Ground Gas Risk Assessment

BELLE VUE STREET
BATLEY

for

Mr. J. Kilroy

Report Number 4278

February 2023

Michael D Joyce Associates LLP
Geotechnical and Geoenvironmental Consultants
Charnock Court 6 South Parade Wakefield West Yorkshire WF1 1LR UK
T +44(0)1924 360458 **E** mdja@geoenvironmental.co.uk **W** www.geoenvironmental.co.uk

Ground Gas Risk Assessment

BELLE VUE STREET, BATLEY

Contents

1.	Introduction
2.	The Site
3.	Site History
4.	Geology and Mining
5.	Radon
6.	Ground Gas Risk Assessment
	Procedure Notes

Figures

Figure 1	Site Location
Figure 2	Site Plan and Development Proposals
Figure 3	Conceptual Site Model

Appendices

Appendix 1	Rhinoplast Super Gas Barrier
	Standard Appendices A and B

1 INTRODUCTION

1.1 At the request of Mr. J. Kilroy, a Phase I Geoenvironmental and Geotechnical Assessment (Desk Study) has previously been carried out at Belle Vue Street in Batley. It was proposed to redevelop the site with a pair of semi-detached houses.

1.2 The purpose of the desk study was to review and assess information on the site including geological, mining and hydrogeological data, to review the past history of the site and its environmental setting, and to determine if there are any geotechnical or geoenvironmental hazards that may impair its safe and economic development.

1.3 Following consultation with Kirklees Council, there remained a request for further clarification in respect of the risk associated from ground gases, in particular the potential from shallow coal workings. This latest Ground Gas Risk Assessment addresses this concern.

1.4 The findings of the Phase 1 are presented in Report No. 4202 dated April 2022, and should be read in conjunction with this latest report.

2 THE SITE

2.1 The site covers an area of approximately 0.04 hectares. It is located on Belle Vue Street, approximately 3 km west of the centre of Batley. The Ordnance National Survey Grid Reference is 422675, 424185 and it lies at approximately 138 mAOD. Figure 1 shows the general site location, whilst figure 2 shows the site in more detail.

2.2 The site was originally inspected on 21st April 2022. Clearance work was underway, and a domestic garage which once stood on the site has been demolished, and the concrete base is currently being excavated. There was no visible contamination on the surface of the site.

2.3 Since then the houses have been completed.

3 SITE HISTORY

3.1 The site history is presented in Report No. 4202.

4 GEOLOGY AND MINING

4.1 Geology

4.1.1 Maps of the British Geological Survey (BGS) show the site to be underlain by the Thornhill Rock Sandstone of the Carboniferous Middle Coal Measures.

4.1.2 There are no drift deposits shown on the geological maps, which also show the site to be free of faulting.

4.2 Mining

4.2.1 A mining report has been obtained from the Coal Authority, and is reproduced in full in Appendix 2 of Report No. 4202. It states that there has been recorded mining in one seam of coal (Black Bed) at 281m depth, with the last date of working being 1908. Under normal circumstances, ground movement should have ceased by now.

4.2.2 The report also states that there are possible shallow workings beneath the site. The Joan Coal outcrops approximately 200m to the north and west of the site and dips below it.

4.2.3 **However, according to the geological memoir for Huddersfield, published in 1930, the Joan Coal was "not fit to have been worked" except to the east of Dewsbury. As such there is no evidence of this seam having been worked.**

4.2.4 The Joan Coal is underlain by the Flockton Thick (aka Adwalton Stone Coal). This is a compound seam of several layers, and was extensively worked. It comprises a bed

of stone coal approximately 0.15m to 0.40m thick, resting on a middle bed of coal between 0.1m and 0.35m thick. There is then a band of dirt not exceeding 0.2m before the Low Bed which is between 0.25m and 0.45m thick. The geological map records a total thickness of 0.86m in the area.

4.2.5 The geological map records the Joan Coal as lying approximately 12m below the base of the Thornhill Rock, and the Flockton Thick to be 17m below the Joan. As such the Flockton Thick lies at least 30m below the site, and as such, is too deep to be of concern, even if it has been worked.

4.2.6 **No shaft or adits are reported on, or within 100m of the site boundary, and no evidence of shafts or adits was found during the groundworks.** No past, present or future opencasts are reported within the vicinity of the site.

4.2.7 In addition, the mining report states that none of the following are recorded;

- Spine roadways
- Outcrops
- Geological faults, fissures or breaklines
- Coal Authority managed tips
- Remediated sites
- Coal mining subsidence damage notices or claims
- **Mine gas**
- Mine Water Treatment Schemes
- Future underground mining
- Coal mining licencing
- Court Orders
- Section 46 Notice
- Withdrawal of Support Notices
- Payment to owner of former copyhold land

4.2.8 It is therefore concluded that the risk from mine gas is low. The shallowest potential workings lie at least 30m below the site in the Flockton Thick Coal seam. There is currently no recorded evidence that this seam has been worked below the site, but even if it has, it is considered to be sufficiently deep that the risk of mine gases migrating to the surface is low, particularly in the absence of any faulting or mine entries.

5 RADON

5.1 According to the GroundSure Geo-Insight Report the site lies in an area where between 5% and 10% of homes are above the action level recommended by Public Health England. Basic radon protective measures have therefore been installed in the properties.

5.2 This comprises a Rhinoplast Super Gas Barrier (Yellow) which provides basic gas protection in respect of radon, methane and carbon dioxide. The datasheet is given in Appendix 1. It is understood that this has been inspected and found to be satisfactory, by a building control officer from Kirklees Council and an inspector from the warranty provider.

6 GROUND GAS RISK ASSESSMENT

6.1 There was a former landfill site approximately 44m to the northwest of the study site, at its nearest point. The waste is identified as inert, commercial and industrial, and given the operator was an excavation business, is most likely to be demolition material. Landfilling ceased in 1984.

6.2 Given the type of waste accepted, and the fact that tipping ceased 38 years ago, the risk from landfill gases is likely to be low. Any degradable materials are likely to be coming to the end of their active gas generation. The landfill site is also surrounded by existing residential properties. **The risk is therefore considered to be low.**

6.3 In respect of potential mine gases, reference should be made to Section 4.2. **The risk is therefore considered to be low.**

Pathways and Receptors

6.4 The principal receptors are occupants of the properties. However based on the past known history of the site, the probability of ground gases from mining and landfill being present, sufficient to affect the identified receptors, is considered to be **low risk.**

6.5 In addition, basic radon protection measures have also been installed. This also affords protection against any unforeseen methane or carbon dioxide. As such the risk associated with **all ground gases is low.**

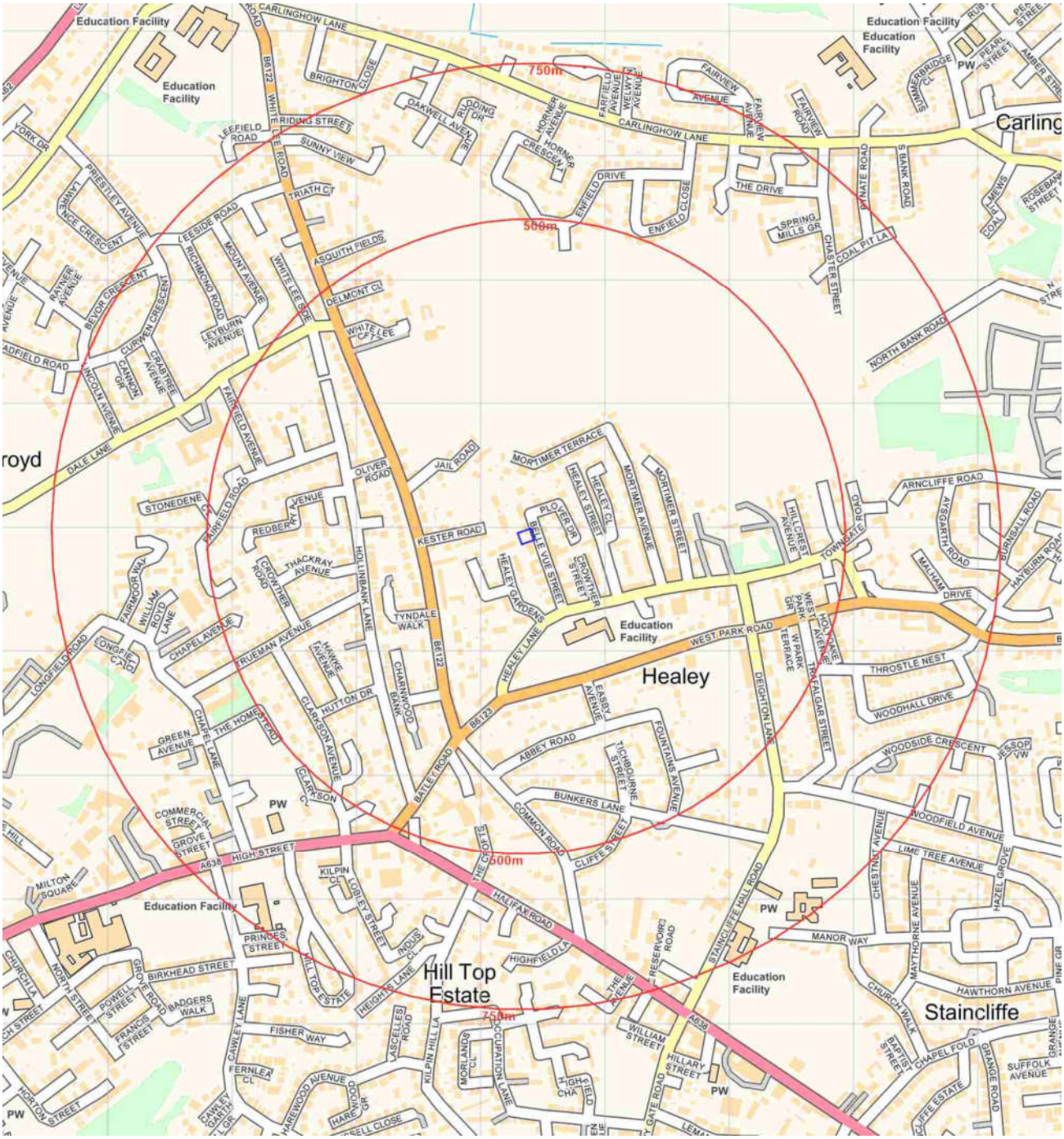
6.6 In conclusion, it is considered that there are no plausible sources of ground gas, nor any possible pathways. The overall risk from all ground gases is as low as reasonably practicable.

A D Joyce

BSc MSc ARSM CEng CGeol CEnv MICE FGS SiLC SQP

February 2023

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Belle Vue Street, Batley

Site Location

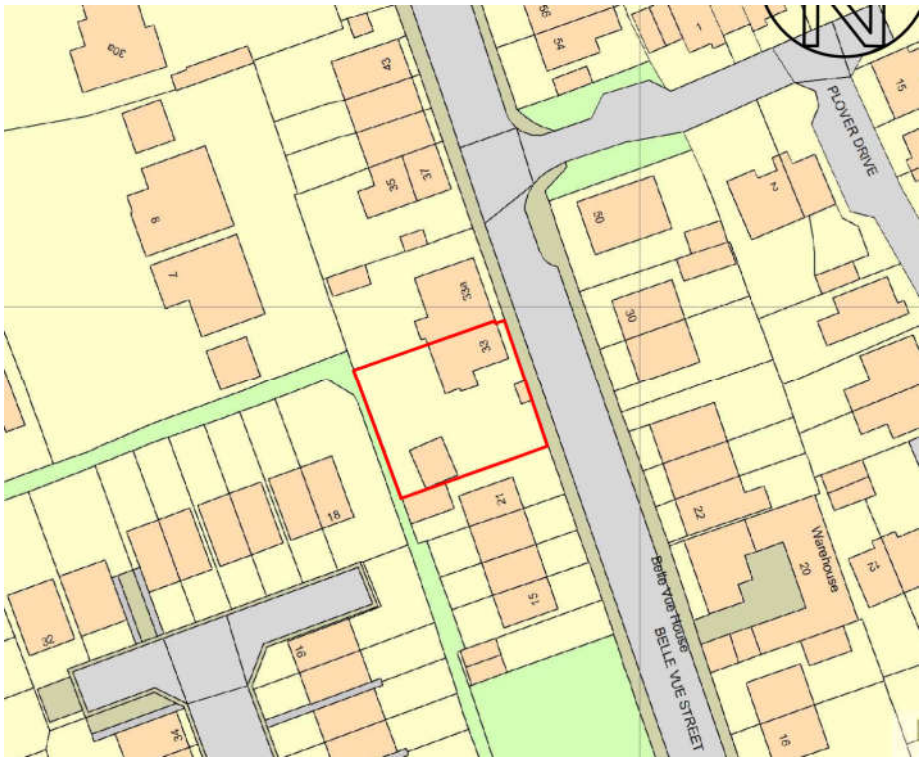
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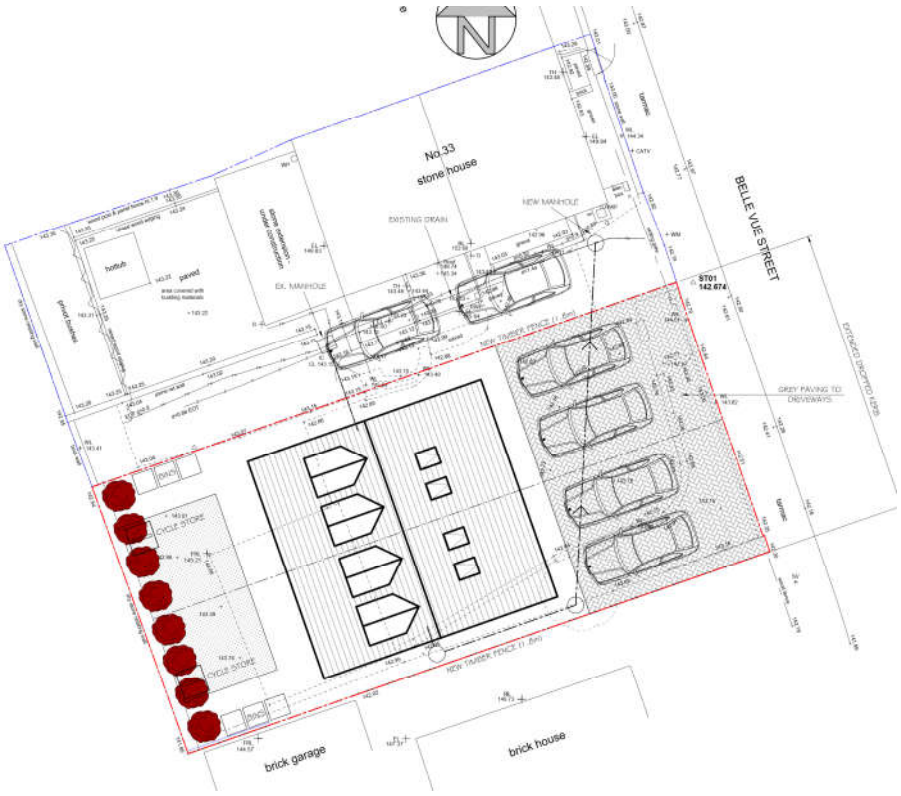
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Scale: NTS

Figure: 1





Belle Vue Street, Batley

Site Plan and Development Proposals

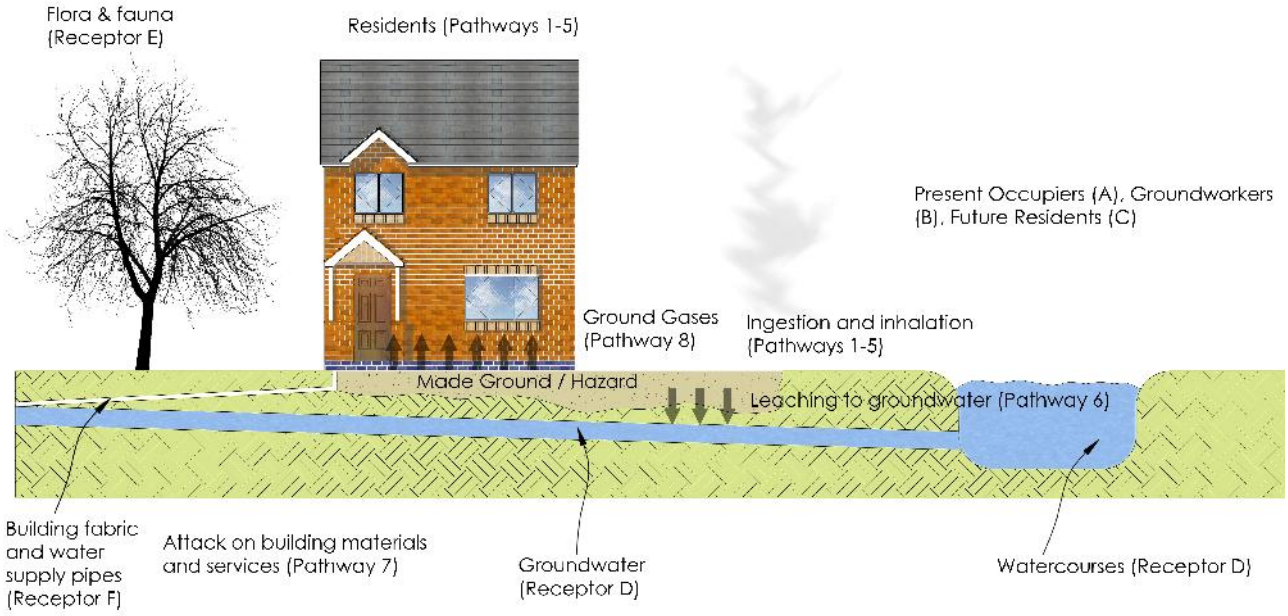
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Scale: NTS

Figure: 2



Pathways

1. Ingestion of contaminated soil/dust
2. Ingestion of contaminated food
3. Ingestion of contaminated water
4. Inhalation of contaminated vapours
5. Dermal contact with contaminated soil/dust or water
6. Pollution of controlled water and off site migration
7. Attack on building materials and services
8. Migration of landfill gases and radon

Receptors

A. Present site occupiers
B. Site development personnel
C. Future residents
D. Controlled waters
E. Flora and fauna
F. Building and services

Schematic Representation of Conceptual Site Model

Schematic Representation of Conceptual Site Model

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Figure: 3

APPENDIX 1

Rhinoplast Super Gas Barrier

Rhinoplast Super Gas Barrier

Data Sheet



Product Description

A monolithic hybrid co-polymer barrier giving excellent performance. Fully tested for Radon, Methane and C02. Approved by NSAI (IAB) Exceeds the requirements of BRE211. Complies with NHBC Amber 1 Installations. CS2 dependent on construction type.

The Rhinoplast range of Gas Barrier Systems has been designed to provide a complete solution to the problems associated with construction on land associated with a range of hazardous gasses, when installed in accordance with the relevant codes of practise. The primary method of protection to the structure is by way of a complete “footprint” membrane system combined with underfloor passive venting. The key to a successful outcome is installation. The best membranes poorly installed are likely to fail. The Rhinoplast range includes pre-formed details and tapes to facilitate this. Where necessary we will provide on-site advice and training to ensure a successful outcome. We even offer a “pre pour” inspection service to ensure correct installations and detailing. These barriers are designed to protect structures and inhabitants from the effects of these gasses. They will also act as damp-proof membranes where applicable and are intended to last the life time of the building. All of our membranes can be welded. With the increase in awareness of such gasses, along with more and more stringent requirements, it is becoming more and more important for contractors to use “fit for purpose materials” in the secure knowledge that they will perform satisfactorily. As pressure mounts on the construction industry to build on “Brown Field Sites” the demand for these products is increasing daily. All Rhinoplast membranes will also function as damp-proof membranes and are CE marked to BS EN 13967 for this purpose.

Colour:

Yellow

Technical Data:

Property	Test Method	Data
Weight		356g/m²
Thickness		375µm
Tensile Strength	MD	21.5MPa
	CD	29.4MPa
Elongation	MD & CD	>800%
Dart Impact Strength		1.012kg
Tear Resistance	MD	248N/mm
	CD	303N/mm
Low Temperature Flexibility		-25°C
Radon Permeability		4x10-¹²m²/s
C0² Transmittance		26.53cc/m²hr
Methane Transmittance		6.43cc/m²/hr
MVTR		0.16g/m²/day
Standard Roll Width		4m
Standard Roll Length		20,25m
Standard Roll Weight		28.48 35.60kg

Ancillary Components

Rhinoplast Joint Strip



A butyl modified reinforced double sided bitumen tape, 1.5mm thick, designed to form a gas tight gasket. Excellent adhesion and tolerance to damp conditions.

Colour: black.
Available in: 50mm x 15m rolls,
100mm x 15m rolls

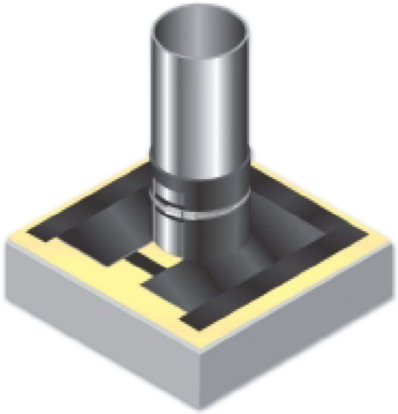
Girth Tape



A single sided girth tape used to secure and protect linear joints. Excellent adhesion, dimensionally stable and water resistant.

Colour: black.
Available in: 72mm x 50m rolls.

Top Hats



A pre-formed pipe seal complete with stainless steel jubilee clip. Easily fixed and sealed on site.

Size range from 50mm to 200mm.

Radon Sump Units



The Radoncare Sump and Cavity Gas Vent System is manufactured be a rotational moulding process from heavy duty polyethylene. The sump is constructed with a solid roof and base and is provided with 40mm diameter holes in the walls. Spigots for 100mm pipe connections are provided at each end of the sump, but are blanked off with knock outs to allow choice of direction for extract pipe. The cavity gas vent comes with a detachable polyethylene cap, which can be easily removed if an extraction system has to be attached.

Useful References

The Building Regulations Approved Document Part C 2004, CP 102: 1973 code of practice for the protection of buildings against water from the ground.

BR211 "Radon - Guidance on protective measures for new buildings"

BRE414 "Protective measures for housing on gas-contaminated land"

CIRIA 665 Ground gas handbook 2009

CIRIA C748 Guidance on the use of plastic membranes as VOC vapour barriers

BS8485:2015 Code of Practice for the Characterization and Remediation from Ground Gas in Affected

Developments **NHBC** "Guidance on methane and carbon dioxide" and technical extra April 2016, issue 20.

Principal Building Products Ltd, Barbot Hall Industrial Estate,
Mangham Road, Rotherham S61 4RJ | Telephone: 01709 728150
Email: sales@pbpltd.co.uk

CE

Standard Appendices

A and B

STANDARD APPENDIX A

NOTES ON SITE INVESTIGATION PROCEDURE (June 2021)

1. **GENERAL.** The ground investigation has been carried out in accordance with the requirements of BS5930: 2015 and BS10175: 2011+A1: 2020. By its very nature, any ground investigation only samples a small percentage of the ground. Consequently, changes in ground conditions and soil properties can occur between any two exploratory points, for example local features such as soft ground, pockets of contamination and faults. This is also true of the exploration of mineworkings and such features can extend beneath parts of the site not investigated. Unrecorded bell pits and shafts can also exist between exploratory points. The ground investigation is designed to minimise such risks but they cannot be eliminated.

2. **GROUND INVESTIGATION.**

2.1 **BOREHOLE AND TRIAL PIT RECORDS.** These illustrate the ground conditions only at the location of the particular borehole or trial pit. Correlation between boreholes is for guidance only and its accuracy cannot be guaranteed.

2.2 **SHELL AND AUGER BORING.** This technique uses a tripod winch and an essentially percussive action using a variety of tools. Disturbed and undisturbed samples can be taken. This is the most suitable method for soft ground investigation, enabling the maximum amount of information to be obtained. However, minor changes in lithology may be overlooked unless continuous undisturbed sampling is used.

2.3 **GROUNDWATER**. Groundwater levels vary seasonally and the details given on the borehole logs relate only to the dates and the conditions described in the borehole records. The rate of boring may not have allowed an equilibrium water level to be established and the use of casing may seal off certain seepages.

2.4 **SAMPLING.** Disturbed samples of soils are taken for identification and classification purposes. In cohesive soils 'undisturbed' samples 100mm in diameter are taken by open drive sampler for laboratory testing of strength, permeability and consolidation characteristics.

2.5 **STANDARD PENETRATION TESTS**. S.P.T tests are used in granular and cohesive materials and in soft or weathered rocks. Difficulties in obtaining true 'N' values mean they must only be used as a guide and not as an absolute value in foundation design.

2.6 **ROTARY DRILLING.** Two main types of rotary drilling are carried out in rock. Rock coring using diamond or tungsten carbide tipped core bits provides samples and information on rock types, fissuring and weathering. Openhole drilling only produces small particles for identification purposes and the information gained is therefore limited. The latter is, however, useful as a quick method for detecting major strata changes and for the location of coal seams and old workings. Water, air, foam or drilling muds may be used as the flushing medium in either case.

2.7 **PERMEABILITY TESTS.** These can be carried out in boreholes or trial pits and gives a good indication of in-situ permeability.

2.8 **TRIAL PITTING.** This enables soil conditions to be closely examined at any specific point and samples taken. It also gives useful information on the stability of excavations and ingress of water.

2.9 **WINDOW SAMPLING**. Window sampling consists of driving a series of 1m-long tubes into the ground using a dropping weight. On completion of each 1m run, the tube is withdrawn. The next tube is then inserted and the process repeated to provide a continuous profile of the ground. On each run the tube diameter is reduced in order to assist in its recovery.

2.10 **GAS MONITORING.** This is routinely carried out in trial pits or probe holes to check for elevated levels of methane and carbon dioxide or oxygen deficiency, particularly since risks can exist from natural gases, landfill sites and rising groundwater levels in mine workings below ground. Longer term monitoring is carried out with gas monitoring standpipes.

3. **SOIL DESCRIPTION.** Samples from borings or trial pits are described as specified in the standard procedure outlined in the British Standards. The description includes colour, consistency, structure, weathering, lithological type, inclusions and origin. All descriptions are based on visual and manual identification.

Fire Soils (Cohesive Soils)

The following field terms are used:

Soil Type	Description
Very soft	Exudes between fingers
Soft	Moulded by light finger pressure
Firm	Cannot be moulded by the fingers but can be rolled in hand to 3mm threads.
Stiff	Crumbles and breaks when rolled to 3mm threads but can be remoulded to a lump.
Very stiff	No longer moulded but crumbles under pressure. Can be indented with thumbs.

The following terms are used in accordance with the results of laboratory and field tests.

Description	Undrained Shear Strength Cu (kPa)
Extremely Low	<10
Very Low	10 - 20
Low	20 - 40
Medium	40 - 75
High	75 - 150
Very High	150 - 300
Extremely High	>300

Fine soils can also be classified according to their sensitivity, which is the ratio between undisturbed and remoulded undrained shear strength.

Sensitivity	Ratio
Low	8
Medium	8 - 30
High	>30
Quick	>50

Granular Soils (Non-Cohesive)

The following descriptions are used for granular soils.

Description	Normalised Blow Count (N_1) 60
Very Loose	0 - 3
Loose	3 - 8
Medium	8 - 25
Dense	25 - 42
Very Dense	42 - 58

4. **NATURAL OR IN-SITU MOISTURE CONTENT**. The natural or in-situ moisture content of a soil is defined as the weight of water contained in the pore space, expressed as a percentage of the dry weight of solid matter present in the soil. Soil properties are greatly affected by the moisture content and the test can help to give an indication of likely engineering behaviour.

5. **LIQUID AND PLASTIC LIMITS**. Two simple classification tests are known as the liquid and plastic limits. If a cohesive soil is remoulded with increasing amounts of water, a point will be reached at which it ceases to behave as a plastic material and becomes essentially a viscous fluid. The moisture content corresponding to this change is arbitrarily determined by the liquid limit test. 'Fat' clays, which have high contents of colloidal particles, have high liquid limits; 'lean' clays, having low colloidal particle contents have correspondingly low liquid limits. An increase in the organic content of a clay is reflected by an increase in the liquid and plastic limits.

   If a cohesive soil is allowed to dry progressively, a point is reached at which it ceases to behave as a plastic material, which can be moulded in the fingers, and it becomes friable. The moisture content of the soil at this point is known as the 'plastic limit' of the soil.

   The range of water content over which a cohesive soil behaves plastically, i.e. the range lying between the liquid and plastic limits, is defined as the plasticity index.

   A cohesive soil with a natural water content towards its liquid limit will, in general, be an extremely soft material whereas a cohesive soil with a natural water content below its plastic limit will tend to be a stiff material.

6. **PARTICLE-SIZE DISTRIBUTION.** A knowledge of particle-size distribution is used to classify soils and to indicate likely engineering behaviour. British Standards define soils in relation to their particle-size as shown below:-

Boulders	>200mm	Coarse Sand	2.0 to 0.63mm
Cobbles	200 to 63mm	Medium Sand	0.63 to 0.2mm
		Fine Sand	0.2 to 0.063mm
Coarse Gravel	63 to 20mm	Coarse Silt	0.063 to 0.02mm
Medium Gravel	20 to 6.3mm	Medium Silt	0.02 to 0.0063mm
Fine Gravel	6.3 to 2mm	Fine Silt	0.0063 to 0.002mm
		Clay	<0.002mm

7. **BULK DENSITY.** The bulk density of a material is the weight of that material per unit volume and includes the effects of voids whether filled with air or water. The 'dry density' of a soil is defined as the weight of solids contained in a unit volume of the soil.

8. **PERMEABILITY.** The permeability of a material is defined as the rate at which water flows through it per unit area of soil under unit hydraulic gradient.

9. **CONSOLIDATION CHARACTERISTICS.** When subjected to pressure, a soil tends to consolidate as the air or water in the pore space is forced out and the grains assume a denser state of packing. The decrease in volume per unit of pressure is defined as the 'compressibility' of the soil, and a measure of the rate at which consolidation proceeds is given by the 'coefficient of consolidation' of the soil. These two characteristics Mv and Cv are determined in the consolidation test and the results are used to determine settlement of structures or earthworks.

10. **STRENGTH CHARACTERISTICS.** The strength of geological materials is generally expressed as the maximum resistance that they offer to deformation or fracture by applied shear or compressive stress. The strength characteristics of geological materials depend to an important degree on their previous history and on the conditions under which they will be stressed in practice. Consequently, it is necessary to simulate in the laboratory tests the conditions under which the material will be stressed in the field.

In general, the only test carried out on hard rocks is the determination of their compressive strength but consideration must be given to fissuring, jointing and bedding planes.

The tests at present in use for soils and soft rocks fall into two main categories. Firstly, those in which the material is stressed under conditions of no moisture content change, and secondly those in which full opportunity is permitted for moisture content changes under the applied stresses. Tests in the first category are known as undrained (immediate or quick) tests, while those in the second category are known as drained (slow or equilibrium) tests. The tests are normally carried out in the triaxial compression apparatus but granular materials may be tested in the shear box apparatus.

The undrained triaxial test gives the apparent cohesion C_u and the angle of shearing resistance $\emptyset_u$. In dry sands, $C_u = 0$ and $\emptyset_u$ is equal to the angle of internal friction whereas with saturated non-fissured clays $\emptyset u$ tends to 0 and the apparent cohesion C_u is equal to one-half the unconfined compression strength qu. On site the vane test gives an approximate measure of shear strength.

For some stability problems use is made of a variant of the undrained triaxial test in which the specimen is allowed to consolidate fully under the hydrostatic pressure and is then tested to failure under conditions of no moisture content change. This is known as the consolidated undrained triaxial test. Pore water pressures may be measured during this test or a fully drained test may be carried out. In either case the effective shear strength parameters C' and $\emptyset$' can be obtained which can be used to calculate shear strength at any given pore water pressure.

11. **COMPACTION.** The density at which any soil can be placed in an earth dam, embankment or road depends on its moisture content and on the amount of work which is used in compaction. The influence of these two factors can be studied in compaction tests, which can determine the maximum dry density (MDD) achievable at a certain optimum moisture content (OMC).

12. **CALIFORNIA BEARING RATIO TEST.** In flexible pavement design a knowledge of the bearing capacity of the subgrade is necessary to enable the thickness of pavement for any particular combination of traffic and site conditions to be determined. The quality of the subgrade can be assessed by means of the California Bearing Ratio Test or approximately by the MEXE cone penetrometer.

13. **ROCK DESCRIPTION.** This is based on;

i. Colour (minor then principal colour).
ii. Grain Size.

Description	Predominate Grain Size (mm)
Very Coarse - grained	>63
Coarse - grained	63 - 2
Medium - grained	2 - 0.063
Fine - grained	0.063 - 0.002
Very Fine - grained	<0.002

iii. Matrix.
iv. Weathering.

Term	Description
Fresh	No visible sign of weathering/alteration of the rock material.
Discoloured	The colour of the original fresh rock material is changed and is evidence of weathering/alteration. The degree of change from the original colour should be indicated. If the colour change is confined to particular mineral constituents, this should be mentioned.
Disintegrated	The rock material is broken up by physical weathering, so that bonding between grains is lost and the rock is weathered/altered towards the condition of a soil in which the original material fabric is still intact. The rock material is friable but the grains are not decomposed.
Decomposed	The rock material is weathered by the chemical alteration of the mineral grains to the condition of a sol in which the original material fabric is still intact; some or all of the grains are decomposed.

v. Carbonate Content.
vi. Stability of Rock Material.

Stable indicates no changes when sample left in water for 24 hours. Fairly stable indicates fissuring and crumbling of surfaces. Unstable indicates complete disintegration of the sample.

vii. Unconfined Compressive Strength.

Term	Field Identification	Unconfined Compressive Strength (MPa)
Extremely Weak[a]	Indented by thumbnail.	Less than 1
Very Weak	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife.	1 to 5
Weak	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer.	5 to 25
Medium Strong	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer.	25 to 50
Strong	Specimen required more than one blow of geological hammer to fracture it.	50 to 100
Very Strong	Specimen requires many blows of geological hammer to fracture it.	100 to 250
Extremely Strong	Specimen can only be chipped with geological hammer.	Greater than 250

[a] Some extremely weak rocks will behave as soils and should be described as soils.

viii. Structure.

Sedimentary	Metamorphic	Igneous
Bedded	Cleaved	Massive
Interbedded	Foliated	Flowbanded
Laminated	Schistose	Folded
Folded	Banded	Lineated
Massive	Lineated	
Graded	Gneissose	
	Folded	

ix. Discontinuities.
x. Discontinuity Spacing, persistence and roughness, infilling and seepage.
xi. Weathering of the Rock Mass.

Term	Description	Grades
Fresh	No visible sign of rock material weathering; perhaps slight discolouration on major discontinuity surfaces.	0
Slightly weathered	Discolouration indicates weathering of rock material and discontinuity surfaces.	1
Moderately weathered	Less than half of the rock material is decomposed or disintegrated. Fresh or discoloured rock is present either as a continuous framework or as core stones.	2
Highly weathered	More than half of the rock material is decomposed or disintegrated. Fresh or discoloured rock is present either as a continuous framework or as core stones.	3
Completely weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.	4
Residual soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soils has not been significantly transported.	5

xii. Rock Mass Permeability

14. **CHEMICAL TESTS.** A knowledge of total soluble sulphate content and pH of soils and groundwater is important in determining the protection required for concrete or steel in contact with the ground. Other specialist tests may be carried out on sites suspected of being contaminated by toxic materials (see standard appendix B).

15. **REFERENCES**

BS5930: 2015+A1:2020 British Standard Code of Practice for Site Investigations
BS10175: 2011+A2:2017 British Standard Code of Practice for the Investigation of Potentially Contaminated Sites

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STANDARD APPENDIX B

NOTES ON CONTAMINATION INVESTIGATION PROCEDURE (June 2021)

mdja

1. **GENERAL.** The desk study and/or intrusive ground investigation is typically carried out in accordance with the Environment Agency's "Land Contamination Risk Management (LCRM) documents and the requirements of BS5930: 2015 and BS10175: 2011+A1: 2020. In relation to contamination the desk study is referred to as the preliminary investigation in BS10175 and the intrusive ground investigation is referred to as the Exploratory Investigation. This appendix briefly describes the nature of the work carried out and explains the standards against which contamination data has been assessed. The nature of any contamination investigation is such that only a small percentage of the ground, and therefore potential contamination, is sampled. Consequently variations in both ground conditions and contaminant levels can occur between any two sampling positions. The contamination investigation is designed to minimise such risks, but they cannot be eliminated.

2. **REVIEW OF CONTAMINATION ISSUES –** The National Planning Policy Framework (NPPF) and Part 2A of the Environmental Protection Act 1990 create a new regime for the identification and remediation of contaminated land. It introduced a definition of contaminated land described in Section 78A(2) of the Act of:

"any 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

(a) significant harm is being caused or there is a significant possibility of such harm being caused; or

(b) significant pollution of controlled waters is being caused or there is a significant possibility of such pollution being caused:

Both Part 2A and the planning regime embrace the "suitable for use" approach. In the context of Part IIA, action is necessary only where there are unacceptable risks to health or to the environment, taking into account the current use of the land and its environmental setting.

For humans, significant harm is defined as "death, disease, serious injury ". Specifically, disease is taken to mean an unhealthy condition of the body or part of it. "Significant possibility of significant harm" is described as health effects arising from the intake of a contaminant or other direct bodily contact with the contaminant where the intake or exposure is unacceptable. The assessment should also take into account the total intake from all sources, the relative contribution of the pollutant linkage in question, and the duration of intake or exposure. The various statutory definitions are given overleaf.

The presence of unnatural substances does not automatically constitute a risk unless there is a link or pathway between the contamination (the hazard) and the receptor (the target) be it humans, the environment or property. Therefore the assessment needs to determine whether a hazard is present and whether the necessary pathway exists the so-called "pollution linkage" or "conceptual site model".

The effect of any hazard on a site depends primarily on the site use and groundwater conditions since these determine who and what may be at risk and the routes by which they may be exposed to the hazard. Site uses can include allotments, domestic gardens on residential developments, amenity and recreational areas, public open space and industrial and commercial buildings. On any site, the potential contaminants have to be identified together with the potential receptors. The pathway for that contaminant to reach its target has then to be considered.

3. **PRELIMINARY INVESTIGATION.** The preliminary Phase I Geoenvironmental Assessment (desk study) report normally considers the following key sections:

Introduction	
The Site	Contaminated Land
Site History	Radon
Geology and Mining	Geoenvironmental Risk Assessment
Hydrogeology	Geotechnical Assessment
Groundsure Geo-Insight and Enviro-Insight	Ground Investigation (Recommendations)

The report will summarise the findings and also relate our opinions to the potential for a site to be geoenvironmentally impaired, at levels likely to warrant mitigation or further consideration appropriate to the current or future use. Findings are based on information obtained and described during the desk study and site inspection without intrusive ground investigation. It is possible that further information exists. The absence of indicators of impairment does not mean that such impairment does not exist. Additional investigation including intrusive methods can reduce the risks but cannot eliminate them and may not be cost effective. We can advise on the additional research opportunities, their cost and their possible impact on mitigating risk. Recommendations are normally given based on the redevelopment proposals for the site.

Type of Receptor	Description of harm that is to be regarded as significant harm	Conditions For There Being A Significant Possibility Of Significant Harm
1. Human beings	Death, disease, serious injury, genetic mutation, birth defects or the impairment of reproductive functions. For these purposes, disease is to be taken to mean an unhealthy condition of the body or a part of it and can include, for example, cancer, liver dysfunction or extensive skin ailments. Mental dysfunction is included only insofar as it is attributable to the effects of a pollutant on the body of the person concerned.	If the amount of the pollutant in the pollutant linkage represents an unacceptable intake or direct bodily contact, assessed on the basis of relevant information on the toxicological properties of that pollutant. Such an assessment should take into account: • the likely total intake of, or exposure to, the substance or substances which form the pollutant, from all sources including that from the pollutant linkage in question; • the relative contribution of the pollutant linkage in question to the likely aggregate intake of, or exposure to, the relevant substance or substances; and • the duration of intake or exposure resulting from the pollutant linkage in question. The question of whether an intake or exposure is unacceptable is independent of the number of people who might experience or be affected by that intake or exposure. Toxicological properties should be taken to include carcinogenic, mutagenic, teratogenic, pathogenic, endocrine-disrupting and other similar properties.
2. All other human health effects (particularly by way of explosion or fire)		If the probability, or frequency, of significant harm of that description is unacceptable. The pollutant linkage might cause "significant harm which" • would be irreversible or incapable of being treated; • would affect a substantial number of people; • would result from a single incident such as a fire or an explosion; or • would be likely to result from a short-term (lees than 24-hour) exposure to the pollutant.
3. Any ecological system, or living organism forming part of such a system, within a location which is protected.	For any protected location: • harm which results in an irreversible adverse change, or in some other substantial adverse change, in the functioning of the ecological system within any substantial part of that location; or • harm which affects any species of special interest within that location and which endangers the long-term maintenance of the population of that species at that location.	If either: • significant harm of that description is more likely than not to result from the pollutant linkage; or • there is a reasonable possibility of significant harm of that description being caused, and if that harm were to occur, it would result in such a degree of damage to features of special interest at the location in question that they would be beyond any practicable possibility of restoration.
4. Property in the form of: • crops, including timber; • produce grown domestically, or on allotments, for consumption; • livestock; • other owned or domesticated animals; • wild animals which are the subject of shooting or fishing rights.	For crops, a substantial diminution in yield or other substantial loss in the value resulting from death, disease or other physical damage. For domestic pets, death, serious disease or serious physical damage. For other property in this category, a substantial loss in its value resulting from death, disease or other serious physical damage.	If significant harm of that description is more likely than not to result from the pollutant linkage in question.
5. Property in the form of buildings.	Structural failure, substantial damage or substantial interference with any right of occupation.	If significant harm of that description is more likely than not to result from the pollutant linkage in question during the expected economic life of the building.
6. Controlled waters.		

4. **INTRUSIVE INVESTIGATION.** BS10175 describes this as an exploratory investigation. Intrusive ground investigation is described in Standard Appendix A. During the investigation representative or indicative samples are obtained for testing by an accredited laboratory. The aim is to determine (with a degree of confidence appropriate to the objectives), the presence, concentration and distribution of contaminants in respect of those points investigated. The extent of any necessary intrusive investigation will depend on the size of the site and any hazards, either known or suspected.

5. **ASSESSMENT OF CONTAMINATION.** The assessment of contaminated land under the terms of Part II A of the Environmental Protection Act 1990 is based upon pollution linkage (source - pathway - receptor model) and the principles of the Environment Agency's "Contamination Land Risk Management" documentation.

DEFRA previously issued "Outcome of the Way Forward Exercise on Soil Guideline Values". This document was intended to provide guidance to determine if there is a Significant Possibility of Significant Harm (SPOSH) i.e. whether land meets the legal trigger of being contaminated land.

In the context of Part 2A, a risk assessor using an SGV would conclude the following (DEFRA, 2008).

- At a representative average soil concentration at or below an SGV, it is very unlikely that there will be a *significant possibility of significant harm (SPOSH)*.

- At a representative average soil concentration above an SGV, there *might* be a *significant possibility of significant harm* with the significance linked to the margin of exceedance, the duration and frequency of exposure, and other site-specific factors that the enforcing authority may wish to take into account. Further investigation and/or detailed evaluation will usually be required.

It should be stressed that where there is any uncertainty as to whether or not there is a SPOSH, it was the policy of this practice to adopt a conservative approach, particularly in the adoption of clean cover systems.

In April 2012, Defra both published new Statutory Guidance which forms a major part of their contaminated land regimes under Part 2A of the Environment Protection Act 1990. The regime provides a means of dealing with contaminated land which poses a significant risk to human health or the environment where there is no alternative solution. It also works alongside planning rules and building regulations to help ensure that affected land is made suitable for use when it is redeveloped.

Since the regime was introduced in 2000 there has been considerable uncertainty over how to decide when land is, and is not contaminated land on grounds of the legal test of *significant possibility of significant harm to human health or the environment*.

To help address this, one of the main changes set out in the new Statutory Guidance, is the introduction of a new four category test to help decide when land is, and is not, contaminated land on grounds of *significant possibility of significant harm to human health*. Under the new four category test:

- Category 1 describes land that is clearly contaminated land, for example because similar land is known to have caused significant harm in the past.

- Categories 2 and 3 cover less straightforward land where more detailed consideration is needed before the regulator can decide either: (a) that there is a strong case for regulatory action, in which case the land would be in Category 2 and be classified as contaminated land under Part 2A; or (b) that such a case does not exist, in which case the land would be in Category 3 and not be classified as contaminated land under Part 2A.

- Category 4 describes land that is clearly not contaminated land, as discussed below.

One of the main purposes of including the Categories in the Statutory Guidance is to provide a legal framework against which new technical tools can be developed by the land contamination sector to describe the Categories in more detail with regard to specific substances and/or situations.

The new Category 4 test is particularly important in terms of reducing uncertainty over when land is definitely not caught by the regime.

The new Statutory Guidance makes clear what land should be placed into Category 4, for example:

(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 the guidance), unless there is a particular reason to consider otherwise. In other words land with normal background concentrations in the soil.

(c) Land that has been excluded from the need for further inspection and assessment under Part 2A because contaminant levels do not exceed relevant generic assessment criteria in accordance with Section 3 of the guidance, or relevant technical tools or advice that may be developed in accordance with paragraph 3.30 of the guidance, e.g. Category 4 Screening Levels.

(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 to in the normal course of their lives).

The guidance clarifies how generic assessment criteria (including the currently available SGVs/GACs) should and should not be used. It states that:

3.27 It is common practice in contaminated land risk assessment to use "generic assessment criteria" (GACs) as screening tools in generic quantitative human health risk assessment to help assessors decide when land can be excluded from the need for further inspection and assessment, or when further work may be warranted.

3.28 Local authorities may use GACs and other technical tools to inform certain decisions under the Part 2A regime, provided: (i) they understand how they were derived and how they can be used appropriately; (ii) they have been produced in an objective, scientifically robust and expert manner by reputable organizations; and (iii) they are only used in a manner that is in accordance with Part 2A and this Guidance.

3.29 GACs relating to human health risk assessment represent cautious estimates of levels of contaminants in soil at which there is considered to be no risk to health or, at most, a minimal risk to health. With regard to such GACs:

(a) They may be used to indicate when land is very unlikely to pose a significant possibility of significant harm to human health. This is on the basis that they are designed to estimate levels of contamination at which risks are likely to be negligible or minimal and far from posing a significant possibility of significant harm to human health.

(b) They should not be used as direct indicators of whether a significant possibility of significant harm to human health may exist. Also, the local authority should not view the degree by which GACs are exceeded (in itself) as being particularly relevant to this consideration, given that the degree of risk posed by land would normally depend on many factors other than simply the amount of contaminants in soil.

(c) They should not be seen as screening levels which describe the boundary between Categories 3 and 4 in terms of Section 4 (i.e. the two Categories in which land would not be contaminated land on grounds of risks to human health). In the very large majority of cases, these SGVs/GACs describe levels of contamination from which risks should be considered to be comfortably within Category 4.

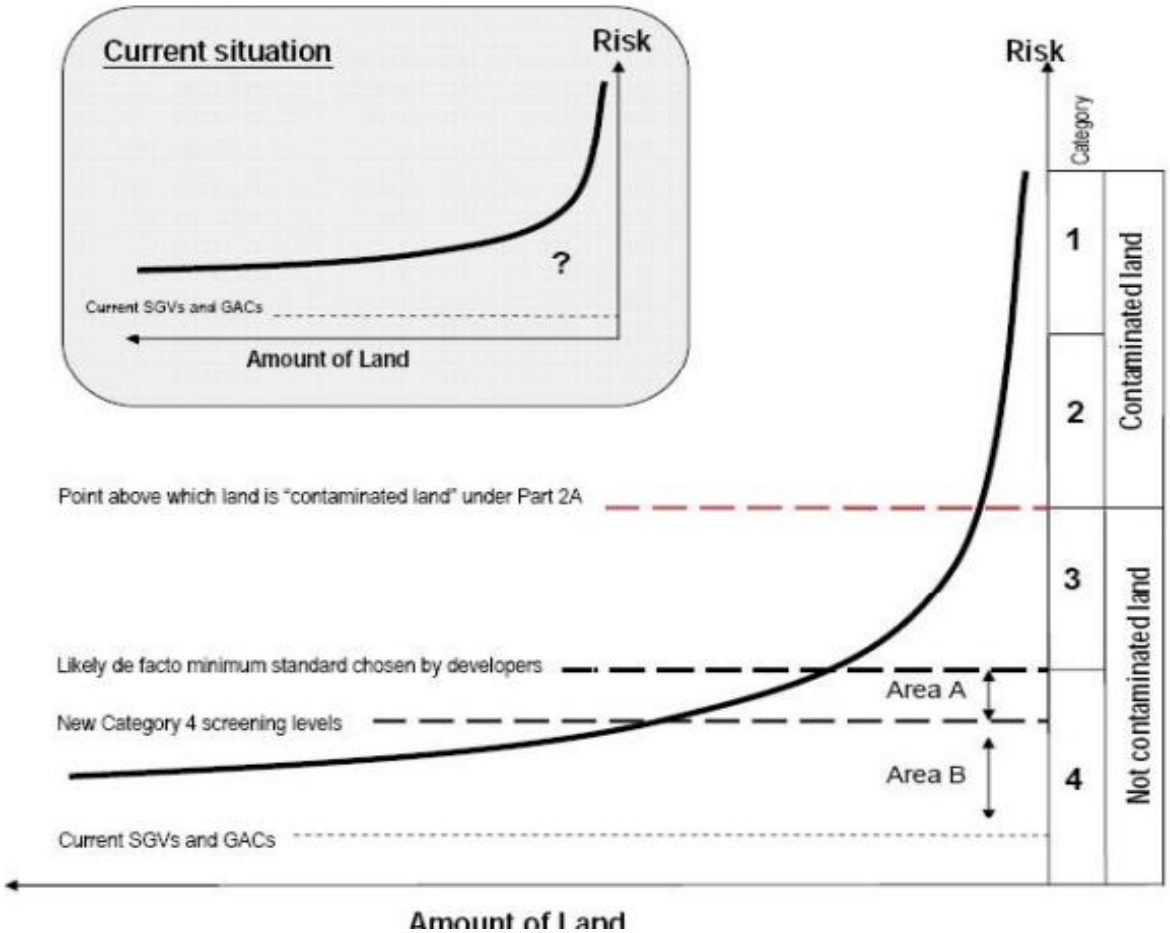
(d) They should not be viewed as indicators of levels of contamination above which detailed risk assessment would automatically be required under Part 2A.

(e) They should not be used as generic remediation targets under the Part 2A regime. Nor should they be used in this way under the planning system, for example in relation to ensuring that land affected by contamination does not meet the Part 2A definition of contaminated land after it has been developed.

The way in which the new four category system is intended to operate and the place of the C4SLs within that system, was explained in detail in the Impact Assessment which accompanied the Statutory Guidance. Please note that although the detail of the Impact Assessment is included here to provide clarity on the job expected of C4SLs, the Statutory Guidance, itself, sets out the regime that needs to be delivered under Part 2A.

Paragraph 47 of the Impact Assessment describes the diagram in detail. Of particular relevance to this project is the description of the overall diagram (sub-paragraph a), description of category 4 (sub-paragraphs c (part iv) and h) and the description of how the monetised benefits of the new system will be realised (sub-paragraph h). These sub-paragraphs are reproduced below.

Diagram showing the new Category 1-4 system (compared to current situation)



The diagram above seeks to illustrate, in a simplified manner, broadly what the changes to the statutory guidance on significant possibility of significant harm to human health are intended to achieve. To explain:

(a) The curved line and axes illustrate the spectrum of risk presented by land contamination. The idea is to show that a very large amount of land is low risk, and only a small amount of land would pose sufficient risk to be contaminated land in the legal sense. The axes and lines in the diagrams are not to scale, and they have been compressed for the purposes of illustration (in reality the risks on Category 1 land would probably be orders of magnitude above Category 4 risks, and vastly more land would be in Category 4 compared to the other Categories).

(b) The smaller diagram summarizes the current situation. In the area below the SGV/GACs there is near certainty that land is not contaminated land, however, above the line there is increasing uncertainty. As explained above, currently remediation usually occurs to just below the SGV/GAC level because they are perceived as offering the only cast-iron guarantee of when land is definitely not contaminated land. Sometimes consultants are employed to justify remediating to levels above the SGV/GACs, however the further they go away from the SGV/GACs the more legal risk they and their clients are exposed to.

(c) The new statutory guidance will end the current situation, and it would not be legally possible e.g. for individual regulators to ignore the changes being made. For example, as explained above, the new statutory guidance will specifically say:

(i) that Part 2A cannot be used to force remediation to below a point where it ceases to be contaminated land in the legal sense i.e. the Category 2/3 border in terms of the diagram), although responsible parties can choose to go further;

(ii) that SGV/GACs cannot be used as one size fits all remediation thresholds under either Part 2A of the planning system;

(iii) that normal background levels of contamination are not caught by Part 2A; and

(iv) that SGV/GACs are well into Category 4, sometimes by only a few times and sometimes by orders of magnitude. These changes and others also provide the legal backing for the development e.g. of Category 4 screening levels, as discussed below.

(d) The new Category 1-4 system divides the spectrum of risk posed by contaminated land into four different categories, and the statutory guidance will explain how to decide when land falls into each Category. This is more sophisticated than the current statutory guidance, which in effect has only two categories (contaminated land or not) and does not explain how to decide which category land falls into. The new Category 1-4 system

reflects what assessors find when they investigate real sites i.e. some are clearly contaminated land (Category 1) ; some clearly are not (Category 4) and some are less-straightforward and need some level of detailed assessment before a decision can be taken as to whether or not they are contaminated land (Categories 2 and 3).

(e) In the case of Category 2 and 3 sites, the regulator will have flexibility to take decisions within the parameters set by the new Guidance. There would be less flexibility for Category 2 and 3 sites that clearly pose either a high or low risk. However, the regulator will have considerable flexibility for sites closer to the Category 2/3 border to judge which side of the border a site would fall (e.g. taking account of their understanding of the risks, uncertainties and the interests of the local community). These are often complex decisions which need to be taken case-by-case given the many factors involved.

(f) In the case of Categories 1 and 4 the regulator will have far less flexibility. For example, if a regulator claimed that a site matching the Category 1 description was not contaminated land, or that a site matching the Category 4 description was contaminated land, they would be acting directly against the statutory guidance which the Act requires that they follow, and decisions could be challenged (e.g. in a law court) with a high chance that the challenge would be successful. Among other things, the intention of doing this is to create far more legal certainty around when land is definitely not contaminated land in the legal sense. With the specific wording of the new statutory guidance, and the supporting tools such as the new Category 4 screening levels, it would be very difficult for a regulator e.g. to threaten landowners with the Part 2A regime, and if they tried to determine land as contaminated land they would be operating in direct opposition to the statutory guidance.

(g) In the many consultation meetings held in developing the Category 1-4 system, all the developers, landowners and consultants we spoke to were strongly of the view that they would want the ensure their land is safely within Category 4 (even though in theory they could remediate to a level within Category 3 and still satisfy Part 2A and planning rules). They would do this for various reasons, including the fact that the flexibility granted to regulators in Categories 2 and 3 means that the further into Category 3 a site gets, the greater the risk that the regulator might decide it is in Category 2. Also they would want to be in Category 4 for reasons of marketability, future proofing etc. So developers and others would have a strong incentive to seek the regulatory certainty of being safely within Category 4. Thus, as far as development taking place under the planning system is concerned, Category 3 would, in effect, normally be a buffer which provides added reassurance that development falling within Category 4 will not be caught by the Part 2A regime.

(h) The new statutory guidance will bring about a situation where the current SGV/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. Above the C4SLs, in Area A on the diagram, there will be much stronger legal backing for experts to use their judgement to make sensible and precautionary decisions on when land should be considered to be towards the top end of Category 4, without fear that land may be caught as contaminated land. This recognizes that the generic C4SLs will not be able to describe the Category 3/4 border itself because they are generic and would therefore have to err on the side of caution whilst a detailed site specific assessment would be able to push further by looking at specific circumstances relating to a specific site.

(i) The very large majority of the monetized benefits of the changes to the regime discussed in this Impact Assessment manifest themselves in Category 4, and in particular in Areas A and B on the diagram. The main effects of moving to the new system would include Low risk land falling within Area B (pre-development) on the diagram would no longer have to be remediated because it would fall below the new C4SLs. Similarly land which is in Area A pre-development would no longer need to be remediated if justified by a detailed site-specific assessment. For these sites the cost of remediation would be removed altogether. The cost of remediating land which is initially in Categories 3, 2 or 1 would fall because it would be remediated to the new C4SL levels (or somewhere within Area A if there has been a detailed assessment) rather than the SGV/GAC level. This will have the overall effect of reducing the cost of remediation, with the effect varying according to specific site circumstances, the type of remediation etc. Generally the cost of remediation would fall for many affected brownfield land sites. This would have the general effect of making such land more economically viable for development. It would also mean that some land that is not currently economically viable to develop becomes reduce pressure to develop Greenfield land in some cases. The C4SLs will also speed up regulatory decisions on the reuse of brownfield land by providing a simple remediation standard.

The C4SLs are intended as "*relevant technical tools*" (in relation to Paragraph 4.2.1(c)) provides 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 SG (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 with 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 soils that, unless stated otherwise, are tolerable or pose a minimal risk to human health".*

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.

CL:AIRE (Contaminated Land: Application in Real Environments) has published "*Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination*". In it a series of C4SLs were proposed as follows;

Analyte	Residential (with home grown produce) (mg/kg)	Residential (without home grown produce) (mg/kg)	Allotments (mg/kg)	Commercial (mg/kg)	POS (mg/kg)
Arsenic	37	40	49	640	79
Benzene	0.87	3.3	0.18	98	140
Benzo(a)Pyrene	5	5.3	5.7	77	10
Cadmium	22	150	3.9	410	880
Chromium (vi)	21	21	170	49	21
Lead	200	310	80	2300	630

Where C4SL's are not available, Generic Assessment Criteria have been used as follows;

Generic Assessment Criteria for Human Health Risk Assessment Comparison
METALS/CYANIDE

Based on sandy loam soil as defined in SR3 (Environment Agency, 2009) and based on 6% soil organic matter (SOM)
Values are expressed in mg/kg

	S4UL						C4SL						EA SGV			EIC/AGS/CL:AIRE or *ATRISKSOIL		
	Residential with homegrown produce	Residential without homegrown produce	Allotment	Commercial	POSresi	POSpark	Residential with homegrown produce	Residential without homegrown produce	Allotment	Commercial	POSresi	POSpark	Residential	Allotment	Commercial	Residential without consumption of homegrown produce	Allotment	Commercial
Antimony[1]																550	ND	7500
Arsenic (6% SOM)	37	40	43	640	79	170	37	40	49	640	79	170	32	43	640			
Barium[1]																1300	ND	22000
Beryllium (6% SOM)	1.7	1.7	35	12	2.2	63												
Boron (6% SOM)	290	11000	45	240000	21000	46000												
Cadmium (6% SOM)	11	85	1.9	190	120	560	22	150	3.9	410	220	880	10	1.8	230			
Chromium (III) (6% SOM)	910	910	18000	8600	1500	33000												
Chromium (VI) (6% SOM)	6	6	1.8	33	7.7	220	21	21	170	49	21	250						
Copper (6% SOM)	2400	7100	520	68000	12000	44000												
Cyanide (AtriskSoil)																34*	34*	34*
Lead (6% SOM)							200	310	80	2300	630	1300						
Nickel (6%SOM)	130	180	53	980	230	800												
Mercury (Elemental) (6% SOM)	1.2	1.2	21	58	16	30							1.0	26	26			
Mercury (Inorganic) (6% SOM)	40	56	19	1100	120	240							170	80	3600			
Mercury (Methyl) (6% SOM)	11	15	6	320	40	68							11	8	410			
Molybdbenum[1]																670	ND	17000
Selenium (6% SOM)	250	430	88	12000	1100	1800							350	120	13000			
Vanadium (6% SOM)	410	1200	91	9000	2000	5000												
Zinc (6% SOM)	3700	40000	620	730000	81000	170000												

Additional notes for EIC/AGS/CL:AIRE GAC

1 Due to the limitations in time and scope of the EIC/AGS/CL:AIRE project, plant uptake factors were not derived for metals and therefore the metals GAC have only been produced for residential without consumption of homegrown produce and commercial land-uses. Note that the derived GAC are not dependent on SOM.

PETROLEUM HYDROCARBONS

Based on sandy loam soil as defined in SR3 (Environment Agency, 2009) and 1%, 2.5% and 6% soil organic matter (SOM).
SGVs based on 6% SOM, at a lower SOM the SGV may not be sufficiently protective.
Generic assessment criteria for Petroleum Hydrocarbons will vary according to SOM for all land values
Values are expressed in mg/kg
GACs assume that free phase contamination is not present
GACs are based on sub-surface soil to indoor air correction factor of 10

	S4UL						C4SL						EA SGV			EIC/AGS/CL:AIRE			
Compound	**Residential with homegrown produce**	**Residential without homegrown produce**	**Allotment**	**Commercial**	**POSresi**	**POSpark**	**Residential with homegrown produce**	**Residential without homegrown produce**	**Allotment**	**Commercial**	**POSresi**	**POSpark**	**Residential**	**Allotment**	**Commercial**	**Residential with consumption of homegrown produce**	**Residential without consumption of homegrown produce**	**Allotment**	**Commercial**
Aliphatic EC 5-6 (1% SOM)	42	42	730	3200 (340)	570000 (304)	95000 (304)													
Aliphatic EC 5-6 (2.5% SOM)	78	78	1700	5900 (558)	590000	130000 (558)													
Aliphatic EC 5-6 (6% SOM)	160	160	3900	12000 (1150)	600000	18000 (1550)													
Aliphatic EC>6-8 (1% SOM)	100	100	2300	7800 (144)	600000	150000 (144)													
Aliphatic EC>6-8 (2.5% SOM)	230	230	5600	17000 (322)	610000	220000 (322)													
Aliphatic EC>6-8 (6% SOM)	530	530	13000	40000 (736)	620000	320000 (736)													
Aliphatic EC>8-10 (1% SOM)	27	27	320	2000 (78)	13000	14000 (78)													
Aliphatic EC>8-10 (2.5% SOM)	65	65	770	4800 (190)	13000	18000 (190)													
Aliphatic EC>8-10 (6% SOM)	150	150	1700	11000 (451)	13000	21000 (451)													
Aliphatic EC>10-12 (1% SOM)	130 (48)	130 (48)	2200	9700 (48)	13000	21000 (48)													
Aliphatic EC>10-12 (2.5% SOM)	330 (118)	330 (118)	4400	23000 (118)	13000	23000 (118)													
Aliphatic EC>10-12 (6%SOM)	760 (283)	770 (283)	7300	47000 (283)	13000	24000 (283)													
Aliphatic EC>12-16 (1% SOM)	1100 (24)	1100 (24)	11000	59000 (24)	13000	25000 (24)													
Aliphatic EC>12-16 (2.5% SOM)	2400 (59)	2400 (59)	13000	82000 (59)	13000	25000 (59)													
Aliphatic EC>12-16 (6% SOM)	4300 (142)	4300 (142)	13000	90000 (142)	13000	26000 (142)													
Aliphatic EC>16-35 (1% SOM)	65000 (8.48)	65000 (8.48)	260000	1600000	250000	450000													
Aliphatic EC>16-35 (2.5% SOM)	92000 (21)	92000 (21)	270000	1700000	250000	480000													
Aliphatic EC>16-35 (6% SOM)	110000	110000	270000	1800000	250000	490000													
Aliphatic EC>35-44 (1% SOM)	65000 (8.48)	65000 (8.48)	260000	1600000	250000	450000													
Aliphatic EC>35-44 (2.5% SOM)	92000 (21)	92000 (21)	270000	1700000	250000	480000													
Aliphatic EC>35-44 (6% SOM)	110000	110000	270000	1800000	250000	490000													
Aromatic EC 5-7 (1% SOM)	70	370	13	26000 (1220)	56000	76000 (1220)													
Aromatic EC 5-7 (2.5% SOM)	140	690	27	46000 (2260)	56000	84000 (2260)													
Aromatic EC 5-7 (6% SOM)	300	1400	57	86000 (4710)	56000	92000 (4710)													
Aromatic EC>7-8 (1% SOM)	130	860	22	56000 (869)	56000	87000 (869)													
Aromatic EC>7-8 (2.5% SOM)	290	1800	51	110000 (1920)	56000	95000 (1920)													
Aromatic EC>7-8 (6% SOM)	660	3900	120	180000 (4360)	56000	100000 (4360)													
Aromatic EC>8-10 (1% SOM)	34	47	8.6	3500 (613)	5000	7200 (613)													
Aromatic EC>8-10 (2.5% SOM)	83	110	21	8100 (1500)	5000	8500 (1500)													
Aromatic EC>8-10 (6% SOM)	190	270	51	17000 (3580)	5000	9300 (3580)													
Aromatic EC>10-12 (1% SOM)	74	250	13	16000 (364)	5000	9200 (364)													
Aromatic EC>10-12 (2.5% SOM)	180	590	31	28000 (899)	5000	9700 (899)													
Aromatic EC>10-12 (6% SOM)	380	1200	74	34000 (2150)	5000	10000													
Aromatic EC>12-16 (1% SOM)	140	1800	23	36000 (169)	5100	10000													
Aromatic EC>12-16 (2.5% SOM)	330	2300 (419)	57	37000	5100	10000													
Aromatic EC>12-16 (6% SOM)	660	2500	130	38000	5000	10000													
Aromatic EC>16-21 (1% SOM)	260	1900	46	28000	3800	7600													
Aromatic EC>16-21 (2.5% SOM)	540	1900	110	28000	3800	7700													
Aromatic EC>16-21 (6% SOM)	930	1900	260	28000	3800	7800													
Aromatic EC>21-35 (1% SOM)	1100	1900	370	28000	3800	7800													
Aromatic EC>21-35 (2.5% SOM)	1500	1900	820	28000	3800	7800													
Aromatic EC>21-35 (6% SOM)	1700	1900	1600	28000	3800	7900													
Aromatic EC>35-44 (1% SOM)	1100	1900	370	28000	3800	7800													
Aromatic EC>35-44 (2.5% SOM)	1500	1900	820	28000	3800	7800													
Aromatic EC>35-44 (6% SOM)	1700	1900	1600	28000	3800	7900													
Aliphatic + Aromatic EC>44-70 (	1600	1900	1200	28000	3800	7800													
Aliphatic + Aromatic EC>44-70 (	1800	1900	2100	28000	3800	7800													
Aliphatic + Aromatic EC>44-70 (	1900	1900	3000	28000	3800	7800													

	S4UL						C4SL						EA SGV			EIC/AGS/CL:AIRE			
Compound	**Residential with homegrown produce**	**Residential without homegrown produce**	**Allotment**	**Commercial**	**POSresi**	**POSpark**	**Residential with homegrown produce**	**Residential without homegrown produce**	**Allotment**	**Commercial**	**POSresi**	**POSpark**	**Residential**	**Allotment**	**Commercial**	**Residential with consumption of homegrown produce**	**Residential without consumption of homegrown produce**	**Allotment**	**Commercial**
Benzene (1% SOM)	0.087	0.38	0.017	27	72	90													
Benzene (2.5% SOM)	0.17	0.7	0.034	47	72	100													
Benzene (6% SOM)	0.37	1.4	0.075	90	73	110	0.87	3.3	0.18	98	140	230	0.33	0.07	95				
Toluene (1% SOM)	130	880 (869)	22	56000 (869)	56000	87000 (869)													
Toluene (2.5% SOM)	290	1900	51	110000 (1920)	56000	95000 (1920)													
Toluene (6% SOM)	660	3900	120	180000 (4360)	56000	100000 (4360)							610	120	$4.4x10^3$				
Ethyl benzene (1% SOM)	47	83	16	5700 (518)	24000	17000 (518)													
Ethyl benzene (2.5% SOM)	110	190	39	13000 (1220)	24000	22000 (1220)													
Ethyl benzene (6% SOM)	260	440	91	27000 (2840)	25000	27000 (2840)							350	90	$2.8x10^3$				
o-xylene (1%SOM)	60	88	28	6600 (478)	41000	17000 (478)													
o-xylene (2.5% SOM)	140	210	67	15000 (1120)	42000	24000 (1120)													
o-xylene (6% SOM)	330	480	160	33000 (2620)	43000	33000 (2620)							250	160	$2.6x10^3$				
m-xylene (1% SOM)	59	82	31	6200 (625)	41000	17000 (625)													
m-xylene (2.5% SOM)	140	190	74	14000 (1470)	42000	24000 (1470)													
m-xylene (6% SOM)	320	450	170	31000 (3460)	43000	32000 (3469)							240	180	$3.5x10^3$				
p-xylene (1% SOM)	56	79	29	5900 (576)	41000	17000 (478)													
p-xylene (2.5% SOM)	130	180	69	14000 (1350)	42000	23000 (1350)													
p-xylene (6% SOM)	310	430	160	30000 (3170)	43000	31000 (3170)							230	160	$3.2x10^3$				
Methyl tert-butyl ether (1% SOM)																49	73	23	7900
Methyl tert-butyl ether (2.5% SOM)																84	120	44	13000
Methyl tert-butyl ether (6% SOM)																160	220	90	24000

Additional Notes for LQM/CIEH Generic Assessment Criteria

1 For residential land use the inhalation of vapours indoors exposure pathway is the most significant exposure pathway for the lighter end aliphatic and aromatic fractions (up to aliphatic EC>12-16 and aromatic EC>10-12). The ingestion of soil and indoor dust and consumption of homegrown produce exposure pathways are the most significant for the higher end fractions (aliphatics EC>16-35 and EC>35-44; aromatics EC>12-16, EC16-21, EC>21-35, EC>35-44 and EC44-70).

2 For the allotment land use the consumption of homegrown produce exposure pathway is the most significant for the aromatic and lighter end aliphatic fractions. The ingestion of soil and and indoor dust is the most significant exposure pathway for the higher end aliphatics EC>12-16, EC>16-35 and EC35-44.

3 For the commercial land use the indoor inhalation of vapour exposure pathway is a significant exposure pathway for the lighter end aliphatic and aromatic fractions (up to aliphatic EC>12-16 and aromatic EC>10-12.

4 Background exposure represents a significant proportion of the total exposure for all fractions expect aromatic fractions EC>5-7 and EC>7-8 in all land uses.

Notes for SGVs

1 Based on a sandy loam as defined in Environment Agency (2009b) and 6% SOM. At a lower SOM, SGVs may not be sufficient protective.
2 Generic assessment criteria will vary according to SOM for all land uses.
3 SGVs assume that free phase contamination is not present.
4 SGVs based on a sub-surface soil to indoor air correction air correction factor of 10.
5 SGV presented for Toluene Commercial based on the vapour saturation limit.
6 SGV presented for Ethylbenzene Allotment and Xylene Allotment - in applying the rules for non-soil background, the inhalation background ADE is limited to being no larger than the contribution of the inhalation soil ADE.
7 Exposure of all isomers of xylene should be considered together, because the HCV applied is based on intake of total xylene and not an individual isomer in isolation.

Notes for EIC/AGS/CL:AIRE Generic Assessment Criteria

1 GAC have been derived for 4 generic land uses; residential with consumption of homegrown produce, residential without consumption of homegrown produce, allotments and commercial land-use.

POLYAROMATIC HYDROCARBONS

Based on sandy loam soil as defined in SR3 (Environment Agency, 2009) and 1%, 2.5% and 6% soil organic matter (SOM)
Generic assessment criteria for Polycyclic Aromatic Hydrocarbons will vary according to SOM for all land values
Values are expressed in mg/kg
GACs assume that free phase contamination is not present
GACs are based on sub-surface soil to indoor air correction factor of 1

	LQM/CIEH						C4SL					
Compound	**Residential with home grown produce**	**Residential without home grown produce**	**Allotment**	**Commercial**	**POSresi**	**POSpark**	**Residential with home grown produce**	**Residential without home grown produce**	**Allotment**	**Commercial**	**POSresi**	**POSpark**
Acenaphthene (1% SOM)	210	3000 (57)	34	84000 (57)	15000	29000						
Acenaphthene (2.5% SOM)	510	4700 (141)	85	97000 (141)	15000	30000						
Acenaphthene (6% SOM)	1100	6000 (336)	200	100000	15000	30000						
Acenaphthylene (1% SOM)	170	2900 (86.1)	28	83000 (86.1)	15000	29000						
Acenaphthylene (2.5% SOM)	420	4600 (212)	69	97000 (212)	15000	30000						
Acenaphthylene (6% SOM)	920	6000 (506)	160	100000	15000	30000						
Anthracene (1% SOM)	2400	31000 (1.17)	380	520000	74000	150000						
Anthracene (2.5% SOM)	5400	35000	950	540000	74000	150000						
Anthracene (6% SOM)	11000	37000	2200	540000	74000	150000						
Benz(a)anthracene (1% SOM)	7.2	11	2.9	170	29	49						
Benz(a)anthracene (2.5% SOM)	11	14	6.5	170	29	56						
Benz(a)anthracene (6% SOM)	13	15	13	180	29	62						
Benzo(a)pyrene (1% SOM)	2.2	3.2	0.97	35	5.7	11						
Benzo(a)pyrene (2.5% SOM)	2.7	3.2	2.0	35	5.7	12						
Benzo(a)pyrene (6% SOM)	3.0	3.2	3.5	36	5.7	13	5.0	5.3	5.7	77	10	21
Benzo(b)fluoranthene (1% SOM)	2.6	3.9	0.99	44	7.1	13						
Benzo(b)fluoranthene (2.5% SOI	3.3	4.0	2.1	44	7.2	15						
Benzo(b)fluoranthene (6% SOM)	3.7	4.0	3.9	45	7.2	16						
Benzo(ghi)perylene (1% SOM)	320	360	290	3900	640	1400						
Benzo(ghi)perylene (2.5% SOM)	340	360	470	4000	640	1500						
Benzo(ghi)perylene (6% SOM)	350	360	640	4000	640	1600						
Benzo(k)fluoranthene (1% SOM)	77	110	37	1200	190	370						
Benzo(k)fluoranthene (2.5% SOI	93	110	75	1200	190	410						
Benzo(k)fluoranthene (6% SOM)	100	110	130	1200	190	440						
Chrysene (1% SOM)	15	30	4.1	350	57	93						
Chrysene (2.5% SOM)	22	31	9.4	350	57	110						
Chrysene (6% SOM)	27	32	19	350	57	120						
Dibenzo(ah)anthracene (1% SOI	0.24	0.31	0.14	3.5	0.57	1.1						
Dibenzo(ah)anthracene (2.5% S	0.28	0.32	0.27	3.6	0.57	1.3						
Dibenzo(ah)anthracene (6% SOI	0.3	0.32	0.43	3.6	0.58	1.4						
Fluoranthene (1% SOM)	280	1500	52	23000	3100	6300						
Fluoranthene (2.5% SOM)	560	1600	130	23000	3100	6300						
Fluoranthene (6% SOM)	890	1600	290	23000	3100	6400						
Fluorene (1% SOM)	170	2800 (30.9)	27	63000 (30.9)	9900	20000						
Fluorene (2.5% SOM)	400	3800 (76.5)	67	68000	9900	20000						
Fluorene (6% SOM)	860	4500 (183)	160	71000	9900	20000						
Indeno(123cd)pyrene (1% SOM)	27	45	9.5	500	82	150						
Indeno(123cd)pyrene (2.5% SOI	36	46	21	510	82	170						
Indeno(123cd)pyrene (6% SOM)	41	46	39	510	82	180						
Naphthalene (1% SOM)	2.3	2.3	4.1	190 (76.4)	4900	1200 (76.4)						
Naphthalene (2.5% SOM)	5.6	5.6	10	460 (183)	4900	1900 (183)						
Naphthalene (6% SOM)	13	13	24	1100 (432)	4900	3000						
Phenanthrene (1% SOM)	95	1300 (36)	15	22000	3100	6200						
Phenanthrene (2.5% SOM)	220	1500	38	22000	3100	6200						
Phenanthrene (6% SOM)	440	1500	90	22000	3100	6300						
Pyrene (1% SOM)	620	3700	110	54000	7400	15000						
Pyrene (2.5% SOM)	1200	3800	270	54000	7400	15000						
Pyrene (6% SOM)	2000	3800	620	54000	7400	15000						
Coal Tar (BaP as surrogate marl	0.79	1.2	0.32	15	2.2	4.4						
Coal Tar (BaP as surrogate marl	0.98	1.2	0.67	15	2.2	4.7						
Coal Tar (BaP as surrogate marl	1.1	1.2	1.2	15	2.2	4.9						

CHLOROALCANES AND ALKANES

Based on sandy loam soil as defined in SR3 (Environment Agency, 2009) and 1%, 2.5% and 6% soil organic matter (SOM)
Generic assessment criteria will vary according to SOM for all land values
Values are expressed in mg/kg
GACs assume that free phase contamination is not present
GACs are based on sub-surface soil to indoor air correction factor of 1

	S4UL						EIC/AGS/CL:AIRE			
Compound	**Residential with home grown produce**	**Residential without home grown produce**	**Allotment**	**Commercial**	**POSresi**	**POSpark**	**Residential with consumption of homegrown produce**	**Residential without consumption of homegrown produce**	**Allotment**	**Commercial**
1,1-Dichloroethane (1% SOM)							2.4	2.5	9.2	280
1,1-Dichloroethane (2.5% SOM)							3.9	4.1	17	450
1,1-Dichloroethane (6% SOM)							7.4	7.7	35	850
1,2-Dichloroethane (1% SOM)	0.0071	0.0092	0.0046	0.67	29	21				
1,2-Dichloroethane (2.5% SOM)	0.011	0.013	0.0083	0.97	29	24				
1,2-Dichloroethane (6% SOM)	0.019	0.023	0.016	1.7	29	28				
1,1,1-Trichloroethane (1% SOM)	8.8	9	48	660	140000	57000 (1425)				
1,1,1-Trichloroethane (2.5% SOI	18	18	110	1300	140000	76000 (2915)				
1,1,1-Trichloroethane (6% SOM)	39	40	240	3000	140000	100000 (6392)				
1,1,2-Trichloroethane (1% SOM)							0.6	0.88	0.28	94
1,1,2-Trichloroethane (2.5% SOM)							1.2	1.8	0.61	190
1,1,2-Trichloroethane (6% SOM)							2.7	3.9	1.4	400
1,1,1,2-Tetrachloroethane (1% S	1.2	1.5	0.79	110	1400	1500				
1,1,1,2-Tetrachloroethane (2.5%	2.8	3.5	1.9	250	1400	1800				
1,1,1,2-Tetrachloroethane (6% S	6.4	8.2	4.4	560	1400	2100				
1,1,2,2-Tetrachloroethane (1%SI	1.6	3.9	0.41	270	1400	1800				
1,1,2,2-Tetrachloroethane (2.5%	3.4	8.0	0.89	550	1400	2100				
1,1,2,2-Tetrachloroethane (6%SI	7.5	17	2.0	1100	1400	2300				
1,1-Dichloroethene (1% SOM)							0.23	0.23	2.8	26
1,1-Dichloroethene (2.5% SOM)							0.40	0.41	5.6	46
1,1-Dichloroethene (6% SOM)							0.82	0.82	12	92
Tetrachloroethene (1% SOM)	0.18	0.18	0.65	19	1400	810 (424)				
Tetrachloroethene (2.5% SOM)	0.39	0.40	1.5	42	1400	1100 (951)				
Tetrachloroethene (6% SOM)	0.9	0.92	3.6	95	1400	1500				
Tetrachloromethane (1% SOM)	0.026	0.026	0.45	2.9	890	190				
Tetrachloromethane (2.5% SOM	0.056	0.056	1.0	6.3	920	270				
Tetrachloromethane (6% SOM)	0.13	0.13	2.4	14	950	400				
Trichloroethene (1% SOM)	0.016	0.017	0.041	1.2	120	70				
Trichloroethene (2.5% SOM)	0.034	0.036	0.091	2.6	120	91				
Trichloroethene (6% SOM)	0.075	0.080	0.21	5.7	120	120				
Trichloromethane (1% SOM)	0.91	1.2	0.42	99	2500	2600				
Trichloromethane (2.5% SOM)	1.7	2.1	0.83	170	2500	2800				
Trichloromethane (6% SOM)	3.4	4.3	1.7	350	2500	3100				
Vinyl Chloride (1% SOM)	0.00064	0.00077	0.00055	0.059	3.5	4.8				
Vinyl Chloride (2.5% SOM)	0.00087	0.0010	0.0010	0.077	3.5	5.0				
Vinyl Chloride (6% SOM)	0.0014	0.0015	0.0018	0.12	3.5	5.4				
Chloroethane (1% SOM)							8.3	8.4	110	960
Chloroethane (2.5% SOM)							11	11	200	1300
Chloroethane (6% SOM)							18	18	380	2100
1,2-Dichloropropane (1% SOM)							0.024	0.024	0.62	3.3
1,2-Dichloropropane (2.5% SOM)							0.042	0.042	1.2	5.9
1,2-Dichloropropane (6% SOM)							0.084	0.085	2.6	12
2-Chloronaphthalene (1% SOM)							3.7	3.8	40	390
2-Chloronaphthalene (2.5% SOM)							9.2	9.3	98	960
2-Chloronaphthalene (6% SOM)							22	22	230	2200
Bromodichloromethane (1% SOM)							0.016	0.019	0.016	2.1
Bromodichloromethane (2.5% SOM)							0.030	0.034	0.032	3.7
Bromodichloromethane (6% SOM)							0.061	0.07	0.068	7.6
Chloromethane (1% SOM)							0.0083	0.0085	0.066	1
Chloromethane (2.5% SOM)							0.0098	0.0099	0.13	1.2
Chloromethane (6% SOM)							18	18	380	2100

	S4UL						EIC/AGS/CL:AIRE			
Compound	**Residential with home grown produce**	**Residential without home grown produce**	**Allotment**	**Commercial**	**POSresi**	**POSpark**	**Residential with consumption of homegrown produce**	**Residential without consumption of homegrown produce**	**Allotment**	**Commercial**
cis -1,2 Dichloroethene (2.5% SOM)							0.19	0.20	0.50	24
cis -1,2 Dichloroethene (6% SOM)							0.37	0.39	1.0	47
trans -1,2 Dichloroethene (1% SOM)							0.19	0.19	0.93	22
trans -1,2 Dichloroethene (2.5% SOM)							0.34	0.35	1.9	40
trans -1,2 Dichloroethene (6% SOM)							0.70	0.71	4.0	81
Dichloromethane (1% SOM)							0.58	2.1	0.1	270
Dichloromethane (2.5% SOM)							0.98	2.8	0.19	360
Dichloromethane (6% SOM)							1.7	4.5	0.34	560
Hexachloroethane (1% SOM)							0.2	0.22	0.27	22
Hexachloroethane (2.5% SOM)							0.48	0.54	0.67	53
Hexachloroethane (6% SOM)							1.1	1.3	1.6	120

Notes for EIC/AGS/CL:AIRE Generic Assessment Criteria

1 GAC have been derived for 4 generic land uses; residential with consumption of homegrown produce, residential without consumption of homegrown produce, allotments and commercial land-use.

EXPLOSIVES

Based on sandy loam soil as defined in SR3 (Environment Agency, 2009) and 1%, 2.5% and 6% soil organic matter (SOM)
Generic assessment criteria will vary according to SOM for all land values
Values are expressed in mg/kg
GACs assume that free phase contamination is not present
GACs are based on sub-surface soil to indoor air correction factor of 1

	S4UL					
Compound	**Residential with home grown produce**	**Residential without home grown produce**	**Allotment**	**Commercial**	**POSresi**	**POSpark**
RDX (1% SOM)	120	13000	17	210000	210000	210000
RDX (2.5% SOM)	250	13000	38	210000	26000	49000 (18.7)
RDX (6% SOM)	540	13000	85.0	210000	27000	53000
HMX (1% SOM)	5.7	6700	0.86	110000	13000	23000 (0.35)
HMX (2.5% SOM)	13	6700	1.9	110000	13000	23000 (0.39)
HMX (6% SOM)	26	6700	3.9	110000	13000	24000 (0.48)

PESTICIDES

Based on sandy loam soil as defined in SR3 (Environment Agency, 2009) and 1%, 2.5% and 6% soil organic matter (SOM)
Generic assessment criteria will vary according to SOM for all land values
Values are expressed in mg/kg
GACs assume that free phase contamination is not present
GACs are based on sub-surface soil to indoor air correction factor of 1

Compound	S4UL Residential with home grown produce	Residential without home grown produce	Allotment	Commercial	POSresi	POSpark
Aldrin (1% SOM)	5.7	7.3	3.2	170	18	30
Aldrin (2.5% SOM)	6.6	7.4	6.1	170	18	31
Aldrin (6% SOM)	7.1	7.5	9.6	170	18	31
Dieldrin (1% SOM)	0.97	7	0.17	170	18	30
Dieldrin (2.5% SOM)	2	7.3	0.41	170	18	30
Dieldrin (6% SOM)	3.5	7.4	0.96	170	18	31
Atrazine (1% SOM)	3.3	610	0.5	9300	1200	2300
Atrazine (2.5% SOM)	7.6	620	1.2	9400	1200	2400
Atrazine (6% SOM)	17.4	620	2.7	9400	1200	2400
Dichlorovos (1% SOM)	0.032	6.4	0.0049	140	16	26
Dichlorovos (2.5% SOM)	0.066	6.5	0.010	140	16	26
Dichlorovos (6% SOM)	0.14	6.6	0.022	140	16	27
Alpha-Endosulfan (1% SOM)	7.4	160 (0.003)	1.2	5600 (0.003)	1200	2400
Alpha-Endosulfan (2.5% SOM)	18	280 (0.007)	2.9	7400 (0.007)	1200	2400
Alpha-Endosulfan (6% SOM)	41	410 (0.016)	6.8	8400 (0.016)	1200	2500
Beta-Endosulfan (1% SOM)	7	190 (0.00007)	1.1	6300 (0.00007)	1200	2400
Beta-Endosulfan (2.5% SOM)	17	320 (0.0002)	2.7	7800 (0.0002)	1200	2400
Beta-Endosulfan (6% SOM)	39	440 (0.0004)	6.4	8700	1200	2500
Alpha-Hexachlorocyclohexanes (	0.23	6.9	0.035	170	24	47
Alpha-Hexachlorocyclohexanes (	0.55	9.2	0.087	180	24	48
Alpha-Hexachlorocyclohexanes (	1.2	11	0.21	180	24	48
Beta-Hexachlorocyclohexanes (1	0.085	3.7	0.013	65	8.1	15
Beta-Hexachlorocyclohexanes (2	0.2	3.8	0.032	65	8.1	15
Beta-Hexachlorocyclohexanes (6	0.46	3.8	0.077	65	8.1	16
Gamma-Hexachlorocyclohexane	0.06	2.9	0.0092	67	8.2	14
Gamma-Hexachlorocyclohexane	0.14	3.3	0.023	69	8.2	15
Gamma-Hexachlorocyclohexane	0.33	3.5	0.054	70	8.2	15

CHLOROBENZENES & METHYLBENZENES

Based on sandy loam soil as defined in SR3 (Environment Agency, 2009) and 1%, 2.5% and 6% soil organic matter (SOM)
Generic assessment criteria will vary according to SOM for all land values
Values are expressed in mg/kg
GACs assume that free phase contamination is not present
GACs are based on sub-surface soil to indoor air correction factor of 1

	S4UL						EIC/AGS/CL:AIRE			
Compound	**Residential with homegrown produce**	**Residential without homegrown produce**	**Allotment**	**Commercial**	**POSresi**	**POSpark**	**Residential with consumption of homegrown produce**	**Residential without consumption of homegrown produce**	**Allotment**	**Commercial**
Chlorobenzene (1% SOM)	0.46	0.46	5.9	56	11000	1300 (675)				
Chlorobenzene (2.5% SOM)	1.0	1.0	14	130	13000	2000 (1520)				
Chlorobenzene (6% SOM)	2.4	2.4	32	290	14000	2900				
1,2-Dichlorobenzene (1% SOM)	23	24	94	2000 (571)	90000	24000 (571)				
1,2-Dichlorobenzene (2.5% SOM	55	57	230	4800 (1370)	95000	36000 (1370)				
1,2-Dichlorobenzene (6% SOM)	130	130	540	11000 (3240)	98000	51000 (3270)				
1,3-Dichlorobenzene (1% SOM)	0.40	0.44	0.25	30	300	390				
1,3-Dichlorobenzene (2.5% SOM	1.0	1.1	0.6	73	300	440				
1,3-Dichlorobenzene (6% SOM)	2.3	2.5	1.5	170	300	470				
1,4-Dichlorobenzene (1% SOM)	61	61	15	4400 (224)	17000	36000 (224)				
1,4-Dichlorobenzene (2.5% SOM	150	150	37	10000 (540)	17000	36000 (540)				
1,4-Dichlorobenzene (6% SOM)	350	350	88	25000 (1280)	17000	36000 (1280)				
1,2,3-Trichlorobenzene (1% SOI	1.5	1.5	4.7	102	1800	770 (134)				
1,2,3-Trichlorobenzene (2.5% S(	3.6	3.7	12	250	1800	110 (330)				
1,2,3-Trichlorobenzene (6% SOI	8.6	8.8	28	590	1800	1600 (789)				
1,2,4-Trichlorobenzene (1% SOI	2.6	2.6	55	220	15000	1700 (318)				
1,2,4-Trichlorobenzene (2.5% S(	6.4	6.4	140	530	17000	2600 (786)				
1,2,4-Trichlorobenzene (6% SOI	15	15	320	1300	19000	400 (1880)				
1,3,5-Trichlorobenzene (1% SOI	0.33	0.33	4.7	23	1700	380 (36.7)				
1,3,5-Trichlorobenzene (2.5% S(	0.81	0.81	12	55	1700	580 (90.8)				
1,3,5-Trichlorobenzene (6% SOI	1.9	1.9	28	130	1800	860 (217)				
1,2,3,4-Tetrachlorobenzene (1%	15	24	4.4	1700 (122)	830	1500 (122)				
1,2,3,4-Tetrachlorobenzene (2.5	36	56	11	3080 (304)	830	1600				
1,2,3,4-Tetrachlorobenzene (6%	78	120	26	4400 (728)	830	1600				
1,2,3,5-Tetrachlorobenzene (1%	0.66	0.75	0.38	49 (39.4)	78	110 (39)				
1,2,3,5-Tetrachlorobenzene (2.5	1.6	1.9	0.90	120 (98.1)	79	120				
1,2,3,5-Tetrachlorobenzene (6%	3.7	4.3	2.2	240 (235)	79	130				
1,2,4,5-Tetrachlorobenzene (1%	0.33	0.73	0.06	42 (19.7)	13	25				
1,2,4,5-Tetrachlorobenzene (2.5	0.77	1.7	0.16	72 (49.1)	13	26				
1,2,4,5-Tetrachlorobenzene (6%	1.6	3.5	0.37	96	13	26				
Pentachlorobenzene (1% SOM)	5.8	19	1.2	640 (43.0)	100	190				
Pentachlorobenzene (2.5% SOM	12	30	3.1	770 (107)	100	190				
Pentachlorobenzene (6% SOM)	22	38	7.0	830	100	190				
Hexachlorobenzene (1% SOM)	1.8 (0.20)	4.1 (0.20)	0.47	110 (0.20)	16	30				
Hexachlorobenzene (2.5% SOM)	3.3 (0.50)	5.7 (0.50)	1.1	120	16	30				
Hexachlorobenzene (6% SOM)	4.9	6.7 (1.2)	2.5	120	16	30				
1,2,4-Trimethylbenzene (1% SOM)							0.35	0.41	0.38	42
1,2,4-Trimethylbenzene (2.5% SOM)							0.85	0.99	0.93	99
1,2,4-Trimethylbenzene (6% SOM)							2	2.3	2.2	220
Isopropyl benzene (1% SOM)							11	12	32	1400
Isopropyl benzene (2.5% SOM)							27	28	79	3300
Isopropyl benzene (6% SOM)							64	67	190	7700
Propylbenzene (1% SOM)							34	40	34	4100
Propylbenzene (2.5% SOM)							82	97	83	9700
Propylbenzene (6% SOM)							190	230	200	21000
Styrene (1% SOM)							8.1	35	1.6	3300
Styrene (2.5% SOM)							19	78	3.7	6500
Styrene (6% SOM)							43	170	8.7	11000

PHENOLS AND CHLOROPHENOLS

Based on sandy loam soil as defined in SR3 (Environment Agency, 2009) and 1%, 2.5% and 6% soil organic matter (SOM)
Generic assessment criteria will vary according to SOM for all land values
Values are expressed in mg/kg
GACs assume that free phase contamination is not present
GACs are based on sub-surface soil to indoor air correction factor of 1

	LQM/CIEH						EA SGV			EIC/AGS/CL:AIRE			
Compound	**Residential with home grown produce**	**Residential without home grown produce**	**Allotment**	**Commercial**	**POSresi**	**POSpark**	**Residential**	**Allotment**	**Commercial**	**Residential with consumption of homegrown produce**	**Residential without consumption of homegrown produce**	**otm**	**Commercial**
Phenol (1% SOM)	120	440 (460)	23	440 (26000)	440 (10000)	440 (7600)							
Phenol (2.5% SOM)	200	690	42	690 (30000)	690 (10000)	690 (8300)							
Phenol (6% SOM)	380	1200	83	1300 (34000)	1300 (10000)	1300 (9300)	420	280	3200 (38000)				
Chlorophenol (1% SOM)	0.87	94	0.13	3500	620	1100							
Chlorophenol (2.5% SOM)	2.0	150	0.30	4000	620	1100							
Chlorophenol (6% SOM)	4.5	210	0.70	4300	620	1100							
Pentachlorophenol (1% SOM)	0.22	27 (16.7)	0.03	400	60	110							
Pentachlorophenol (2.5% SOM)	0.52	29	0.08	400	60	120							
Pentachlorophenol (6% SOM)	1.2	31	0.19	400	60	120							
2,4-Dimethylphenol (1% SOM)										19	210	3	16000
2,4-Dimethylphenol (2.5% SOM)										43	410	7	24000
2,4-Dimethylphenol (6%SOM)										97	730	17	30000
Total Cresols (2-Methylphenol, 3-methylphenol, 4-methylphenol) (1%SOM)										80	3700	12	160000
Total Cresols (2-Methylphenol, 3-methylphenol, 4-methylphenol) (2.5%SOM)										180	5400	27	180000
Total Cresols (2-Methylphenol, 3-methylphenol, 4-methylphenol) (6%SOM)										400	6900	63	180000

PHTHALATES

Based on sandy loam soil as defined in SR3 (Environment Agency, 2009) and 1%, 2.5% and 6% soil organic matter (SOM)
Generic assessment criteria will vary according to SOM for all land values
Values are expressed in mg/kg
GACs assume that free phase contamination is not present
GACs are based on sub-surface soil to indoor air correction factor of 1

	EIC/AGS/CL:AIRE			
Compound	**Residential with consumption of homegrown produce**	**Residential without consumption of homegrown produce**	**Allotment**	**Commercial**
Bis (2-ethylhexyl) phthalate (1%	280	2700	47	85000
Bis (2-ethylhexyl) phthalate (2.5	610	2800	120	86000
Bis (2-ethylhexyl) phthalate (6%	1100	2800	280	86000
Butyl benzyl phthalate (1% SOM	1400	42000	220	940000
Butyl benzyl phthalate (2.5% SO	3300	44000	550	940000
Butyl benzyl phthalate (6% SOM	7200	44000	1300	950000
Diethyl Phthalate (1% SOM)	120	1800	19	1500000
Diethyl Phthalate (2.5% SOM)	260	3500	41	220000
Diethyl Phthalate (6% SOM)	570	6300	94	290000
Di-*n*-butyl phthalate (1% SOM)	13	450	2	15000
Di-*n*-butyl phthalate (2.5% SOM	31	450	5	15000
Di-*n*-butyl phthalate (6% SOM)	67	450	12	15000
Di-*n*-octyl phthalate (1% SOM)	2300	3400	940	89000
Di-*n*-octyl phthalate (2.5% SOM	2800	3400	2100	89000
Di-*n*-octyl phthalate (6% SOM)	3100	3400	3900	89000

OTHER ORGANICS

Based on sandy loam soil as defined in SR3 (Environment Agency, 2009) and 1%, 2.5% and 6% soil organic matter (SOM)
Generic assessment criteria will vary according to SOM for all land values
Values are expressed in mg/kg
GACs assume that free phase contamination is not present
GACs are based on sub-surface soil to indoor air correction factor of 1

	S4UL						EIC/AGS/CL:AIRE			
Compound	**Residential with home grown produce**	**Residential without home grown produce**	**Allotment**	**Commercial**	**POSresi**	**POSpark**	**Residential with consumption of homegrown produce**	**Residential without consumption of homegrown produce**	**Allotment**	**Commercial**
Carbon disulphide (1% SOM)	0.14	0.14	4.8	11	11000	1300				
Carbon disulphide (2.5% SOM)	0.29	0.29	10	22	11000	1900				
Carbon disulphide (6% SOM)	0.62	0.62	23	47	12000	2700				
Hexachloro-1,3-butadiene (1% S	0.29	0.32	0.25	31	25	48				
Hexachloro-1,3-butadiene (2.5%	0.70	0.78	0.61	66	25	50				
Hexachloro-1,3-butadiene (6% S	1.6	1.8	1.4	120	25	51				
Tributyl tin oxide (1% SOM)							0.25	1.4	0.042	130
Tributyl tin oxide (2.5% SOM)							0.59	3.1	0.1	180
Tributyl tin oxide (6% SOM)							1.3	5.7	0.24	200
Biphenyl (1% SOM)							66	220	14	18000
Biphenyl (2.5% SOM)							160	500	35	33000
Biphenyl (6% SOM)							360	980	83	48000
2,4-Dinitrotoluene (1% SOM)							1.5	170	0.22	3700
2,4-Dinitrotoluene (2.5% SOM)							3.2	170	0.49	3700
2,4-Dinitrotoluene (6% SOM)							7.2	170	1.1	3800
2,6-Dintrotoluene (1% SOM)							0.78	78	0.12	1900
2,6-Dintrotoluene (2.5% SOM)							1.7	84	0.27	1900
2,6-Dintrotoluene (6% SOM)							3.9	87	0.61	1900
Bromoform (1% SOM)							2.8	5.2	0.95	760
Bromoform (2.5% SOM)							5.9	11	2.1	1500
Bromoform (6% SOM)							13	23	4.6	3100

6. GEOENVIRONMENTAL RISK ASSESSMENT

6.1 **Potential Hazard Sources.** Ground contamination can occur through several causes, particularly from historical use of the site and is often linked to the processes of waste disposal, underground storage, open storage, process pipework, leaks, spillages, tanks, site filling and various other reasons. The contamination can either arise from site sources or be the result of migration from other sources off site.

6.2 **Potential Migratory Pathways.** The primary pathways are considered to be laterally or vertically downward through underlying strata or upward to the ground surface. Such pathways also provide the potential for contaminants to migrate towards local watercourses and groundwater.

6.3 **Potential Targets At Risk.** Potential environmental liabilities related to current legislation associated with contaminated land with regard to existing ownership and redevelopment are summarised.

The probability of a hazard, linked with its consequences, can be used to assess risk in accordance with the tables below for use in decision making.

Consequence of Pollution Linkage

Severe	Damage to human health. Substantial pollution of controlled waters. Significant change in ecosystem population. Irreparable damage to property.
Moderate	Non-permanent damage to human health. Minor pollution of controlled waters. Change in ecosystem. Damage to property.
Mild	Short term health effects. Slight pollution of controlled waters. Slight effect on ecosystem. Minor repairable damage to property.
Near Zero	No noticeable effect on human health. No significant pollution to controlled waters. No measurable effect on ecosystem densities. Non-structural cosmetic damage to property.

Decision Making

Probability of a hazard and an associated linkage	**Consequences of a pollution linkage (hazard-pathway-target)**			
	Severe	Moderate	Mild	Near Zero
High	High	High	Medium/low	Negligible
Medium	High	Medium	Low	Negligible
Low	High/medium	Medium/low	Low	Negligible
Unlikely	High/medium/low	Medium/low	Low	Negligible

Final overall risk is based on an assessment of probability of a hazard and its consequences. Risk categories are shown shaded in the table above and defined below.

Risk	**Description**
High	Site probably or certainly unsuitable for present use or environmental setting. Contamination probably or certainly present and likely to have an unacceptable impact on key targets. Urgent action needed.
Medium/ Moderate	Site may not be suitable for present use or environmental setting. Contamination may be present, and likely to have unacceptable impact on key targets. Action may be needed on the medium term.
Low	Site considered suitable for present use and environmental setting. Contamination may be present but unlikely to have unacceptable impacts on key targets. Action unlikely to be needed in present use.
Negligible	Site considered suitable for present use and environmental setting. Contamination may be present but unlikely to have unacceptable impacts on key targets. No action needed while site remains in present use.

The review of the information from the exploratory investigation may be such that a decision is made that there is no need for further investigation. Alternatively, it may be necessary to carry out a further main investigation.

The Environment Agency has set out guidance as to the classification of waste arising from construction sites in its document "The Definition of Waste" dated April 2006. This document outlines how waste is to be handled

The following activities are not regarded as a waste management activity requiring licencing.

1) Construction activities carried out for the purpose of producing a suitably engineered soil e.g. lime stabilisation, vibro-replacement and piling.

2) Uncontaminated materials produced on site (including excavated soils and materials from demolition) which can be reused without further treatment. Examples include site regrading and footing excavations.

   These must be done in accordance with the Planning Permission. Demolition material must be used in accordance with the quality protocols for the production of aggregates from inert waste, subject to appropriate testing and the lack of any harmful constituents. Uses include pipe bedding, backfill and sub-base.

3) Contaminated soils can be moved on-site providing they do not require treatment or containment. There should be no risk to the environment i.e. non-leachable and in accordance with Planning Permission. Relevant activities can include site regarding and use of materials below clean cover systems, capping, buildings and hardstanding.

Where contaminated materials have to be placed in an engineered cell to prevent pollution, then this would be classed as landfilling and require PPC permits. Any material taken off site is considered to be waste. However, this is under review. If material is waste, then there is a duty of care including ensuring material is transported by a registered carrier. The destination of material leaving the site should be regularly checked and Waste Transfer Notes kept.

Clean Cover Systems

According to the Environment Agency's Remediation Position Statements of May 2006, the placement of a cover system using "clean" material is not treatment of waste. Consequently, no licensing/permitting position statements are applicable to this type of remediation. If the cover system uses 'waste materials' in its construction, waste management licensing exemption paragraph 9A may be applicable to its installation. If the installation of the proposed cover system does not meet the criteria for registration of this exemption, the activity may be regulated through a waste management site license.

7. WASTE ACCEPTANCE CRITERIA (WAC)

The main objective of the Landfill Directive is to prevent or reduce as far as possible the negative effects of landfilling waste on the environment and on human health. It is intended to reduce the disposal of waste materials to landfills and to encourage more sustainable approaches to dealing with wastes. It bans the landfill of liquids and certain solid wastes, introduces requirements for the treatment of wastes prior to landfill and provides for the classification of landfills as sites for inert, hazardous or non-hazardous waste and prohibits co-disposal.

It sets out procedures for waste acceptance at landfills and the types of waste for each class of landfill as specified by Waste Acceptance Criteria (WAC). The WAC are predominantly lists of "limit values" for certain parameters obtained from standard leaching tests of wastes going to landfills. WAC are set out in the Landfill Directive itself. Full details can be found in the Environment Agency document "Waste Classification – Guidance on the classification and Assessment of Waste " Technical Guidance WM3 - 2015

8. MAIN REFERENCES

British Standards	BS3882: 2015 British Standard Specification for Topsoil BS5930: 2015+A1:2020 British Standard Code of Practice for Site Investigations BS8485: 2015 British Standard Code of Practice for the design and protective measures from methane and carbon dioxide ground gases for new buildings BS10175: 2011+A2:2017 British Standard Code of Practice for the Investigation of Potentially Contaminated Sites
BRE	Radon: Guidance on protective measures for new dwellings, BR211, 2015 Protective measures for housing on gas-contaminated land, BR414, 2015 Cover systems for land regeneration, 2004 Concrete in aggressive ground. Special Digest SD1, 3rd Edition, 2005 Soakaway Design (DG365)
CIEH	The LQM / CIEH Generic Assessment Criteria for Human Health Risk Assessment (2nd Edition)
CIRIA	Assessing risks posed by hazardous ground gases to buildings, CIRIA C665 Asbestos in Soil and Made Ground: a guide to understanding and managing risks, CIRIAC733, 2014 Good Practice on the testing and verification of protection systems for buildings against hazardous ground gases. C735:2014
CL:AIRE	Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination, SP1010, 2013
DEFRA	Contaminated Land Report CLR 11, 2002 (7-10 withdrawn) R & D Publications TOX 1 – 12, 14, 16 – 25 R & D Publications SGV 1, 3, 4, 5, 7, 8, 9, 10, 15 and 16 (withdrawn) Improvements to Contaminated Land Guidance - "Outcome of the "Way Forward", 2008 Exercise on Soil Guideline Values. July 2008 Guidance on the Legal Definition of Contaminated Land. July 2008 Simplification of the Contaminated Land Regime Impact Assessment No: Defra 1133
DETR	Circular 02/2000. Contaminated Land, 2000 Guidelines for Environmental Risk Assessment and Management, 2000
Environment Agency	Guidance for the Safe Development of Housing on Land Affected by Contamination, 2000 Protective measures for housing on gas-contaminated land Remediation Position Statements, May 2006 Guidance and monitoring of landfill leachate, groundwater and surface water Human health toxicological assessment of contaminants in soil (Science Report SC050021/SR2) 2008 Updated technical background in the CLEA model (Science Report SC0520021/SR3) Waste Classification – Guidance on the classification and Assessment of Waste - Technical Guidance WM3 (2015) Contaminated Land Risk Management (2021)
HMSO	Part 2A of the Environmental Protection Act Part 2A Statutory Guidance – April 2012 Contaminated Land (England) Regulations 2006 The Contaminated Land (England) (Amendment) Regulations 2012 The Water Act 2003 (Commencement No. 11) Order 2012
Institution of Civil Engineers	Contaminated Land: Investigation, Assessment and Remediation, 2nd Edition
NHBC	Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present, 2007

This list is not intended to be exhaustive.



Michael D Joyce Associates LLP

Geotechnical and Geoenvironmental Consultants

Charnock Court 6 South Parade Wakefield West Yorkshire WF1 1LR

Tel: 01924 360458

Web: www.geoenvironmental.co.uk Email: mdja@geoenvironmental.co.uk