Published Date : 1967

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From:	Greenfield, Ben
To:	Greenfield, Ben
Subject:	FW: Contaminated Land Enquiry: Royal Mail Mount Pleasant Sorting Office; "Calthorpe House", 15-20 Phoenix Place Site (ref. 2013/3807/P)
Date:	29 July 2016 10:36:00

From: Arthur, Anona [mailto:Anona.Arthur@camden.gov.uk]
Sent: 13 July 2016 11:11
To: Greenfield, Ben <ben.greenfield@watermangroup.com>
Subject: Contaminated Land Enquiry: Royal Mail Mount Pleasant Sorting Office; "Calthorpe House", 15-20 Phoenix Place Site (ref. 2013/3807/P)

Dear Ben Greenfield

Thank you for your contaminated land enquiry relating to the above land I would like to confirm the following:

The site has not been determined as contaminated land under Part IIA of the Environmental Protection Act 1990.

With regards to details under the Council's Part IIA Strategy, Camden has a Contaminated Land Database to identify and prioritise sites within the Borough with a former potentially contaminative land use. Sites recorded on the database are not contaminated land (as defined by Part IIA of the Environmental Protection Act 1990); rather they are considered as having the potential to be contaminated land through their previous use. The Council is currently reviewing its Strategy for inspecting prioritised sites. The site at Phoenix Place has former industrial land use (see attachments and map below) therefore it has been identified as a medium to high priority for inspection.

Further to your enquiry, a historical record search was performed to determine historical land uses and it appears that there are past industrial uses of plausible concern carried out on or within **50 metres** of the site (please see attached and map below).

Foundry
Works
Printers
Garage
Joinery
Unknown Industrial

According to our contaminated land risk categorisation, land on which the above processes/activities were carried out is inherently considered to present a possible risk of contamination. It is conservatively considered likely that such land would exhibit areas of elevated contamination levels. However as explained above the site is not being investigated under Part IIA Contaminated Land regime. The Council has no present evidence that confirms there are contamination issues affecting the site, other than potentially contaminative past uses on the site.

If the land was to be redeveloped in the future and the works would involve excavations, it would be likely that a planning condition would be imposed with a

requirement to carry out site investigation (desk top, walkover and intrusive investigation) and if necessary remediation works.

Additional Information:

- The Council holds no information on pollution incidents in the area.
- There are no historical landfills identified within 250 metres of the site.
- Currently, the Council holds no information about water abstraction points or private water supplies.
- The Council holds no information relating to materials extraction, mine gasses, or animal burial grounds.
- There are no IPPC (Environment Agency) industrial processes within 50 metres of the site.
- There are no LAPPC (Local Authority) industrial process within 50 metres of the site.
- The Council has no information about the extent of made ground on subject site, however Camden soil profile tends to exhibit high levels of Lead (BGS data)
- The Council holds no information relating to radon levels (this can be enquired with the Environment Agency)
- Details of any records of complaints, notices etc. about nuisance relating to the current or previous site uses and its environs may be obtained from Council's Land Charges Department (0207 974 4444 – Contact Camden) but those will be limited to actual entries relating to outstanding matters i.e.: fees for works in default etc. Details with regards to complaints relating to noise issues may be obtained from Council's Noise & Licensing Team, odour issues from our Private Sector Housing Team. Both can be contact via the main line: 0207 974 4444.

Disclaimer:

The above response is provided from such information that is readily available to the Council and in its possession. It is believed to be correct but the Council expressly gives no warranty in this respect nor will the Council accept any liability whatsoever for any error, omission or loss occasioned thereby to any person (whether or not the person requested the information) and in particular the Council gives no warranty that it has researched all its relevant archives in order to respond to the request for information.

I hope the information provided is sufficient, however if you require further clarification please do not hesitate to contact me.

Anona Arthur
Environmental Health Officer / Contaminated Land Officer

Telephone: 020 7974 2990

LONDON FIRE
AND EMERGENCY
PLANNING AUTHORITY

Petroleum Group LFB Headquarters - 2nd Floor
169 Union Street London SE1 0LL
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Mr Ben Greenfield
Waterman Infrastructure & Environment Ltd
Pickfords Wharf
Clink Street
London
SE1 9DG

London Fire and Emergency Planning Authority runs the London Fire Brigade

Date 1 July 2016
Our Ref 02/016229/BCW
Your Ref WIE13235-102

Dear Sir

THE ENVIRONMENTAL INFORMATION REGULATIONS 2004 - ENVIRONMENTAL ENQUIRY

Premises: ROYAL MAIL MOUNT PLEASANT SORTING OFFICE, CALTHORPE HOUSE,
PHOENIX PLACE WC1X 0DL

As requested, a search has been made for information on the above site. A thorough search of current and historical files and databases has revealed no petroleum tank information for the site.

Please note that this report is restricted to matters currently known by the London Fire and Emergency Planning Authority. Although we hold extremely comprehensive records, it is possible that we do not hold any records whatsoever for some solid-filled and very old tanks. This will be for one of the following reasons:-

1. The records held by this Authority were passed to it from the Greater London Council in 1986. In 1965 the Greater London Council inherited petroleum related records from the London County Council and the outer London Boroughs / Councils. Some of the outer London records were incomplete.

2. For premises where petroleum tanks have been either removed or permanently made safe, the Authority's records have (in a minority of cases) been destroyed; and for these cases the Authority does not hold any records that indicate that there was ever a 'petroleum' interest at the premises.

As you are aware, a fee is levied for the provision of this information and payment should be made in accordance with the invoice, which will be sent under separate cover.

Any queries regarding this letter should be addressed to the Petroleum Group Admin Manager. If you are dissatisfied in any way with the response given, please ask to speak to the Team Leader quoting our reference.

Yours faithfully,

Barry Walford

for Assistant Commissioner (Fire Safety)
Directorate of Operations
petroleum@london-fire.gov.uk

Reply to Barry Walford
Direct **T** 020 85551200 x30858
Direct **F** 020 7960 3624

ENVIRONMENTAL ENQUIRY DETAIL FORM

Premises:
ROYAL MAIL MOUNT PLEASANT SORTING OFFICE,ROYAL MAIL MOUNT PLEASANT SORTING OFFICE, CALTHORPE HOUSE,
Our Reference:
02/016229/BCW

Current licence / Petroleum Storage Certificate in force?
YES ☐ NO ☒
Date last licence(s)/storage certificate(s) issued:
N/A

Known leaks or spills at this site:
N/A

Comments:
The Authority holds no record of petroleum storage tanks on this site. However, I list below details of Petroleum records found relating to Phoenix Place WC1 which may be helpful to you. According to our database records, at 7 & 8 Phoenix Place, there was located a 5682 litre petrol tank which is recorded as being water filled. At 12 Phoenix Place, a 13638 litre petrol tank was situated and is also recorded as being water filled. A 9092 litre tank which was converted to diesel use is documented as being located at 13 & 14 Phoenix Place. The use of these tanks cannot be confirmed. Due to the lack of any further historical information, I cannot confirm the current status , location or dates of water filling of any of the tanks mentioned above.

Signed:	Barry Walford
Name:	Barry Walford
Position:	Administrative Officer
Date:	1 July 2016

Appendix D Risk Rating Matrix

Table D.1: Risk rating for contaminated land qualitative risk assessment

Level of Severity	Likelihood		
	Most Likely	Reasonably Foreseeable	Unlikely
Acute harm or severe chronic harm. Direct pollution of sensitive water receptors or serious pollution of other water bodies.	High	High	Low
Harm from long-term exposure. Slight pollution of sensitive receptors or pollution of other water bodies.	Medium	Medium	Low
No significant harm in either short or long term. No pollution of water that is likely to affect sensitive receptors. No more than slight pollution of other water bodies.	Low	Low	Low

Appendix E Environmental Receptors

The Contaminated Land Statutory Guidance has a four category system that considers harm to human health, controlled waters, flora and fauna, property, livestock and crops. The Categories are broadly defined as follows:

1 Contaminated Land – similar to land where it is known that significant harm has been caused or significant harm is being caused

2 Contaminated Land – no significant harm being caused but there is a significant possibility for significant harm to be caused in the future

3 Not Contaminated Land – there may be harm being caused but no significant possibility for significant harm to be caused in the future

4 Not Contaminated Land – no pollutant linkage, normal levels of contaminants and no significant harm being caused and no significant possibility for significant harm to be caused in the future.

Table E.1: Significant pollution to controlled waters

Pollution of controlled waters
Under Section 78A(9) of Part 2A the term "pollution of controlled waters means the entry into controlled waters of any poisonous, noxious or polluting matter or any solid waste matter. The term "controlled waters" in relation to England has the same meaning as in Part 3 of the Water Resources Act 1991, except that "ground waters" does not include water contained in underground strata but above the saturation zones. (Paragraph 4.36)
Given that the Part 2A regime seeks to identify and deal with significant pollution (rather than lesser levels of pollution), the local authority should seek to focus on pollution which: (i) may be harmful to human health or the quality of aquatic ecosystems or terrestrial ecosystems directly depending on aquatic ecosystems; (ii) which may result in damage to material property; or (iii) which may impair or interfere with amenities and other legitimate uses of the environment. (Paragraph 4.37)
Significant pollution of controlled waters
Paragraph 4.38 states that "The following types of pollution should be considered to constitute significant pollution of controlled waters:
(a) Pollution equivalent to "environmental damage" to surface water or groundwater as defined by The Environmental Damage (Prevention and Remediation) Regulations 2009, but which cannot be dealt with under those Regulations.
(b) Inputs resulting in deterioration of the quality of water abstracted, or intended to be used in the future, for human consumption such that additional treatment would be required to enable that use.
(c) A breach of a statutory surface water Environment Quality Standard, either directly or via a groundwater pathway.
(d) Input of a substance into groundwater resulting in a significant and sustained upward trend in concentration of contaminants (as defined in Article 2(3) of the Groundwater Daughter Directive (2006/118/EC)5)".
Paragraph 4.39 states that "In some circumstances, the local authority may consider that the following types of pollution may constitute significant pollution: (a) significant concentrations6 of hazardous substances or non-hazardous pollutants in groundwater; or (b) significant concentrations of priority hazardous substances, priority substances or other specific polluting substances in surface water; at an appropriate, risk based compliance point. The local authority should only conclude that pollution is significant if it considers that treating the land as contaminated land would be in accordance with the broad objectives of the regime as described in Section 1 (of the Contaminated Land Statutory Guidance). This would normally mean that the authority should conclude that less serious forms of pollution are not significant. In such cases the authority should consult the Environment Agency".
The following types of circumstance should not be considered to be contaminated land on water pollution grounds:
(a) The fact that substances are merely entering water and none of the conditions for considering that significant pollution is being caused set out in paragraphs 4.38 and 4.39 above are being met.
(b) The fact that land is causing a discharge that is not discernible at a location immediately downstream or down-gradient of the land (when compared to upstream or up-gradient concentrations).
(c) Substances entering water in compliance with a discharge authorised under the Environmental Permitting Regulations.

Significant pollution of controlled waters is being caused

In deciding whether significant pollution of controlled waters is being caused, the local authority should consider that this test is only met where it is satisfied that the substances in question are continuing to enter controlled waters; or that they have already entered the waters and are likely to do so again in such a manner that past and likely future entry in effect constitutes ongoing pollution. For these purposes, the local authority should:

(a) Regard substances as having entered controlled waters where they are dissolved or suspended in those waters, or (if they are immiscible with water) they have direct contact with those waters on or beneath the surface of the water.

(b) Take the term "continuing to enter" to mean any measurable entry of the substance(s) into controlled waters additional to any which has already occurred.

(c) Take the term "likely to do so again" to mean more likely than not to occur again.

Land should not be determined as contaminated land on grounds that significant pollution of controlled waters is being caused where: (a) the relevant substance(s) are already present in controlled waters; (b) entry into controlled waters of the substance(s) from land has ceased; and (c) it is not likely that further entry will take place.

Significant Possibility of Significant Pollution of Controlled Waters

In deciding whether or not a significant possibility of significant pollution of controlled waters exists, the local authority should first understand the possibility of significant pollution of controlled waters posed by the land, and the levels of certainty/uncertainty attached to that understanding, before it goes on to decide whether or not that possibility is significant. The term "possibility of significant pollution of controlled waters" means the estimated likelihood that significant pollution of controlled waters might occur. In assessing the possibility of significant pollution of controlled waters from land, the local authority should act in accordance with the advice on risk assessment in Section 3 and the guidance in this sub-section.

In deciding whether the possibility of significant pollution of controlled waters is significant the local authority should bear in mind that Part 2A makes the decision a positive legal test. In other words, for particular land to meet the test the authority needs reasonably to believe that there is a significant possibility of such pollution, rather than to demonstrate that there is not.

Before making its decision on whether a given possibility of significant pollution of controlled waters is significant, the local authority should consider:

(a) The estimated likelihood that the potential significant pollution of controlled waters would become manifest; the strength of evidence underlying the estimate; and the level of uncertainty underlying the estimate.

(b) The estimated impact of the potential significant pollution if it did occur. This should include consideration of whether the pollution would be likely to cause a breach of European water legislation, or make a major contribution to such a breach.

(c) The estimated timescale over which the significant pollution might become manifest.

(d) The authority's initial estimate of whether remediation is feasible, and if so what it would involve and the extent to which it might provide a solution to the problem; how long it would take; what benefit it would be likely to bring; and whether the benefits would outweigh the costs and any impacts on local society or the environment from taking action.

Reproduced from DEFRA (2012) Contaminated Land Statutory Guidance pursuant to section 78YA of the Environmental Protection Act 1990 as amended by Section 57 of the Environment Act 1995.

Table E.2: Significant harm to human health, ecological systems and property

Relevant types of receptor	Significant harm	Significant possibility of significant harm
Human beings	The following health effects should always be considered to constitute significant harm to human health:	The risk posed by one or more relevant contaminant linkage(s)

Relevant types of receptor	Significant harm	Significant possibility of significant harm
	death; life threatening diseases (eg cancers); other diseases likely to have serious impacts on health; serious injury; birth defects; and impairment of reproductive functions. Other health effects may be considered by the local authority to constitute significant harm. For example, a wide range of conditions may or may not constitute significant harm (alone or in combination) including: physical injury; gastrointestinal disturbances; respiratory tract effects; cardio-vascular effects; central nervous system effects; skin ailments; effects on organs such as the liver or kidneys; or a wide range of other health impacts. In deciding whether or not a particular form of harm is significant harm, the local authority should consider the seriousness of the harm in question: including the impact on the health, and quality of life, of any person suffering the harm; and the scale of the harm. The authority should only conclude that harm is significant if it considers that treating the land as contaminated land would be in accordance with the broad objectives of the regime as described in Section 1 of the Contaminated Land Statutory Guidance.	relating to the land comprises: (a) The estimated likelihood that significant harm might occur to an identified receptor, taking account of the current use of the land in question. (b) The estimated impact if the significant harm did occur – i.e. the nature of the harm, the seriousness of the harm to any person who might suffer it, and (where relevant) the extent of the harm in terms of how many people might suffer it. In estimating the likelihood that a specific form of significant harm might occur the local authority should, among other things, consider: (a) The estimated probability that the significant harm might occur: (i) if the land continues to be used as it is currently being used; and (ii) where relevant, if the land were to be used in a different way (or ways) in the future having regard to the guidance on "current use" in Section 3 of the Contaminated Land Statutory Guidance. (b) The strength of evidence underlying the risk estimate. It should also consider the key assumptions on which the estimate of likelihood is based, and the level of uncertainty underlying the estimate.
Any ecological system, or living organism forming part of such a system, within a location which is: • a site of special scientific interest (under section 28 of the Wildlife and Countryside Act (WCA) 1981 (as amended) and Part 4 of the Natural Environment and Rural Communities Act 2006 (as amended)); • a national nature reserve (under Section 35 of the WCA 1981 (as amended));	The following types of harm should be considered to be significant harm: • 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 significantly 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.	Conditions would exist for considering that a significant possibility of significant harm exists to a relevant ecological receptor where the local authority considers that: • significant harm of that description is more likely than not to result from the contaminant linkage in question; or • there is a reasonable possibility of significant harm of that description being caused, and if that harm

Relevant types of receptor	Significant harm	Significant possibility of significant harm
• a marine nature reserve (under Section 36 of the WCA 1981 (as amended)); • an area of special protection for birds (under Section 3 of the WCA 1981 (as amended)); • a "European site" within the meaning of regulation 8 of the Conservation of Habitats and Species Regulations 2010 (as amended); • any habitat or site afforded policy protection under Section 11 of The National Planning Policy Framework (NPPF) on conserving and enhancing the natural environment (i.e. possible Special Areas of Conservation, potential Special Protection Areas and listed or proposed Ramsar sites); or • any nature reserve established under Section 21 of the National Parks and Access to the Countryside Act 1949.	In the case of European sites, harm should also be considered to be significant harm if it endangers the favourable conservation status of natural habitats at such locations or species typically found there. In deciding what constitutes such harm, the local authority should have regard to the advice of Natural England and to the requirements of the Conservation of Habitats and Species Regulations 2010 (as amended).	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. Any assessment made for these purposes should take into account relevant information for that type of contaminant linkage, particularly in relation to the ecotoxicological effects of the contaminant.
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 their 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. The local authority should regard a substantial loss in value as occurring only when a substantial proportion of the animals or crops are dead or otherwise no longer fit for their intended purpose. Food should be regarded as being no longer fit for purpose when it fails to comply with the provisions of the Food Safety Act 1990. Where a diminution in yield or loss in value is caused by a pollutant linkage, a 20% diminution or loss should be regarded as a benchmark for what constitutes a substantial diminution or loss. In the Guidance states that this description of significant harm is referred to as an "animal or crop effect".	Conditions would exist for considering that a significant possibility of significant harm exists to the relevant types of receptor where the local authority considers that significant harm is more likely than not to result from the contaminant linkage in question, taking into account relevant information for that type of contaminant linkage, particularly in relation to the ecotoxicological effects of the contaminant.
Property in the form of buildings. For this purpose 'building' means any structure or erection and any part of	Structural failure, substantial damage or substantial interference with any right of occupation. The local authority	Conditions would exist for considering that a significant possibility of significant harm

Relevant types of receptor	Significant harm	Significant possibility of significant harm
a building, including any part below ground level, but does not include plant or machinery comprised in a building, or buried services such as sewers, water pipes or electricity cables.	should regard substantial damage or substantial interference as occurring when any part of the building ceases to be capable of being used for the purpose for which it is or was intended. In the case of a scheduled Ancient Monument, substantial damage should be regarded as occurring when the damage significantly impairs the historic, architectural, traditional, artistic or archaeological interest by reason of which the monument was scheduled. The Guidance states that this description of significant harm is referred to as a 'building effect'.	exists to the relevant types of receptor where the local authority considers that significant harm is more likely than not to result from the contaminant linkage in question during the expected economic life of the building (or in the case of a scheduled Ancient Monument the foreseeable future), taking into account relevant information for that type of contaminant linkage.
Reproduced from DEFRA (2012) Contaminated Land Statutory Guidance pursuant to section 78YA of the Environmental Protection Act 1990 as amended by Section 57 of the Environment Act 1995.		

Appendix F Generic Assessment Criteria

Human Health Generic Assessment Criteria

Background

In order to be able to make inference on whether the results obtained during the site investigation (e.g. chemical concentrations in soils, waters and gas) point to the presence of a potential hazard to human health, it is necessary to distinguish between the results, reflecting background and/or insignificantly elevated levels of contamination (i.e. with negligible potential to cause harm or pollution) and the results with significantly elevated concentrations (i.e. with significant potential to cause harm or pollution).

The approach to risk assessment with respect to risks to human health from contaminated land in the UK is set out in the publication Model Procedures for the Management of Land Contamination (CLR11) Environment Agency (2004).

This sets out a tiered approach:

- Preliminary Risk Assessment (e.g. establishing potential pollutant linkages);
- Generic Quantitative Risk Assessment (GQRA) (e.g. comparison of site contaminant concentrations against generic standards and compliance criteria e.g. Soil Guideline Values (SGV) or other Generic Assessment Criteria including an assessment of risk using the source pathway target model); and
- Detailed Quantitative Risk Assessment (DQRA) (e.g. the comparison of contaminant concentrations against site specific assessment criteria).

Preliminary Risk Assessment

This typically encompasses a desk based generation of a conceptual model to establish the potential pollutant linkages associated with the site and any proposed development. Works would typically involve:

- Evaluation of the potential sources of contamination on the site and in the locality and from both a current and historical perspective
- Statutory Consultation;
- Evaluation of a sites geology, hydrology and hydrogeology;
- Site inspection;
- Additional pertinent information as necessary on a site by site basis.
- Where works indicate the presence of a potential pollutant linkage further evaluation and potentially site investigation works are necessary to determine the significance of the linkage.

Generic Quantitative Risk Assessment (GQRA)

In August 2008 the Environment Agency (EA) and Department of Environment Food and Rural Affairs (DEFRA) announced the withdrawal of the Contaminated Land Reports CLR7 – 10, CLEA UK (beta) and existing SGV reports as they no-longer fully reflected the revised approach to human health risk assessment.

New partial guidance (in particular Science Reports SR2, SR3 and SR7) and new risk assessment tools (CLEA model version v1.04, v1.05 and currently v1.06) were published in 2009 and these allow environmental practitioners to derive generic and site specific Soil Assessment Criteria (GAC and SAC).

Soil Guideline Values (SGVs)

The EA and DEFRA updated the TOX reports and Soil Guideline Values (SGVs) to reflect the guidance documents published in 2009. SGVs for arsenic, cadmium, nickel, mercury, selenium, BTEX compounds (benzene, toluene, ethylbenzene and xylenes), dioxins, furans and dioxin like PCBs and phenol have been made available.

Since publishing the revised SGVs the CLEA model was updated to version v1.06. The Environment Agency has however confirmed that v1.05 has only a "minor effect on assessment criteria calculated using the CLEA software 1.04" and consequently the GACs derived are considered to remain valid. Environment Agency SGVs generated using v1.04 have also not been updated. Software version v1.06 is identical to v1.05 with some password protection enhancements that in no way affect the GAC values generated.

Owing to the scientific advances since 2009 and in particular toxicological research outputs, less significance is now placed on the SGVs in the hierarchy outlined below.

Category 4 Screening Levels (C4SLs)

Category 4 Screening Levels were generated by Contaminated Land: Applications in Real Environments (CL:AIRE) on behalf of DEFRA and made available to the public in April 2014. Category 4 Screening Levels were derived in response to policy changes outlined in the recently revised Statutory Guidance (SG) for Part 2A of the Environmental Protection Act 1990 (Part 2A). Part 2A was originally introduced to ensure that the risks from land contamination to human health, property and the environment are managed appropriately, with the revised SG being designed to address concerns regarding its real-world application. The revised SG presents a new four category system for classifying land under Part 2A, ranging from Category 4, where the level of risk posed is acceptably low, to Category 1, where the level of risk is clearly unacceptable.

The document SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document (March 2014) states that:

The Impact Assessment that accompanied the revised Part 2A Statutory Guidance identified a potential role for new 'Category 4 Screening Levels' in providing a simple test for deciding when land is suitable for use and definitely not contaminated land. It was envisaged that these new screening levels would allow 'low-risk' land to be dismissed from the need for further risk assessment more quickly and easily and allow regulators to focus efforts on the highest-risk land. The C4SLs were proposed to be more pragmatic (whilst still strongly precautionary) compared to existing generic screening levels. It is anticipated that, where they exist, C4SLs will be used as generic screening criteria that can be used within a GQRA, albeit describing a higher level of risk than the currently or previously available SGVs.

Suitable For Use Screening Levels (S4USLs)

In January 2015, Land Quality Management (LQM) and the Chartered Institute of Environmental Health (CIEH) have published updated screening criteria that were derived in line with UK guidance on risk assessment (SR2 and SR3). The resultant screening criteria reflect the industries greater knowledge of the relevant toxicology and further consideration of exposure scenarios as set out in SP1010.

Waterman's Generic Assessment Criteria (GACs)

Waterman have used the following hierarchy for the generic assessment of soils to evaluate Human Health.

- Published Category 4 Screening Values (C4SLs) derived by CL:AIRE on behalf of DEFRA; or in their absence;
- Suitable 4 Use Screening Levels (S4USLs) derived by LQM/CIEH; or in their absence;
- Published Soil Guideline Values (SGVs);
- GAC prepared in accordance with the CLEA v1.04 / v1.06 model by authoritative bodies (e.g. Contaminated Land Applications in Real Environments (CL:AIRE) 2009; and
- Waterman in-house GAC prepared in accordance with the CLEA V1.06 model and associated documents.

Tabulated values of the GACs used are presented overleaf. The references of the sources quoted in the table are:-

- Environment Agency, 2009. CLEA Software, version 1.06;
- DEFRA, Environment Agency, 2004. Model Procedures for the Management of Land Contamination, Contaminated Land Report 11;
- DEFRA, 2014, SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document and appendices;
- LQM / CIEH, 2015. The LQM/CIEH S4ULs for Human Health Risk Assessment;
- Environment Agency, 2009. Human health toxicological assessment of contaminants in soil. Report SC050021/SR2;
- Environment Agency, 2009. Updated technical background to the CLEA model. Report SC050021/SR3;
- Environment Agency, 2008. Compilation of chemical data for priority organic pollutants for derivation of Soil Guideline Values. Report SC050021/SR7; and
- EIC / CL:AIRE, 2010. Soil generic assessment criteria for human health risk assessment.

Detailed Quantitative Risk Assessment (DQRA)

Detailed Quantitative Risk Assessments are undertaken on a site specific basis and full details of the alterations to the CLEA model and generic land use scenarios will be described within the specific reports.

Generic Quantitative Risk Assessment Criteria

Proposed End Use	units	Residential without plant uptake			Source
Soil Organic Matter Content	%	1	2.5	6	
Arsenic	mg/kg	40	40	40	DEFRA C4SLs
Antimony	mg/kg	550	550	550	CL:AIRE 2009
Barium	mg/kg	1300	1300	1300	CL:AIRE 2009
Beryllium	mg/kg	1.7	1.7	1.7	LQM S4ULs 2015
Boron (Water Soluble)	mg/kg	11000	11000	11000	LQM S4ULs 2015
Cadmium	mg/kg	150	150	150	DEFRA C4SLs
Chromium (Total)	mg/kg	910	910	910	LQM S4ULs 2015
Chromium (VI)	mg/kg	21	21	21	DEFRA C4SLs
Copper	mg/kg	7100	7100	7100	LQM S4ULs 2015
Lead	mg/kg	310	310	310	DEFRA C4SLs
Mercury	mg/kg	1.2	1.2	1.2	LQM S4ULs 2015
Molybdenum	mg/kg	670	670	670	CL:AIRE 2009
Nickel	mg/kg	180	180	180	LQM S4ULs 2015
Selenium	mg/kg	430	430	430	LQM S4ULs 2015
Vanadium*	mg/kg	1200	1200	1200	LQM S4ULs 2015
Zinc	mg/kg	40000	40000	40000	LQM S4ULs 2015
Cyanide (Free)	mg/kg				Waterman GAC - CLEA v1.06
Complex Cyanide	mg/kg				Waterman GAC - CLEA v1.06
Thiocyanate	mg/kg				Waterman GAC - CLEA v1.06
Aliphatic EC5 - EC6	mg/kg	42	78	160	LQM S4ULs 2015
Aliphatic EC6 - EC8	mg/kg	100	230	530	LQM S4ULs 2015
Aliphatic EC8-EC10	mg/kg	27	65	150	LQM S4ULs 2015
Aliphatic EC10-EC12	mg/kg	130	330	770	LQM S4ULs 2015
Aliphatic EC12-EC16	mg/kg	1100	2400	4400	LQM S4ULs 2015
Aliphatic EC16-EC35	mg/kg	65000	92000	110000	LQM S4ULs 2015
Aliphatic EC35-EC44	mg/kg	65000	92000	110000	LQM S4ULs 2015
Aromatic C5-C7	mg/kg	370	690	1400	LQM S4ULs 2015
Aromatic C7-C8	mg/kg	860	1800	3900	LQM S4ULs 2015
Aromatic C8-C10	mg/kg	47	110	270	LQM S4ULs 2015
Aromatic C10-C12	mg/kg	250	590	1200	LQM S4ULs 2015
Aromatic C12-C16	mg/kg	1800	2300	2500	LQM S4ULs 2015
Aromatic C16-C21	mg/kg	1900	1900	1900	LQM S4ULs 2015
Aromatic C21-C35	mg/kg	1900	1900	1900	LQM S4ULs 2015
Aromatic C35-C44	mg/kg	1900	1900	1900	LQM S4ULs 2015
Benzene	mg/kg	0.38	0.7	1.4	LQM S4ULs 2015
Toluene	mg/kg	880	1900	3900	LQM S4ULs 2015

Ethyl Benzene	mg/kg	83	190	440	LQM S4ULs 2015
Xylene - o	mg/kg	82	190	450	LQM S4ULs 2015
Xylene - m	mg/kg	88	210	480	LQM S4ULs 2015
Xylene - p	mg/kg	79	180	430	LQM S4ULs 2015
MTBE (Methyl tert-butyl ether)	mg/kg				CL:AIRE 2009
Naphthalene	mg/kg	2.3	5.6	13	LQM S4ULs 2015
Acenaphthylene	mg/kg	2900	4600	6000	LQM S4ULs 2015
Acenaphthene	mg/kg	3000	4700	6000	LQM S4ULs 2015
Fluorene	mg/kg	2800	3800	4500	LQM S4ULs 2015
Phenanthrene	mg/kg	1300	1500	1500	LQM S4ULs 2015
Anthracene	mg/kg	31000	35000	37000	LQM S4ULs 2015
Fluoranthene	mg/kg	1500	1600	1600	LQM S4ULs 2015
Pyrene	mg/kg	3700	3800	3800	LQM S4ULs 2015
Benzo(a)anthracene	mg/kg	11	14	15	LQM S4ULs 2015
Chrysene	mg/kg	30	31	32	LQM S4ULs 2015
Benzo(b)fluoranthene	mg/kg	3.9	4	4	LQM S4ULs 2015
Benzo(k)fluoranthene	mg/kg	110	110	110	LQM S4ULs 2015
Benzo(a)pyrene	mg/kg	3.2	3.2	3.2	LQM S4ULs 2015
Indeno(1,2,3-cd)pyrene	mg/kg	45	46	46	LQM S4ULs 2015
Di-benzo(a.h.)anthracene	mg/kg	0.31	0.32	0.32	LQM S4ULs 2015
Benzo(g.h.i.) Perylene	mg/kg	360	360	360	LQM S4ULs 2015
Phenol	mg/kg	750	1300	2300	LQM S4ULs 2015
Pentachlorophenol (PCP)	mg/kg	27	29	31	LQM S4ULs 2015
1,1,2,2 Tetrachloroethane	mg/kg	3.9	8	17	LQM S4ULs 2015
1,1,1,2 Tetrachloroethane	mg/kg	1.5	3.5	8.2	LQM S4ULs 2015
1,1,1 Trichloroethane	mg/kg	9	18	40	LQM S4ULs 2015
Trichloroethene	mg/kg	0.017	0.036	0.08	LQM S4ULs 2015
Tetrachloromethane (Carbon Tetrachloride)	mg/kg	0.026	0.056	0.13	LQM S4ULs 2015
1,2- Dichloroethane	mg/kg	0.0092	0.013	0.023	LQM S4ULs 2015
Chloroethene (Vinyl chloride)	mg/kg	0.00077	0.001	0.0015	LQM S4ULs 2015
Trichloroethene	mg/kg	0.017	0.036	0.08	LQM S4ULs 2015
Tetrachloroethene	mg/kg	0.18	0.4	0.92	LQM S4ULs 2015
Trichloromethane (Chloroform)	mg/kg	1.2	2.1	4.2	LQM S4ULs 2015
Sum of PCDDs, PCDFs and dioxin like PCBs	mg/kg				CLEA SGVs 2009
Isopropylbenzene	mg/kg	12	28	67	CL:AIRE 2009
Propylbenzene	mg/kg	40	97	230	CL:AIRE 2009
Styrene	mg/kg	35	78	170	CL:AIRE 2009
Bromobenzene	mg/kg	0.91	2.1	4.9	CL:AIRE 2009
1,1,2 Trichloroethane	mg/kg	0.88	1.8	3.9	CL:AIRE 2009
1,1-Dichloroethane	mg/kg	2.5	4.1	7.7	CL:AIRE 2009

1,1-Dichloroethene	mg/kg	0.23	0.41	0.82	CL:AIRE 2009
1,2,4-Trimethylbenzene	mg/kg	0.41	0.99	2.3	CL:AIRE 2009
1,2-Dichloropropane	mg/kg	0.024	0.042	0.085	CL:AIRE 2009
2-Chloronaphthalene	mg/kg	3.8	9.3	22	CL:AIRE 2009
Bromodichloromethane	mg/kg	0.019	0.034	0.07	CL:AIRE 2009
Bromoform	mg/kg	5.2	11	23	CL:AIRE 2009
Chloroethane	mg/kg	8.4	11	18	CL:AIRE 2009
Chloromethane	mg/kg	0.0085	0.0099	0.013	CL:AIRE 2009
Cis 1,2 Dichloroethene	mg/kg	0.12	0.2	0.39	CL:AIRE 2009
Dichloromethane	mg/kg	2.1	2.8	4.5	CL:AIRE 2009
Hexachloroethane	mg/kg	0.22	0.54	1.3	CL:AIRE 2009
Trans 1,2 Dichloroethene	mg/kg	0.19	0.35	0.71	CL:AIRE 2009
Bis (2-ethylhexyl) phthalate	mg/kg	2700	2800	2800	CL:AIRE 2009
Butyl benzyl phthalate	mg/kg	42000	44000	44000	CL:AIRE 2009
Diethyl Phthalate	mg/kg	1800	3500	6300	CL:AIRE 2009
Di-n-butyl phthalate	mg/kg	450	450	450	CL:AIRE 2009
Di-n-octyl phthalate	mg/kg	3400	3400	3400	CL:AIRE 2009
Biphenyl	mg/kg	220	500	980	CL:AIRE 2009
2,4-Dinitrotoluene	mg/kg	170	170	170	CL:AIRE 2009
2,6-Dinitrotoluene	mg/kg	78	84	87	CL:AIRE 2009
Tributyl tin oxide	mg/kg	1.4	3.1	0.24	CL:AIRE 2009

Soil Contamination – Risk of Harm to Property

Structures and Underground Services

Buried Concrete

BRE Special Digest 1 (2005), 3rd Edition, entitled *Concrete in aggressive ground*, provides guidance on the specification for concrete for installation in natural ground and in brownfield locations. The procedures given for the ground assessment and concrete specification cover the fairly common occurrences of sulfates, sulfides and acids, and the more rarely occurring aggressive carbon dioxide found in some ground and surface waters, which affects concrete foundations and sub-structures. It gives procedures for specification of concrete and applies to both buildings and civil engineering construction.

Water Supply Pipes

Guidance is provided in the UK Water Industry Research (UKWIR) report entitled *"Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites"* Report Ref. No. 10/WM/03/21, 2010.

Guidance is provided in the November 2010 Q&A Update and the Questions and Answers Sheet dated 4 May 2011 included at the back of the UKWIR report. Item 3 has been reproduced here:

Item	Question	Answer
3	Following the flow chart in Figure 1.1, **would it be acceptable to not undertake a site investigation and specify the use of barrier pipes** (these seem to be suitable for all conditions)? Would it be acceptable to adopt the blanket approach of always using barrier pipes at Brownfield sites, negating the need for a desk study or intrusive investigation?	The UKWIR project steering group decided that barrier pipes would provide sufficient protection for the supply of drinking water in all Brownfield site conditions. It is therefore reasonable to expect that water companies will accept the use of barrier pipe in all situations as a blanket approach

Soil Contamination – Risk of Combustion

The combustibility of soils is a complex function of soil type, energy content, and availability of oxygen. The Building Research Establishment (BRE) has published guidance based on Calorific Value (i.e. energy content, alone), namely *IP 2/87, Fire and explosion hazards associated with the redevelopment of contaminated land*. This document provides a level below which combustibility is unlikely (2MJ/kg) and a level above which combustibility is likely (10MJ/kg). In the range between these two values combustibility is uncertain. Therefore, where the lower value is exceeded, the other key factors mentioned above need to be considered.

Soil Contamination – Risk of Harm to Vegetation

Where there is topsoil present on Site and it is being considered for reuse in landscaped areas then it needs to be assessed for its suitability for use by an appropriately qualified specialist. Topsoil can be both naturally-occurring and manufactured. The requirements for topsoil that is to be reused on site are specified in BS3882:2007 and cover a range of properties including texture, organic matter content, grading, pH, nutrients and phytotoxic contaminants. The specification for phytotoxic contaminants is reproduced in the table below:

Phytotoxic Contaminants (by soil pH) for Topsoil

Contaminant*	pH		
	<6	6.0 to 7.0	>7
Zinc (Nitric acid extractable**)	<200mg/kg	<200mg/kg	<300mg/kg
Copper (Nitric acid extractable**)	<100mg/kg	<135mg/kg	<200mg/kg
Nickel (Nitric acid extractable**)	<60mg/kg	<75mg/kg	<110mg.kg

Footnotes: * The lower of the Generic Assessment Criteria for chemical contaminants (human health and the environment) and phytotoxicity shall be used for topsoil

** The method of testing is given in Annex D to BS3882:2007 Specification for topsoil and requirements for use.

The risk to human health and the environment needs to be considered as well as phytotoxicity and this will be carried out using the Generic Assessment Criteria selected for these risks as described elsewhere in this appendix and this report.

In order to assess the suitability of topsoil to be reused the full range of testing specified needs to be carried out and assessed by an appropriately qualified specialist.

Controlled Waters Generic Assessment Criteria

The Screening Values adopted by Waterman for ground and surface water quality have been selected on the basis of the water quality standards that apply at the controlled water receptor considered to be at potential risk of harm.

Surface Waters

The Water Framework Directive (WFD) (2000/60/EC) was originally introduced in 2000, however a raft of Daughter Directives have been brought in to address the objectives the WFD originally set out. Over time the WFD and its Daughter Directives have gradually replaced number of the existing Directives including the Dangerous Substances Directive (DSD) and Surface Water Directive (SWD).

The WFD identifies 'Priority' and 'Priority Hazardous Substances', to which Environmental Quality Standards (EQS) have been determined. The WFD EQS do not provide a full complement of applicable values to adopt. In the absence of an EQS, values under the replaced Surface Water Directive have been used as a guide.

Groundwater

The EU Drinking Water Directive (DWD) (98/83/EC) lays out the standards for drinking water EU wide. The UK have followed the EU regulations and translated the Directive into the Water Supply (Water Quality) Regulations England 2000. The UK Drinking Water Standards are the most relevant criteria to use for the assessment of risks to water destined for potable sources.

The WFD, to date, have not set threshold values for groundwater on a river basin basis.

TPH and PAHs

A suitable risk based assessment criteria for risks from TPH in both surface waters and groundwater are not available in the UK. The WHO have produced a health based risk assessment for drinking waters with regard to TPH “Petroleum Products in Drinking Waters, Background document for development of WHO Guidelines for Drinking-water Quality. Ref. WHO/SDE/WSH/05.08/123”.

The WHO Guideline values have been amended for the UK standard body weight and behaviour to derive a UK guideline for DWS of TPH (70kg body weight and 2l of water consumed per day).

A complete list of assessment criteria for PAHs is absent from the UK (benzo(a)pyrene is available). However, the risk from PAHs should be considered. The theory presented in the WHO document "Petroleum Products in Drinking Waters, Background document for development of WHO Guidelines for Drinking-water Quality. Ref. WHO/SDE/WSH/05.08/123" has been applied to provide indicative screening values for PAHS with regard to drinking water. Published TDI and ID effects have been amended for the UK standard body weight and behaviour to derive a UK guideline for DWS of PAHs (70kg body weight and 2l of water consumed per day).

The derived TPH and PAH screening values are used as an indication of the risks from TPH and PAHs to human health through drinking water only.

The standards for the substances tested for in this investigation are provided in Table D3 and D4 below.

Table D3 - Screening Values – Surface Water Receptor

	Concentration (ug/l)		
Determinand	**EQS Priority and Specific Priority**	**Surface Water Directive (revoked)**	**Non-Statutory EQS**
Arsenic	50		
Barium		100	
Boron		1,000	
Cadmium	0.45 – 1.5*		
Cobalt			100
Copper	1 – 28*		
Chromium (total)	3.4		
Chromium (VI)	3.4		
Chromium (III)	4.7		
Iron	1		
Lead	7.2		
Manganese		50	
Mercury	0.07		
Nickel	20		
Selenium		10	
Tin			25
Zinc	8 – 125*		
Cyanide (free)	1		
Ammonia (total)	0.3,1.3		
Chloride	2		
Fluoride			3,000 – 15,000
Nitrate		50	
Phosphate			
Sulphate		250,000	

Determinand	Concentration (ug/l)		
	EQS Priority and Specific Priority	Surface Water Directive (revoked)	Non-Statutory EQS
Conductivity		1,000	
Benzene	50		
Ethyl Benzene			20
Toluene	50		
Xylene (p+m)	30	1	
Phenol	7.7		

Footnotes:
NV – No value
(*) – Dependant on Hardness (See DoE circular 7/89).

Table D4 - Screening Values – Risks to Groundwater

Determinand	Concentration (ug/l)		
	UK Drinking Water Standards	Groundwater Drinking Water Protected Areas	WHO Derived Screening
pH (Acid)	6.2		
pH (Alkaline)	9.5		
Aluminium	200		
Antimony	5		
Arsenic	10		
Boron	1,000		
Cadmium	5		
Copper	2,000		
Chromium (total)	50		
Iron	200		
Lead	10		
Manganese	50		
Mercury	1		
Nickel	20		
Selenium	10		
Zinc		3,750	
Sulphate	250,000		
Cyanide	50		
Ammonia (total)	500		
Bromate	10		
Chloride	250,000		
Fluoride	1,500		
Nitrate	50,000		
Nitrite	500		

Determinand	Concentration (ug/l) UK Drinking Water Standards	Groundwater Drinking Water Protected Areas	WHO Derived Screening
Sodium	200,000		
Sulphate	250,000		
Conductivity	2,500		
Aliphatic EC5 - EC6			17.5
Aliphatic EC6 - EC8			17.5
Aliphatic EC8-EC10			0.35
Aliphatic EC10-EC12			0.35
Aliphatic EC12-EC16			0.35
Aliphatic EC16-EC21			7
Aliphatic EC21-EC35			7
Aromatic EC6-EC7 (Benzene)	1		
Aromatic EC7-EC8 (Toluene)		*276*	
Aromatic EC8-EC10			
Aromatic EC10-EC12			0.105
Aromatic EC12-EC16			0.105
Aromatic EC16-EC21			0.105
Aromatic EC21-EC35			0.105
Benzene	1		
Ethyl Benzene			300*
Toluene		276	
Xylene		166	
Acenaphthene			210
Acenaphthylene			210
Anthracene			1050
Benzo(a)anthracene			0.5425
Benzo(a)pyrene	0.01		
Benzo(b)fluoranthene			0.1365
Benzo(g.h.i.) Perylene			12.04
Benzo(k)fluoranthene			3.605
Chrysene			1.085
Di-benzo(a.h.)anthracene			0.01085
Fluoranthene			43.75
Fluorene			140
Indeno(1,2,3-cd)pyrene			1.5505

Determinand	Concentration (ug/l) UK Drinking Water Standards	Groundwater Drinking Water Protected Areas	WHO Derived Screening
Naphthalene			70
Phenanthrene			43.75
Pyrene			105

*WHO Drinking Water Standard

Ground Gas and Volatile Organic Compounds Generic Assessment Criteria

Ground Gas

The Building Regulations 2000 Approved Document C (2004 Edition) require that methane and other gases from the ground are considered on a risk assessment basis. Methane and other gases from the ground are defined in this document as *"hazardous soil gases which originate from waste deposited in landfill sites or are generated naturally"*. Ground gas can also be generated by fill materials present on sites that are not classed as landfills. Therefore a preliminary ground gas risk assessment should consider the potential for methane or other gases to be present. This includes identification of the potential sources on or near to the site that could produce methane or other ground gas.

The most common gases assessed with respect to development are methane and carbon dioxide. Methane forms a potentially explosive mixture when mixed with air within certain concentration limits, known as the 'explosive range'. The Lower Explosive Limit (LEL) for methane is 5%. Carbon dioxide (CO_2) is a dense gas, capable of accumulating in confined spaces such as basements, causing a potential asphyxiation hazard. The Occupational Exposure Limit (OEL) for a short-term exposure to carbon dioxide is 1.5% over a 15 minute period. Both methane and carbon dioxide when present at high concentrations can act as simple asphyxiants by reducing the oxygen content by dilution.

Reference in the Building Regulations is made to guidance documents produced by a variety of organisations, primarily those produced by the Construction Industry Research and Information Association (CIRIA). These include the following documents:

- CIRIA Report 149 Protecting development from methane, 1995
- CIRIA Report 131 The measurement of methane and other gases from the ground, 1993.
- CIRIA Report 150 Methane investigation strategies, 1995
- CIRIA Report 151 Interpreting measurements of gas in the ground, 1995
- CIRIA Report 152 Risk assessment for methane and other gases from the ground, 1995

In addition guidance is provided in the BRE document 'Construction of new buildings on gas-contaminated land (BRE Report BR212)'.

CIRIA, Report 131, 1993, suggests that there are no fixed rules for safe gas concentrations on a site since this risk is dependent on a number of factors that include gas emission rate from the ground and the potential for gas to enter into structures.

The Building Regulations relate to domestic dwellings. However, for non-domestic dwellings the same principle of risk assessment applies.

The latest guidance document is provided by CIRIA Report C665, “Assessing risks posed by hazardous ground gases to buildings”, 2007 and BS8485:2007: “Code of practice for the characterisation and remediation from ground gas in affected developments”.

CIRIA C665 aims to consolidate good practice in investigation, facilitate the collection of relevant data, instigate appropriate monitoring programmes, all in a risk based approach to gas contaminated land. As with BS8485, this document largely focuses on Methane and Carbon Dioxide. However, much of the text is also relevant to consideration of other contamination present in vapour phase.

BS8485, 2007 describes methods for the investigation and assessment of the ground gases methane and carbon dioxide provides recommendations for protection of new development on affected sites. This standard is not intended for the assessment of completed developments and considers only methane and carbon dioxide.

Both of these publications have been prepared to be generally consistent with CLR11, Model Procedures for the management of land contamination, (DEFRA and the Environment Agency, 2004a) and follow a step by step approach summarised below:-

1. Desk Study and Site Walkover
2. Development of a Preliminary Conceptual Model and Risk Assessment
3. Site Investigation (If deemed necessary from stage 2)
4. Risk Assessment and Site Characterisation
5. Recommendation and Mitigation

Where, the preliminary conceptual model has deemed further investigation necessary to characterise the ground gas regime, an appropriate site investigation and monitoring regime should be designed and undertaken. In-depth guidance to assist in the design of the investigation is provided within C665, which describes intrusive investigation techniques and provides guidance on selecting the number and location of monitoring wells based on the site specific conceptual model.

Waterman has generally followed the approach recommended in CRIRIA C665 with respect to characterising a site and determining the levels of gas protection methods required. This approach is generally consistent with the guidance provided in BS8485.

In accordance with C665, to assess the ground gas regime at a site, the ground gas monitoring data should be assessed by determining the Gas Screening Value (GSV) (l/hr) (BS8485 refers to the GSV as the Hazardous Gas Flow Rate). The GSV is calculated as follows:

GSV = (Measured Maximum CO2 or CH4 Gas Concentration (%) / 100) x Maximum Measured Gas Flow Rate from boreholes (l/hr)

Where the gas flow rate has been measured as less than the detection limit of the instrument used (ie <0.1 l/hr), C665 recommends that the detection limit for the Gas Analyser is used as the gas flow rate (ie 0.1l/hr).

The Gas Screening Value is used to classify the site, subject to the proposed end use of the site, falling into either Situation A or Situation B, as described below.

Situation A – For All Development Types except Low Rise Housing with a ventilated underfloor void (150mm)

For situation A, the Modified Wilson and Card classification system is used. This system attributes a Characteristic Situation (CS) value to the site/zone depending upon the calculated GSV. When attributing a CS, additional factors including the maximum recorded gas concentration and the maximum recorded gas flow rate should also be taken into account and may result in an increase in the CS value. Table I.2 below, outlines the CS values associated GSV's and additional factors which must be taken into account.

Modified Wilson and Card Classification

Characteristic Situation (CIRIA 149)	Risk Classification	Gas screening value (CH_4 CO_2) l/hr	Additional Factors	Typical source of generation
1	**Very low risk**	**<0.07**	Typically methane ≤1% and / or carbon dioxide ≤5%. Otherwise consider increase to CS 2.	Natural soils with low organic content 'Typical' made ground
2	**Low risk**	**<0.7**	Borehole air flow rate not to exceed 70 l/hr. Otherwise consider increase to CS 3.	Natural soil, high peat/organic content. 'Typical' made ground
3	**Moderate risk**	**<3.5**		Old landfill, inert waste, mineworking flooded
4	**Moderate to high risk**	**<15**	Quantitative risk assessment required to evaluate scope of protective measures.	Mineworking – susceptible to flooding, completed landfill (WMP 26B criteria)
5	**High risk**	**<70**		Mineworking unflooded inactive with shallow workings near surface
6	**Very High risk**	**>70**		Recent landfill site

Notes:
1. Gas screening value: litres of gas / hour is calculated by multiplying the gas concentration (%) by the measured borehole flow rate (l/hr)
2. Source of gas and generation potential/performance must be identified.
3. If there is no detectable flow use the limit of detection of the instrument.

Once the characteristic situation has been determined, the requirements and scope of gas protection measures can be determined based on Table I.3 below (based on guidance provided within C665):

Modified Wilson and Card Protection Measures

CS*	Residential building (not those subject to NHBC Classification Method			Office/commercial/industrial development	
	Risk Classification	No. of levels of protection	Typical scope of protective measures	No. of levels of protection	Typical scope of protective measures
1	**Very low risk**	**None**	No special precautions	None	
2	**Low risk**	**2**	1. Reinforced concrete cast in situ floor slab (suspended, non-suspended or raft) with at least 1200g DPM[2,7] and underfloor venting. 2. Beam and block or pre-cast concrete and 2000g DPM[7]/ reinforced gas membrane and underfloor venting. All joints and penetrations sealed	1 to 2	Reinforced concrete cast in situ floor slab (Suspended, non-suspended or raft) with at least 1200g DPM[2,7]. Beam and block or pre-cast concrete slab and minimum 2000g DPM / reinforced gas membrane. Possibly underfloor venting or pressurisation in combination with a) and b) depending on use. All joints and penetrations sealed
3	**Moderate risk**	**2**	All types of floor slab as above. All joints and penetrations sealed. Proprietary gas resistant membrane and passively ventilated or positively pressurised underfloor sub-space.	1 to 2	All types of floor slab as above. All joints and penetrations sealed. Minimum 2000g/reinforced gas proof membrane and passively ventilated underfloor sub-space or positively pressurised underfloor sub-space.
4	**Moderate to high risk**	**3**	All types of floor slab as above. All joins and penetrations sealed. Proprietary gas resistant membrane and passively ventilated underfloor sub-space or positively pressurised underfloor sub-space, oversite capping or binding and in ground venting layer.	2 to 3	All types of floor slab as above. All joins and penetrations sealed. Proprietary gas resistant membrane and passively ventilated or positively pressurised underfloor sub-space.
5	**High risk**	**4**	Reinforced concrete cast in situ floor slab (suspended, non-suspended or raft). All joints and penetrations sealed. Proprietary gas resistant membrane and ventilated or positively pressurised underfloor sub-space, oversite capping and in ground venting layer and	3 to 4	Reinforced concrete cast in situ floor slab (suspended, non-suspended or raft). All joins and penetrations sealed. Proprietary gas resistant membrane and passively ventilated or positively pressurised underfloor sub-space with monitoring facility. In ground venting wells or barriers.

CS*	Residential building (not those subject to NHBC Classification Method			Office/commercial/industrial development	
	Risk Classification	No. of levels of protection	Typical scope of protective measures	No. of levels of protection	Typical scope of protective measures
			in ground venting wells or barriers		
6	**Very high risk**	**5**	Not suitable unless gas regime is reduced first and quantitative risk assessment carried out to assess design of protection measures in conjunction with foundation design.	4 to 5	Reinforced concrete cast in-situ floor slab (suspended, non-suspended or raft). All joints and penetration sealed. Proprietary gas resistant membrane and actively ventilated or positively pressurised underfloor sub-space with monitoring facility, with monitoring. In ground venting wells and reduction of gas regime.

Notes:

1. Typical scope of protective measures may be rationalised for specific developments on the basis of quantitative risk assessments.
2. Note, the type of protection is given for illustrative purposes only. Information on the detailing and construction of passive protection measures is given in BR414 [Ref: 16]. Individual site specific designs should provide the same number of separate protective methods for any given characteristic situation.
3. In all cases there should be minimum penetration of ground slabs by services and minimum number of confined spaces such as cupboards above the ground slab. Any confined spaces should be ventilated.
4. Foundation design must minimise differential settlement particularly between structural elements and ground baring slabs.
5. Floor slabs should provide an acceptable formation on which to lay the gas membrane. If a block beam floor is used it should be well detailed so it has no voids in it that membranes have to span and all holes for service penetrations should be filled. The minimum density of the blocks should be 600kg/m^3 and the top surface should have a 4:1 sand cement grout brushed into all joints before placing any membranes (this is also good practice to stabilise the floor and should be carried out regardless of the need for gas membranes).
6. The gas resistant membrane can also act as the damp proof membrane.
7. DPM = Damp Proof Membrane

Situation B – For Low Rise Housing with a ventilated underfloor void (min 150mm)

Situation B should be used for low-rise residential housing with gardens and sub-floor void. Where a sub-space void is not proposed, the development should be assessed using the situation A classification system above.

For situation B, the National House Building Council's (NHBC) Traffic Light classification system is used. This system attributes a colour to a site/zone depending upon the calculated GSV. As with the Wilson and Card system, in addition to the GSV, additional factors including the maximum recorded gas concentration and the maximum recorded gas flow rate must be taken into account when determining the Traffic Light classification. Table I.4, outlines the Traffic Light classification system, based on the calculated GSV's and additional factors which must be taken into account.

NHBC traffic light system for 150mm void

Traffic Light	Methane		Carbon Dioxide	
	Typical Maximum Concentration (% v/v)	Gas Screening Value (GSV) l/hr	Typical Maximum Concentration (% v/v)	Gas Screening Value (GSV) l/hr
Green				
Amber 1	1	0.16	5	0.78
Amber 2	5	0.63	10	1.56
Red	20	1.56	30	3.13

Notes:

1. The worst gas regime identified at the site, either methane or carbon dioxide, recorded from monitoring in the worst temporal conditions, will be the decider as to what Traffic Light and GSV is allocated.
2. Generic GSVs are based on guidance contained within latest revision of Department of the Environment and the Welsh Office (2004 edition) "The Building Regulations: Approved Document C" [Ref:17] and used a sub-floor void of 150mm thickness.
3. This assessment is based on a small room e.g. downstairs toilet with dimensions of 1.5 x 2.5m, with a soil pipe passing into the sub-floor void.
4. The GSV, in litres per hour, is as defined as the bore hole flow rate multiplied by the concentration of the particular gas being considered.
5. The typical maximum concentrations can be exceeded in certain circumstances should the conceptual site model indicate it is safe to do so. This is where professional judgement will be required based on a thorough understanding of the gas regime identified at the site where monitoring in the worst case temporal conditions has occurred.
6. The GSV threshold should not generally be exceeded without completion of a detailed gas risk assessment taking into account site specific conditions.

Once the Traffic Light classification has been determined, the requirements and scope of gas protection / mitigation measures can also be determined based on Table I.5 below (based on guidance provided within CIRIA C665):

Gas Protection Measures for Low-Rise Housing Development Based Upon Allocation NHBC Traffic Light (Boyle and Witherington, 2006)

Traffic Light Classification	Protection Measures Required
Green	Negligible gas regime identified and gas protection measures are not considered necessary.
Amber 1.	Low to intermediate gas regime identified, which requires low-level gas protection measures, comprising a membrane and ventilated sub-floor void to create a permeability contrast to limit the ingress into buildings. Gas protection measures should be as prescribed in BRE Report 414 (Johnson 2001). Ventilation of sub-floor void should facilitate a minimum of one complete volume change per 24 hours.
Amber 2.	Intermediate to high gas regime identified, which requires high level gas protection measures, comprising a membrane and ventilated sub-floor void to create a permeability contrast to prevent the ingress of gas into buildings. Gas protection measures should be as prescribed in BRE Report 414. Membranes should always be fitted by a specialist contractor. As with Amber 1, ventilation of the sub-floor void should facilitate a minimum of one complete volume change per 24 hours. Certification that these passive protection measures have been installed correctly should be provided.
Red	High gas regime identified. It is considered that standard residential housing would not normally be acceptable without a further Gas Risk Assessment and / or possible remedial mitigation measures to reduce and / or remove the source of gas.

Volatile Organic Compounds

The Building Regulations 2000 Approved Document C (2004 Edition) also refers to volatile organic carbons (VOCs). These are primarily assessed by examination of the VOC content of site soils. Further guidance on VOCs is provided in *"The VOCs Handbook; Investigating, assessing and managing risks from inhalation of VOCs at land affected by contamination"*, CIRIA Report C682, 2009.

For former landfill sites the risk from a wider range of trace gases are considered on a site specific basis when appropriate.

UK and Ireland Office Locations