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Phase 1 Land Contamination Risk Assessment

for

Residential development

on the site of

Lowfield Farm, Lowfield Road, Bolton Upon Dearne, Rotherham S63 8GZ

Date: April 2018

Status:	Final Report
Reference:	1278G P1 White - Rotherham - Appendix
Date:	28/04/2018

EXECUTIVE SUMMARY

The site is currently a mostly cleared site occupied by 1 farm building and a stockpile of demolition rubble

The site has historic agricultural uses and surrounding sites have had potentially contaminative uses. Many historic agricultural practices may have caused contamination to have occurred.

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

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.

It is recommended that a remediation in line with section 11.0 is undertaken.

A watching brief should be had during the course of demolition, site clearance and 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.

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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 Dylan White to undertake a Phase 1 Desk study on Lowfield Farm, Lowfield Road, Bolton Upon Dearne, Rotherham S63 8GZ

4.0 SCOPE

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

- paragraphs 120 and 121 of the NPPF,
- part C1 of the building regulations.

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 preliminary risk assessment in accordance with BS10175:2011+A1:2013 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 on the outskirts of Bolton upon Dearne at National Grid 446094,402622 and is approximately 0.52ha in area.

The site is a former farm yard. There is one agricultural building on site. There is large stockpile of demolition rubble. There are no obvious signs of contamination on site

Photos of the site are present in Appendix C

6.0 REGULATORY AUTHORITY AND OTHER ENVIRONMENTAL DATA

An environmental search listing historical and environmental factors likely to affect the property has been reviewed.

The most pertinent information is summarised in the following sections.

A copy is presented in Appendix A

Additional geological and hydrological data was obtained from the British Geological Survey.

6.1 HYDROLOGICAL

6.1.1 AQUIFER

6.1.1.1 SUPERFICIAL GEOLOGY

No superficial deposits on site

6.1.1.2 BEDROCK GEOLOGY

ID	Distance (m)	Direction	Designation	Description
1	0	On Site	Secondary A	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers

6.1.2 ABSTRACTIONS AND PRIVATE WATER SUPPLIES

None within 250m

6.1.3 SOURCE PROTECTION ZONE

Not in a source protection source

6.1.4 GROUNDWATER VULNERABILITY AND SOIL LEACHING POTENTIAL

Minor Aquifer/Low Leaching Potential L Soils in which pollutants are unlikely to penetrate the soil layer because either water movement is largely horizontal, or they have the ability to attenuate diffuse pollutants.

6.1.5 POTENTIAL SURFACE WATER

Distance (m)	Direction
25	N
156	NE
163	NE
174	NE
188	N
193	E
209	SE
211	N
216	N

6.1.6 DISCHARGE CONSENTS

ID	Distance (m)	Direction	NGR	Description
8	201	SE	446300 402500	Address: SSO AT LOWFIELD ROAD PUMPING STATIO, N, BOLTON ON DEARNE (EMERGENCY O, VERFLOW) Effluent Type: SEWAGE DISCHARGES - PUMPING STATION - WATER COMPANY Permit Number: 3599 Permit Version: 3 Receiving Water: TRIB OF CRANE WELL DIKE Status: MODIFIED - (WRA 91 SCHED 10 – AS AMENDED BY ENV ACT 1995) Issue date: 31/03/2003 Effective Date: 31-Mar-2003 Revocation Date: -

6.2 PERMITTED PROCESSES

ID	Distance (m)	Direction	NGR	Description	
11	88	SW	446002 402513	Address: Process: Status: Permit Type: Enforcement: Date of Enforcement: Comment:	Addspace Furniture Limited, Lowfield Road, Bolton On Dearne, Rotherham, S63 8JE Timber process Historical Permit Part B No Enforcements Notified No Enforcements Notified No Enforcements Notified
12	233	W	445820 402534	Address: Process: Status: Permit Type: Enforcement: Date of Enforcement: Comment:	Coltran Ltd, Lowfield Rd, Bolton Upon Dearne, Rotherham, S63 8JT timber process Historical Permit Part B No Enforcements Notified No Enforcements Notified No Enforcements Notified

6.3 POLLUTION INCIDENTS

ID	Distance (m)	Direction	NGR	Description	
1	27	S	446094 402553	Incident Date: Incident Identification: Pollutant: Pollutant Description: Water Impact: Land Impact: Air Impact:	30-Aug-2002 104291 Atmospheric Pollutants and Effects Smoke Category 4 (No Impact) Category 4 (No Impact) Category 3 (Minor)

6.4 RADIOACTIVE SUBSTANCES REGISTRATIONS

None within 250m.

6.5 WASTE

6.5.1 LICENSED WASTE MANAGEMENT FACILITIES (LOCATIONS)

None within 250m

6.5.2 LANDFILL SITES

None within 250m

6.5.3 REGISTERED WASTE TREATMENT OR DISPOSAL SITES

None within 250m

6.6 HAZARDOUS SUBSTANCES

None within 250m

6.7 ECOLOGICAL RECEPTORS

None within 250m

6.8 SOILS AND GEOLOGY

"Contains British Geological Survey materials © NERC 2018" obtained from http://www.bgs.ac.uk/data/mapViewers/home.html under the Open Government Licence

6.8.1 SUPERFICIAL DEPOSITS

No superficial geology data

6.8.2 BEDROCK

Mexborough Rock - Sandstone. Sedimentary Bedrock formed approximately 310 to 315 million years ago in the Carboniferous Period. Local environment previously dominated by rivers.

Pennine Middle Coal Measures Formation - Mudstone, Siltstone And Sandstone. Sedimentary Bedrock formed approximately 310 to 318 million years ago in the Carboniferous Period. Local environment previously dominated by swamps, estuaries and deltas.

6.8.3 COAL MINING

The property is in a surface area that could be affected by underground mining in 5 seams of coal at 220m to 680m depth, and last worked in 1980. Any movement in the ground due to coal mining activity should have stopped

The property is not within a surface area that could be affected by present underground mining

There are no known coal mine entries within, or within 20 metres of, the boundary of the property.

6.8.4 NON-COAL MINING

No non-coal mining areas within 50m

6.8.5 RADON

The site is in a Radon Affected Area, as between 1 and 3% of properties are above the Action Level. No radon protective measures are necessary as described in publication BR211:2015 by the Building Research Establishment

6.9 AERIAL PHOTOGRAPHY

Aerial photography shows the following

6.9.1 BING

Site is a farm occupied by several buildings.

6.9.2 GOOGLE MAPS

Site is a farm occupied by several buildings.

6.9.3 GOOGLE EARTH

5 images are held in the historic imagery dataset, as follows:

Date	Description
2002	Site is a farm occupied by several buildings .
2003	Site is a farm occupied by several buildings .
21/9/2008	Site is a farm occupied by several buildings
2009	Site is a farm occupied by several buildings
18/06/2017	Site is a farm occupied by several buildings

6.9.4 ENVIRONMENTAL SEARCH

Image taken 07/06/2013

Site is a farm occupied by several buildings

6.10 GOOGLE STREET VIEW

There is one set of images for the site available the site consists of a farm house and several farm buildings. No additional information can be discerned

6.11 HISTORIC MAPPING

The following historic maps have been reviewed as part of this assessment. Castledine and Co. do not hold a license for the reproduction and/or distribution of this data.

Map	Onsite	Offsite
OS County Series: YORKSHIRE (partial) 1854-1855 1:10,560	Site is an agricultural field	Site is surrounded by agricultural fields
OS County Series: YORKSHIRE 1892 1:2,500	No discernable change	No discernable change
OS County Series: YORKSHIRE (partial) 1893-1894 1:10,560	No discernable change	No discernable change
OS County Series: YORKSHIRE 1903 1:2,500	No discernable change	No discernable change
OS County Series: YORKSHIRE (partial) 1905-1906 1:10,560	No discernable change	No discernable change

Map	Onsite	Offsite
OS County Series: YORKSHIRE 1930 1:2,500	Some buildings have been erected on site	Allotments are shown to the west
OS County Series: YORKSHIRE (partial) 1938 1:10,560	No discernable change	No discernable change
OS Plan 1956 1:10,560	No discernable change	No discernable change
OS Plan 1962 1:2,500	Additional buildings are shown onsite	No discernable change
OS Plan 1966-1967 1:10,560	No discernable change	No discernable change
OS Plan (partial) 1972 1:2,500	No discernable change	No discernable change
OS Plan 1976-1980 1:10,000	No discernable change	No discernable change
OS Plan 1988-1989 1:10,000	No discernable change	No discernable change

6.12 CURRENT LAND USE DATA

ID	Distance [m]	Direction	Company	Activity	Category
1	200	SE	Water Pumping Station	Water Pumping Stations	Industrial Features

6.13 PETROL AND FUEL SITES

None within 250m

6.14 HISTORICAL PETROL AND FUEL SITE DATABASE

None within 250m

6.15 POTENTIAL CONTAMINATIVE LAND USES IDENTIFIED ON MAPPING

ID	Distance [m]	Direction	Use	Date
1A	111	W	Unspecified Factory	1974
2A	111	W	Unspecified Factory	1986

6.16 HISTORICAL TANK DATABASE

None within 250m

6.17 HISTORICAL ENERGY FACILITIES

None within 250m

6.18 HISTORICAL GARAGE AND MOTOR VEHICLE REPAIR DATABASE

None within 250m

6.19 POTENTIALLY INFILLED LAND

None within 250m

7.0 POLLUTANT LINKAGE ASSESSMENT

The risk posed by any contaminants in soil or groundwater will depend on the nature of the hazard, the probability of exposure, the pathway by which exposure occurs, and the likely effects on the receptors. A contaminant is defined as a substance that has the potential to cause harm, while a risk is considered to exist if such a substance is present in sufficient concentration to cause harm and a pathway exists for a receptor to be exposed to the substance.

The following sections discuss all the identified potential on and off site sources, pathways and receptors in the context of the proposed development and plausible pollutant linkages which may represent a risk to identified receptors from the data gained from the desk study. At this stage the assessment is qualitative and aimed to determine all pollutant linkages, irrespective of significance or allowing for uncertainty.

Three impact potentials exist for any given site, these are:

- The site impacting upon itself;
- The site impacting on its surroundings; and
- The surroundings impacting on the site.

All three impacts need to be considered in a risk assessment.

7.1 SOURCES

The following potential sources of contamination have been identified.

7.1.1 ONSITE

- agricultural use of the site
- Unknown use of the buildings

7.1.2 OFFSITE

- Allotments
- Unknown works

7.2 PATHWAYS

A pathway is defined as a mechanism or route by which a contaminant comes into contact with, or otherwise affects a receptor. Pathways by which the identified receptors may be impacted upon in the context of the proposed development are identified as follows:

- Ingestion;
- Skin contact;
- Inhalation;
- Plant uptake,
- Direct contact by buried structures;
- Leaching of soluble contamination into groundwater

7.3 RECEPTORS

Receptors are defined as people, living organisms, ecological systems, controlled waters, atmosphere, structures and utilities that could be adversely affected by contaminant(s).

- Human Health
    - Current users of the site;
    - Future users of the site;
    - Users of neighbouring sites;

  - Construction workers; and
  - Services personnel working in trenches.
  - Construction Materials
- Buried concrete, which may be affected by high concentrations of sulphate and/or low pH, in the soils and groundwater underlying the site; and
- Buried water pipes.
- Controlled Waters
- Ecological Receptors
- Flora and fauna using the proposed development

8.0 CONCEPTUAL SITE MODEL

The Conceptual Site Model (CSM) is a hypothesis of the nature and sources of contamination, potential receptors that may be the recipient of contamination arising from those sources and any pathways that may exist. It creates a plausible source-pathway-receptor pollutant linkage (hazard), set within the context of the ground and proposed end use of the site.

8.1 PRELIMINARY CONCEPTUAL SITE MODEL

8.1.1 SOIL CONTAMINATION

Site is currently a cleared site with a demolition rubble stock pile formerly used as a farm

Historic agricultural practices and have the potential to have contaminated the site with various substances including

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

There is a requirement to raise ground level across the site.

8.1.2 HAZARDOUS GROUND GAS AND VAPOURS

There are no significant sources of ground gas in the vicinity of the site

As such the protection offered by modern building regulations compliant floor is likely to provide sufficient protection as outlined in CL:AIRE RB17 A Pragmatic Approach to Ground Gas Risk Assessment.

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	Lw	Md	M/L	Site workers to wear appropriate PPE for health and safety reasons
Contaminated Soils	Inhalation of Dust	Site Workers	Lw	Md	M/L	
Contaminated Soils	Direct Ingestion & Direct Contact	End Users	Lw	Md	M/L	
Contaminated Soils	Inhalation of Dust	End Users	Lw	Md	M/L	
Contaminated Soils	Direct Ingestion	Flora and Fauna	Lw	Md	M/L	
Contaminated Soils	Vertical and lateral migration	Controlled Waters	Lw	Md	M/L	
Contaminated Soils	Direct contact	Services	Lw	Md	M/L	
Ground Gases (Methane and CO_2)	Vertical and lateral migration	End Users & Building Envelope	Ul	Md	L	
Volatile and Semi-volatile Organic Compounds	Vertical and lateral migration	End Users & Building Envelope	Lw	Md	M/L	
Radon	Vertical and lateral migration	End Users & Building Envelope	Ul	Md	L	

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 PRELIMINARY ENVIRONMENTAL RISK ASSESSMENT

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

It is recommended that remediation in-line with section 11.0 is undertaken

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.

This should be Discussed with the Local Planning Authority / Local council Contaminated Land Officer

10.0 FURTHER ENVIRONMENTAL INVESTIGATION

It is not envisaged that further testing will be required.

This should be Discussed with the Local Planning Authority / Local council Contaminated Land Officer

11.0 REMEDIAL ACTIONS AND VERIFICATION

1. There is a requirement for the raising of ground levels across the site therefor the Capping of soft-landscaping areas with a minimum of 600mm of clean material. Prior to the placement of material it should be tested in line with Guidance And Good Practice Verification Of Cover Systems – Testing Criteria For Subsoil And Topsoil, page 10, NHBC Technical Extra Note Issue 8 Nov 2012. (http://www.nhbc.co.uk/NHBCPublications/LiteratureLibrary/Technical/TechnicalExtra/filedownload,48980,en.pdf). The chemical testing criteria are presented in Appendix D.
   The suitability of the soil should be confirmed with the **Local Planning Authority** prior to its importation.
   All transfer notes and/or receipts for the soil should be retained.
   The thickness of the soil placed will require evidence either via photographs during its placement or by digging of post placement verification trial holes
2. A watching brief should be had during the course of demolition, site clearance and 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.

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 5930:1999 Code of practice for site investigations

[10] BS 10175:2011+A1:2013 Investigation of potentially contaminated sites - Code of practice

[11] BS 8485:2015 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

[15] Mallett, H., Cox, L., Wilson, S. and ,Corban M... 2014, *C 735 Good practice on the testing and verification of protection systems for buildings against hazardous ground gases* London: Construction Industry Research and Information Association

12.4.3 CL:AIRE

[16] 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 ENVIRONMENTAL SEARCH

APPENDIX B PROPOSED AND CURRENT SITE PLANS

APPENDIX C SITE PHOTOS AND LOCATIONS


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FARM CLOSE
Lowfield

1.

2.

3.

4.

5.

6.

7.

8.

APPENDIX D SOIL SCREENING CRITERIA

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 COAL REPORT