table in Appendix C.

The maximum Q_{hg} recorded for methane was 0.00002l/hr from WS03 on the 28th March 2024 and for carbon dioxide, a value of Q_{hg} of 0.00368l/hr was recorded in WS01 on the 28th March 2024. Flow rates on these dates were -0.2l/hr in WS03 and 0.2l/hr in WS01.

As explained above, the flow rates used to calculate the maximum Q_{hg} for methane and carbon dioxide are not considered representative and a lower flow rate should be adopted.

The main method of characterising a site is the method described by Wilson and Card (2004) and is termed Situation A. This can be used for all types of development except conventional low-rise housing with suspended ground floor and ventilated underfloor void. Low rise housing (generally up to three storeys), Situation B, was developed by Boyle and Witherington (2006) and was developed for the NHBC for classifying gassing sites for houses with suspended ground floor slab with a ventilated void.

As the site is to be developed as a commercial development, Situation A applies.

The method uses both gas concentrations and borehole flow rate for methane and carbon dioxide to define a Characteristic Situation for a site.

The calculations should be made for both methane and carbon dioxide and the worst case adopted. The GSV is only a guideline.

In accordance with the methodology published in CIRIA Document C665, the maximum recorded values were taken to calculate a Gas Screening Value (GSV) for the site. The GSV is calculated as follows:

$$GSV = \frac{\text{Characteristic gas flow rate (l/hr)} \times \text{Concentration of gas (\% v/v)}}{100}$$

Although this is not dissimilar to the Q_{hg} outlined above, the GSV is determined using the most representative values for methane and carbon dioxide.

Given the low Q_{hg} for both methane and carbon dioxide, these are deemed to be representative of the site and the Q_{hg} is equivalent to the GSV. Based on a GSV for methane of 0.00002l/hr and 0.00368l/hr for carbon dioxide, the site may be designated as Characteristic Situation (CS) 1.

9. REVISED CONCEPTUAL SITE MODEL

9.1 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:

Made ground used to backfill the site after dismantling of the railway;
Asbestos cement sheeting;

Potential off-site sources of contaminants include:

Fuel tanks about 60m to the northeast of the site.
Electrical substation
Cemetery
Petrol filling stations
Factories
Nurseries
Gas works
Cement works
Timber Yard
Made ground used to backfilled chalk pits

Potential Receptors

SES has identified the following possible receptors;

Future site users and construction workers.
Underlying Principal Chalk Aquifer.

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

Soil leaching and subsequent vertical migration.

Existing Active Pollutant Linkages associated with the Subject Site

The site was on the Saffron Walden Railway until the 1970 when this was dismantled. The Phase I report indicated that a potential active pollutant linkage was noted based upon the presence of made ground that could impact upon the underlying aquifer. However, the proposed development will introduce potential pathways between the identified made ground and receptors by introducing a more sensitive receptor to the site (full time employees).

Potential Pollution Linkages and Updated Risk Assessment

The intrusive investigations have shown that there are no pollutant linkages for the commercial site use.

9.2 Discussion of the Revised Conceptual Site Model

It is understood that the roof of the existing building is to be replaced and the building extended to provide eco cycle storage/retail space.

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 13: Outline Conceptual Site Model

Potential Source	Contaminants of Concern	Via	Potential Pathways	Linkage Potentially Active?	Receptors
On-site – current and historical Made Ground Asbestos cement roof	PAHs, TPHs, PCBs, heavy metals, Asbestos	Soil	Direct contact/ingestion	**X**	Site users
			Inhalation of volatiles	**X**	
			Airborne migration of soil or dust	**X**	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
Off-site – current Electrical substation	PAHs, PCBs, heavy metals, TPHs, VOCs,	Ground water	Direct contact/ingestion	**X**	Site users

Potential Source	Contaminants of Concern	Via	Potential Pathways	Linkage Potentially Active?	Receptors
Cement works Cemetery Fuel stations Factories Timber yard **Off-site – historical:** Gas works Chalk Pits Nurseries	Solvents, Chemical additives, herbicides, pesticides, fertilisers, chlorinated solvents		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 Cemetery	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 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.

10. MANAGEMENT OF CONTAMINATION

10.1 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 did not identify any contaminant above their respective S4UL/C4UL, therefore it is considered there is a negligible potential to pose a risk to human health via the direct contact, ingestion, dust inhalation and plant uptake exposure pathways.

No pollutant linkages have been identified, as demonstrated in the updated conceptual model.

Therefore, no remediation is deemed to be necessary at the site in relation to the proposed commercial use.

10.2 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.

10.3 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.

11. CONCLUSIONS

This Phase II Generic Risk Assessment has considered a variety of sources of information regarding the past land uses at the Unit 12, Dencora Park, Saffron Walden, Shire Hill, Saffron Walden, CB11 3GB. The site may be located by National Grid Reference TL 547382.

It is understood that the roof of the existing building is to be replaced and the building extended to provide eco-cycle storage/retail space.

A Phase I Desk Study and Preliminary Risk Assessment for the site was carried out by SES and issued on the 8th March 2024 v1.0, project ref. CON257-SAFF-001. Significant pollutant linkages were identified associated with the site and, therefore, further works were recommended with respect to contamination.

An intrusive investigation was undertaken on the 15th of March and consisted of three dynamic window sampler boreholes to a maximum depth of 4.00m. Standpipes were inserted into selected holes for ongoing gas and groundwater monitoring. Suitable soil samples were taken and subjected to a range of contaminant testing.

The intrusive investigation encountered Made Ground to 4.00m bgl corresponding to the maximum depth drilled.

All the boreholes were dry during the subsequent monitoring visits except for WS03 where the groundwater level was measured at 3.50m bgl on the 28th March 2024.

Raft foundation or, alternatively, pile foundations are suggested for the proposed building extension.

A Design Sulphate Class of DS-1 and ACEC Class of AC-1 should be adopted for the site.

Based on the gas monitoring carried out on site during three visits in March 2024, the site may be designated as Characteristic Situation (CS) 1.

None the contaminants tested in the samples collected from the Made Ground exceeded their respective S4UL/C4SL in all instances. Therefore, 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.

In light of this, no pollutant linkages have been identified and no remediation is deemed to be necessary at the site in relation to the proposed commercial use.

This report should be submitted to the Local Authority as suitable evidence to discharge Condition 3 of the Planning Application UTT/23/3202/FUL, relating to contamination.

APPENDICES

A. PLANS & FIGURES
B. EXPLORATORY HOLE RECORDS
C. SITE WORK RECORDS
D. RESULTS OF LABORATORY ANALYSIS – GEOTECHNICAL
E. RESULTS OF LABORATORY ANALYSIS – CONTAMINATION
F. SOIL ASSESSMENT CRITERIA & GENERIC RISK ASSESSMENT
G. GROUND GAS RISK ASSESSMENT

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A. PLANS & FIGURES

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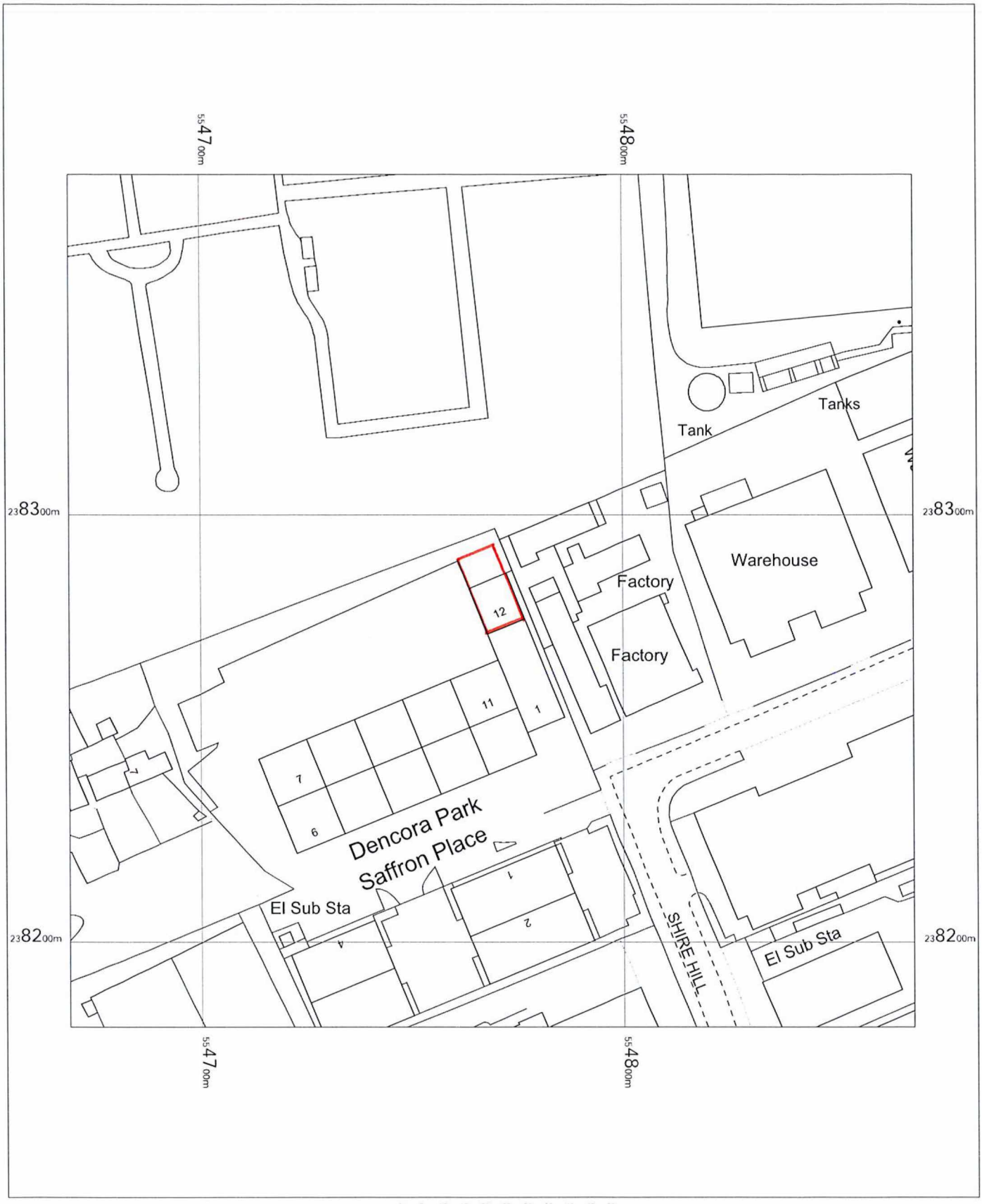

Unit 12,
Dencora Park,
Shire Hill,
Saffron Walden,
Essex,
CB11 3GB

OS MasterMap 1250/2500/10000 scale
Friday, October 27, 2023, ID: BW1-01132720
www.blackwellmapping.co.uk

1:1250 scale print at A4, Centre: 554769 E, 238280 N

N

BLACKWELL'S
www.blackwellmapping.co.uk
TEL: 0114 268 7658
maps.sheffield@blackwell.co.uk

PLEASE NOTE THE BLOCK PLAN IS BASED ON THE CURRENT ORDNANCE SURVEY EXTRACT

0 10 20 30

north

cemetary

proposed extension

replace roof finish

12

car park

1

11

10

9

8

7

6

5

4

3

2

DENCORA PARK

SHIRE HILL

UNIT 12 DENCORA PARK SHIRE HILL SAFFRON WALDEN
PROPOSED BLOCK PLAN
980/09^ 1:500 @ A3 OCTOBER 2023
Julie Barnes Architect

REV. A 12.02.2024 STEPS REMOVED

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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** Unit 12 Dencora Park, Saffron Walden		**Number** **WS01**
Machine : Archway Dart **Method :** Drive-in Windowless Sampler	**Dimensions**	**Ground Level (mOD)**	**Client** Digicopy Limited	**Job Number** CON257-SAFF-001
	Location See Location Plan	**Dates** 15/03/2024	**Project Contractor** Borehole Solutions	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
					(0.40)	MADE GROUND: Grass over light brown slightly gravelly CLAY with frequent rootlets. Gravel is subangular to subrounded fine to coarse chalk, brick, concrete and coal.			
0.20	ES1				0.40				
					(1.10)	MADE GROUND: Brown mottled white slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse chalk and rare coal.			
1.00-1.45	SPT N=9		2,2/2,3,2,2						
					1.50	MADE GROUND: Stiff orangish brown slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse chalk and flint.			
1.80	D1								
2.00-2.45	SPT N=15		2,3/3,4,4,4						
					(2.40)				
3.00-3.45	SPT N=18		3,4/4,4,5,5						
3.80	D2				3.90				
4.00-4.45	SPT N=15		3,4/4,4,3,4		4.00	MADE GROUND:Black mottled white sandy slightly silty very angular to angular fine to medium GRAVEL of coal, clinker and chalk, with occasional coal ash.			
						Complete at 4.00m			

Remarks

Scale (approx)	Logged By
1:50	GS

Figure No.
CON257-SAFF-001.WS01

Stansted Environmental Services Limited The Stansted Centre, Parsonage Road Takeley,Essex,CM22 5PU	**Site** Unit 12 Dencora Park, Saffron Walden	**Number** **WS02**
Machine : Archway Dart **Method :** Drive-in Windowless Sampler	**Dimensions**	**Ground Level (mOD)**	**Client** Digicopy Limited	**Job Number** CON257-SAFF-001
	Location See Location Plan	**Dates** 15/03/2024	**Project Contractor** Borehole Solutions	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.20	ES1				(0.45) 0.45	MADE GROUND: Grass over light brown slightly gravelly CLAY with frequent rootlets. Gravel is subangular to subrounded fine to coarse chalk, brick, concrete and coal.		
					(0.35) 0.80	MADE GROUND: Brown mottled white slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse chalk.		
0.90-1.00 1.00-1.45	D2 SPT N=4	DRY	0,0/1,1,1,1		(0.90)	MADE GROUND: Soft to firm brown mottled white slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium chalk.		
1.80-1.90 2.00-2.45	D1 SPT N=14	DRY	2,3/3,3,4,4		1.70	MADE GROUND: Stiff orangish brown slightly gravelly CLAY. Gravel subangular of subrounded fine to medium chalk and flint.		
3.00-3.45	SPT N=8	DRY	1,1/2,2,2,2		(2.30)			
4.00-4.45	SPT N=16	DRY	2,4/4,4,4,4		4.00	Complete at 4.00m		

Remarks
Location CAT scanned prior excavation.
No groundwater encountered during drilling operations.
After completion, borehole backfilled with arisings.

Scale (approx)	Logged By
1:50	GS

Figure No.
CON257-SAFF-001.WS02

Stansted Environmental Services Limited The Stansted Centre, Parsonage Road Takeley,Essex,CM22 5PU	**Site** Unit 12 Dencora Park, Saffron Walden		**Number** **WS03**
Machine : Archway Dart **Method :** Drive-in Windowless Sampler	**Dimensions**	**Ground Level (mOD)**	**Client** Digicopy Limited	**Job Number** CON257-SAFF-001
	Location See Location Plan	**Dates** 15/03/2024	**Project Contractor** Borehole Solutions	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
					(0.70)	MADE GROUND: Grass over light brown slightly gravelly CLAY with frequent rootlets. Gravel is subangular to subrounded fine to coarse chalk, brick and concrete.			
0.45	ES1				0.70				
1.00-1.45	SPT N=9	DRY	2,2/2,3,2,2		(0.80)	MADE GROUND: Brown mottled white slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse chalk and rare coal.			
					1.50				
					(0.50)	MADE GROUND: Stiff orangish brown slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse chalk and flint.			
2.00-2.45	SPT N=15	DRY	2,3/3,4,4,4		2.00	MADE GROUND: Stiff orangish brown slightly gravelly CLAY with low cobble content of chalk and flint. Gravel is subangular to subrounded fine to coarse chalk and flint.			
2.60-2.70	D1								
3.00-3.45	SPT N=18	DRY	3,4/4,4,5,5		(1.90)				
					3.90				
4.00-4.45	SPT N=15	DRY	3,4/4,4,3,4		4.00	MADE GROUND: Stiff black and grey gravelly fine to coarse SAND with occasional coal ash. Gravel is angular to subangular fine to coarse clinker.			
						Complete at 4.00m			

Remarks
Location CAT scanned prior excavation.
No groundwater encountered during drilling operations.
After completion, borehole installed with monitoring pipe to 4.00m.

Scale (approx)	Logged By
1:50	GS

Figure No.
CON257-SAFF-001.WS03

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

V	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. SITE WORK RECORDS

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	Date of Visit	21/03/2024		Time	11:00			Weather Condtions	Cloudy
	Background Readings	CH_4 - % v/v	CO_2 - % v/v	O_2 - % v/v	H_2S - ppm	CO - ppm	VOC - ppm	Ground Conditions	Wet
		0.00	0.03	20.9	0.0	-	0.0	Atmospheric Pressure	1014mb

Hole No.	Time hr:mm	Atmos Pressure mb	Flow Rate l/hr	CH_4 % v/v		CO_2 % v/v		O_2 % v/v		H2S ppm		CO ppm		VOC ppm		Water Level m bgl	Depth of Well m bgl	Sample Collected Y/N	Hazardous Gas Flow Rate (Q_{hg} - CH_4) (after BS8485)	Hazardous Gas Flow Rate (Q_{hg} - CO_2) (after BS8485)
				peak	steady	peak	steady	peak	steady	peak	steady	peak	steady	peak	steady					
WS01	11:00	1014	0.0	0.01	0.00	0.09	0.08	20.9	20.8	0	0	-	-	2.6	0.0	DRY	3.96	N	0.00000	0.00000
WS03	11:10	1014	0.00	0.00	0.00	0.12	0.12	20.9	20.5	0	0	-	-	1.2	0.0	DRY	3.93	N	0.00000	0.00000

Comments

Originator	GS	UNIT 12 DENCORA PARK, SAFFRON WALDEN CON257-SAFF-001
Checked & Approved	WGG	RESULTS OF GAS & GROUNDWATER MONITORING

SES STANSTED ENVIRONMENTAL SERVICES

	Date of Visit	28.03.2024		Time	11:15			Weather Condtions	sunny/windy
	Background Readings	CH_4 - % v/v	CO_2 - % v/v	O_2 - % v/v	H_2S - ppm	CO - ppm	VOC - ppm	Ground Conditions	Wet
		0.00	0.04	21.0	0.0	-	0.0	Atmospheric Pressure	969mb

Hole No.	Time hr:mm	Atmos Pressure mb	Flow Rate l/hr	CH_4 % v/v		CO_2 % v/v		O_2 % v/v		H2S ppm		CO ppm		VOC ppm		Water Level m bgl	Depth of Well m bgl	Sample Collected Y/N	Hazardous Gas Flow Rate (Q_{hg} - CH_4) (after BS8485)	Hazardous Gas Flow Rate (Q_{hg} - CO_2) (after BS8485)
				peak	steady	peak	steady	peak	steady	peak	steady	peak	steady	peak	steady					
WS01	11:15	969	0.2	0.00	0.00	1.92	1.71	21.0	19.1	0	0	-	-	0.0	0.0	DRY	3.96	N	0.00000	0.00384
WS03	11:25	969	-0.2	0.01	0.00	0.18	0.17	21	20.8	0	0	-	-	0.0	0.0	3.50	3.93	N	0.00002	0.00036

Comments

Originator	GS	UNIT 12 DENCORA PARK, SAFFRON WALDEN CON257-SAFF-001
Checked & Approved	WGG	RESULTS OF GAS & GROUNDWATER MONITORING

SES
STANSTED ENVIRONMENTAL SERVICES

	Date of Visit	03/04/2024		Time	12:00			Weather Condtions	cloudy/windy
	Background Readings	CH_4 - % v/v	CO_2 - % v/v	O_2 - % v/v	H_2S - ppm	CO - ppm	VOC - ppm	Ground Conditions	Wet
		0.00	0.03	20.9	0.0	-	0.0	Atmospheric Pressure	987mb

Hole No.	Time hr:mm	Atmos Pressure mb	Flow Rate l/hr	CH_4 % v/v		CO_2 % v/v		O_2 % v/v		H2S ppm		CO ppm		VOC ppm		Water Level m bgl	Depth of Well m bgl	Sample Collected Y/N	Hazardous Gas Flow Rate (Q_{hg} - CH_4) (after BS8485)	Hazardous Gas Flow Rate (Q_{hg} - CO_2) (after BS8485)
				peak	steady	peak	steady	peak	steady	peak	steady	peak	steady	peak	steady					
WS01	12:00	987	0.1	0.00	0.00	1.74	1.70	20.9	18.9	0	0	-	-	0.0	0.0	DRY	3.96	N	0.00000	0.00174
WS03	12:10	987	-0.1	0.00	0.00	0.18	0.16	20.9	20.4	0	0	-	-	0.0	0.0	DRY	3.93	N	0.00000	0.00018

Comments

Originator	GS	UNIT 12 DENCORA PARK, SAFFRON WALDEN CON257-SAFF-001
Checked & Approved	WGG	RESULTS OF GAS & GROUNDWATER MONITORING

SES STANSTED ENVIRONMENTAL SERVICES

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D. RESULTS OF LABORATORY ANALYSIS - GEOTECHNICAL

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Stansted Environmental Services
The Stansted Centre
Parsonage Road
Takeley
Essex
CM22 6PU

26 March 2024
Report No : GEO/40098/01

For the attention of Mr G Greenwood

Date samples received	15/03/2024
Date written instructions received	15/03/2024
Date testing commenced	16/03/2024
Date of sample disposal	**23/04/2024**

Our ref **GEO / 40098**
Your Ref **CON257-SAFF-001**

Project **UNIT 12, DENCORA PARK**

Further to your instructions we have pleasure in enclosing the results of the tests you requested in the attached figures.

LABORATORY TEST REPORT

Item No	Test Quantity	Description
1	3	Water Content

Any opinions or interpretations expressed herein are outside the scope of UKAS accreditation. All results contained in this report are provisional unless signed by an approved signatory. The results contained in this report relate only to samples received in the laboratory and are tested 'as received' unless otherwise stated. This report should not be reproduced, except in full, without the written approval of the laboratory. The results reported are applicable only to the test items received by the laboratory.

All the necessary data required by the documented test procedures has been recorded and will be stored for a period of not less than 6 years. This data will be issued to yourselves at your request. All samples will be disposed of after the date shown above. Written confirmation will be required to retain the samples beyond this period and a storage charge may be applied.

We trust that the above meets your requirements and should you require any further information or assistance, please do not hesitate to contact us.

Yours faithfully
on behalf of **GEOLABS Limited**

S Burke
Senior Technician

BS EN ISO 17892-1:2014+A1:2022

WATER CONTENT

Location	Depth m	Sample Ref	Spec. Ref	Spec. Depth (m)	Sample Type	Description	Water Content %	Oven Temp. °C
WS01	0.80	D2			D	Cream structureless CHALK with small pockets of brown CLAY.	30.9	105
WS02	0.90-1.00	D2			D	Brown and grey black sandy fine to medium gravel sized CHALK.	20.0	105
WS03	2.60-2.70	D1			D	Brown slightly sandy fine to medium gravel sized CHALK.	19.2	105

Checked and Approved by:

S Burke

S Burke - Senior Technician
26/03/2024

Project Number:

GEO / 40098

Project Name:

UNIT 12, DENCORA PARK
CON257-SAFF-001

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1982

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E. RESULTS OF LABORATORY ANALYSIS - CONTAMINATION

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Stansted Environmental Services Ltd
The Stansted Centre
Parsonage Road
Takeley
Bishop's Stratford
CM22 6PU

e: enquiries@sestesting.com

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

Analytical Report Number : 24-009198

Project / Site name:	Unit 12 Dencora Park	Samples received on:	15/03/2024
Your job number:	CON257-SAFF-001	Samples instructed on/ Analysis started on:	15/03/2024
Your order number:	SES	Analysis completed by:	21/03/2024
Report Issue Number:	1	Report issued on:	08/04/2024
Samples Analysed:	5 soil samples		

Signed:

Joanna Wawrzeczko
Senior Reporting Specialist
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 24-009198
Project / Site name: Unit 12 Dencora Park
Your Order No: SES

Lab Sample Number				145796	145797	145798	145799	145800
Sample Reference				WS02	WS01	WS01	WS02	WS03
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.80	1.30	0.35	0.20	0.45
Date Sampled				15/03/2024	15/03/2024	15/03/2024	15/03/2024	15/03/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	17	18	14	17	17
Total mass of sample received	kg	0.1	NONE	0.6	0.5	0.9	0.9	0.8
Asbestos								
Asbestos in Soil Detected/Not Detected	Type	N/A	ISO 17025	-	-	Not-detected	Not-detected	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	-	-	IZJ	IZJ	IZJ
General Inorganics								
pH (L099)	pH Units	N/A	MCERTS	8.1	8.4	8.5	8.5	8.7
Total Cyanide	mg/kg	1	MCERTS	-	-	< 1.0	< 1.0	< 1.0
Water Soluble Sulphate as SO_4 16hr extraction (2:1)	mg/kg	2.5	MCERTS	64	31	60	130	100
Water Soluble SO_4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	-	-	30	66.3	50
Water Soluble SO_4 16hr extraction (2:1)	mg/l	1.25	MCERTS	31.8	15.7	-	-	-
Organic Matter (automated)	%	0.1	MCERTS	-	-	2	3.6	2.4
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	-	-	< 1.0	< 1.0	< 1.0
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	-	-	0.17	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	-	-	0.05	0.06	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	-	-	1.2	0.2	< 0.05
Fluorene	mg/kg	0.05	MCERTS	-	-	0.91	0.14	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	-	-	13	2.2	0.62
Anthracene	mg/kg	0.05	MCERTS	-	-	3.8	0.5	0.17
Fluoranthene	mg/kg	0.05	MCERTS	-	-	26	4.4	1.4
Pyrene	mg/kg	0.05	MCERTS	-	-	22	3.8	1.3
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	-	12	2.2	0.69
Chrysene	mg/kg	0.05	MCERTS	-	-	9.9	1.9	0.72
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	-	-	12	2.4	0.81
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	-	-	4.8	0.98	0.38
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	-	9.8	1.8	0.73
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	-	4.3	0.87	0.3
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	-	1.4	0.27	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	-	5.1	1.1	0.36
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	-	-	126	22.9	7.51

Analytical Report Number: 24-009198
Project / Site name: Unit 12 Dencora Park
Your Order No: SES

Lab Sample Number				145796	145797	145798	145799	145800
Sample Reference				WS02	WS01	WS01	WS02	WS03
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.80	1.30	0.35	0.20	0.45
Date Sampled				15/03/2024	15/03/2024	15/03/2024	15/03/2024	15/03/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	-	-	9.5	9.6	9.4
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	-	-	0.64	0.65	0.47
Boron (water soluble)	mg/kg	0.2	MCERTS	-	-	1.7	3.2	1.2
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	-	-	0.4	0.4	0.4
Chromium (hexavalent)	mg/kg	1.8	MCERTS	-	-	< 1.8	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	83	83	120
Copper (aqua regia extractable)	mg/kg	1	MCERTS	-	-	23	28	24
Lead (aqua regia extractable)	mg/kg	1	MCERTS	-	-	55	60	51
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	-	-	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	-	-	23	38	56
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	24	25	23
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	-	-	76	170	80
Petroleum Hydrocarbons								
TPHCWG - Aliphatic >C5 - C6 HS_1D_AL	mg/kg	0.02	NONE	-	-	< 0.020	< 0.020	< 0.020
TPHCWG - Aliphatic >C6 - C8 HS_1D_AL	mg/kg	0.02	NONE	-	-	< 0.020	< 0.020	< 0.020
TPHCWG - Aliphatic >C8 - C10 HS_1D_AL	mg/kg	0.05	NONE	-	-	< 0.050	< 0.050	< 0.050
TPHCWG - Aliphatic >C10 - C12 EH_CU_1D_AL	mg/kg	1	MCERTS	-	-	< 1.0	< 1.0	< 1.0
TPHCWG - Aliphatic >C12 - C16 EH_CU_1D_AL	mg/kg	2	MCERTS	-	-	< 2.0	< 2.0	< 2.0
TPHCWG - Aliphatic >C16 - C21 EH_CU_1D_AL	mg/kg	8	MCERTS	-	-	< 8.0	< 8.0	< 8.0
TPHCWG - Aliphatic >C21 - C35 EH_CU_1D_AL	mg/kg	8	MCERTS	-	-	24	14	< 8.0
TPHCWG - Aliphatic >C5 - C35 EH_CU+HS_1D_AL	mg/kg	10	NONE	-	-	24	14	< 10
TPHCWG - Aromatic >EC5 - EC7 HS_1D_AR	mg/kg	0.01	NONE	-	-	< 0.010	< 0.010	< 0.010
TPHCWG - Aromatic >EC7 - EC8 HS_1D_AR	mg/kg	0.01	NONE	-	-	< 0.010	< 0.010	< 0.010
TPHCWG - Aromatic >EC8 - EC10 HS_1D_AR	mg/kg	0.05	NONE	-	-	< 0.050	< 0.050	< 0.050
TPHCWG - Aromatic >EC10 - EC12 EH_CU_1D_AR	mg/kg	1	MCERTS	-	-	< 1.0	< 1.0	< 1.0
TPHCWG - Aromatic >EC12 - EC16 EH_CU_1D_AR	mg/kg	2	MCERTS	-	-	6.9	4.3	< 2.0
TPHCWG - Aromatic >EC16 - EC21 EH_CU_1D_AR	mg/kg	10	MCERTS	-	-	44	15	< 10
TPHCWG - Aromatic >EC21 - EC35 EH_CU_1D_AR	mg/kg	10	MCERTS	-	-	68	23	16
TPHCWG - Aromatic >EC5 - EC35 EH_CU+HS_1D_AR	mg/kg	10	NONE	-	-	120	42	16
VOCs								
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	-	-	< 5.0	< 5.0	< 5.0
Benzene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
Toluene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
Ethylbenzene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
p & m-Xylene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
o-Xylene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

Analytical Report Number : 24-009198
Project / Site name: Unit 12 Dencora Park

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
145796	WS02	None Supplied	1.8	Brown clay and sand with chalk and gravel
145797	WS01	None Supplied	1.3	Brown clay and sand with chalk and gravel
145798	WS01	None Supplied	0.35	Brown clay and sand with chalk and gravel
145799	WS02	None Supplied	0.2	Brown clay and sand with chalk and gravel
145800	WS03	None Supplied	0.45	Brown clay and sand with chalk and gravel

Analytical Report Number : 24-009198
Project / Site name: Unit 12 Dencora Park

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in Soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques	In-house method based on HSG 248, 2021	A001B	D	ISO 17025
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate (Walkley Black Method)	In-house method	L009B	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically (up to 30°C)	In-house method	L019B	W	NONE
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight	In-house method based on British Standard Methods and MCERTS requirements.	L019B	D	NONE
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil	L038B	D	MCERTS
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES	In-house method based on Second Site Properties version 3	L038B	D	MCERTS
Sulphate, water soluble, in soil (16hr extraction)	Sulphate, water soluble, in soil (16hr extraction)	In-house method	L038B	D	MCERTS
Speciated EPA-16 PAHs and/or Semi-volatile organic compounds in soil	Determination of semi-volatile organic compounds (including PAH) in soil by extraction in dichloromethane and hexane followed by GC-MS	In-house method based on USEPA 8270	L064B	D	MCERTS
BTEX and/or Volatile organic compounds in soil	Determination of volatile organic compounds in soil by headspace GC-MS	In-house method based on USEPA 8260	L073B	W	MCERTS
Total petroleum hydrocarbons with carbon banding by GC-FID/GC-MS HS in soil	Determination of total petroleum hydrocarbons in soil by GC-FID/GC-MS HS with carbon banding aliphatic and aromatic	In-house method	L076B/L088	D/W	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in NaOH and addition of 1,5 diphenylcarbazide followed by colorimetry	In-house method	L080	W	MCERTS
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080	W	MCERTS
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080	W	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement	In-house method	L099	D	MCERTS

For method numbers ending in 'UK' or 'A' analysis have been carried out in our laboratory in the United Kingdom (Watford).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
For method numbers ending in 'PL' or 'B' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.
Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Analytical Report Number : 24-009198
Project / Site name: Unit 12 Dencora Park

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics
AR	Aromatics
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
_	Operator - understore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

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F. 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

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%
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
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	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

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%
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
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

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%
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
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

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%
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)

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G. GROUND GAS RISK ASSESSMENT

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GROUND GAS RISK ASSESSMENT

General

In the past, a series of guidance documents were published by CIRIA (CIRIA Report 130 'Methane: Its Occurrence and Hazards on Construction'; CIRIA Report 149 'Protecting Development from Methane'; CIRIA Report 151 'Interpreting Measurements of Gas in the Ground'; CIRIA Report 152 'Risk Assessment for Methane and Other Gases in the Ground') which provided advice on hazards associated with methane. This earlier guidance was consolidated in CIRIA Document C659 'Assessing Risks Posed by Hazardous Ground Gases to Buildings' to provide a risk based approach to gas contaminated land. This was subsequently updated and re-issued as CIRIA Document C665 'Assessing Risks Posed by Hazardous Ground Gases to Buildings'.

In 2007, British Standard, BS8485: Code of Practice for the Characterisation and Remediation from Ground Gas in Affected Developments, dealing with ground gas was published and subsequently updated in 2015.

This guidance is based on a similar approach to that for dealing with contaminated soil. The presence of hazardous gases could be deemed to be the 'source' in a 'pollutant linkage' that could lead to the conclusion that significant harm is or could be caused to people, buildings or the environment. In such circumstances the land could be deemed 'contaminated'.

Should a potential source of gas be identified in the conceptual model, a gas risk assessment should be carried out, sufficient to demonstrate to the local authority that the proposals mitigate any hazards associated with ground gas.

Approach

A flow chart detailing the approach to assessing a site is given in CIRIA document C665, Figure 1.1. This may be summarised as follows.

Carry out Phase 1 desk study, including initial conceptual model
Assess site, potential presence of gas/potential unacceptable risk/identify further action, if necessary
Monitor gas concentrations
Assessment of Risk
Recommendations / remediation
Validation

Pollutant Linkage Assessment

A pollutant linkage assessment is usually presented within the Phase I Desk Study & Preliminary Risk Assessment. Using the risk model in the Phase I report, the pollutant linkage can be identified and a preliminary estimate of risk undertaken. If there is no

relevant pollutant linkage identified there is no risk. If there is a very low risk, it is likely that no further assessment is required. If further assessment is necessary, then gas monitoring will be required.

Site Monitoring

For sites with low generation potential, giving consistently low concentrations of soil gas under the worst case conditions, a limited programme of monitoring would be appropriate. Where high or variable concentrations are anticipated or recorded, an extended programme of monitoring would be appropriate. The following guideline has been proposed by Wilson & Haines (2005).

TABLE I1: Frequency of Gas Monitoring

Sensitivity of Development		Generation Potential of Source				
		Very Low	Low	Moderate	High	Very High
	Low (Commercial)	4/1	6/2	6/3	1/6	12/12
	Moderate (Apartment Blocks)	6/2	6/3	9/6	12/12	24/24
	High (Housing)	6/3	9/6	12/6	24/12	24/24

NOTES:

1. First number of minimum number of readings and second number s minimum period in months.
2. At least two sets of readings should be at low and falling atmospheric pressure.
3. The frequency and period stated are considered to represent typical minimum requirements. Depending on specific circumstances fewer or additional readings may be required.
4. Historical data can be used as part of the data set.

Before taking any readings, zero the instrument, record atmospheric pressure and temperature. Gas flow should be recorded, giving the range of pressures, ensuring positive or negative flow is recorded. Record gas levels, recording peak and steady. Where steady state not obtained within 3 minutes, record change in concentration, where concentrations are decreasing, always record peak value. For very high concentrations, record for longer period of up to 10 minutes.

Assessment of Risk

BS8485:2015+A1:2019 has introduced a borehole hazardous gas flow rate Q_{hg}. The Q_{hg}, in l/hr, should be calculated for each monitoring location and each monitoring event for each hazardous gas.

$$Qh = \frac{c\ p\ lsp\ lf\ gfl\ ps\ lo\ ul/hs)y\ \_\ b\ d\ tp\ o\ d\ f\ o\ u\ (\%\ vb/wu\ i\ p\ o}{100}$$

The method uses both gas concentrations and borehole flow rates for methane and carbon dioxide to define a Q_{hg}.

CIRIA 665 uses a similar method to calculate a Gas Screening Value (GSV) using the worst case values for methane carbon dioxide and flow rate and, therefore, may be

significantly higher than the Q_{hg}. In such cases, further analysis of the data may be required and unrepresentative values discounted.

$$GSV = \frac{\text{Characteristic flow rate (l/hr)} \times \text{Characteristic concentration (\% v/v)}}{100}$$

Although this is not dissimilar to the Q_{hg} outlined above, the GSV is determined using the most representative values for methane and carbon dioxide.

Based on the value of GSV, a Characteristic Situation (CS) can be adopted for the site.

TABLE I2: Characteristic Situation

Characteristic Situation	Risk Classification	GSV (CH_4 or CO_2 – l/hr)	Additional Factors
CS1	Very Low Risk	<0.07	Typically CH_4 ≤1% and/or CO_2 ≤5%. Otherwise consider increase to CS2.
CS2	Low Risk	<0.7	Borehole air flow not to exceed 70l/hr. Otherwise consider increase to CS3.
CS3	Moderate Risk	<3.5	
CS4	Moderate to High Risk	<15	Quantitative risk assessment required.
CS5	High Risk	<70	
CS6	Very High Risk	>70	

Situation A

BS8485:2015+A1:2019 Code of Practice for the Design of Protective Measures for CH_4 and CO_2 for New Buildings provides a risk based score based on the Characteristic Situation (CS) and building type.

TABLE I3: Building Types

	Type A	Type B	Type C	Type D
Ownership	Private	Private or commercial/ public, possible multiple	Commercial/ public	Commercial/ industrial
Control (change of use, structural alterations, ventilation)	None	Some but not all	Full	Full
Room Sizes	Small	Small/medium	Small to large	Large industrial/retail park style

NOTES:

TYPE A: private ownership with no building management controls on alterations to the internal structure, the use of rooms, the ventilation of room or the structural fabric of the building. Some small rooms present. Probably conventional building construction (rather than civil engineering). Examples include private housing and small retail premises.

TYPE B: private or commercial property with central building management control of any alterations to the building or its uses but limited or no central building management control of the maintenance of the

	building, including the gas protection measures. Multiple occupancy. Up to medium size rooms with passive ventilation of rooms and other internal spaces throughout ground floor and basement areas. May be conventional building or civil engineering construction. Examples include managed apartments, multiple occupancy offices, some retail premises and parts of some public buildings (such as schools, hospitals, leisure centres) and parts of hotels.
TYPE C:	commercial building with central building management control of any alterations to the building or its uses and central building management control of the maintenance of the building, including the gas protection measures. Single occupancy of ground floor and basement areas. Small to large size rooms with active ventilation or good passive ventilation of all rooms and other internal spaces throughout ground floor and basement areas. Probably civil engineering construction. Examples include offices, some retail premises, and parts of some public buildings (such as schools, hospitals, leisure centres and parts of hotels).
TYPE D:	industrial style building having large volume internal space(s) that are well ventilated. Corporate ownership with building management controls on alterations to the ground floor and basement areas of the building and on maintenance of ground gas protective measures. Probably civil engineering construction. Examples are retail park sales buildings, factory shop floor areas, warehouses. (Small rooms within these style buildings should be separately categorized as Type B or Type C).

Based on the building type and Characteristic Situation (CS) a Minimum Gas Protection Score can be evaluated.

TABLE I4: Minimum Gas Protection Score

CS	High Risk		Medium Risk	Low Risk
	Type A	**Type B**	**Type C**	**Type D**
1	0	0	0	0
2	3.5	3.5	2.5	1.5
3	4.5	4	3	2.5
4	6.5[1]	5.5[1]	4.5	3.5
5	-[2]	6[1]	5.5	4.5
6	-[2]	-[2]	-[2]	6

NOTES:

1. Residential buildings should not be built on CS4 or higher sites unless the type of construction or site circumstances allow additional levels of protection to be incorporated, e.g. high-performance ventilation or pathway intervention measures, and an associated sustainable system of management of maintenance of the gas control system, e.g. in institutional and/or fully serviced contractual situations.
2. The gas hazard is too high for this empirical method to be used to define the gas protection measures.

When the minimum gas protection score has been determined for the building as a whole, or for each part of the building, then a combination of two or more of the following three types of protection measures should be used to achieve that score:

the structural barrier of the floor slab, or of the basement slab and walls if a basement is present;
ventilation measures; and/or
gas resistant membrane.

TABLE I5: Gas Protection Measures

Protection Element		Score	Comments
Barriers (Table 5 BS8485:2015)			
Block and beam floor slab		0	It is good practice to install ventilation in all foundation systems to effect pressure relief as a minimum. Breached in floor slabs such as joints have to be effectively sealed against gas ingress in order to maintain these performances
Reinforced concrete ground bearing slab		0.5	
Reinforced concrete ground bearing foundation raft with limited service penetration that are cast into slab		1	
Reinforced concrete cast insitu suspended slab with minimal service penetrations and water bars around all slab penetrations and at joints		1.5	
Fully tanked basement		2-2.5	
Ventilation/Dilution (Table 6 BS8485:2015)			
Passive sub floor ventilation (venting layer can be a clear void or formed using gravel, geocomposites, polystyrene void formers, etc.)	Very Good Performance	2.5	If passive ventilation is poor this is generally unacceptable and some form of active system will be required
	Good Performance	1.5	
Subfloor ventilation with active abstraction/ pressurization (venting layer can be a clear void or formed using gravel, geocomposites, polystyrene void formers, etc.)		1.5-2.5	There have to be robust management systems in place to ensure the continued maintenance of any ventilation system. Active ventilation can always be designed to meet good performance. Mechanically assisted systems come in two main forms; extraction and positive pressurization.
Ventilated car park(basement or undercroft)		4	Assumes car park is vented to deal with car exhaust fumes, designed to Building Regulations Document F and IstructE guidance
Membranes (Table 7 BS8485:2015)			
Gas resistant membrane meeting all of the following criteria: Sufficiently impervious to the gases with a methane gas transmission rate <40ml/day/m²/atm (average) for sheet and joints. Sufficiently durable to remain serviceable for the anticipated life span of the building and duration of gas emissions. Sufficiently strong to withstand in-service stresses. Sufficiently strong to withstand the installation process and following trades until covered. Capable, after installation, of providing a complete barrier to the entry of the relevant gas Verified in accordance with CIRIA C735		2	If a membrane is installed that does not meet all the criteria in Column 1 the score is zero.

For further details, reference should be made to BS8485:2015+A1:2019.

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