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Phase 2 Land Contamination Risk Assessment

for

Proposed change of use of agricultural building to create a single dwelling

on the site of

Widowfields Farm,

Ford Hayes Lane,

Hulme, ST3 5BJ

Date: February 2020

Status:	Final Report
Reference:	1506D Tart - Longton
Date:	26/02/2020

Executive Summary

The site is currently occupied by a large agricultural building which is surrounded by grass with a concreted area located north of the building. The agricultural building was noted to be constructed of cinderblock and corrugated metal with concrete flooring and is marked on plans as a ‘hay barn’.

Based on the information contained in this report, it is the opinion of Castledine & Co that the site represents a **LOW** to **MODERATE** risk with respect to the proposed development.

The site is to be covered in hard standing with areas of contaminant exceedances located outside the site curtilage area. No exceedances were noted within the curtilage area. The area of exceedance is a well-vegetated, former sewage works with features that have been cleaned, are concrete lined and filled with a large grade, inert gravel medium. Dust formation, migration and inhalation very unlikely due to these factors. Therefore it is envisaged no further testing would be required, with a recommendation that:

Remediation in-line with section 11.0 is undertaken involving the placement of hardstanding and installation of ground gas protection measures inline with BS8485:2015 and inline with characteristic situation 2.

It is recommended that the Buildings on site should be subject to an asbestos survey and removal by appropriately qualified personal prior to any demolition or redevelopment occurring in order to ensure site works do not cause future contamination of the site.

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1.0 QUALITY ASSURANCE

Castledine & Co. confirm that all reasonable efforts have been made to ensure that the information outlined within this report is accurate.

Castledine & Co. would further confirm that due care, attention and technical skill were used in the creation of this report.

For and on behalf of Castledine & Co.

Kevin Castledine

(Proprietor)

2.0 LIMITATIONS

The conclusions and recommendations made in this report are limited to those based on the findings of the investigation. Where comments are made based on information obtained from third parties, Castledine & Co. assumes that all third party information is true and correct. No independent action has been undertaken to validate the findings of third parties. The assessments and interpretation have been made in line with legislation and guidelines in force at the time of writing, representing best practice at the time.

This survey has not included asbestos within existing structures, invasive plant species or any elements unconnected with potential ground contamination at the site. If required, such surveys should be undertaken by suitably accredited organisations.

There may be other conditions prevailing at the site which have not been disclosed by this investigation and which have not been taken into account by this report. Responsibility cannot be accepted for conditions not revealed by the investigation.

3.0 INTRODUCTION

Castledine & Co. have been appointed by Crane Tart to undertake a Phase 2 investigation of Widowfields Farm, Ford Hayes Lane, Hulme, ST3 5BJ.

A Phase 1 report was carried out by Castledine & Co in September of 2019.

- Phase 1 Land Contamination Risk Assessment for the Proposed Change of Use of Agricultural Building to create a Single Dwelling on the site of Widowfields Farm, Ford Hayes Lane, Hulme, ST3 5BJ.

The report is attached as Appendix A

4.0 SCOPE

Castledine & Co. have prepared this report for the sole use and reliance of Crane Tart and appointees for the purpose of ensuring compliance with:

- paragraph 170, 178, & 179 of the National Planning Policy Framework 2018,
- part C1 of the building regulations.
- Condition No.4 of the Staffordshire Moorlands District Council planning approval reference - DET/2019/0018 http://publicaccess.staffsmoorlands.gov.uk/portal/servlets/ApplicationSearchServlet?PKID=129980

4. Unless otherwise agreed in writing by the Local Planning Authority, development other than that required to be carried out as part of an approved scheme of remediation must not commence until conditions a and b have been complied with.

a) An investigation and risk assessment, in addition to any assessment provided with the planning application, must be completed in accordance with a scheme to assess the nature and extent of any contamination on the site, whether or not it originates on the site. The contents of the scheme shall be submitted to and approved in writing by the Local Planning Authority. The investigation and risk assessment must be undertaken by competent persons and a written report of the findings must be produced. The written report must be submitted to

and approved in writing by the Local Planning Authority. The report of the findings must include:

(i) a survey of the extent, scale and nature of contamination;

(ii) an assessment of the potential risks to:
- human health,
property (existing or proposed) including buildings, crops, livestock, pets, woodland and service lines and pipes,
- adjoining land,
- groundwaters and surface waters,
- ecological systems,
- archaeological sites and ancient monuments;

(iii) an appraisal of remedial options, and proposal of the preferred option(s).

This must be conducted in accordance with DEFRA and the Environment Agency's 'Model Procedures for the Management of Land Contamination, CLR 11'.

b) A detailed remediation scheme to bring the site to a condition suitable for the intended use by removing unacceptable risks to human health, buildings and other property and the natural and historical environment must be prepared, submitted to and approved in writing by the Local Planning Authority. The scheme must include all works to be undertaken, proposed remediation objectives and remediation criteria, timetable of works and site management procedures. The scheme must ensure that the site will not qualify as contaminated land under Part 2A of the Environmental Protection Act 1990 in relation to the intended use of the land after remediation.

c) The approved remediation scheme must be carried out prior to the first occupation of the development. The Local Planning Authority must be given two weeks written notification of commencement of the remediation scheme works. Following completion of measures identified in the approved remediation scheme, a verification report (referred to in PPS23 as a validation report) that demonstrates the

effectiveness of the remediation carried out must be produced, submitted to and approved in writing by the Local Planning Authority.

d) In the event that contamination is found at any time when carrying out the approved development that was not previously identified it must be reported in writing immediately to the Local Planning Authority. An investigation and risk assessment must be undertaken in accordance with the requirements of condition a, and where remediation is necessary a remediation scheme must be prepared in accordance with the requirements of condition b, and a verification report must be prepared, in accordance with condition c.

This report should be read in conjunction with reports listed in section 3.0

This report may not be used or relied upon by any unauthorised third party, or for any other proposed use than that specified above, without the explicit written agreement of Castledine & Co.

The report consists of a risk assessment in accordance with BS10175:2011+A2:2017 and CLR11 “Model Procedures for the Management of Land Contamination”.

The objectives of the report are:-

- To assess historical activities at the site with respect to their potential impact on the site environment.
- To characterise the environmental setting of the site, identify migration pathways and vulnerable receptors for contamination originating at the site, focusing on potential soil and groundwater liabilities.
- To assess historical and current surrounding land use in relation to known or potential off site contamination issues that may impact on the subject site and
- To develop a preliminary conceptual site model (CSM).

5.0 SITE DESCRIPTION

The site is located in Hulme at National Grid Reference: 392590,346611 and is approximately 0.0314 in area.

The site is currently occupied by a large agricultural building which is surrounded by grass with a concreted area located north of the building. The agricultural building was noted to be constructed of cinderblock and corrugated metal with concrete flooring and is marked on plans as a ‘hay barn’.

6.0 FINDINGS IN PREVIOUS REPORT

The site is occupied by a hay barn constructed of cinderblock, corrugated metal with concrete flooring. The building is surrounded by grass with a concreted area located to the north of the building.

Historical known and unknown practises on the site coupled have the potential to have introduced contaminants into the site soils, including:

- Metals and metalloids;
- Polycyclic aromatic hydrocarbons (PAH’s);
- Petroleum hydrocarbons
- Pesticides

The report also highlighted potential contamination and ground gas generation risks associated with a former sewage works located in proximity to the east of site.

Castledine & Co recommended installation of ground gas protection measures inline with BS8485:2015 inline with characteristic situation 2 and a watching brief during the course of the site works.

The client informed Castledine & Co that the whole of the outside space within the curtilage of the planning application will be covered in hard standing. Regardless, due to the proximate presence of a former sewage works it was recommended that further testing of the site soils be undertaken.

7.0 CHEMICAL ASSESSMENT CRITERIA

On establishing the presence of pollutant linkages, it is then necessary to assess whether or not any of the linkages are significant, whereby significant harm is being caused or there is significant possibility of significant harm being caused to human health or the environment. In the absence of any evidence of 'significant harm', the risks will be assessed on the basis of a 'significant possibility of significant harm' being caused. In order to initially assess the risks, appropriate Tier 1 assessment criteria are derived which represent benchmark contamination concentrations with respect to relevant receptors. Concentrations recorded in excess of these levels **may** represent a significant risk to a specific receptor when considered as part of a pollutant linkage.

7.1 HUMAN HEALTH

The Environment Agency, through its Contaminated Land Exposure Assessment (CLEA) framework, published toxicological reports (TOX) and soil guideline values (SGVs).

SGVs are science-based generic assessment criteria that indicate human health risks from long-term exposure to soil contaminants. They are set at levels where there are 'no appreciable' or 'minimal' risks to human health. For each substance, different SGVs are applicable according to land use, for example, whether residential, allotment or commercial. They have been widely seen as over precautionary and offering councils a very weak indication of whether sites represent a "significant possibility of significant harm" (SPOSH) requiring determination under the contaminated land regime.

Following publication of the revised Part IIa Statutory Guidance DEFRA has commissioned the creation of Category 4 Screening levels (C4SL's) They are set at levels where there is a "Low" risk to Human Health (i.e. higher than that of SGV's but still sufficiently low to defiantly not be "Contaminated Land" as defined by section 78A of the Environmental Protection Act 1990 as amended). The C4SL's are calculated using the

CLEA model using less conservative exposure and toxicological assumptions than the SGV's. C4SL's have also been calculated for Open Space land use.

LAQM in association with the CIEH have produced S4UL's are reproduced with permission; Publication Number S4UL3693

The pathways considered for the standard land uses include:

- Ingestion of soils;
- Ingestion of household dust;
- Ingestion of contaminated vegetables (residential with plant uptake only);
- Ingestion of soil attached to vegetables (residential with plant uptake only);
- Dermal contact with soils;
- Dermal contact with household dust;
- Inhalation of fugitive dusts from soils;
- Inhalation of fugitive household dust;
- Inhalation of vapours in outdoor air; and
- Inhalation of vapours in buildings.

These exposure routes have been evaluated independently of one another to identify the most sensitive exposure route. The SSV adopted for a given land use scenario is the most stringent screening value of all those relevant to the site.

The current proposals are to redevelop the site for a residential use with gardens. It is considered appropriate to compare the chemical testing results to those SGVs/SSVs with the appropriate 'residential with plant uptake' settings. Selected Tier 1 Human Health Assessment Criteria Values are detailed in the following table.

8.0 SITE WORKS AND FINDINGS

8.1 FEILDWORK 13TH FEBRUARY 2020

Castledine & Co undertook a Phase 2 Ground Investigation on land at Widowfields Farm, Ford Hayes Lane, Hulme on the 13th February, 2020. The aim of the investigation was to identify any potential contamination on the site and the areas in which they are situated.

Castledine & Co utilised a targeted sampling regime. On the day of the site works a total of 4 No. trial pits were formed to maximum depths of 0.02mbgl. Castledine & Co took a total of 4 No. environmental soil samples from depths of 0.10m to 0.20m depth.

8.2 SAMPLE RESULTS

Sample results have been compared with generic screening criteria presented in Appendix D. Sample results are attached as Appendix C

A total of 4 No. samples were tested for standard contaminants including metals, metalloids, pH and PAH.

Metals and Semi Metals with Residential Plant Uptake:

Determinant	Units	Accreditation	C4SL	S4UL	Highest Value	Location of Highest value	Exceedance?
Arsenic	(mg/kg)	MCERTS	37	37	24	TP3	NO
Cadmium	(mg/kg)	MCERTS	26	11	2.0	TP3	NO
Chromium (total)	(mg/kg)	UKAS	NC	910	27	TP3	NO
Copper	(mg/kg)	MCERTS	NC	2400	260	TP3	NO
Lead	(mg/kg)	MCERTS	200	NC	170	TP3	NO
Mercury	(mg/kg)	UKAS	NC	1.2	<2.5	ALL	NO
Nickel	(mg/kg)	MCERTS	NC	130	36	TP3	NO
Zinc	(mg/kg)	MCERTS	NC	3700	360	TP3	NO
Total Phenols	(mg/kg)	MCERTS			1.9	TP4	NA
Chromium (Hexavalent)	(mg/kg)	U			<1.0	ALL	NO
pH	pH units	MCERTS			7.3	TP1	

No exceedances noted.

Non-Metals with Residential and Plant Uptake:

Determinant	Units	Accreditation	C4SL	S4UL	Highest Value	Location of Highest value	Exceedance?
Acenaphthene	(mg/kg)	UKAS	NC	210	1.3	TP1	NO
Acenaphthylene	(mg/kg)	UKAS	NC	170	0.39	TP1	NO
Anthracene	(mg/kg)	MCERTS	NC	2400	3.4	TP1	NO
Benzo(a)anthracene	(mg/kg)	MCERTS	NC	7.2	21	TP1	YES
Benzo(a)pyrene	(mg/kg)	MCERTS	3.2	2.2	27	TP1	YES
Benzo(b)fluoranthene	(mg/kg)	MCERTS	NC	2.2	34	TP1	YES
Benzo (g, h, i) perylene	(mg/kg)	MCERTS	NC	320	17	TP1	NO
Benzo (k) fluoranthene	(mg/kg)	MCERTS	NC	77	13	TP1	NO
Chrysene	(mg/kg)	MCERTS	NC	15	22	TP1	YES
Dibenzo (a,h) anthracene	(mg/kg)	MCERTS	NC	0.24	3.7	TP1	YES
Fluoranthene	(mg/kg)	MCERTS	NC	280	39	TP1	NO
Fluorene	(mg/kg)	MCERTS	NC	170	0.80	TP1	NO
Indeno (1, 2, 3,-cd) pyrene	(mg/kg)	MCERTS	NC	2.3	18	TP1	YES
Naphthalene	(mg/kg)	MCERTS	NC	1.5	0.38	TP1	NO
Phenanthrene	(mg/kg)	MCERTS	NC	95	14	TP1	NO
Pyrene	(mg/kg)	MCERTS	NC	620	35	TP1	NO
Total PAH (Sum of USEPA 16)	(mg/kg)	UKAS	NC	NC	250	TP1	

Laboratory testing indicates Residential with Plant Uptake threshold exceedances of Benzo(a)anthracene (21mg/kg to S4UL threshold of 7.2mg/kg); Benzo(a)pyrene (27mg/kg to C4SL threshold of 3.2mg/kg and S4UL threshold of 2.2mg/kg); Benzo(b)fluoranthene (34mg/kg to S4UL threshold of 2.2mg/kg); Chrysene (22mg/kg to S4UL threshold of 15mg/kg); Dibenzo(a,h)anthracene (3.7mg/kg to S4UL threshold of 0.24mg/kg); and Indeno(1,2,3-cd)pyrene (18mg/kg to S4UL threshold of 2.3mg/kg).

All non-metal exceedances were noted at TP1, which is located approximately 80m east of the site building and outside of the site curtilage area, toward the former sewage works area. The former sewage works circular pits noted east of site are known to be concreted lined and filled with an inert, gravel sized material.

8.3 ANALYSIS OF RESULTS

TABLE 1 SUMMARY OF SIGNIFICANT POLLUTION LINKAGES

Contaminant	Pathway	Receptor	Probability of Pollutant Linkage	Consequence	Risk	Possible Mitigation
Contaminated Soils	Direct Ingestion & Direct Contact	Site Workers	Li	Md	M	Site workers to wear appropriate PPE for health and safety reasons, considered usage would mitigate this risk to **LOW**.
Contaminated Soils	Inhalation of Dust	Site Workers	Li	Md	M	
Contaminated Soils	Direct Ingestion & Direct Contact	End Users	Ul	Md	L	No exceedances noted within site boundaries, no soft landscaping proposed, site will be covered in hard standing. Site soils have low leaching potential and soils have ability to attenuate diffuse pollutants. Utility piping already installed along access road, witnessed by Severn Trent Water. Dust inhalation from PAH area located 80m east very unlikely due to gravel sized nature of medium and vegetated topsoil.
Contaminated Soils	Inhalation of Dust	End Users	Ul	Md	L	
Contaminated Soils	Direct Ingestion	Flora and Fauna	Ul	Md	L	
Contaminated Soils	Vertical and lateral migration	Controlled Waters	Ul	Md	L	
Contaminated Soils	Direct contact	Services	Ul	Md	L	
Ground Gases (Methane and CO_2)	Vertical and lateral migration	End Users & Building Envelope	Li	Md	M	A nearby former sewage works has the potential to be producing ground gases, therefore installation of ground gas protection measures as below.
Volatile and Semi-volatile Organic Compounds	Vertical and lateral migration	End Users & Building Envelope	Li	Md	M	PAH's have been identified in proximity to site, therefore Installation of ground gas protection measures inline with BS8485:2015 inline with characteristic situation 2.
Radon	Vertical and lateral migration	End Users & Building Envelope	Ul	Md	L	The property is not in a Radon Affected Area. No radon protective measures are necessary.

KEY: Probability of pollutant linkage Hi = Highly likely, Li = Likely, Lw = Low Likelihood, Ul = Unlikely

Consequence Sv = Severe, Md = Medium, Mi = Mild, Mr = Minor,

Overall Risk VH = Very High, H = High, M = Moderate, M/L = Moderate/Low, L = Low, VL = Very Low

Based on the preliminary CSM for the site, an environmental risk assessment has been undertaken. A simple matrix can provide a consistent basis for decision making. It should be used with caution, recognising the over-simplification that it will normally represent. The probability and consequences are defined according to parameters relevant to the situation; the boundaries of risk acceptability (and tolerability, where relevant) indicated on the matrix provided in Table 2, can be tailored to the factors influencing the significance of the risk. Individual situations are mapped onto the matrix to provide a ready and consistent indication of their acceptability or tolerability.

TABLE 2 RISK CLASSIFICATION MATRIX

		Consequence			
		Severe (Sv)	Medium (Md)	Mild (Mi)	Minor (Mr)
Probability	High (Hi)	Very high risk	High risk	Moderate Risk	Moderate/ Low Risk
	Likely (Li)	High risk	Moderate Risk	Moderate/ Low Risk	Low Risk
	Low Likelihood (Lw)	Moderate Risk	Moderate/ Low Risk	Low Risk	Very Low Risk
	Unlikely (Ul)	Moderate/ Low Risk	Low Risk	Very Low Risk	Very Low Risk

Source: CIRIA Report C552, Contaminated Land Risk Assessment. A Guide to Good Practice, 2001

These attributes are evaluated qualitatively against individual hazard assessments to determine the likelihood of a given hazard occurring. The risk evaluations for each plausible pollutant linkage are given in the last three columns of Table 1.

TABLE 3 CLASSIFICATION OF RISK

Very high risk (Vh)	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required.
High risk (Hi)	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short-term and are likely over the longer term.

Moderate risk (Md)	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer-term.
Low risk (Lw)	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very low risk (Vl)	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.

Source: CIRIA Report C552, Contaminated Land Risk Assessment. A Guide to Good Practice, 2001

9.0 REVISED ENVIRONMENTAL RISK ASSESSMENT

Based on the information contained in this report, it is the opinion of Castledine & Co that the site represents a **LOW** to **MODERATE** risk with respect to the proposed development.

The site is to be covered in hard standing with areas of contaminant exceedances located outside the site curtilage area. No exceedances were noted within the curtilage area. Area of exceedances is vegetated, former sewage works features have been cleaned, are concrete lined and filled with a large, inert gravel medium. Dust formation, migration and inhalation very unlikely due to these factors. Therefore it is envisaged no further testing would be required, with a recommendation that:

Remediation in-line with section 11.0 is undertaken involving the placement of hardstanding and installation of ground gas protection measures inline with BS8485:2015 and inline with characteristic situation 2.

It is recommended that the Buildings on site should be subject to an asbestos survey and removal by appropriately qualified personal prior to any demolition or redevelopment occurring in order to ensure site works do not cause future contamination of the site.

10.0 FURTHER ENVIRONMENTAL INVESTIGATION

It is not envisaged that further testing will be required.

The findings of this report should be discussed with the Local Planning Authority / Local Council Contaminated Land Officer prior to submission to planning as inline with section 5.2.4 of BS10175 so that a Phase 3 remediation scheme and verification plan can be drafted.

11.0 PROPOSED REMEDIAL ACTIONS AND VERIFICATION

1. No soft landscaping is proposed, should soft landscaping areas be proposed then these areas should be excavated to a depth of 600mm. The excavated material can be encapsulated below buildings and hard- landscaping or removed from site to an appropriately licensed facility. Additionally a 300mm 'No Dig Layer' of crushed stone, brick, concrete or other inert subbase atop a hi-visibility geo-membrane and finishing with a permeable surface could in installed, to prevent any potential future pathway linkages;
2. PAH's have been identified within soils at the location of TP1, as such the installation of ground gas protection measures inline with BS8485:2015 inline with characteristic situation 2 should be undertaken, alternatively, ground gas monitoring could be carried out and this may negate the need for protection measures. Inhalation of dust particles very unlikely due to vegetation coverage, gravel sized inert backfill medium, concrete lining of the features and distance to site;
3. A watching brief inline with Appendix E should be had during the course of any permitted demolition, site clearance, or construction works for any obvious contamination (e.g. oil spillage in ground, buried waste, possible asbestos containing material) development should stop and Castledine & Co should be contact to determine if further assessment or changes to the remediation scheme are required.

4. These works will require verification. Once the excavations have taken place this should be photographed. If the material is to be encapsulated on site a plan and photographs of where is encapsulated should be made. If it is removed from site a copy of the transfer notes and permit for the site accepting the material should be made. Photos of the placement of the 600mm cover system should be made during its placement or the placement of hard standing. If imported material is used copies of the testing certificates will be required.

The findings of this report should be discussed with the Local Planning Authority / Local Council Contaminated Land Officer prior to submission to planning as inline with section 5.2.4 of BS10175 so that a Phase 3 remediation scheme and verification plan can be drafted.

12.0 REFERENCES

12.1 LEGISLATION AND REGULATIONS

12.1.1 ACTS

[1]. Environmental Protection Act 1990, Part IIA: inserted by Environment Act 1995, Section 57. See Environment Act 1995 for text of Part IIA.

12.1.2 PLANNING REGULATIONS

[2]. The Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999 SI1999/No.293

[3]. The Town and Country Planning (Environmental Impact Assessment) (England and Wales) (Amendment) Regulations 2000 SI2000/No.2867

12.1.3 CONTAMINATED LAND REGULATIONS

[4]. The Contaminated Land (England) Regulations 2000. SI2000/No.227

[5]. The Contaminated Land (England) (Amendment) Regulations 2001 SI2001/No.663

[6]. The Contaminated Land (England) Regulations 2006 SI2006/No.1380

12.2 STATUTORY GUIDANCE

[7]. Department of Environment, Food and Rural Affairs. 2012. *Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance.* Department of Environment, Food and Rural Affairs

[8]. Communities and local Government, 2012: National Planning Policy Framework.

12.3 BRITISH STANDARDS

[9]. BS 5930:2015 Code of practice for site investigations

[10]. BS 10175:2011+A2:2017 Investigation of potentially contaminated sites - Code of practice

[11]. BS 8485:2015+A1:2019 BS 8485 - 2015 - Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings

[12]. BS 8576:2013 Guidance on investigations for ground gas. Permanent gases and Volatile Organic Compounds (VOCs)

12.4 NON STATUTORY TECHNICAL GUIDANCE

12.4.1 ENVIRONMENT AGENCY

[13]. Cassella Stranger, 2002. Model Procedures for the Management of Contaminated Land, Contaminated Land Report (CLR) 11, Department for Environment, Food, and Rural Affairs.

12.4.2 CIRIA PUBLICATIONS

[14]. Wilson, S., Oliver, S., Mallett, H., Hutchings, H., and Card, G.. 2007, *C 665 Assessing risks posed by hazardous ground gases to buildings* London: Construction Industry Research and Information Association

12.4.3 CL:AIRE

[15]. Card G, Wilson S, Mortimer S. 2012. *A Pragmatic Approach to Ground Gas Risk Assessment. CL:AIRE Research Bulletin RB17*. CL:AIRE, London, UK. ISSN 2047- 6450 (Online)

13.0 APPENDICES

APPENDIX A PHASE 1 REPORT

APPENDIX B **SITE PLAN INCLUDING TRIAL PIT LOCATIONS**



APPENDIX C TEST RESULTS

APPENDIX D GENERIC ACCEPTANCE CRITERIA

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Contaminant	Source of GAC	Human Health Generic Assessment Criteria (mg/kg)																	
		residential without plant uptake (1%SOM)	residential without plant uptake (2.5%SOM)	residential without plant uptake (6%SOM)	residential with plant uptake (1%SOM)	residential with plant uptake (2.5%SOM)	residential with plant uptake (6%SOM)	allotments (1%SOM)	allotments (2.5%SOM)	allotments (6%SOM)	commercial (1%SOM)	commercial (2.5%SOM)	commercial (6%SOM)	POSresi (1%SOM)	POSresi (2.5%SOM)	POSresi (6%SOM)	POSpark (1%SOM)	POSpark (2.5%SOM)	POSpark (6%SOM)
Default Suite																			
Arsenic	C4SL			40			37			49			640			79			170
Beryllium	S4UL			1.7			1.7			35			12			2.2			63
Boron	S4UL			290			11000			45			240000			21000			46000
Cadmium	C4SL			22			150			3.9			410			220			880
Chromium (III)	S4UL			910			910			18000			8600			1500			33000
Chromium (VI)	C4SL			21			21			170			49			21			250
Copper	S4UL			2400			7100			520			68000			12000			44000
Lead	C4SL			310			200			80			2330			630			1300
Mercury Elemental	S4UL			1.2			1.2			21			58 VAP (25.8)			16			30 VAP (25.8)
Mercury inorganic	S4UL			40			56			19			1100			120			240
Mercury methyl	S4UL			11			19			6			320			40			68
Nickel	S4UL			180			180			230			980			230			3400
Selenium	S4UL			250			430			88			12000			1100			1800
Vanadium	S4UL			410			1200			91			9000			2000			5000
Zinc	S4UL			3700			40000			620			730000			81000			170000
Phenol	S4UL	280	550	1100	750	1300	2300	66	140	280	760 DIR (31000)	1500 DIR (35000)	3200 DIR (37000)	760 DIR (11000)	1500 DIR (11000)	3200 DIR (11000)	760 DIR (8600)	1500 DIR (9700)	3200 DIR (11000)
Acenaphthene	S4UL	3000 SOL (57)	4700 SOL (141)	6000 SOL (336)	210	510	1100	34	85	200	84000 SOL (57.0)	97000 SOL (141)	100000	15000	15000	15000	29000	30000	30000
Acenaphthylene	S4UL	2900 SOL (86.1)	4600 SOL (212)	6000 SOL (506)	170	420	920	28	69	160	83000 SOL (86.1)	97000 SOL (212)	100000	15000	15000	15000	29000	30000	30000

Contaminant	Source of GAC	Human Health Generic Assessment Criteria (mg/kg)																	
		residential without plant uptake (1%SOM)	residential without plant uptake (2.5%SOM)	residential without plant uptake (6%SOM)	residential with plant uptake (1%SOM)	residential with plant uptake (2.5%SOM)	residential with plant uptake (6%SOM)	allotments (1%SOM)	allotments (2.5%SOM)	allotments (6%SOM)	commercial (1%SOM)	commercial (2.5%SOM)	commercial (6%SOM)	POSresi (1%SOM)	POSresi (2.5%SOM)	POSresi (6%SOM)	POSpark (1%SOM)	POSpark (2.5%SOM)	POSpark (6%SOM)
Anthracene	S4UL	31000 VAP (1.17)	35000	37000	2400	5400	11000	380	950	2200	520000	540000	540000	74000	74000	74000	150000	150000	150000
Benz(a)anthracene	S4UL	11	14	15	7.2	11	13	2.9	6.5	13	170	170	180	29	29	29	49	56	62
Benzo(a)pyrene	S4SL	3.2	3.2	3.2	2.2	2.7	3.0	0.97	2.0	3.5	35	35	36	5.7	5.7	5.7	11	12	13
Benzo(b)fluoranthene	S4UL	3.9	4.0	4.0	2.6	3.3	3.7	0.99	2.1	3.9	44	44	45	7.1	7.2	7.2	13	15	16
Benzo(ghi)perylene	S4UL	360	360	360	320	340	350	290	470	640	3900	4000	4000	640	640	640	1400	1500	1600
Benzo(k)fluoranthene	S4UL	110	110	110	77	93	100	37	75	130	1200	1200	1200	190	190	190	370	410	440
Chrysene	S4UL	30	31	32	15	22	27	4.1	9.4	19	350	350	350	57	57	57	93	110	120
Dibenz(ah)anthracene	S4UL	0.31	0.32	0.32	0.24	0.28	0.3	0.14	0.27	0.43	3.5	3.6	3.6	0.57	0.57	0.58	1.1	1.3	1.4
Fluoranthene	S4UL	1500	1600	1600	280	560	890	52	130	290	23000	23000	23000	3100	3100	3100	6300	6300	6400
Fluorene	S4UL	2800 SOL (30.9)	3800 SOL (76.5)	4500 SOL (183)	170	400	860	27	67	160	63000 SOL (30.9)	68000	71000	9900	9900	9900	20000	20000	20000
Indeno(123cd)pyrene	S4UL	45	46	46	27	36	41	9.5	21	39	500	510	510	82	82	82	150	170	180
Naphthalene	S4UL	2.3	5.6	13	2.3	5.6	13	4.1	10	24	190 SOL (76.4)	460 SOL (183)	1100 SOL (432)	4900	4900	4900	1200 SOL (76.4)	1900 SOL (183)	3000
Phenanthrene	S4UL	1300 SOL (36)	1500	1500	95	220	440	15	38	90	22000	22000	23000	3100	3100	3100	6200	6200	6300
Pyrene	S4UL	3700	3800	3800	620	1200	2000	110	270	620	54000	54000	54000	7400	7400	7400	15000	15000	15000
TPH fractions																			
TPH ali EC05-EC06	S4UL	42	78	160	42	78	160	730	1700	3900	3200 SOL (304)	5900 SOL (558)	12000 SOL (1150)	570000 SOL (304)	590000	600000	95000 SOL (304)	130000 SOL (558)	180000 SOL (1150)
TPH ali >EC06-EC08	S4UL	100	230	530	100	230	530	2300	5600	13000	7800 SOL (144)	17000 SOL (322)	40000 SOL (736)	600000	610000	620000	150000 SOL (144)	220000 SOL (322)	320000 SOL (736)
TPH ali >EC08-EC10	S4UL	27	65	150	27	65	150	320	770	1700	2000 SOL (78)	4800 VAP (190)	11000 VAP (451)	13000	13000	13000	14000 SOL (78)	18000 VAP (190)	21000 VAP (451)

Contaminant	Source of GAC	Human Health Generic Assessment Criteria (mg/kg)																
		residential without plant uptake (1%SOM)	residential without plant uptake (2.5%SOM)	residential without plant uptake (6%SOM)	residential with plant uptake (1%SOM)	residential with plant uptake (2.5%SOM)	residential with plant uptake (6%SOM)	allotments (1%SOM)	allotments (2.5%SOM)	allotments (6%SOM)	commercial (1%SOM)	commercial (2.5%SOM)	commercial (6%SOM)	POSresi (1%SOM)	POSresi (2.5%SOM)	POSresi (6%SOM)	POSpark (1%SOM)	POSpark (2.5%SOM)	POSpark (6%SOM)
TPH ali >EC10-EC12	S4UL	130 VAP (48)	330 VAP (118)	770 VAP (283)	130 VAP (48)	330 VAP (118)	760 VAP (283)	2200	4400	7300	9700 SOL (48)	23000 VAP (118)	47000 VAP (283)	13000	13000	13000	21000 SOL (48)	23000 VAP (118)	24000 VAP (283)
TPH ali >EC12-EC16	S4UL	1100 SOL (24)	2400 SOL (59)	4400 SOL (142)	110 SOL (24)	2400 SOL (59)	4300 SOL (142)	11000	13000	13000	59000 SOL (24)	82000 SOL (59)	90000 SOL (142)	13000	13000	13000	25000 SOL (24)	25000 SOL (59)	26000 SOL (142)
TPH ali >EC16-EC35	S4UL	65000 SOL (8.48)	92000 SOL (21)	110000	65000 SOL (8.4)	92000 SOL (21)	110000	260000	270000	270000	1600000	1700000	1800000	250000	250000	250000	450000	480000	490000
TPH ali >EC35-EC44	S4UL	65000 SOL (8.48)	92000 SOL (21)	110000	65000 SOL (8.48)	92000 SOL (21)	110000	260000	270000	270000	1600000	1700000	1800000	250000	250000	250000	450000	480000	490000
TPH aro EC05-EC07	S4UL	370	690	1400	70	140	300	13	27	57	26000 SOL (1220)	46000 SOL (2260)	86000 SOL (4710)	56000	56000	56000	76000 SOL (1220)	84000 SOL (2260)	92000 SOL (4710)
TPH aro >EC07-EC08	S4UL	860	1800	3900	130	290	660	22	51	120	56000 VAP (869)	110000 SOL (1920)	180000 VAP (4360)	56000	56000	56000	87000 VAP (869)	95000 SOL (1920)	100000 VAP (4360)
TPH aro >EC08-EC10	S4UL	47	110	270	34	83	190	8.6	21	51	3500 VAP (613)	8100 VAP (1500)	17000 VAP (3580)	5000	5000	5000	7200 VAP (613)	8500 VAP (1500)	9300 VAP (3580)
TPH aro >EC10-EC12	S4UL	250	590	1200	74	180	380	13	31	74	16000 SOL (364)	28000 SOL (899)	34000 SOL (2150)	5000	5000	5000	9200 SOL (364)	9700 SOL (899)	10000
TPH aro >EC12-EC16	S4UL	1800	2300 SOL (419)	2500	140	330	660	23	57	130	36000 SOL (169)	37000	38000	5100	5100	5000	10000	10000	10000
TPH aro >EC16-EC21	S4UL	1900	1900	1900	260	540	930	46	110	260	28000	28000	28000	3800	3800	3800	7600	7700	7800
TPH aro >EC21-EC35	S4UL	1900	1900	1900	1100	1500	1700	370	820	1600	28000	28000	28000	3800	3800	3800	7800	7800	7900
TPH aro >EC35-EC44	S4UL	1900	1900	1900	1100	1500	1700	370	820	1600	28000	28000	28000	3800	3800	3800	7800	7800	7900
TPH >EC44-EC70	S4UL	1900	1900	1900	1600	1800	1900	1200	2100	3000	28000	28000	28000	3800	3800	3800	7800	7800	7900
VOCs - BTEX & MTBE																			
Benzene	C4SL			0.87			3.3			0.18			98			140			230

Contaminant	Source of GAC	Human Health Generic Assessment Criteria (mg/kg)																	
		residential without plant uptake (1%SOM)	residential without plant uptake (2.5%SOM)	residential without plant uptake (6%SOM)	residential with plant uptake (1%SOM)	residential with plant uptake (2.5%SOM)	residential with plant uptake (6%SOM)	allotments (1%SOM)	allotments (2.5%SOM)	allotments (6%SOM)	commercial (1%SOM)	commercial (2.5%SOM)	commercial (6%SOM)	POSresi (1%SOM)	POSresi (2.5%SOM)	POSresi (6%SOM)	POSpark (1%SOM)	POSpark (2.5%SOM)	POSpark (6%SOM)
Toluene	S4UL	880 VAP (869)	1900	3900	130	290	660	22	51	120	56000 VAP (869)	110000 VAP (1920)	180000 VAP (4360)	56000	56000	56000	100000 VAP (869)	100000 VAP (192)	100000 VAP (4360)
Ethylbenzene	S4UL	83	190	440	47	110	260	16	39	91	570 VAP (518)	13000 VAP (1220)	27000 VAP (2840)	24000	24000	25000	17000 VAP (518)	22000 VAP (1220)	27000 VAP (2840)
Xylene, o-	S4UL	88	210	480	60	140	330	28	67	160	6600 VAP (478)	15000 SOL (1120)	33000 SOL (2620)	41000	42000	43000	17000 SOL (478)	24000 SOL (1120)	33000 SOL (2620)
Xylene, m-	S4UL	82	190	450	59	140	320	31	74	170	6200 VAP (625)	14000 VAP (1470)	31000 VAP (3460)	41000	42000	43000	17000 VAP (625)	24000 VAP (1470)	32000 VAP (3460)
Xylene, p- (use this for combined m & p)	S4UL	79	180	430	59	130	310	29	69	160	5900 SOL (576)	14000 SOL (1350)	30000 SOL (3170)	41000	42000	43000	17000 SOL (576)	23000 SOL (2620)	31000 SOL (3170)
VOCs – chlorobenzenes																			
Chlorobenzene	S4UL	0.46	1	2.4	0.46	1	2.4	5.9	14	32	56	130	290	11000	13000	14000	1300 SOL (675)	2000 SOL (1520)	2900
1,2-Dichlorobenzene	S4UL	24	57	130	23	55	130	94	230	540	2000 SOL (571)	4800 SOL (1370)	11000 SOL (3240)	90000	95000	98000	24000 SOL (571)	36000 SOL (1370)	51000 SOL (3240
1,3-Dichlorobenzene	S4UL	0.44	1.1	2.5	0.4	1	2.3	0.25	0.6	1.5	30	73	170	300	300	300	390	440	470
1,4-Dichlorobenzene	S4UL	61	150	350	61	150	350	15	37	88	4400 VAP (224)	10000 VAP (540)	2500 VAP (1280)	17000	17000	17000	36000 VAP (224)	36000 VAP (540)	36000 VAP (1280)
Hexachlorobenzene	S4UL	4.1 VAP (0.2)	5.7 VAP (0.5)	6.7 VAP (1.2)	1.8 VAP (0.2)	3.3 VAP (0.5)	4.9	0.47	1.1	2.5	110 VAP (0.2)	120	120	16	16	16	30	30	30
Pentachlorobenzene	S4UL	19	30	38	5.8	12	22	1.2	3.1	7	640 SOL (43)	770 SOL (107)	830	100	100	100	190	190	190
1,2,3-trichlorobenzene	S4UL	1.5	3.7	8.8	1.5	3.6	8.6	4.7	12	28	102	250	590	1800	1800	1800	770 VAP (134)	1100 VAP (330)	1600 VAP (789)
1,2,4-trichlorobenzene	S4UL	2.6	6.4	15	2.6	6.4	15	55	140	320	220	530	1300	15000	17000	19000	1700 VAP (318)	2600 VAP (786)	4000 VAP (1880)

Contaminant	Source of GAC	Human Health Generic Assessment Criteria (mg/kg)																	
		residential without plant uptake (1%SOM)	residential without plant uptake (2.5%SOM)	residential without plant uptake (6%SOM)	residential with plant uptake (1%SOM)	residential with plant uptake (2.5%SOM)	residential with plant uptake (6%SOM)	allotments (1%SOM)	allotments (2.5%SOM)	allotments (6%SOM)	commercial (1%SOM)	commercial (2.5%SOM)	commercial (6%SOM)	POSresi (1%SOM)	POSresi (2.5%SOM)	POSresi (6%SOM)	POSpark (1%SOM)	POSpark (2.5%SOM)	POSpark (6%SOM)
1,3,5-trichlorobenzene	S4UL	0.33	0.81	1.9	0.33	0.81	1.9	4.7	12	28	23	55	130	1700	1700	1800	380 VAP (36.7)	580 VAP (90.8)	860 VAP (217)
1,2,3,4-tetrachlorobenzene	S4UL	24	56	120	15	36	78	4.4	11	26	1700 VAP (122)	3080 VAP (304)	4400 VAP (728)	830	830	830	1500 VAP (122)	1600	1600
1,2,3,5-tetrachlorobenzene	S4UL	0.75	1.9	4.3	0.66	1.6	3.7	0.38	0.90	2.2	49 VAP (39.4)	120 VAP (98.1)	240 VAP (235)	78	79	79	110 VAP (39)	120	130
1,2,4,5-tetrachlorobenzene	S4UL	0.73	1.7	3.5	0.33	0.77	1.6	0.06	0.16	0.37	42 SOL (19.7)	72 SOL (49.1)	96	13	13	13	25	26	26
VOCs - chloroalkanes & alkanes																			
Chloroethene (aka vinyl chloride)	S4UL	0.00077	0.0010	0.0015	0.00064	0.00087	0.0014	0.00055	0.0010	0.0018	0.059	0.077	0.12	3.5	3.5	3.5	4.8	5	5.4
1,2-Dichloroethane	S4UL	0.0092	0.013	0.023	0.0071	0.011	0.019	0.0046	0.0083	0.016	0.67	0.97	1.7	29	29	29	21	24	28
Tetrachloroethene	S4UL	0.18	0.4	0.92	0.18	0.39	0.9	0.65	1.5	3.6	19	42	95	1400	1400	1400	810 SOL (424)	1100 SOL (951)	1500
1,1,1,2-Tetrachloroethane	S4UL	1.5	3.5	8.2	1.2	2.8	6.4	0.79	1.9	4.4	110	250	560	1400	1400	1400	1500	1800	2100
1,1,2,2-Tetrachloroethane	S4UL	3.9	8	17	1.6	3.4	7.5	0.41	0.89	2.0	270	550	1100	1400	1400	1400	1800	2100	2300
Tetrachloromethane	S4UL	0.026	0.056	0.13	0.026	0.056	0.13	0.45	1	2.4	2.9	6.3	14	890	920	950	190	270	400
Trichloroethene	S4UL	0.017	0.036	0.080	0.016	0.034	0.075	0.041	0.091	0.21	1.2	2.6	5.7	120	120	120	70	91	120
1,1,1-Trichloroethane	S4UL	9	18	40	8.8	18	39	48	110	240	660	1300	3000	140000	140000	140000	57000 VAP (1425)	76000 VAP (2915)	100000 VAP (6392)
Trichloromethane	S4UL	1.2	2.1	4.2	0.91	1.7	3.4	0.42	0.83	1.7	99	170	350	2500	2500	2500	2600	2800	3100
Other phenols & chlorophenols																			
Chlorophenols	S4UL	0.87	2	4.5	94	150	210	0.13	0.3	0.7	3500	4000	4300	620	620	620	1100	1100	1100
Pentachlorophenol	S4UL	27 VAP (16.4)	29	31	0.22	0.52	1.2	0.03	0.08	0.19	400	400	400	60	60	60	110	120	120
Pesticides																			
Aldrin	S4UL	7.3	7.4	7.5	5.7	6.6	7.1	3.2	6.1	9.6	170	170	170	18	18	18	30	31	31

Contaminant	Source of GAC	Human Health Generic Assessment Criteria (mg/kg)																	
		residential without plant uptake (1%SOM)	residential without plant uptake (2.5%SOM)	residential without plant uptake (6%SOM)	residential with plant uptake (1%SOM)	residential with plant uptake (2.5%SOM)	residential with plant uptake (6%SOM)	allotments (1%SOM)	allotments (2.5%SOM)	allotments (6%SOM)	commercial (1%SOM)	commercial (2.5%SOM)	commercial (6%SOM)	POSresi (1%SOM)	POSresi (2.5%SOM)	POSresi (6%SOM)	POSpark (1%SOM)	POSpark (2.5%SOM)	POSpark (6%SOM)
Atrazine	S4UL	610	620	620	3.3	7.6	17.4	0.5	1.2	2.7	9300	9400	9400	1200	1200	1200	2300	2400	2400
Dichlovos	S4UL	6.4	6.5	6.6	0.032	0.066	0.14	0.0049	0.010	0.022	140	140	140	16	16	16	26	26	27
Dieldrin	S4UL	7	7.3	7.4	0.97	2	3.5	0.17	0.41	0.96	170	170	170	18	18	18	30	30	31
Endosulfan - alpha	S4UL	160 VAP (0.003)	280 VAP (0.007)	410 VAP (0.016)	7.4	18	41	1.2	2.9	6.8	5600 VAP (0.003)	7400 VAP (0.007)	8400 VAP (0.016)	1200	1200	1200	2400	2400	2500
Endosulfan - beta	S4UL	190 VAP (0.00007)	320 VAP (0.0002)	440 VAP (0.0004)	7	17	39	1.1	2.7	6.4	6300 VAP (0.00007)	7800 VAP (0.0002)	8700	1200	1200	1200	2400	2400	2500
Hexachlorocyclohexanes - alpha (inc. Lindane)	S4UL	6.9	9.2	11	0.23	0.55	1.2	0.035	0.087	0.21	170	180	180	24	24	24	47	48	48
Hexachlorocyclohexanes - beta (inc. Lindane)	S4UL	3.7	3.8	3.8	0.085	0.2	0.46	0.013	0.032	0.077	65	65	65	8.1	8.1	8.1	15	15	16
Hexachlorocyclohexanes - gamma (inc. Lindane)	S4UL	2.9	3.3	3.5	0.06	0.14	0.33	0.0092	0.023	0.054	67	69	70	8.2	8.2	8.2	14	15	15
Explosives																			
HMX	S4UL	6700	6700	6700	5.7	13	26	0.86	1.9	3.9	110000	110000	110000	13000	13000	13000	23000 VAP (0.35)	23000 VAP (0.39)	24000 VAP (0.48)
RDX	S4UL	13000	13000	13000	120	250	540	17	38	85	210000	210000	210000	26000	26000	27000	49000 SOL (18.7)	51000	53000
2,4,6-Trinitrotoluene	S4UL	65	66	66	1.6	3.7	8.1	0.24	0.58	1.4	1000	1000	1000	130	130	130	260	270	270
Other organics																			
Carbon disulphide	S4UL	0.14	0.29	0.62	0.14	0.29	0.62	4.8	10	23	11	22	47	11000	11000	12000	1300	1900	2700
Hexachloro-1,3-butadiene	S4UL	0.29	0.7	1.6	0.32	0.78	1.8	0.25	0.61	1.4	31	66	120	25	25	25	48	50	51

VAP S4UL exceeds vapour saturation limit (presented in brackets)

SOL S4UL exceeds solubility saturation limit (presented in brackets)

DIR S4UL based on treshold protective of direct skin contact (value in brackets based on health effects of long term exposure)

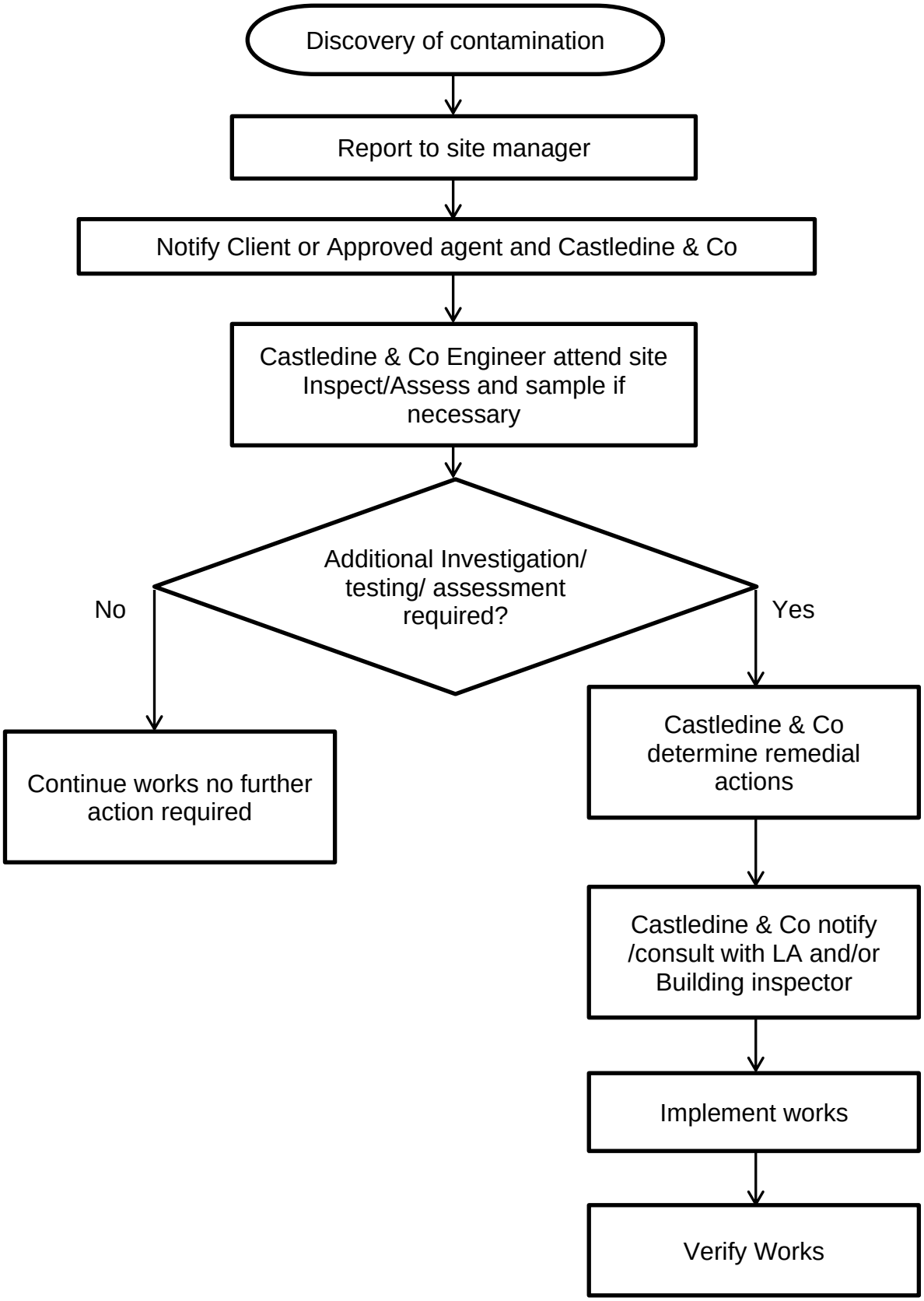
APPENDIX E WATCHING BRIEF

It remains possible that previously unexpected soil conditions may be encountered during the construction process. Examples may include oily pockets within the soil, potential for asbestos containing materials, black ashy materials, soils exhibiting strong odours, brightly coloured materials, and former demolition materials.

Should previously undiscovered contamination be encountered during the demolition/construction of the new buildings the following course of action should be adhered to:

1. The ground workers should report any suspected contamination immediately to the Client's site supervisor. The supervisor should contact the Client or their appointed agent who will in turn contact Castledine & co to request an engineer to visit the site to assess the extent of the 'contamination'.
2. Castledine & co shall make records of their inspection, and pass details of these to the Local Authority.
3. Where the conditions revealed differ from those previously anticipated, the Castledine & co shall take samples as deemed appropriate to be dispatched for appropriate chemical testing.
4. Depending on the results of the testing either:
    a. no further work will be required;
    b. a further detailed risk assessment will be required; and/or
    c. Localised specific remedial measures will be necessary. Appraisal criteria will vary depending on the nature of the assessment.
5. The results of any such testing will be sent to the Local Authority Pollution Control Section, Local Authority development control section, and the appointed building inspector. If remediation is required, the LA/Building inspector will be informed of the date and time of the proposed works.

6. Remediation will be undertaken in accordance with a method statement submitted for approval. The works shall be supervised where necessary by Castledine & co who shall provide a Verification Report for the Local Authorities.
7. A copy of the discovery strategy should be lodged on site and provisions made to ensure that all workers are made aware of their responsibility to observe, report and act on any potentially suspicious or contaminated materials they may encounter.


Discovery of contamination
Report to site manager
Notify Client or Approved agent and Castledine & Co
Castledine & Co Engineer attend site Inspect/Assess and sample if necessary
Additional Investigation/ testing/ assessment required?
No
Yes
Continue works no further action required
Castledine & Co determine remedial actions
Castledine & Co notify /consult with LA and/or Building inspector
Implement works
Verify Works