

JAMES STREET NORTH RADCLIFFE

FINAL PHASE 2 GEO-ENVIRONMENTAL INVESTIGATION, RISK ASSESSMENT AND REMEDIATION STRATEGY

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CONTENTS

1	Introduction	1
1.1	Background.....	1
1.2	Site Details.....	1
2	Previous Work	2
2.1	Summary of Existing Information.....	2
2.2	Site History.....	2
2.3	Environmental Setting	3
2.4	Site Reconnaissance.....	4
2.5	Contamination Sources / Pathways and Receptors.....	4
2.6	LKC Preliminary Contamination Conceptual Model	6
2.7	Recommendations	7
3	Ground Investigation	9
3.1	Site Investigation Design and Methodology.....	9
3.2	Well Installations	9
3.3	Sampling Protocol.....	9
3.4	Gas Monitoring.....	10
3.5	Site Investigation Scope.....	10
3.6	Geotechnical Testing.....	11
4	Ground Conditions.....	12
4.1	Geology – Generalised Sequence.....	12
4.2	Groundwater	12
4.3	In-Situ Geotechnical Testing	13
4.4	Geotechnical Laboratory Testing.....	14
5	Geotechnical Assessment.....	15
5.1	Proposed Development.....	15
5.2	Summary of Ground Conditions	15
5.3	Site Preparation	15
5.4	Foundation Conditions and Bearing Capacity.....	16
5.5	Ground Floor Slabs	17
5.6	Concrete Durability.....	17
5.7	Excavations.....	17
5.8	Construction Activity and Inspection.....	17
6	Generic Risk Assessment	18
6.1	Introduction	18
6.2	Soil Risk Assessment.....	18

6.3	Gas Risk Assessment	21
6.4	Controlled Water Assessment	23
6.5	Additional Risk Assessments	23
6.6	Revised Contamination Conceptual Model.....	24
7	Waste Disposal Assessment.....	27
8	Conclusions.....	28
8.1	Geotechnical	28
8.2	Contamination Assessment.....	28
9	Recommendations and Remedial Strategy	30
9.1	Remediation and Validation Recommendations	30
9.2	Validation of Subsoil / Topsoil	31
9.3	Site Completion Report	32

FIGURES

Figure 1: Site Location and Boundary Plan

Figure 2: Site Investigation Location Plan

APPENDICES

Appendix A:	Risk Matrix
Appendix B:	Profile Logs
Appendix C:	Certificate of Analysis - Soil
Appendix D:	Certificate of Analysis - Geotechnical
Appendix E:	Gas Monitoring Results
Appendix F:	Generic Assessment Criteria Values
Appendix G:	HazWaste Online Output Sheet

1 Introduction

1.1 Background

LK Consult Ltd (LKC) has been commissioned by MaiRose Property Development Ltd to carry out a Phase 2 Geo-Environmental Investigation, Risk Assessment and Remediation Strategy for James Street North, Radcliffe. The investigation was undertaken in support of a future planning application for residential use.

The following work has previously been undertaken:

- » Preliminary Risk Assessment (PRA) report, undertaken by LKC (Ref: LKC 20 1984, dated January 2021).

This investigation has been undertaken to confirm the ground conditions below the site and to allow a contamination and geotechnical assessment to be undertaken.

The investigation will aim to confirm the risks of the potential pollutant linkages identified in the PRA and recommend further assessment / remediation, as required.

The aims of this report are also to establish the feasibility of developing this site, to demonstrate to the Local Planning Authority that in accordance with the National Planning Policy Framework (NPPF)¹ the site may be developed for a residential end use and that appropriate site investigation and risk assessment works are in place to allow conditional approval of any future planning application.

1.2 Site Details

A summary of the site details is presented in Table 1-1. Figure 1 indicates the site location and boundary.

Location	North east end of James Street, and southwest end of James Street North, Radcliffe, Greater Manchester. Centred at approximate National Grid Reference 378640E 406660N.
Area	200m ² .
Topography	Approximately 78 metres Above Ordnance Datum (AOD). Site is general uneven and slightly higher than the road to the west. Land adjacent to the west slopes down the north west.
Land Use	Site Vacant site covered by overgrown vegetation. <u>Surrounding Area</u> The surrounding area comprises residential properties to the east and south, with vacant land to the north, and industrial / commercial properties to the west and south.
Proposed Development	It is understood that the development will include residential housing with soft landscaping / gardens. However, no proposed development plan has been provided at this stage.

Table 1-1. Summary of site details.

¹ DCL (2018). "National Planning Policy Framework." Department of Communities and Local Government.

2 Previous Work

2.1 Summary of Existing Information

A PRA report (Ref: CL-602-LKC 20 1984-01 dated January 2021) has previously been undertaken by LKC and is summarised in Section 2.2-2.6

2.2 Site History

Table 2-1 summarises features on site.

Table 2-2 summarises potentially contaminative land uses within approximately 50m and potentially infilled features within approximate 250m.

Site Features	Location on Site	Dates Present		Comments
		From	To	
Unreferenced Building	N	1972	1992	Small unreferenced building. Use unknown. No longer annotated by 1996 mapping.
Vacant Site	Whole Site	1850 1996	1965 2020	Site vacant between 1850-1965, with development by 1972 mapping. Site vacant again by 1996 mapping with dense vegetation shown on 2000 aerial photograph.

Table 2-1: Summary of site features. Dates based on available historical map editions.

Surrounding Area Features	Distance (m)	Direction	Dates Present		Comments
			From	To	
Reservoir	5	W	1850	1989	Disused by 1988 mapping. No longer annotated by 1992 mapping, potentially infilled feature.
Depot	30	NW	1992	2020	
Blue Mill	35	N	1891	1937	Annotated as 'Bleach and Dye Works'. No longer annotated by 1938 mapping.
Chimney	40	N	1909	1937	Associated with 'Blue Mill'. No longer annotated by 1938 mapping.
Paper Mill	40	S	1937	2000	Annotated as 'Radcliffe Paper Mill'. Building present prior to 1937, however located over 50m from site. Extension to mill from 1937 mapping and now extends to within 50m of site. Replaced by residential properties by 2020 mapping.
Reservoir	85	SW	1850	1895	No longer annotated by 1909 mapping, potentially infilled feature.
Reservoir	115	S	1850	1989	No longer annotated by 1992 mapping, potentially infilled feature.
Reservoir	120	W	1850	1985	No longer annotated by 1898 mapping, potentially infilled feature.
Reservoir	130	S	1850	1910	No longer annotated by 1922 mapping, potentially infilled feature.
Reservoir	135	NW	1891	1893	No longer annotated by 1894 mapping, potentially infilled feature.

Table 2-2: Summary of potentially contaminative features within 50m and potentially infilled features with 250m. Dates are based on available historical map editions.

Surrounding Area Features	Distance (m)	Direction	Dates Present		Comments
			From	To	
Reservoir	180	E	1850	1909	No longer annotated by 1910 mapping, potentially infilled feature.
Reservoir	180	W	1891	1965	No longer annotated by 1972 mapping, potentially infilled feature.
Reservoir	200	SE	1893	1965	No longer annotated by 1975 mapping, potentially infilled feature.
Surrounding Area Features	Distance (m)	Direction	Dates Present		Comments
			From	To	
Reservoir	230	NW	1891	1910	No longer annotated by 1922 mapping, potentially infilled feature.
Old Coal Pit / Shaft	245	SE	1850	1938	Associated with 'Stand Lane Colliery'. Annotated as 'Shaft' by 1891 mapping. No longer annotated by 1956 mapping.

Table 2-2 Continued: Summary of potentially contaminative features within 50m and potentially infilled features with 250m. Dates are based on available historical map editions.

2.3 Environmental Setting

The environmental setting is summarised in Table 2-3.

Categories ^(data sources)			Details
Geology ¹	Artificial		- None recorded on site.
	Superficial		- Till across the majority of site. - Glaciofluvial Deposits (Sand and Gravel) along the NW boundary and in the far most northern corner of site.
	Bedrock		- Nob End Rock (Sandstone).
	BGS Logs (<50m)		- None.
Hydro-geology	Aquifer Designation	- Superficial	- Secondary A Aquifer in N. - Secondary Undifferentiated Aquifer in NW.
		- Bedrock	- Secondary A Aquifer.
	Source Protection Zone (SPZ)		- Site not within an SPZ.
	Groundwater Abstractions (100m)		- None recorded within 100m.
Hydrology	Surface Water Courses (100m)		- 157m NW, River Irwell.
	Flooding risk		Flood Zone 1. Potential for groundwater flooding of property situated below ground level.
	Surface Water Abstractions (100m)		- None recorded within 100m.
	Discharge Consents		- None recorded on site.
	Pollution Incidents		- None recorded on site.
Minerals & Mining	Coal Mining		- Within a Coal Reporting Area. - Not within a Development High Risk Area.
	Surface Mineral Extractions (250m)		- 6no. within 250m. - Nearest 34m SE: 'Stand Lane Colliery'. Underground extraction of coal (deep). Operations ceased. - No active mineral extraction within 250m.
	Cheshire Brine Compensation District		- Not within Compensation District. - Not within Consultation Area.
	Non-Coal Mining Area		- Not within an area of conclusive metalliferous mining.

Table 2-3: Summary of the environmental setting.

Categories ^(data sources)		Details
Ground Stability	Collapsible Ground	- Very low hazard.
	Compressible Ground	- No hazard.
	Ground Dissolution	- No hazard.
	Landslide	- Very low hazard.
	Running Sand	- Very low hazard.
	Shrinking / Swelling Clay	- No hazard.
Categories ^(data sources)		Details
Landfill Sites (250m)	Known / Registered	- None recorded within 250m.
	Potentially Infilled Land (non-water and water), based on Envirocheck Report	- 7no. features: 4m NW, 93m SW, 117m W, 140m S, 147m S, 202m E, 231m SE.
	Potentially infilled sites, based on LKC historical review	- 10no. features: See Table 2-1.
Radon Potential		- 1-3% of homes above Action Level. No protective measures are necessary in the construction of new dwellings or extensions.
Designated Sites (50m)		- None recorded within 50m.
Contemporary Trade Directory (50m)		- 3no. within 50m. - 21m SE: Pottery Manufacturers and Suppliers. Inactive. - 31m NW: Commercial Vehicle Bodybuilders and Repairers. Active. - 32m NW: Sheet Metal Works. Inactive.
Fuel Station Entries (50m)		- None recorded within 50m.
Unexploded Ordnance Risk (UXO)	Zetica Risk Map	- Low.
	Historical / Current Military Activity	- None identified within 100m

Table 2-3 Continued: Summary of the environmental setting.

2.4 Site Reconnaissance

A site reconnaissance was carried out on 05 January 2021. Hand dug trial holes were undertaken in accessible areas to confirm the shallow ground conditions.

Relevant features identified on site are summarised below:

- The site is currently vacant with no buildings and covered by dense vegetation.
- Fly tipping of household waste is present in the south and west of site.
- Access for site investigation is currently limited due to dense vegetation. It is understood that the vegetation is to be cleared. The site is bound by a wooden fence with concrete blocks beneath it which further limit access.
- Vegetation is most dense in the centre and north of site (brambles), with ivy covering most of the surface in the southwest.
- A metal fence is present along the north western boundary.
- The site is generally uneven, with a possible mound of material in the south-eastern corner making the site topographically higher than the road to the west. A large tree is present in the southeast.
- A steep slope to the northwest is present just off the northwest boundary.
- No visual evidence of significant contamination identified.

2.5 Contamination Sources / Pathways and Receptors

Potential contamination sources are detailed in Table 2-4.

Potential Source	Contaminants
On Site	
Shallow Made Ground below some or all of site (e.g. small former unreferenced building, mound of unknown material, fly tipping on surface).	- Assuming predominantly reworked natural soils with possible demolition rubble, ash and clinker: Asbestos, heavy metals, sulphates, PAHs². - Not expected to be a significant source of gas given anticipated depth and nature of Made Ground.
Demolished unreferenced building	- Asbestos Containing Material (ACM).
Surrounding Area	
Current Depot (30m NW)	- Possible heavy metals, PAHs, sulphates, organic and inorganic contamination. - Unlikely to be significant source of contamination due to topography difference between feature and site (feature topographically lower).
Former bleach and dye works (Blue Mills) and associated chimney (35m N) ³	- Typical contaminants include bleaching agents and dyes such as acids and alkalis, chlorine, and caustic soda. - Other ancillary activities could include coal fired boilers producing large quantities of boiler ash (heavy metals, sulphates and PAHs). - Unlikely to be significant source of contamination due to topography difference between feature and site (feature topographically lower).
Radcliffe Paper Mill (40m S) ⁴	- Typical contaminants could include heavy metals, PAHs, acids, alkalis, solvents, other organic and inorganic contaminants. - The feature has since been redeveloped for residential purposes and likely remediated, therefore unlikely to pose a significant risk.
Offsite potentially infilled features within 250m	- Given size, distance and age of features, there is considered to be a source of hazardous gas (principally carbon dioxide and methane).

Table 2-4: Potential contamination sources.

Potential receptors are detailed in Table 2-5.

Receptors	
Human Health	- Future site users (including residents, visitors and site workers). - Offsite land users.
Controlled Waters	- Secondary A and Undifferentiated Aquifers. - No surface water within influencing distance.
Buildings and structures.	
Potable water pipes.	
Flora within future gardens and landscaping.	

Table 2-5: Potential receptors.

Potential pathways are detailed in Table 2-6.

² Defra (2002). "Potential Contaminants for the Assessment of Land". R&D Publication CLR 8.

³ Department of the Environment. Industry Profile. Textile Works and Dye Works. 1995

⁴ Department of the Environment. Industry Profile. Pulp and Paper Manufacturing Dye Works. 1995

Pathways		
Soil	Human Health ⁵ (residential land use: houses with private gardens)	- Ingestion of soil. - Ingestion of soil-derived indoor dust. - Ingestion of contaminated vegetables. - Ingestion of soil attached to vegetables. - Dermal contact with soil. - Dermal contact with soil-derived indoor dust. - Inhalation of soil-derived outdoor dust. - Inhalation of soil-derived indoor dust. - Inhalation of vapours outside. - Inhalation of vapours inside.
		- Windblown dust and fibres to adjacent receptors.
		- Direct contact with receptors (building foundations, services).
		- Root uptake.
Water		- Surface run-off over impermeable surface. - Site is relatively flat and grassed; therefore, surface run-off will be limited.
		- Infiltration into the ground, through potentially contaminated material (contamination possibly going into solution).
Water and Gas		- Migration through potentially permeable strata and preferential pathways. - Superficial (Till) expected beneath majority of site likely to be of low permeability. - Superficial (sand and gravel) expected in the north is likely to be relatively permeable. - Bedrock (sandstone) likely to be relatively permeable. - No preferential pathways are anticipated.
Gas		- Migration into buildings (e.g. via services) and accumulation of gases in confined spaces (potentially causing explosion if methane is present).

Table 2-6: Potential pathways.

2.6 LKC Preliminary Contamination Conceptual Model

The preliminary contamination conceptual model using contaminant-pathway-receptor linkages based on guidance in LCRM⁶ has been summarised in Table 2-7.

The aim of the conceptual model is to provide a preliminary assessment of the likelihood of a pollutant linkage for each potential combination of contaminant, pathway and receptor. A conceptual model can be used to make an informed decision on the contamination risks associated with the site and determine what site investigation work is required.

The preliminary contamination conceptual model has identified seven generic potential pollutant linkages. Each linkage is described along with an assessment of the risk based upon guidance on probabilities and consequences outlined in CIRIA C552⁷.

In order to assess the potential risk for each pollutant linkage, an assessment of the magnitude of the potential consequence (severity) of the risk occurring and the magnitude of the probability (likelihood) of the risk occurring has been considered and classified. This is based on the guidance provided in CIRIA C552 and further details including a risk matrix is provided in Appendix A.

Where LKC identified a low to very low risk, limited intrusive investigation work, a watching brief (during construction work) or no investigation work will be

⁵ EA (2008). "Updated Technical Background to the CLEA Model". Science Report – SC050021/SR3.

⁶ Land Contamination Risk Management (LCRM) <https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm>

⁷ CIRIA (2001). "Contaminated land risk assessment: A guide to good practice". C552.

recommended. This will be dependent on the nature of the site and the proposed development.

Where the risk falls into the moderate/low risk, LKC will undertake an assessment to establish what category the pollutant linkage will fall into (i.e. moderate or low risk will be chosen).

Where LKC identifies a moderate or higher risk, intrusive work or precautionary remedial measures will be recommended.

It should be noted that there may be risk from short term exposure from contaminated soil to site workers during development work. The Preliminary Contamination Conceptual Model deals with long term exposure to key receptors associated with the future use of the site. Acute risks can be easily mitigated by good environmental management of the site during site works. Standard health and safety precautions (as per HSE guidance⁸) should be adopted by all workers involved with site enabling and construction works. Therefore, this receptor is not considered in the contamination conceptual model.

2.7 Recommendations

Based upon the Preliminary Contamination Conceptual Model a site investigation was recommended to assess the potential pollutant linkages further.

⁸ HSE (1991). "Protection of Workers and the General Public During Development of Contaminated Land" London HMSO.

PL	Pathway	Receptor	Contaminants of Concern (CoC)	Probability	Consequence	Risk	Recommendations
1	- Dermal contact. - Inhalation of soil, fibres and dust. - Ingestion of soils, dust, vegetables, soil attached to vegetables. - Windblown dust.	- Future site users. - Offsite receptors.	- ACM - Heavy metals. - PAHs. - Petroleum hydrocarbons. - Other inorganic and organic contaminants.	Low Likelihood (given site history no significant demolition recorded and no significant onsite source identified)	Medium	Moderate / Low (moderate assumed until ground conditions confirmed given sensitive proposed end use)	Intrusive investigation required. Precautionary soil analysis of CoC.
2	- Inhalation of vapours. - Migration via permeable strata and preferential pathways.	- Future site users. - Offsite receptors.	- Volatile contaminants (TPHCWG, SVOC, VOCs).	Low Likelihood (given site history, site conditions and proposed end use)	Medium	Moderate / Low (low assumed given no significant anticipated source)	Intrusive investigation required, to include PID testing. Soil analysis of CoC, subject to ground conditions encountered and PID testing.
3	- Inhalation of gas. - Migration via permeable strata and preferential pathways. - Explosion in confined spaces. - Exposure to radon.	- Future site users. - Buildings. - Offsite land users.	- Hazardous gas (carbon dioxide, methane).	Likely (given viable gas source, proposed end use and viable pathway)	Severe	High	Gas monitoring or precautionary gas protection measures required.
			- Radon	Unlikely (as 1-3% of homes above action level)	Medium	Low	(1-3%) No protective measures are necessary in the construction of new dwellings or extensions.
4	- Surface run-off. - Migration via permeable strata and preferential pathways. - Perched waters migration.	- Groundwater (Secondary A and Undifferentiated Aquifers).	- Mobile contaminants such as metals, PAHs, hydrocarbons, volatile compounds.	Low Likelihood (given site history and anticipated cohesive superficial deposits expected beneath majority of site)	Medium	Moderate / Low (moderate assumed until ground conditions confirmed)	Intrusive investigation required. Groundwater sampling, subject to ground conditions encountered. Analysis of CoC.
5	- Sulphate attack on concrete.	- Building structure.	- Sulphate.	Likely (given ground conditions not confirmed across site)	Mild	Moderate / Low (moderate assumed until ground conditions confirmed)	Low density intrusive investigation required. Soil analysis of CoC.
6	- Ingestion of tainted water supply.	- Future site users. - Water pipes.	- Organic contaminants such as petroleum hydrocarbons, naphthalene, volatile compounds.	Low Likelihood (although some contamination may be present, significant contamination not expected at pipeline depth)	Medium	Moderate / Low (moderate risk assumed until ground conditions confirmed)	Intrusive investigation required. Soil analysis of CoC, subject to ground conditions encountered.
7	- Direct contact (plant uptake).	- Flora.	- Phytotoxic contaminants such as heavy metals.	Likely (given site conditions and proposed end use)	Minor	Low	Low density intrusive investigation required. Soil analysis of CoC.

Table 2-7. Preliminary Contamination Conceptual Model.

3 Ground Investigation

3.1 Site Investigation Design and Methodology

In order to assess the ground conditions at the site and to investigate the potential pollutant linkages identified in the preliminary contamination conceptual model an intrusive investigation was undertaken.

The investigation was carried out on 18th March 2021 and comprised the following:

- » 3no. window sample boreholes drilled to 3.42-5.04 metres below ground level (mbgl) (ref. WS101 to WS105).

All site investigation locations are shown in Figure 2.

The locations were chosen to allow a good spread across the site

The number of site investigation points corresponds to approximately one location per 18m square centres. This is considered to be a conservative sampling density and is in line with BS10175⁹ for a 'main investigation'.

All profile logs are provided in Appendix B and are in line with BS14688-1¹⁰ and BS5930¹¹.

3.2 Well Installations

All of the boreholes were installed with monitoring wells for gas and groundwater monitoring. Monitoring wells were installed in accordance with BS10175 and CIRIA C665¹² and generally comprised approximately 1m plain pipe over a length of slotted pipe surrounded by pea gravel and sealed at the top with bentonite and concrete.

Well installation details are provided in profile logs in Appendix B.

3.3 Sampling Protocol

3.3.1 Soil Sampling (Contamination)

Standard sampling protocol and preservation of samples was undertaken as described in the EA guidance on site investigation¹³.

Soil was collected for onsite testing. A plastic zip bag was half filled with soil allowing a suitably sized headspace. The bag was sealed and stored for at least 20 minutes before being tested for total volatile organic compounds (TVOCs) using a PhoCheck Tiger photoionisation detector (PID). Results of the PID readings are presented on the profile logs (Appendix B). The on-site monitoring was carried out in line CIRIA C665¹⁴ to aid in screening samples for volatile analysis.

Soil samples of approximately 500g were recovered in amber jars, amber vials for volatile analysis and plastic tubs. All the samples were labelled and stored in cool

⁹ British Standard (2017). "Investigation of Potentially Contaminated Sites – Code of Practice." BS10175:2017.

¹⁰ British Standards (2002) Geotechnical investigation and testing – Identification and Classification of Soil. Part 1: Identification and description. BS EN ISO 14688-1:2002.

¹¹ British Standard (2015). "Code of Practice for Ground Investigations". BS5930:2015.

¹² CIRIA (2007). "Assessing Risks Posed by Hazardous Ground Gases to Buildings." CIRIA C665.

¹³ EA (2000). "Technical Aspects of Site Investigation. Volumes 1 & 2 Text Supplements Research and Development Technical Report." P5-065/Tr.

¹⁴ CIRIA (2007). "Assessing Risks Posed by Hazardous Ground Gases to Buildings." CIRIA C665.

boxes prior to being collected by courier at the end of the day for delivery to the Chemtest laboratory in Newmarket for chemical testing. If collection was not possible the same day then samples were stored in the sample storage fridge at the LK Group offices below 4°C. Samples were tracked using appropriate Chain of Custody forms provided by Chemtest.

Many of the contamination tests are UKAS or MCERTS accredited and further details are given in the Certificate of Analysis presented in Appendix C. Table 3-1 shows the soil testing undertaken.

Suites and Contaminants	No. Samples	Location & Depth	Justification
Metals / metalloids, pH, water soluble sulphate, speciated PAHs, SOM and asbestos screen.	3	WS101 0.0-0.3m WS102 0.0-0.3m WS103 0.0-0.2m	A basic suite with a broad selection of contaminants tested on samples across the site where no significant evidence of contamination was identified (with the exception of occasional coal) and no TVOCs identified from the PID tests.

Table 3-1. Summary of soil sample testing undertaken.

Notes:

If asbestos present during screen identification and quantification will be undertaken.

Metal/metalloids=arsenic, cadmium, chromium, (total and hexavalent), copper, lead, mercury, nickel, selenium, vanadium, zinc and boron; PAH=polycyclic aromatic hydrocarbons, SOM=Soil Organic Matter.

3.3.2 Water Sampling / Leaching Testing

Groundwater sampling / leaching testing was not carried out as part of this investigation.

A moderate to low risk was identified in the preliminary contamination conceptual model for controlled waters (pollutant linkage 4) and further action was only recommended if significant soil contamination was identified on site. Based on the ground conditions encountered, LKC did not consider testing to be required. This is discussed further in Section 6.4.

3.4 Gas Monitoring

Six gas monitoring visits have been undertaken over a 3-month period (23rd March 2021 to 21st June 2021) in all installed boreholes.

Monitoring was undertaken using a Geotechnical Instruments GA5000 in accordance with the monitoring protocol outlined in CIRIA C665¹⁵ (flow rate measured first). The monitoring was undertaken over a range of weather conditions (including low and falling barometric pressure and heavy rain) to demonstrate worst-case conditions.

The gas monitoring results are reproduced in full in Appendix E.

3.5 Site Investigation Scope

The scope of the contaminated land investigation was agreed with the Local Authority prior to undertaking the work via an email dated 2nd March 2021. This investigation was in line with the agreed scope.

¹⁵ CIRIA (2007). "Assessing Risks Posed by Hazardous Ground Gases to Buildings." CIRIA C665.

3.6 Geotechnical Testing

3.6.1 In-situ Onsite Geotechnical Testing

In-situ geotechnical tests were performed in the boreholes to further characterise the sub-soil conditions. The following tests were undertaken:

- Standard Penetration Tests (SPTs) were performed in the window sample boreholes at approximately 1m intervals, generally within the natural strata.
- Pocket Penetrometer tests (giving compressive strength converted to undrained shear strength) were performed in the window sample boreholes at approximately 1m intervals, within the natural clay strata.

The SPT and pocket penetrometer readings are provided within the profile logs (Appendix B).

3.6.2 Laboratory Geotechnical Testing

Soil samples taken during the investigation were collected in tubs and bulk bags and sent to Murray Rix Laboratories / Chemtest for geotechnical testing.

Many of the tests are UKAS accredited and further details are given in the laboratory report presented in Appendix D. Table 3-2 shows the geotechnical testing undertaken.

Suites and Contaminants	No. Samples	Location	Justification
BRE Short Suite	1	WS103 0.5-1.0m	Undertaken to aid in concrete classification.
Atterberg Limits (plasticity testing)	2	WS102 2.5-2.7m WS103 1.6-2.0m	A selection of clay samples across the site were tested for Atterberg Limits to assess their shrinkability potential associated with current and proposed trees.
Particle Size Distribution (PSD)	1	WS101 1.5-2.0m	PSD undertaken to confirm grading of granular material.

Table 3-2. Summary of geotechnical testing undertaken.

4 Ground Conditions

4.1 Geology – Generalised Sequence

The ground conditions beneath the site comprised made ground underlain by natural gravelly clayey sand / slightly gravelly clay. A summary section of the logs is provided in Plate 4-1, with additional comments below.



Plate 4-1: Summary of ground conditions.

Additional information on ground conditions:

- Made ground was recorded in WS101 only to a depth of 0.30mbgl and consisted of very sandy organic silt with occasional coal fragments, brick fragments, roots and rootlets.
- Topsoil (very sandy organic silt with rare to occasional coal) was recorded in WS102 and WS103 between 0.00-0.30mbgl.
- No visual / olfactory evidence of hydrocarbons or volatile contaminants in any locations.
- Extremely weathered mudstone bedrock was recorded between 2.70-5.04mbgl.

4.2 Groundwater

4.2.1 Groundwater Levels

Groundwater strikes were recorded during the investigation in trial pits and boreholes. In addition, groundwater monitoring within the borehole wells has been undertaken on six occasions.

Results are summarised in Table 4-1.

BH/TP	Water Strike Depths (mbgl)	Well Response Zone (mbgl)	No. of Monitoring Visits	Monitoring Depths (mbgl)			Sample Taken?	Evidence of Contam?
				Min	Max	Base		
WS101	Dry	0.7-4.7 (S/Ms)	6	2.31	2.68	4.50-4.71	N	N
WS102	Dry	1.0-4.0 (S/C/Ms)	6	0.60	2.01	3.80-4.05	N	N
WS103	2.1	1.0-3.0 (S/C/Ms)	6	1.50	1.87	2.85-3.11	N	N

Table 4-1: Summary of water strike depths within boreholes and trial pits.

Response Zones:

Ms=Mudstone; S=Sand; C=Clay.

4.3 In-Situ Geotechnical Testing

4.3.1 Standard Penetration Tests

In-situ standard penetration tests (SPTs) were undertaken, predominantly in the natural ground. The results are summarised in Table 4-2 and provided within the profile logs in Appendix B.

Approximate Depth (mbgl)	SPT 'N' Values		
	WS101	WS102	WS103
1-2	14 (S)	15 (S)	26 (S/C)
2-3	20 (S)	11 (C)	13 (C)
3-4	24 (MS)	20 (MS)	50 for 365mm (MS)
4-5	27 (MS) 50 for 190mm (MS)	50 for 365mm (MS)	-
5-6	-	-	-
GW Level	Dry-2.60m	Dry-2.01m	1.50-1.87m

Table 4-2: Summary of SPT (N) values.

Notes:

S=Sand; C=Clay; MS=Mudstone.

Groundwater level based on strikes during investigation and monitoring data.

4.3.2 Shear Vanes

Pocket penetrometer, recording compressive strength which has been converted to undrained shear strength (S_u), were taken within the clay strata. The results are summarised in Table 4-3 and provided within the profile logs in Appendix B.

Approximate Depth (mbgl)	Average Undrained Shear Strength (kN/m ²)		
	WS101	WS102	WS103
0-1	-	-	-
1-2	-	-	-
2-3	223	223	223
3-4	-	-	-
GW Level	Dry-2.60m	Dry-2.01m	1.50-1.87m

Table 4-3: Summary of average hand shear vane readings.

Notes:

Groundwater level based on strikes during investigation and monitoring data.

Pocket Penetrometer readings can be influenced by coarse material including coarse silt.

4.4 Geotechnical Laboratory Testing

4.4.1 Particle Size Distribution

Particle size distribution (PSDs) tests were carried out on granular strata to confirm the material type. Full results are presented in Appendix D and summarised below in Table 4-4.

Location	Depth (mbgl)	Material	Percent passing through sieve		
			63mm	2mm	0.063mm
WS101	1.5-2.0	Brown silty SAND and GRAVEL	100%	54%	13%

Table 4-4: Summary of particle size distribution results.

Notes:

% passing: 63mm = cobble / gravel boundary; 2mm = gravel / sand boundary; 0.063mm = sand / silt boundary

4.4.2 Atterberg Limits

Representative samples of natural clay were subjected to Atterberg Limits (plasticity) and Moisture Content testing. Results are presented in Appendix D and summarised in Table 4-5.

Table 4-5 also includes the modified plasticity index as detailed in Chapter 4.2-D5 of the NHBC standards (modified plasticity index = plasticity index x % less than 425µm sieve / 100%).

Location	Depth (mbgl)	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Class	Passing 425 micron (%)	Modified Plasticity Index (%)
WS102	2.5-2.7	13	38	16	22	CI	100	22.00
WS105	1.6-2.0	18	35	14	21	CI	87	18.27

Table 4-5: Summary of plasticity index testing.

The modified plasticity index is between 18% and 22%. This characterises the clay as having a low to medium volume change potential.

4.4.3 Concrete Classification Testing

Chemical tests were carried out on soil samples to inform the concrete classification for the site. Full results are presented in Appendix C and summarised in Table 4-6.

Strata	pH	Sulphate (g/l)	Magnesium (g/l)	Chloride (g/l)	Nitrate (g/l)
Made Ground	8.0	<0.010	-	-	-
Natural	7.7-8.1	<0.010	<0.010	<0.010	<0.010

Table 4-6: Summary of pH and sulphate results.

5 Geotechnical Assessment

5.1 Proposed Development

It is understood that the proposed development will comprise low rise residential housing consisting of 3no. adjoining 3 bedroom units with associated landscaping and infrastructure. Details of the proposed loadings are not known and therefore a line loading of 75kN/m has been assumed for preliminary assessment purposes only.

The finished ground levels have not been provided and it is therefore anticipated that they will not vary significantly from current levels. However, should the development proposals or finished levels be altered then the comments/recommendations in this section may require revising.

The depths of any underground engineering works (sewers etc.) are unknown and therefore have not been taken into account in the following assessment. It is considered that any such works will be designed so as not to have an effect on, or compromise, proposed or existing foundations or ground stability.

Given the nature of the proposed development it is considered that the structure meets the criteria of Geotechnical Category 1 of Euro Code 7.

5.2 Summary of Ground Conditions

Ground conditions identified at the site are detailed in Section 4.1, and typically comprises Made Ground or topsoil to 0.30mbgl over medium dense variably clayey/silty gravelly SAND to 1.40m - 2.40mbgl. At the location of WS101 this is underlain by extremely weak MUDSTONE to the completion depth of the exploratory hole. At the locations of WS102 and WS103 the SAND is underlain by very stiff slightly gravelly CLAY to 2.70m - 3.10mbgl over extremely weak MUDSTONE to the depths of the exploratory holes.

5.3 Site Preparation

The site should be cleared and any vegetation below areas of proposed development stripped in accordance with Series 200 of the Specification for Highway Works. This should include:

- Roots present below the footprint of proposed structures and infrastructure should be grubbed out and the resulting void infilled with suitable compacted engineered fill;
- Redundant services should be sealed off and grubbed out and replaced with suitable compacted engineered fill; and,
- Buried structures and old foundations can be anticipated to be present on site from historical building in the north of the site. These should be excavated from below the proposed development foot print with the resulting void backfilled.

The near surface soils may potentially be disturbed by weathering and site traffic. Precautions should be taken to avoid this, as excessive disturbance may result in increased amount of site disposal etc.

5.4 Foundation Conditions and Bearing Capacity

5.4.1 General

It is considered that the Made Ground and topsoil are not suitable for a founding material due to the inherent variability of the material.

Density of the natural granular SAND material has been assessed using in-situ testing by SPT. Strength of the cohesive CLAY material has been assessed using in-situ testing by SPT and Pocket Penetrometer (PP) as well as by site observations and logging of the strata.

Within the shallow granular material, based on the results of the SPT tests an Allowable Bearing Capacity (ABC) of between 137 and 264kN/m² can be achieved in the SAND. The internal angle of friction (ϕ) of the SAND is between 31-35°. It is considered that the following values are used for design purposes:

- ABC of 137kN/m²,
- $\phi = 33^\circ$,
- Unit weight (γ) 17kN/m³.

Within the shallow cohesive material, based on the results of SPT and PP tests the undrained shear strength (s_u) ranges between 50 and 127kPa from the SPT results and 223 from the PP results. Using the most conservative value of 50kPa an ABC of 103kN/m² can be achieved which is considered more than adequate for the proposed development. It is therefore considered that the following values are used for design purposes:

- s_u of 50kPa,
- ABC of 103kN/m²,
- γ of 19kN/m³.

Within the shallow extremely weak Mudstone, SPT 'N' values ranged between N24 and refusal of 50 blows before completing the full length of the test, returning s_u values of between 87 and 217kPa and an ABC between 178 and 428kN/m².

5.4.2 Strip Foundations

Shallow strip foundations should be constructed at least 150mm in to the underlying medium dense SAND. The medium dense SAND will return an ABC of 137kN/m² considered more than adequate to support low rise residential properties.

As CLAY and MUDSTONE underlies the sand at depths of between 2.05 and 2.70mbgl consideration should be given to using suitable reinforcements to mitigate against the potential for any differential settlements arising from consolidation of the cohesive material.

Atterberg limits determinations, summarised in Table 4-5 show the clay to be of intermediate plasticity with a low to medium volume change potential.

Foundation depths should take account of the presence of existing trees with foundations deepened locally in accordance with the requirements of NHBC Standards for a clay of intermediate plasticity.

5.5 Ground Floor Slabs

As minimal Made Ground was recorded within the exploratory holes then a ground bearing floor slab would be suitable for the proposed development. Alternatively, suspended floor slabs, such as block and beam may be more suitable due to ease of installation and the short spans involved.

Where suspended floor slabs are employed ventilation of the under floor void will be required to address condensation issues.

5.6 Concrete Durability

Based upon the results of the chemical analyses summarised in Table 4-6 it is considered that subsurface concrete can be designed in accordance with Design Sulphate Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with the recommendations provided in BRE Special Digest 1 (2005).

5.7 Excavations

Site observations indicated that excavations should be feasible in the near surface with normal plant, however obstructions can be anticipated identified in the near surface including former foundations. It is anticipated that any obstructions will be grubbed out during the reduced level dig for the sub structure works.

Groundwater was not encountered during the investigation works and generally exploratory holes were stable.

5.8 Construction Activity and Inspection

The following activities and inspections should be incorporated in to the site works:

- » It is recommended that sufficient allowance is made for the inspection of formation and sub formations to foundations and pavement construction;
- » Excavations where access is required should be subject to a risk assessment from a competent person and where appropriate mitigation measures such as benching back the sides or use of support systems in accordance with CIRIA R97 utilised;
- » It is considered that de-watering may be required, especially following periods of heavy rainfall. Removal of surface water and water within trenches should be possible with conventional sump pumping. Discharge of any water should be agreed with the relevant regulatory body and be undertaken under a trade effluent discharge, where required. Measures to remove silt and suspended solids may be required and consideration should be given to provision of space for settling tanks or an attenuation pond;
- » Where access to confined spaces is required appropriate mitigation measures should be addressed within the Construction Stage Health and Safety Plan. Particular account should be taken of the gas results;
- » The presence of potential contamination and mitigation measures should be addressed as part of the Construction Stage Health and Safety Plan and should include measures to design out the risks, reduce their impact and finally the use of Personnel Protective Equipment (PPE).

6 Generic Risk Assessment

6.1 Introduction

Current good practice requires that the findings from a site investigation should be evaluated on a site-specific basis, using a risk-based approach. Risk assessment involves identification and evaluation of the hazards presented by the concentrations of contaminants measured followed by an evaluation of the risks which are associated with these hazards (LCRM¹⁶). Information gathered from the risk assessment has been collated in the revised contamination conceptual model in Section 6.6.

6.2 Soil Risk Assessment

6.2.1 Methodology

With regards to the soil risk assessment LKC will use the following hierarchy:

- Category 4 Screening Levels (C4SLs).
- LQM Suitable 4 Use Levels (S4ULs).
- ATRISK Soil Screening Values (SSVs) and CL:AIRE Generic Assessment Criteria (GACs).

C4SLs were published in 2013^{17,18}. The recent change to the contaminated land guidance has changed the evaluation of risk from 'minimal' (referred to as Health Criteria values (HCVs))¹⁹ used to generate Soil Guideline Values (SGVs) to 'low' (referred to as Lowest Level of Toxicological Concern (LLTCs)). The policy companion document and supporting letter by Defra, dated 3rd September 2014, states that C4SLs '*could be used under the planning regime, as well as within Part 2A*'. Based on these comments LKC considers the justifications and assumptions used to generate 'low' risk are suitable for the planning regime.

Where no C4SLs have been generated LKC will use the LQM S4ULs²⁰. Similar assumptions and land uses to C4SLs have been used. However, toxicological information has been based on 'minimal risk' as per previous guidelines and assumptions^{21,22,23,24}.

If contaminants are not present as C4SLs and S4ULs then LKC will use ATRISK SSVs or CL:AIRE GACs²⁵. These follow the 'minimal' risk principle and more stringent exposure parameters and will be conservative.

LKC consider the main risk drivers for PAHs are benzo(a)pyrene (B(a)P) and naphthalene. This is due to B(a)P possibly being a carcinogen and most toxic of the

¹⁶ Land Contamination Risk Management (LCRM) <https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm>

¹⁷ Defra (2014). "SP1010: Development of Category 4 Screening Levels and Assessment of Land Affected by Contamination – Policy Companion Document."

¹⁸ CL:AIRE (2013). "SP1010: Development of Category 4 Screening Levels and Assessment of Land Affected by Contamination – Final project Report."

¹⁹ EA (2008). "Human Health Toxicological Assessment of Contaminants in Soils." Science Report – SC050021/SR2.

²⁰ LQM (2014). "The LQM/CIEH S4ULs for Human Health Risk Assessment."

²¹ EA (2008). "Updated Technical Background to the CLEA Model." Science Report – SC050021/SR3.

²² EA (2008). "Human Health Toxicological Assessment of Contaminants in Soils." Science Report – SC050021/SR2.

²³ EA (2008). "A Review of Body Weight and Height Data used within the Contaminated Land Exposure Assessment Model (CLEA)." Project SC050021/Technical Review 1.

²⁴ EA (2009). "Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values." Science report SC050021/SR7.

²⁵ CL:AIRE (2009). "The Soil Generic Assessment Criteria for Human Health Risk Assessment."

PAHs^{26,27} and naphthalene the most volatile and soluble²⁸. The new C4SLs indicate B(a)P as a surrogate marker for carcinogenic PAHs, if it falls within appropriate limits, since the risk from other non-carcinogenic PAHs are considered negligible²⁹. For B(a)P to be used as a surrogate marker it should follow the profile described by the HPA (2008)³⁰ and CL:AIRE (2013). Naphthalene will be treated separately using the LQM S4ULs.

The proposed development is for residential houses with gardens, therefore the assessment criteria for residential with plant uptake has been used.

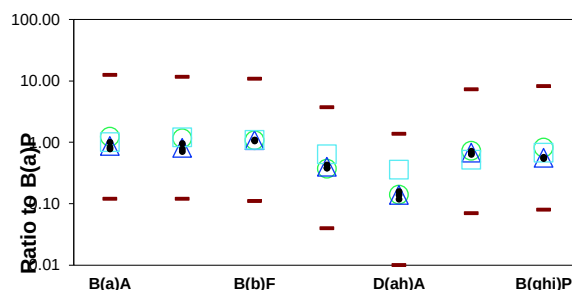
2.5% and 6% Soil Organic matter (SOM). Results will be compared to the nearest appropriate SOM.

A summary of the generic assessment criteria is provided in Appendix G. ATRISK SSVs and CL:AIRE GACs were not required for this dataset and have not been included.

B(a)P as Surrogate Marker

Based on the above assumption for PAHs, LKC undertook an assessment of the data for the site with regards to using B(a)P as a surrogate marker for carcinogenic PAHs as per HPA and CL:AIRE guidelines. The primary toxicological study related to Culp *et al.*³¹, which was based on coal tar mixtures (>80,000mg/kg of total PAHs) fed in food to mice over a two-year carcinogenicity study.

Graph 6-1 summarises the study site data with respect to how the ratios of carcinogenic PAHs relate to B(a)P, within the confidence limits provided in the HPA document.



Graph 6-1: The ratio of PAH to B(a)P in soil for all available data at the site based on 3 samples (where values were >LOD to allow the calculation of a ratio).

Notes:

B(a)P = Benzo(a)pyrene; D(ah)A = Dibenzo(ah)anthracene; B(a)A = Benzo(a)anthracene; B(b)F = Benzo(b)fluoranthene;
 B(k)F = benzo(k)fluoranthene; I(123cd)P = Indeno(123cd)pyrene; B(ghi)P = Benzo(ghi)perylene
 ● = Ratio to B(a)P for all data ○ = Mean ratio to B(a)P for Culp data △ = Mean ratio to B(a)P from all data at the site
 □ = Mean ratio to B(a)P for UK data presented by HPA ■ = Upper and Lower limits (order of magnitude from Culp data)

²⁶ EA (2002). "Contaminants in Soils: Collation of Toxicological Data and Intake Values for Humans. Benzo[a]pyrene." R&D Publication TOX2.

²⁷ USEPA (1984). "Health Effects Assessment of Polycyclic Aromatic Hydrocarbons (PAHs). EPA 540/1-86-013."

²⁸ EA (2003). "Review of the Fate and Transport of Selected Contaminants in the Soil Environment." Draft technical report P5- 079/TR1.

²⁹ CL:AIRE (2013). "SP1010: Development of Category 4 Screening Levels and Assessment of Land Affected by Contamination – Final project Report."

³⁰ HPA (2010). "HPA Contaminated Land Information Sheet: Risk Assessment Approaches for Polycyclic Aromatic Hydrocarbons (PAHs)." Version 3.

³¹ Culp, S; Gaylor, D; Sheldon, W; Goldstein, L and Beland, F (1998). "A Comparison of Tumours Induced by Coal Tar and Benzo-a-pyrene in a 2-Year Bioassay." Carcinogenesis. Vol 19, no. 1, pp. 117-124.

All the data points that could be used to calculate ratios fall inside the upper or lower limits.

Based on this distribution of data LKC considers B(a)P can be used as a surrogate marker for carcinogenic PAHs and the C4SL criteria is suitable for this dataset.

6.2.2 Soil Results Comparison against Assessment Criteria

All analysis sheets are presented in Appendix C. Elevated and pertinent results are presented in Table 6-1.

Contaminant	Units	No. of samples	Elevated Results	Sample Location	Criteria (1%/2.5%/6%)	Source of Criteria
Metals						
Lead	mg/kg	3	330	WS101 (0.0-0.3m)	200	C4SL
PAHs						
Benzo(a)pyrene	mg/kg	3	22	WS101 (0.0-0.3m)	5	C4SL
			12	WS103 (0.0-0.2m)		
GENERAL						
pH	pH	3	Range 7.7-8.1			
SOM	%	3	Range 3.8-12.0			
Asbestos	N/A	3	Not detected.			

Table 6-1: Summary of elevated and pertinent analytical results.

Notes:

Only results that exceeded assessment criteria have been shown and results from **all depths** are noted. Results have been compared to the nearest appropriate SOM.

No asbestos was identified in any soil samples analysed.

6.2.3 Hazard Quotient

As no significant concentrations of petroleum hydrocarbons were identified in any of the soil samples a hazard index (HI) as described by the Environment Agency³² technical report (to examine the potential additivity of toxicological effects between the petroleum hydrocarbon fractions) has not been undertaken as part of this assessment.

6.2.4 Direct Contact Risk – Pollutant Linkage 1

Elevated PAHs (benzo(a)pyrene) and heavy metals (lead) have been identified on site, given the number and location of elevated samples, the contamination is considered to be site wide.

The source of the contamination is expected to the coal and brick noted in the made ground.

At the concentrations identified, the contaminants are considered to pose a potential risk to future site users (residents) in gardens and soft landscaped areas, where made ground may be exposed / in contact with vegetables. The principal pathways are the ingestion pathways (soil, dust and vegetables) and dermal contact.

The probability of PAH and metal contamination affecting site users is likely. With a medium consequence, the risk is considered to be moderate and remediation is recommended in any areas of soft landscaping.

³² EA (2005). "The UK Approach for Evaluating Human Health Risks from Petroleum Hydrocarbons in Soils." Science Report P5-080/TR3.

No asbestos was identified in any of the samples, therefore the probability of asbestos affected site users is considered to be unlikely. With a medium consequence, the risk is low. At this stage, a low risk is assumed (as no asbestos identified) and remediation is not required. However, as a precaution, construction workers should be and vigilant for any suspected ACM during groundworks (discussed further in Section 9.2).

6.2.5 Risk from Inhalation of Vapours – Pollutant Linkage 2

No visual / olfactory evidence of volatile contaminants was identified during the investigation. The PID did not detect any TVOCs. Confirmatory soil analysis did not detect any VOCs / SVOCs above detection limits.

LKC therefore consider the probability of volatile contaminants affecting site users as unlikely. The consequence is expected to be medium, giving a low risk and no remediation is required with respect to pollutant linkage 2.

6.3 Gas Risk Assessment

Gas monitoring results in full are presented in Appendix E. Following guidance set out in CIRIA C665³³ and BS8485³⁴ peak methane and carbon dioxide concentrations have been used in the gas risk assessment. In addition, and as per guidance, flow rates were measured first.

All gas concentrations, flow, pressure and groundwater levels are shown on Table 6-2.

Boreholes	Visit	CH ₄ (%v/v)	CO ₂ (%v/v)	O ₂ (%v/v)	H ₂ S (ppm)	CO (ppm)	Flow (l/h)	Groundwater (mbgl)	Pressure (mb)
WS101	1	0.0	2.7	18.6	<0.1	<0.1	0.0	2.47	995 (f)
	2	0.0	2.4	17.2	1.0	1.0	0.0	2.52	1005 (f)
	3	0.0	3.0	18.4	<0.1	1.0	-0.1	2.68	992 (r)
	4	0.0	3.1	17.4	<0.1	<0.1	0.0	2.31	999 (r)
	5	0.0	2.5	17.8	<0.1	<0.1	0.0	2.45	1016 (r)
	6	0.0	1.1	20.2	<0.1	<0.1	0.0	2.72	1008 (s/r)
WS102	1	0.0	3.1	17.8	<0.1	<0.1	0.0	1.62	996 (f)
	2	0.0	3.2	18.0	<0.1	2.0	0.0	1.40	1004 (f)
	3	0.0	4.0	17.5	<0.1	1.0	0.0	2.01	997 (r)
	4	0.0	4.2	15.8	<0.1	<0.1	0.0	1.30	1000 (r)
	5	0.0	4.1	15.7	<0.1	<0.1	0.0	0.60	1016 (r)
	6	0.0	1.5	17.4	<0.1	1	0.0	1.95	1008 (s/r)
WS103	1	0.0	2.3	19.2	<0.1	<0.1	0.0	1.68	996 (f)
	2	0.0	0.4	19.7	<0.1	1.0	0.0	1.53	1005 (f)
	3	0.0	3.7	17.8	<0.1	4.0	-0.1	1.87	994 (r)
	4	0.0	3.7	15.7	<0.1	1.0	-0.1	1.10	1000 (r)
	5	0.0	3.2	16.3	<0.1	2.0	0.0	1.50	1017 (r)
	6	0.0	1.0	20.2	<0.1	3.0	0.0	1.97	1009 (s/r)

Table 6-2: Summary of gas monitoring.

Notes:

If concentrations / flow is zero, then equipment detection limits are assumed.

Table shows peak concentrations of CH₄, CO₂, O₂, H₂S and CO.

Atmospheric pressure (over past 24hrs): r=rising, f=falling, s=steady

³³ CIRIA (2007). "Assessing Risks Posed by Hazardous Ground Gases to Buildings." CIRIA C665.

³⁴ BSI (2015). "Code of Practice for the Characterisation and Remediation from Ground Gas in Affected Developments." BS8485:2015.

No elevated methane or carbon dioxide concentrations (above 1% and 5%) have been identified (maximum 0.0%v/v CH₄ and 4.2%v/v CO₂).

As expected, the highest concentrations of carbon dioxide coincided with low pressure events (below 1000mb) throughout the monitoring period, and during particularly high groundwater levels (0.60mbgl in WS102) when the highest concentrations of carbon dioxide were recorded during visit 4.

Negligible flow rates have been recorded over the monitoring period.

Carbon monoxide was >1ppm in boreholes during the majority of monitoring visits (maximum 4.0ppm in WS103). This did not appear to correlate with significant oxygen depletion in any of these locations.

Only workplace exposure limits defined by the HSE are available for carbon monoxide and are not fully applicable to a residential setting. A Short-Term Exposure Limit of 200ppm (15-minute period) and Long-Term Exposure Limit of 30ppm have been defined (8-hour period).

Based on the above exposure limits, carbon monoxide is not expected to pose a significant risk to the proposed site receptors.

Gas Screening Value

In accordance with CIRIA C665³⁵, a Gas Screening Value (GSV) may be calculated. Assuming worst-case scenario maximum gas concentrations and flow for each borehole have been used to calculate the GSV. The GSV can be used to determine the characteristic situation (CS).

Table 6-3 shows the maximum GSV for each borehole and the appropriate characteristic situation (based on GSV only). An overall site assessment (WS101-WS106) has also been included (worst case values across the site).

Boreholes	Max GSV (l/hr)	CS / TL
WS101	0.0031	CS1 / Green
WS102	0.0042	CS1 / Green
WS103	0.0037	CS1 / Green
WS101-103	0.0001 (CH ₄) 0.0042 (CO ₂)	CS1 / Green

Table 6-3: Summary of worst-case Gas Screening Values (GSV).

Notes:

CS – Characteristic Situation; TL= Traffic Light.

LKC consider the probability of carbon dioxide and methane gas affecting site users and buildings as unlikely. Assuming a severe consequence, there is a moderate / low risk. Given the minimal gas concentrations and flow, a low risk is considered most appropriate and no remediation is required based on results to date. This will be confirmed on completion of gas monitoring.

³⁵ CIRIA (2007). "Assessing Risks Posed by Hazardous Ground Gases to Buildings." CIRIA C665.

6.4 Controlled Water Assessment

The PRA identified a low risk with respect to controlled waters as no significant source of mobile contamination was anticipated. Furthermore, no abstractions have been identified within influencing distance. The surface water is not considered to be a significant receptor.

No evidence of significant mobile contamination was identified on the site. Although elevated metals and PAHs were identified within the soils, the source is anticipated to be coal noted within the made ground and topsoil. Contamination associated with coal is not anticipated to be mobile due to the residual crystalline nature of the matrix.

The site investigation did not identify any significant sources of likely mobile contamination within the soils. This confirms an unlikely probability of onsite contamination affecting controlled waters. With a medium consequence the risk is anticipated to be low and no remediation is required.

6.5 Additional Risk Assessments

6.5.1 Concrete (Pollutant Linkage 5)

As stated in Section 5, sulphate resistant concrete will not be required at the site. The site was classified as DS-1 AC-1.

Based on the above, the probability of sulphate concentrations affecting buildings is unlikely. Given the consequence is considered to be mild, the risk (pollutant linkage 5) is anticipated to be low and no remediation is required. This should be confirmed with the structural engineer.

6.5.2 Potable Water Supply (Pollutant Linkage 6)

Soil results were compared to United Utilities (UU) guidelines for the selection of potable water pipes in land potentially affected by contamination³⁶. Only contaminants of concern, based on the preliminary conceptual model and ground conditions encountered, were analysed. The following contaminants were not considered to be a risk and therefore not included in the analysis suites: chlorinated compounds, BTEX compounds, phenols, cresols, ethers, nitrobenzene, ketones, aldehydes and amines.

It should be noted typical pipework depths are 0.75mbgl to 1.35mbgl. The pipework will likely be laid into the underlying natural strata after levels have been reduced.

Elevated naphthalene was recorded in WS101 and WS101 between depths of 0.00-0.30mbgl respectively, however not at typical pipework depth of 0.75-1.35mbgl.

The probability of organic contaminants affecting potable water pipes is therefore unlikely. Given the consequence is considered to be medium, the risk (Pollutant Linkage 6) is anticipated to be low and no remediation (i.e. barrier pipe) is likely to be required.

UU may require a Potable Waters Risk Assessment to be carried out prior to the connection of any new water supply. This should be carried out once details of the pipeline location and depths are known.

³⁶ UU(2011). "United Utilities Water Supplementary Guidance for the Selection of Water Pipes in Land Potentially Affected by Contamination."

6.5.3 *Phytotoxicity (Pollutant Linkage 7)*

Soil results were compared to phytotoxic guideline values as outlined in BS3882³⁷.

No elevated contaminants were identified therefore the probability of phytotoxic contaminants affecting vegetation is considered to be unlikely. With a minor consequence, the risk (pollutant linkage 7) is anticipated to be very low.

6.6 **Revised Contamination Conceptual Model**

The preliminary contamination conceptual model (Table 2-7) has been revised following the risk assessments undertaken in Sections 6.1-6.5. The revised contamination conceptual model follows the same methodology and guidance used in the preliminary contamination conceptual model. The risk matrix is provided in Appendix A.

The revised contamination conceptual model is presented in Table 6-4.

Where a very low risk is identified no specific remediation is required.

Where a low risk is identified, some form of remediation may be required depending on the pollutant linkage, the type and concentration of contaminants present and the proposed development.

Where there is a moderate/low risk is identified, an assessment will be undertaken to establish what category the pollutant linkage will fall into.

Where LKC identifies a moderate or higher risk, remediation or further investigation work is recommended.

Further details of the remedial proposals and a remedial option appraisal are given in Section 9.

³⁷ BS (2015). "Specifications for Topsoil and Requirements for Use." BS3882:2015.

Pollutant Linkage	Pathway	Receptor	Contaminant	Probability	Consequence	Risk	Assessment
PL1	- Dermal contact. - Inhalation of soil, fibres and dust. - Ingestion of soils, dust, vegetables, soil attached to vegetables. - Windblown dust.	- Current residents. - Future residents. - Site users. - Offsite receptors.	Heavy metals: - Lead - PAHs: - BaP	Likely	Medium	Moderate	- Likely probability as elevated lead and PAHs identified in which could come into contact with site users in gardens / soft landscaping areas. - Recommendation: Remediation required. Likely to include removal of shallow made ground/ topsoil in garden / soft landscaping areas.
			ACM Hydrocarbons Other inorganic / organic contaminants: -None identified.	Unlikely	Medium	Low	- No ACM detected in soil samples. - No visual or olfactory evidence of hydrocarbon contamination within soil samples. - Recommendation*1*2: No further assessment required. Contractors should remain vigilant for ACM during earth works.
PL2	- Inhalation of vapours. - Migration through permeable strata and preferential pathways.	- Current residents. - Future residents. - Site users.	Volatile Contaminants: - None identified.	Unlikely	Medium	Low	- No elevated volatile contaminants across the site. - Recommendation: No remediation required.
PL3	- Inhalation of gas. - Migration through permeable strata and preferential pathways. - Explosion in confined spaces (methane only).	- Current residents. - Future residents. - Buildings. - Offsite land users.	- Carbon dioxide and methane	Unlikely	Severe	Moderate / Low	- No significant carbon dioxide or methane concentrations (max 4.0%v and 0.0%v/v). Negligible flow rates recorded to date. - Low risk assumed given no significant gas concentrations or flow rates recorded. - Recommendation: Site classified as CS1, no gas protection measures required.
			- Radon	Unlikely	Medium	Low	- No further assessment required.

Table 6-4: Revised Contamination Conceptual Model.

Notes

*1 Although no ACM identified, contractors should be vigilant during earthworks of any potential ACM. This is discussed further in Section 9.

*2 The conceptual model only takes into consideration the future use of the site and long-term exposure. Consideration should also be given to the short-term exposure of construction workers and nearby land users to ACM containing soils during groundworks. This is discussed further in Section 9.

Pollutant Linkage	Pathway	Receptor	Contaminant	Probability	Consequence	Risk	Assessment
PL4	– Surface Run-off. – Migration through permeable strata and preferential pathways – Perched waters migration.	– Groundwater (Secondary A and Undifferentiated Aquifers).	Mobile contaminants: – None identified	Unlikely	Medium	Low	– Although slightly elevated metals and PAHs identified, given the environmental settings and ground conditions encountered not considered to pose a significant risk to groundwater or surface water. – Recommendation: No remediation required.
PL5	– Sulphate attack on concrete.	– Building structure.	– Sulphate	Unlikely	Mild	Very Low	– No elevated sulphate identified in soils. – Recommendation: No remediation required.
PL6	– Ingestion of tainted water supply.	– Future site users (via potable water).	Organic Contaminants: – None identified	Unlikely	Medium	Low	– No elevated contaminants identified at pipeline depth. – Recommendation: Barrier piping unlikely to be required. However, this will need to be confirmed once UU risk assessment undertaken.
PL7	– Direct Contact (plant uptake).	– Flora.	Phytotoxic Contaminants: – None identified	Unlikely	Minor	Very Low	– No elevated contaminants identified. – Recommendation^{*3}: No remediation required.

Table 6-4 Continued: Revised Contamination Conceptual Model.

Notes

^{*3} Although no phytotoxic contaminants identified in soils, the characteristics of the made ground should also be taken into account if it is to be used as a topsoil / growing medium for flora. The material should be assessed against the parameters outlined in Table 1 of BS3882 (not included within this assessment).

7 Waste Disposal Assessment

The soil contamination results as presented in Appendix C have been used to help determine the waste classification of material for off-site disposal.

As an initial screen the soil results were inputted into Hazwaste Online™. This is a web-based facility that allows an assessment waste as either hazardous or non-hazardous waste based on relevant guidance and legislation^{38, 39, 40, 41, 42, 43, 44, 45, 46}.

Hazwaste Online™. has been designed to cover, amongst other waste types, the European Waste List of Waste (LoW) code number 17 "Construction and Demolition Waste (Including Excavated Soil from Contaminated Sites)".

Where less than limits of detection (LOD) were recorded, the value of the LOD was inputted.

Where applicable, appropriate metal species based on hazard statements/ molecular weight, site history, ground conditions and likely species present in soils were used (e.g. metal oxides relating to an ash based source).

The results show that all the samples tested are classified as NON-HAZARDOUS WASTE and LoW code "17-05-04 - soil and stones other than those mentioned in 17 05 03" is suitable. The Hazwaste Online™ output sheets are provided in Appendix G.

³⁸ EA (2018). "Guidance on the Classification and Assessment of Waste (1st Edition v1.1)". Technical Guidance WM3.

³⁹ CLP Regulation - Regulation 1272/2008/EC of 16 December 2008.

⁴⁰ 1st ATP - Regulation 790/2009/EC of 10 August 2009

⁴¹ Correction to 1st ATP - Regulation 758/2013/EU of 7 August 2013

⁴² WFD Annex III replacement - Regulation 1357/2014/EU of 18 December 2014

⁴³ Revised List of Wastes 2014 - Decision 2014/955/EU of 18 December 2014

⁴⁴ 13th ATP - Regulation (EU) 2018/1480 of 4 October 2018

⁴⁵ POPs Regulation 2004 - Regulation 850/2004/EC of 29 April 2004

⁴⁶ 2nd ATP to POPs Regulation - Regulation 757/2010/EU of 24 August 2010

8 Conclusions

8.1 Geotechnical

Detailed geotechnical observations and conclusions are contained in Table 8-1 below, more detailed discussions are contained within Section 5.

Proposed Development	- Low rise residential housing consisting of 3no. adjoining 3 bedroom units
General Ground conditions / Geotechnical Testing	- Based on WS101-WS103. - Maximum investigation depth 5.04mbgl. - Made Ground or Topsoil to 0.3mbgl. - Medium dense clayey/silty gravelly SAND to 1.4-2.40mbgl. SPTs N=14-26 at 1.2mbgl, N=29 at 2mbgl. - Very stiff CLAY to 2.70-3.10mbgl, SPT N=11-26 at 2mbgl. - Extremely weak MUDSTONE bedrock encountered at base of window sample holes. - No groundwater encountered.
Allowable Bearing Pressure	- 137kN/m² within the SAND. - 103kN/m² within the CLAY.
Anticipated Foundation Type	- Traditional shallow foundations recommended from approximately 1mbgl. If soft ground is encountered, foundations may need to be deepened / widened or ground replaced with compacted granular material.
Shallow Groundwater	- Shallow groundwater was not encountered within any of the exploratory holes during the site investigation.
Concrete Requirements	- Based on BRE Digest 2005 ⁴⁷ – DS-1 AC-1 recommended.
Services	- Services – consideration to the potential presence of services running through the site which used to service the former structure historically recorded in the north of the site. Services may need to re-routed.
Coal Mining	- Based on the CON29 report provided by the client, the site is not at risk from coal mining based instability.
Temporary support of excavation	- May be required due to the presence of granular SAND to a depth of 2.40mbgl; however, exploratory holes were generally recorded as stable.
Plasticity	- Consideration will need to be given to the shrink / swell of the clay strata if it is to be used as founding strata, particularly where trees/hedges are present. Foundations may need to be deepened. A low to medium volume change potential has been calculated for the site.

Table 8-1: Geotechnical Observations and Conclusions Table.

8.2 Contamination Assessment

A revised contamination conceptual model has been produced by LKC which is summarised in Table 8-2 below (more detailed model provided in Section 6).

⁴⁷ BRE (2005). "Concrete in Aggressive Ground." Special Digest 1.

Pollutant Linkage		Risk	Recommendations
1	Contaminants posing a risk to site users via dermal contact, ingestion and inhalation (of soil, dust, fibres and vegetables).	Moderate	- Elevated lead and PAHs identified. - Recommendations: Remediation required in garden areas to include removal of shallow made ground / topsoil in any area of soft landscaping.
		Low	- No ACM, elevated petroleum hydrocarbons identified. - Recommendations: No remediation required.
2	Volatile contaminants posing a risk to site users via the inhalation of vapours.	Low	- No elevated volatile contamination identified. - Recommendations: No remediation required.
3	Gas posing a risk to buildings and site users via the migration of gas into building causing explosion and asphyxiation.	Moderate / Low	- Low gas concentrations and flow rates recorded. Low risk assumed. - Recommendations: Site classified as CS1, no gas protection measures required.
4	Mobile contamination posing a risk to controlled waters via the migration through permeable strata.	Low	- No evidence of significant mobile contamination identified in soil. - Recommendations: No remediation required.
5	Sulphate posing a risk to building via direct contact (sulphate attack).	Low	- No elevated sulphate identified on site. - Recommendations: Sulphate resistant concrete not required. This should be confirmed by structural engineer.
6	Organic contaminants posing a risk to water pipes.	Low	- No organic contamination identified at potable pipe depth of 0.75-1.35mbgl. - Recommendations: UU risk assessment to be completed. The site not likely to require barrier piping.
7	Phytotoxic metals posing a risk to flora via root uptake.	Low	- No phytotoxic metals above generic criteria. - Recommendations: No remediation required.

Table 8-2: Summary Risk Table.

Remedial recommendations are presented in Section 9.

9 Recommendations and Remedial Strategy

The recommendations provided below are considered appropriate for the site based on the site investigation work undertaken. LKC should stress that no remediation, enabling works or designing works should take place until Regulatory approval has been obtained. **The remediation recommendations will be confirmed in the final report.**

9.1 Remediation and Validation Recommendations

Table 9-1 details the further works and remedial recommendations / requirements. The table shows work required pre-construction (i.e. during earthworks) and during / post construction.

Phase	PL	Remediation Requirements	Validation Requirements
Pre-Construction	ALL	<u>Earthworks Inspections / Unexpected Contamination</u> The relevant contractors should be briefed that during development works at the site should any unusual ground conditions and / or visual or olfactory evidence of contamination (including asbestos containing material) be encountered at the site, LKC and the Local Authority should be informed, and further assessment of the material may be required. Should asbestos be identified during groundworks, precautions should be taken to ensure the safety of the construction workers and nearby land users. It would be advisable to introduce an asbestos management strategy in line with CIRIA C733⁴⁸.	Log of work undertaken including photographs. Details of any sampling undertaken and validation of any potential additional remedial work.
Build-Phase Construction	1	As the made ground is relatively shallow, the removal of made ground in garden areas has been indicated as the preferred option of remediation. This should comprise removal of all reworked topsoil / made ground from garden and soft landscaping and raise levels (as required) with suitably chemically validated subsoil and topsoil.	<u>Option 1</u> Consignment notes confirming the removal of made ground. Photographic evidence of natural strata. Chemical validation of imported soils: See Table 9-2.
	6	<u>Potable Water Pipes</u> It is recommended that a Water Pipeline Assessment is undertaken once the location and depth of potable water pipes are known. It is unlikely that barrier pipe will be required.	Delivery Notes of Pipe Material. Photographs of the Installed Pipe.
	2, 3, 4, 5, 7	No remediation anticipated with respect to PL2 (inhalation of vapours), PL3 (gas) PL4 (controlled waters). PL5 (sulphate) and PL7 (phytotoxicity).	N/A
Other Considerations		<u>Grubbing Out of In-Ground Structures</u> It is recommended that in-ground structures are grubbed out as part of the groundworks. In-ground structures expected in north of the site associated with the small former building on site.	

⁴⁸ CIRIA (2014). "Asbestos in Soil and Made Ground: A Guide to Understanding and Managing Risks". C733.

	<u>Re-use of site won material</u> To ensure material is compliant with appropriate waste regulations, any site won material re-used onsite should be in recourse to appropriate exemptions. A U1 and T5 exemption should be registered. This will allow the following to be used onsite or brought in for use onsite (refer to guidance for types of waste that can be used ⁴⁹): 5,000 tonnes (c. 2,500m³) <u>treatment</u> of crushed concrete / stone. 1,000 tonnes (c. 500³) <u>use of</u> non-hazardous soil 5,000 tonnes (c. 2,500m³) <u>use of</u> clays, sand, gravel, brick, concrete, stone etc. 50,000 tonnes (c. 25,000m³) <u>use of</u> bituminous material to be used in roadways. A Materials Management Plan (MMP) with recourse to the CL:AIRE Code of Practice may be required if volumes exceed exemption limits. This must be registered <u>before</u> material movement starts onsite. If an MMP is required, this needs to be registered by a Qualified Person (QP) and there must be 'certainty of use' for any material re-used onsite or exported to site to ensure there is no 'sham recovery'. For all the above material will need to be tested at the rate and analytical suites presented in Table 9-2. <u>Topsoil Growing Medium</u> A topsoil cover of approximately 150mm is recommended in gardens and soft landscaping areas. <u>Health and Safety Considerations</u> In working with, removing or treating any contaminating material it is important that any potential risks associated with the actual site works are mitigated by good environmental management of the site during the remedial phases. Standard health and safety precautions (as per HSE guidance⁵⁰) should be adopted by all workers involved with site enabling and construction works.
--	---

Table 9-1: Further work, remediation and validation requirements

Notes: See Table 6-4 for pollutant linkage (PL) details.

9.2 Validation of Subsoil / Topsoil

Chemical validation of all imported soils to be used on site in gardens and soft landscaping areas should be undertaken. Imported soils should be accompanied by a certificate of analysis and source details.

A summary of the required imported material sampling requirements is presented in Table 9-2. Ideally, the material should be sampled at source to prevent double handling if soil fails, with confirmatory sampling undertaken on importation to site. However, where this is not possible then material imported should be segregated based on source and soil type. Validation samples should be taken prior to placement in gardens to ensure suitability for use.

⁴⁹ <https://www.gov.uk/guidance/waste-exemptions-using-waste>

⁵⁰ HSE (1991). "Protection of Workers and the General Public During Development of Contaminated Land" London HMSO.

Material Type	Source	Suite of Analysis	Sampling Rate*
Topsoil	Greenfield	Suite A	1 sample per 50m³
	Brownfield / Unknown	Suite B	
Subsoil	Brownfield / Unknown	Suite B	1 sample per 150m³
	Site won natural material / greenfield	Suite A	
	First Generation i.e. quarried sand (subsoil) or stone (break layer)	No testing is required. Certification of material provenance is required.	
Physical Stone Break Layer	Recycled Stone (6F2 / screened)	Suite B	1 sample per 500m³

Table 9-2: Sampling requirements for imported soils.

Notes:

Suite A - Heavy metals, pH, water soluble sulphate, speciated PAH, soil organic matter and asbestos screen.

Suite B - Heavy metals, pH, water soluble sulphate, speciated PAH, phenol, total and free cyanide, soil organic matter, asbestos screen, banded petroleum hydrocarbons (TPH CWG), BTEX, MTBE.

*Minimum sampling rate of 3 samples per source.

Any soil with visual or olfactory evidence of hydrocarbons should be rejected.

In addition, it should be ensured that the matrix of the topsoil is suitable as a growing medium and no undesirable material is present (in line with BS3882⁵¹). LKC advise this information is provided by the supplier before material is imported onto site.

Imported material to be used in gardens will be compared against residential with plant uptake criteria (as used in the contamination risk assessment (Section 6-1)). Appropriate remedial target criteria are presented in Appendix G.

9.3 Site Completion Report

It is recommended that any remediation carried out on the site is validated by a third party and suitable documentary evidence provided in a Site Completion Report, such as photographs, consignment documents and analytical results. This should include as a minimum:

- » Provision of waste transfer documents.
- » If option 1 (source removal): Validation of any made ground removal (photographic evidence that natural strata was reached).
- » If option 2 (environmental capping layer): Validation of environmental cover system.
- » Verification testing of all imported soil for garden and soft landscaping areas.
- » Information on the installation of protective pipes and / or sterile trenches.
- » Details of any unexpected contamination identified onsite, suitably risk assessed and / or validated.

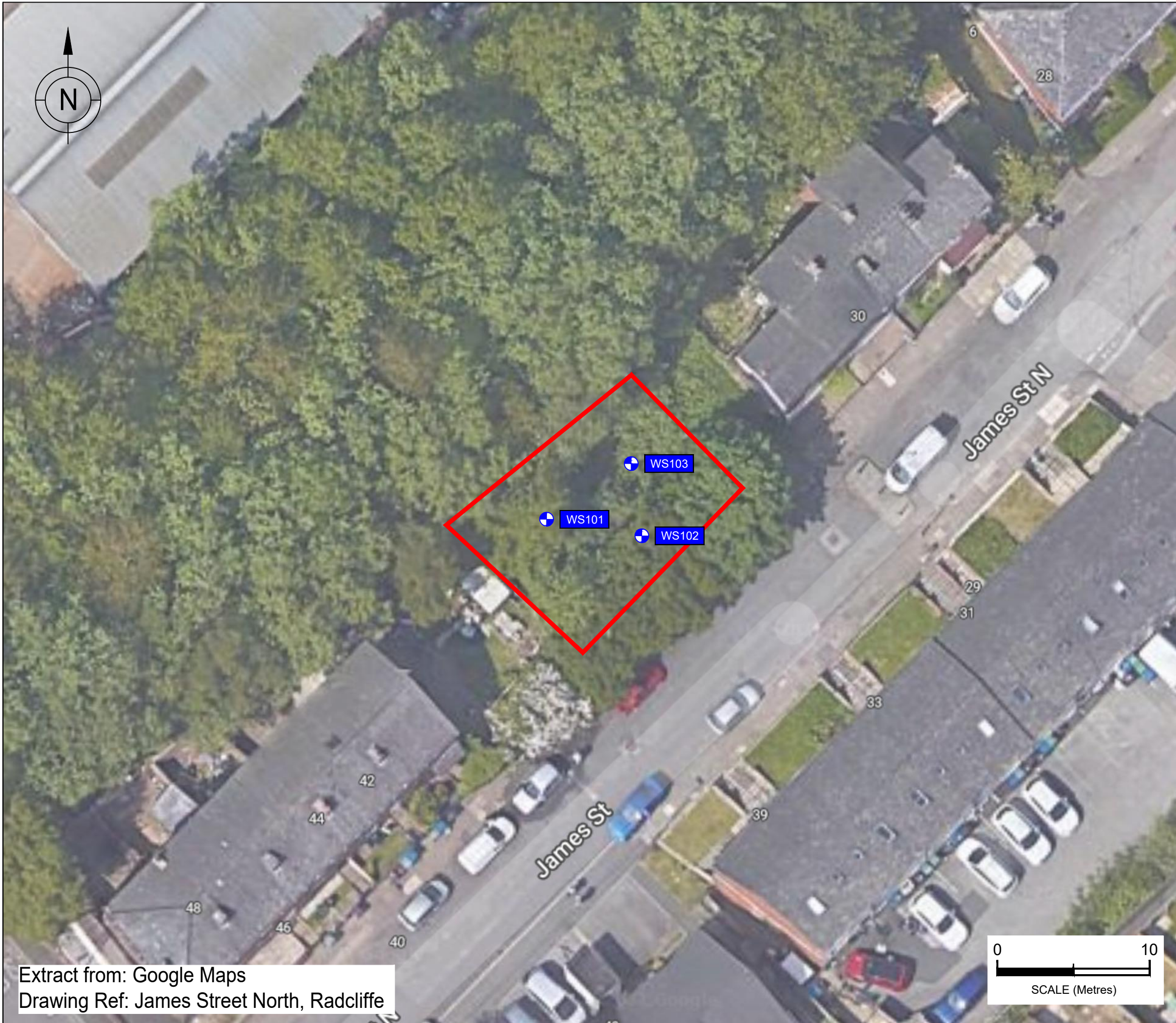
The Site Completion Report will assist the Local Authority in the discharge of any future relevant planning condition and will also be of use to solicitors acting on behalf of any prospective conveyancer who may have concerns over the former use of the site.

⁵¹ BS (2015). "Specifications for Topsoil and Requirements for use." BS3882:2015.

Figures



Client: Mairose Property Developments Ltd				Title: Site Location & Boundary Plan			
Site: James Street North, Radcliffe				Scale (see scale bar): 1:25,000 & 1:1,000 @ A4			
Job No.: LKC 20 1984	Drawn By: HM	Checked By: HM	Drawn: Jan 2021	Figure: 1		Revision:	



Extract from: Google Maps
Drawing Ref: James Street North, Radcliffe

KEY

-  Site Boundary
-  Window Sample Borehole (WS)

Sampling Locations and features annotated by LK Consult Ltd are approximate and are based upon observed measurements unless otherwise stated. Do not scale from this drawing and work from marked dimensions only. All dimensions and features should be confirmed on site by the Contractor. Where this drawing includes information provided to LK Consult Ltd by others, LK Consult Ltd gives no warranty, representation or assurance as to the accuracy of such information.



Client: Mairose Property Developments Ltd			
Site: James Street North, Radcliffe			
Title: Site Investigation Location Plan			
Job No.: LKC 20 1984	Scale (See Scale Bar): 1:250 @ A3	Figure: 2	Revision:
Drawn By: AC	Checked By: BR	Drawn: Apr 2021	

Appendix A

Risk Matrix

Risk Evaluation

The method for risk evaluation is a qualitative method of interpreting the output from the risk estimation stage of the assessment, based on CIRIA 552⁵². It involves the classification of the:

- » Magnitude of the potential consequence (severity) of the risk occurring (Table A).
- » Magnitude of the probability (likelihood) of the risk occurring (Table B).

Consequence (Severity)		
Classification	Definition	Example
Severe	- Short term (acute) risk to human health likely to results in 'significant harm' as defined by the Environment Protection Act 1990, Part IIA. - Short term risk of pollution (note: water Resources Act contains no scope for considering significance of pollution) of sensitive water resource. - Catastrophic damage to buildings/properties. - A short-term risk to a particular ecosystem, or organism forming part of such ecosystem (note: the definition of ecological systems within the Draft Circular on Contaminated Land, DETR, 2000).	- High Concentrations of cyanide on the surface of an informal recreation area. - Major spillage of contaminants from site into controlled waters. - Explosion, causing building collapse (can also equate to short term human health risk if buildings are occupied).
Medium	- Chronic damage to Human Health ('significant harm' as defined in DETR, 2000). - Pollution of sensitive water resources (note Water Resources Act contains no scope for considering significance of pollution). - A significant change in a particular ecosystem, or organism forming part of such ecosystem.	- Concentrations of a contaminant from site exceed generic, or site-specific assessment criteria. - Leaching of contaminants from a site to a major or minor aquifer (Principal and Secondary). - Death of a species within a designated nature reserve.
Mild	- Pollution of non-sensitive water resources. - Significant damage to crops, buildings, structures and services ('significant harm' as defined in DETR, 2000). - Damage to sensitive buildings/structures/services or the environment.	- Pollution of non-classified groundwater. - Damage to building rendering it unsafe to occupy (e.g. foundation damage resulting in instability).
Minor	- Harm, although not necessarily significant harm, which may result in a financial loss, or expenditure to resolve. - Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc). - Easily repairable damage to buildings, structures and services.	- The presence of contaminants at such concentrations that protective equipment is required during site works. - The loss of plants in a landscaping scheme. - Discoloration of concrete.

Table A. Classification of Consequence

Probability (Likelihood)	
Classification	Definition
High Likelihood	- There is a pollutant linkage and an event that either appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution.
Likely	- There is a pollutant linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. - Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low Likelihood	- There is a pollutant linkage and circumstances are possible under which an event could occur. - However, it is by no means certain that even over a longer period such event would take place and is less likely in the shorter term.
Unlikely	- There is a pollutant linkage, but circumstances are such that it is improbable that an event would occur in the very long term.

Table B. Classification of Probability.

⁵² CIRIA C552 (2001) Contaminated Land Risk Assessment - A Guide to Good Practice.

These classifications are then compared to indicate the risk presented by each pollutant linkage (Table C). It is important that this classification is only applied where there is a possibility (which can range from high likelihood to unlikely) of a pollutant linkage existing.

		Consequence			
		Severe	Medium	Mild	Minor
Probability	High Likelihood	Very High Risk	High Risk	Moderate Risk	Moderate / Low Risk
	Likely	High Risk	Moderate Risk	Moderate / Low Risk	Low Risk
	Low Likelihood	Moderate Risk	Moderate / Low Risk	Low Risk	Very Low Risk
	Unlikely	Moderate / Low Risk	Low Risk	Very Low Risk	Very Low Risk

Table C. Comparison of Consequence against Probability

Once the risk has been determined the corresponding action can be assessed (Table D).

Risk	Action Required
Very High Risk	- 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 already undertaken) and remediation are likely to be required.
High Risk	- 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	- 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	- 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	- 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.

Table D. Description of the Classification and Likely Action Required.

Where a very low risk is identified no specific remediation is required.

Where a low risk is identified, some form of remediation may be required depending on the pollutant linkage, the type and concentration of contaminants present and the proposed development.

Where there is a moderate/low risk identified, an assessment will be undertaken to establish what category the pollutant linkage will fall into.

Where LKC identifies a moderate or higher risk, remediation or further investigation work is recommended.

Appendix B

Profile Logs

Window Sample Logs

Excavation Method

Drive-in Windowless Sampler

Dimensions

101mm to 2.00m

Ground Level (mOD)

78.00

Client

Mairose Property Developments Ltd

Job
Number
LKC 20 1984

Location (Observed measurements)

378633 E 406660 N

Dates

19/03/2021

Engineer

LKC

Sheet

1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.00-0.30	ES1 PID=0.1ppm			77.70	(0.30) 0.30	MADE GROUND: Blackish brown very sandy organic SILT with occasional coal, brick fragments, roots and rootlets. Sand is fine the medium. Medium dense brownish orange gravelly clayey SAND with occasional bands of clay. Sand is fine to coarse. Gravel is fine to coarse, angular to subangular comprising sandstone and coal.			
1.20-1.65	SPT N=14		3,3/4,3,4,3		(2.10)				
1.50-2.00	DB2					Pink in colour from 1.60mbgl.			
2.00-2.45	SPT N=29		3,3/4,8,9,8						
2.40-3.00	PP 223kPa DB3			75.60	2.40	Sandstone Cobble at 2.30mbgl.			
2.50-2.70						Extremely weak, extremely weathered red MUDSTONE recovered as very stiff very high strength gravelly clay. Gravel is fine to medium, angular comprising mudstone.			
3.00-3.45	SPT N=24		4,4/4,6,7,7		(2.64)				
4.00-4.45	SPT N=27		6,6/6,7,7,7						
4.70-5.04	SPT 50/190		10,12/12,19,19	72.96	5.04	Complete at 5.04m			

Remarks

Location taken from <https://gridreferencefinder.com>
Elevation taken from <https://www.freemaptools.com/elevation-finder.htm>
No groundwater was encountered.
Borehole stable.
Sampler refusal at 4.70mbgl, SPT driven to 5.04mbgl. Refusal in probable mudstone bedrock.
Pocket penetrometer test taken between 2.40-3.00mbgl exceeded the maximum reading. This has been recorded as the maximum reading of 223kPa.
Monitoring well installed to 4.70mbgl.

Scale
(approx)

1:50

Logged
By

BR

Figure No.

LKC 20 1984.WS101

Excavation Method

Drive-in Windowless Sampler

Dimensions

101mm to 1.00m

Ground Level (mOD)

78.00

Client

Mairose Property Developments Ltd

Job
Number
LKC 20 1984

Location (Observed measurements)

378641 E 406657 N

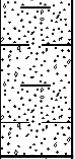
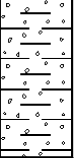
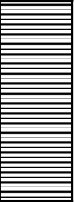
Dates

19/03/2021

Engineer

LKC

Sheet
1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.00-0.30	ES1 PID=<0.1ppm			77.70	(0.30) 0.30	TOPSOIL: Blackish brown very sandy organic SILT with frequent roots and rootlets, rare coal. Sand is fine the medium.			
0.50-1.00	ES2 PID=<0.1ppm					Medium dense brownish orange gravelly silty SAND. Sand is fine to coarse. Gravel is fine to coarse, angular to subangular comprising sandstone and mudstone.			
1.20-1.65 1.30-1.60	SPT N=15 DB3		2,3/3,3,4,5		(1.75)	Pale yellow in colour below 1.20mbgl.			
2.00-2.45	SPT N=11		2,2/2,3,3,3	75.95	2.05	Very stiff consistency reddish brown slightly gravelly CLAY. Gravel is fine to medium, angular comprising mudstone.			
2.40-2.70 2.50-2.70	PP 223kPa DB4				(1.05)				
3.00-3.45	SPT N=20		3,4/5,5,5,5	74.90	3.10	Extremely weak extremely weathered red MUDSTONE.			
					(1.32)				
4.00-4.42	SPT 50/265		9,11/11,14,13,12	73.58	4.42	Complete at 4.42m			

Remarks

Location taken from <https://gridreferencefinder.com>
Elevation taken from <https://www.freemaptools.com/elevation-finder.htm>
No groundwater encountered.
Borehole stable.
Sampler refusal at 4.00mbgl, SPT driven to 4.42mbgl. Refusal in probable mudstone bedrock.
Pocket penetrometer test taken between 2.4-2.7mbgl exceeded the maximum reading. This has been recorded as the maximum reading of 223kPa.
Monitoring well installed to 4.00mbgl.

Scale
(approx)

1:50

Logged
By

BR

Figure No.

LKC 20 1984.WS103

Excavation Method

Drive-in Windowless Sampler

Dimensions

101mm to 1.00m

Ground Level (mOD)

78.00

Client

Mairose Property Developments Ltd

Job
Number

LKC 20 1984

Location (Observed measurements)

378643 E 406665 N

Dates

19/03/2021

Engineer

LKC

Sheet

1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.00-0.20	ES1 PID=0.1ppm				(0.30)	TOPSOIL: Blackish brown very sandy organic SILT with frequent roots and rootlets, occasional coal. Sand is fine the medium.			
0.50-1.00	ES2 PID=<0.1ppm			77.70	0.30				
1.20-1.65	SPT N=26		4,5/6,6,7,7		(1.10)	Medium dense brownish orange gravelly silty SAND. Sand is fine to coarse. Gravel is fine to coarse, angular to subangular comprising sandstone and mudstone.			
1.60-2.00	DB3			76.60	1.40				
2.00-2.45	SPT N=13		3,3/3,3,3,4		(1.30)	Very stiff consistency reddish brown slightly gravelly CLAY. Gravel is fine to medium, angular comprising mudstone.			
2.40-2.70	PP 223kPa								
2.50-2.70	DB4			75.30	2.70				
3.00-3.42	SPT 50/265		8,7/9,15,13,13		(0.72)	Extremely weak extremely weathered red MUDSTONE.			
				74.58	3.42	Complete at 3.42m			

Remarks

Groundwater encountered at 2.10mbgl.
Borehole stable.
Sampler refusal at 3.00mbgl, SPT driven to 3.42mbgl. Refusal in weathered mudstone.
Pocket penetrometer test taken between 2.4-2.7mbgl exceeded the maximum reading. This has been recorded as the maximum reading of 223kPa.
Monitoring well installed to 3.00mbgl.
Location taken from <https://gridreferencefinder.com>
Elevation taken from <https://www.freemaptools.com/elevation-finder.htm>

Scale
(approx)

1:50

Logged
By

BR

Figure No.

LKC 20 1984.WS103

Appendix C

Certificates of Analysis – Soil



Final Report

Report No.: 21-08911-1
Initial Date of Issue: 26-Mar-2021
Client LK Consult
Client Address: Unit 29 Eton Business Park
Eton Hill Road
Radcliffe
Manchester
Lancashire
M26 2ZS
Contact(s): Contaminated Land
Hannah Moss
Project LKC 20 1984 James Street North,
Radcliffe

Quotation No.:		Date Received:	22-Mar-2021
Order No.:	738494	Date Instructed:	22-Mar-2021
No. of Samples:	4		
Turnaround (Wkdays):	5	Results Due:	26-Mar-2021
Date Approved:	26-Mar-2021		

Approved By:

Details: Glynn Harvey, Technical Manager

Results - Soil

Project: LKC 20 1984 James Street North, Radcliffe

Client: LK Consult	Chemtest Job No.:				21-08911	21-08911	21-08911	21-08911
Quotation No.:	Chemtest Sample ID.:				1163834	1163835	1163836	1163837
Order No.: 738494	Client Sample Ref.:				ES1	ES1	ES1	ES2
	Client Sample ID.:				Ws101	Ws102	Ws103	Ws103
	Sample Type:				SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.0	0.0	0.0	0.5
	Bottom Depth (m):				0.3	0.3	0.2	1.0
	Date Sampled:				19-Mar-2021	19-Mar-2021	19-Mar-2021	19-Mar-2021
	Asbestos Lab:				COVENTRY	COVENTRY	COVENTRY	
Determinand	Accred.	SOP	Units	LOD				
ACM Type	U	2192		N/A	-	-	-	
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	
ACM Detection Stage	U	2192		N/A	-	-	-	
Moisture	N	2030	%	0.020	37	17	17	20
Soil Colour	N	2040		N/A	Black	Brown	Black	Brown
Other Material	N	2040		N/A	Roots	Roots	Roots and Wood	None
Soil Texture	N	2040		N/A	Clay	Clay	Sand	Sand
pH	M	2010		4.0	8.0	7.7	8.0	8.1
Magnesium (Water Soluble)	N	2120	g/l	0.010				< 0.010
Sulphate (2:1 Water Soluble) as SO4	M	2120	g/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010
Chloride (Water Soluble)	M	2220	g/l	0.010				< 0.010
Nitrate (Water Soluble)	N	2220	g/l	0.010				< 0.010
Arsenic	M	2450	mg/kg	1.0	21	12	15	
Cadmium	M	2450	mg/kg	0.10	0.45	0.20	0.45	
Chromium	M	2450	mg/kg	1.0	23	20	16	
Copper	M	2450	mg/kg	0.50	64	34	45	
Mercury	M	2450	mg/kg	0.10	0.23	0.13	0.18	
Nickel	M	2450	mg/kg	0.50	23	19	19	
Lead	M	2450	mg/kg	0.50	330	99	130	
Selenium	M	2450	mg/kg	0.20	0.79	0.70	0.50	
Vanadium	U	2450	mg/kg	5.0	31	24	27	
Zinc	M	2450	mg/kg	0.50	220	72	170	
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	
Organic Matter	M	2625	%	0.40	12	3.8	4.0	
Naphthalene	M	2800	mg/kg	0.10	3.6	0.24	1.8	
Acenaphthylene	N	2800	mg/kg	0.10	0.16	0.19	2.0	
Acenaphthene	M	2800	mg/kg	0.10	7.8	0.15	0.35	
Fluorene	M	2800	mg/kg	0.10	4.0	0.16	0.78	
Phenanthrene	M	2800	mg/kg	0.10	46	1.2	8.7	
Anthracene	M	2800	mg/kg	0.10	9.9	0.43	3.4	
Fluoranthene	M	2800	mg/kg	0.10	52	2.5	15	
Pyrene	M	2800	mg/kg	0.10	46	2.7	14	
Benzo[a]anthracene	M	2800	mg/kg	0.10	22	1.5	9.4	
Chrysene	M	2800	mg/kg	0.10	21	1.4	8.5	
Benzo[b]fluoranthene	M	2800	mg/kg	0.10	24	1.9	13	

Results - Soil

Project: LKC 20 1984 James Street North, Radcliffe

Client: LK Consult	Chemtest Job No.:				21-08911	21-08911	21-08911	21-08911
Quotation No.:	Chemtest Sample ID.:				1163834	1163835	1163836	1163837
Order No.: 738494	Client Sample Ref.:				ES1	ES1	ES1	ES2
	Client Sample ID.:				Ws101	Ws102	Ws103	Ws103
	Sample Type:				SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.0	0.0	0.0	0.5
	Bottom Depth (m):				0.3	0.3	0.2	1.0
	Date Sampled:				19-Mar-2021	19-Mar-2021	19-Mar-2021	19-Mar-2021
	Asbestos Lab:				COVENTRY	COVENTRY	COVENTRY	
Determinand	Accred.	SOP	Units	LOD				
Benzo[k]fluoranthene	M	2800	mg/kg	0.10	8.4	0.77	4.6	
Benzo[a]pyrene	M	2800	mg/kg	0.10	22	1.8	12	
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10	14	1.2	8.6	
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	2.6	0.25	1.9	
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10	12	1.0	6.9	
Total Of 16 PAH's	N	2800	mg/kg	2.0	300	17	110	

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2220	Water soluble Chloride in Soils	Chloride	Aqueous extraction and measurement by 'Aquakem 600' Discrete Analyser using ferric nitrate / mercuric thiocyanate.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenzo[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at the indicated laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

- A - Date of sampling not supplied
- B - Sample age exceeds stability time (sampling to extraction)
- C - Sample not received in appropriate containers
- D - Broken Container
- E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

customerservices@chemtest.com

Appendix D

Certificates of Analysis - Geotechnical



TEST REPORT

Client LK Consult Ltd

Address Unit 29 Eton Business Park
Eton Hill Road
Radcliffe
Greater Manchester
M26 2ZS

Contract LKC 20 1984 -
James Street North, Radcliffe

Job Number MRN 4066/66
Date of Issue 09 April 2021
Page 1 of 4

Approved Signatories

S J Hutchings, O P Davies

Notes

- 1 All remaining samples and remnants from this contract will be disposed 28 days from the date of this report unless you notify us to the contrary.
- 2 Result certificates, in this report, not bearing a UKAS mark, are not included in our UKAS accreditation schedule.
- 3 Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation
- 4 Certified that the samples have been examined and tested in accordance with the terms of the contract/order and unless otherwise stated conform to the standards/specifications quoted. This does not, however, guarantee the balance of the materials from which the tested samples have been taken to be of equal quality.



MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

PARTICLE SIZE DISTRIBUTION

BS 1377: PART 2: Clause 9.2: 1990

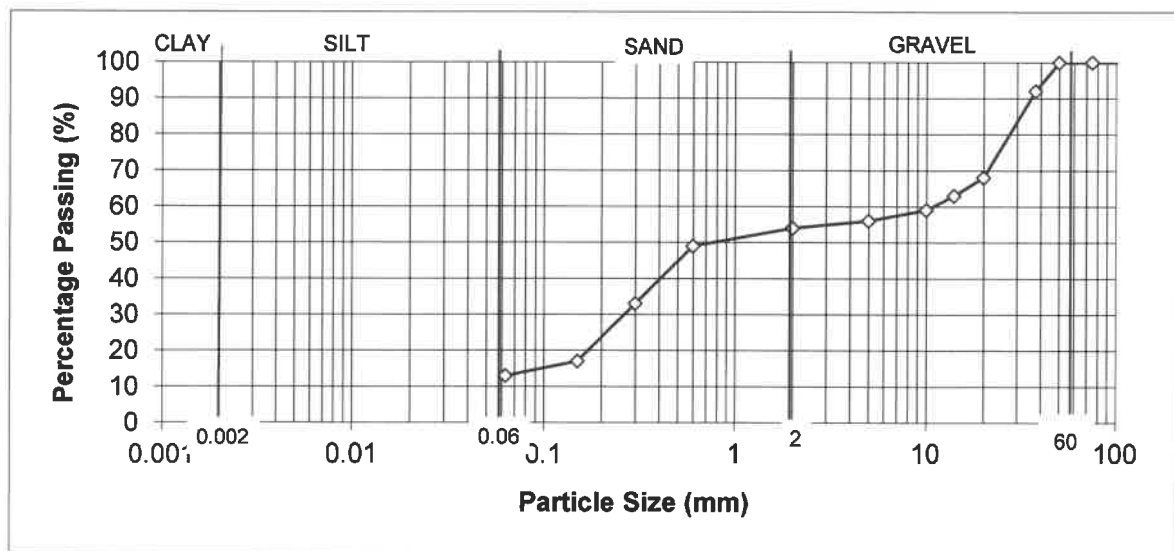
Determination of Moisture Content in accordance with BS 1377: PART 2: Clause 3: 1990 (Oven Dry)

CLIENT	LK Consult Ltd
SITE	LKC 20 1984 - James Street North, Radcliffe
JOB NUMBER	MRN 4066/66

SAMPLE LABEL	WS101 1.50-2.00	DATE SAMPLED	19-Mar-21
LAB SAMPLE No	97386	DATE RECEIVED	26-Mar-21
DATE TESTED	29-Mar-21	SAMPLED BY	Client

MATERIAL	Brown silty SAND and GRAVEL
ADVISED SOURCE	Site Investigation Sample

Sieve Size (mm)	% Passing (%)	Specification (%)	Sieve Size (mm)	% Passing (%)	Specification (%)
150	100		10	59	
125	100		5	56	
75	100		2	54	
50	100		0.6	49	
37.5	92		0.3	33	
20	68		0.15	17	
14	63		0.063	13	



REMARKS

As received moisture content = 13%

SIGNED

NAME

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE

09-Apr-21

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

LIQUID AND PLASTIC LIMIT

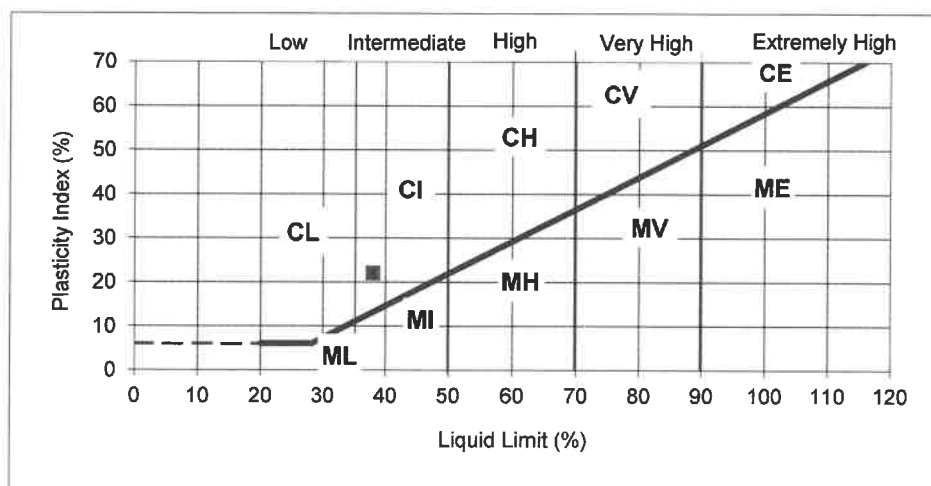
BS 1377: PART 2: 1990 Clause 4.4 ONE POINT METHOD & Clause 5.3
MOISTURE CONTENT METHOD BS 1377: PART 2: 1990 Clause 3.2

CLIENT	LK Consult Ltd
SITE	LKC 20 1984 - James Street North, Radcliffe
JOB NUMBER	MRN 4066/66

SAMPLE LABEL	WS102 2.50-2.70	DATE SAMPLED	19-Mar-21
SAMPLE No.	97387	DATE RECEIVED	26-Mar-21
DATE TESTED	30-Mar-21	SAMPLED BY	Client

MATERIAL	Stiff brown silty sandy CLAY
ADVISED SOURCE	Site Investigation Sample

Moisture Content (Natural) (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
13	38	16	22	100



REMARKS

Sample tested after wet sieving

SIGNED

NAME
Page 3 of 4

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE 09-Apr-21

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

LIQUID AND PLASTIC LIMIT

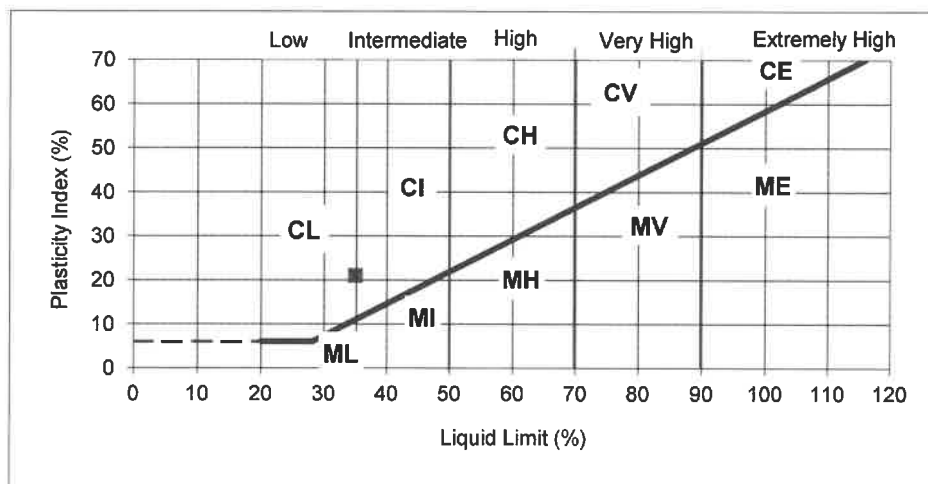
BS 1377: PART 2: 1990 Clause 4.4 ONE POINT METHOD & Clause 5.3
MOISTURE CONTENT METHOD BS 1377: PART 2: 1990 Clause 3.2

CLIENT	LK Consult Ltd
SITE	LKC 20 1984 - James Street North, Radcliffe
JOB NUMBER	MRN 4066/66

SAMPLE LABEL	WS103 1.60-2.00	DATE SAMPLED	19-Mar-21
SAMPLE No.	97388	DATE RECEIVED	26-Mar-21
DATE TESTED	30-Mar-21	SAMPLED BY	Client

MATERIAL	Stiff brown grey silty sandy CLAY with rare gravel
ADVISED SOURCE	Site Investigation Sample

Moisture Content (Natural) (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
18	35	14	21	87



REMARKS

Sample tested after wet sieving

SIGNED

NAME O.P. Davies BA (Hons)
Page 4 of 4 (Laboratory Manager)

DATE 09-Apr-21

Appendix E

Gas Monitoring Results

Site	James Street North, Radcliffe
Job Number	LKC 20 1984
Date	26/03/2021
Engineer	RW
Visit	1 of 6

Equipment ¹		
Instrument	Serial Number	Comments
Gas Analyser GA5000	G502417	Serviced, calibrated, gas checked.
Blue Dipmeter	1	Operating normally.

Atmospheric / Ground Conditions	
Atmospheric pressure trend onsite	Rising then steady
Atmospheric pressure (prev 24hrs)	Falling
Weather Conditions	Raining, Still, cold
Ground Conditions	Wet

[illegible]

ABBREVIATIONS	
ND	Not detected
NR	Not recorded
UR	Unable to record
OS	Off recordable scale
N/A	Not applicable
ppm	Parts per million
mb	Millibars
l/hr	Litres per hour
mbgl	Metres below ground level
LEL	Lower explosive limit in air

NOTES
All monitoring is carried out in line with LK Consult Ltd procedures, with reference to CIRIA C665.
¹ Equipment is serviced and checked as recommended by the manufacturer. Refer to calibration records and service certificates.
² CH4 is explosive between the range of 5-15%v/v. 100% lower explosive limit is equal to 5%v/v CH4.
³ Flow readings are based on a 1 minute average value where flow is detected (equipment range of +/- 12 ltr/hr).

Site	James Street North, Radcliffe
Job Number	LKC 20 1984
Date	09/04/2021
Engineer	RW FP
Visit	2 of 6

Equipment ¹		
Instrument	Serial Number	Comments
Gas Analyser GA5000	G502417	Serviced, calibrated, gas checked.
Blue Geotech Dipmeter	1	Operating normally.

Atmospheric / Ground Conditions	
Atmospheric pressure trend onsite	Rising then steady
Atmospheric pressure (prev 24hrs)	Falling
Weather Conditions	Sunny, still, mild
Ground Conditions	Dry

[illegible]

ABBREVIATIONS	
ND	Not detected
NR	Not recorded
UR	Unable to record
OS	Off recordable scale
N/A	Not applicable
ppm	Parts per million
mb	Millibars
l/hr	Litres per hour
mbgl	Metres below ground level
LEL	Lower explosive limit in air

NOTES
All monitoring is carried out in line with LK Consult Ltd procedures, with reference to CIRIA C665.
¹ Equipment is serviced and checked as recommended by the manufacturer. Refer to calibration records and service certificates.
² CH4 is explosive between the range of 5-15%v/v. 100% lower explosive limit is equal to 5%v/v CH4.
³ Flow readings are based on a 1 minute average value where flow is detected (equipment range of +/- 12 ltr/hr).

Site	James Street North, Radcliffe
Job Number	LKC 20 1984
Date	04.05.2021
Engineer	NJ
Visit	3 of 6

Equipment ¹		
Instrument	Serial Number	Comments
Gas Analyser GA5000	G502417	Serviced, calibrated, gas checked.
Botech Oil-in-Water Interface Me	81454-14	Operating normally.
Tiger PID	N/A	Serviced and operating normally.

Atmospheric / Ground Conditions	
Atmospheric pressure onsite	Rising
Atmospheric pressure (prev 24hrs)	Rising
Weather Conditions	Overcast, intermittent rain
Ground Conditions	Wet

[illegible]

ABBREVIATIONS	
ND	Not detected
NR	Not recorded
UR	Unable to record
OS	Off recordable scale
N/A	Not applicable
ppm	Parts per million
mb	Millibars
l/hr	Litres per hour
mbgl	Metres below ground level
LEL	Lower explosive limit in air

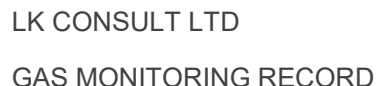
NOTES
All monitoring is carried out in line with LK Consult Ltd procedures, with reference to CIRIA C665.
¹ Equipment is serviced and checked as recommended by the manufacturer. Refer to calibration records and service certificates.
² CH4 is explosive between the range of 5-15%v/v. 100% lower explosive limit is equal to 5%v/v CH4.
³ Flow readings are based on a 1 minute average value where flow is detected (equipment range of +/- 12 ltr/hr).



Atmospheric / Ground Conditions	
Atmospheric pressure trend onsite	Rising
Atmospheric pressure (prev 24hrs)	Rising
Weather Conditions	Overcast, cool, no rain, light breeze
Ground Conditions	Damp

[illegible]

NOTES	
All monitoring is carried out in line with LK Consult Ltd procedures, with reference to CIRIA C665.	
¹ Equipment is serviced and checked as recommended by the manufacturer. Refer to calibration records and service certificates.	
² CH4 is explosive between the range of 5-15%v/v. 100% lower explosive limit is equal to 5%v/v CH4.	
³ Flow readings are based on a 1 minute average value where flow is detected (equipment range of +/- 12 ltr/hr).	



Atmospheric / Ground Conditions	
Atmospheric pressure trend onsite	Rising
Atmospheric pressure (prev 24hrs)	Rising
Weather Conditions	Dry, Still
Ground Conditions	Dry

[illegible]

NOTES
All monitoring is carried out in line with LK Consult Ltd procedures, with reference to CIRIA C665.
¹ Equipment is serviced and checked as recommended by the manufacturer. Refer to calibration records and service certificates.
² CH4 is explosive between the range of 5-15%v/v. 100% lower explosive limit is equal to 5%v/v CH4.
³ Flow readings are based on a 1 minute average value where flow is detected (equipment range of +/- 12 ltr/hr).

Appendix F

Generic Assessment Criteria Values

Summary of Category 4 Screening Levels: 2015

Substance	Residential (with home- grown produce)	Residential (without home- grown produce)	Allotments	Commercial	Public Open Space 1	Public Open Space 2
Arsenic	37 mg/kg	40 mg/kg	49 mg/kg	640 mg/kg	79 mg/kg	170 mg/kg
Benzene	0.87 mg/kg	3.3 mg/kg	0.18 mg/kg	98 mg/kg	140 mg/kg	230 mg/kg
Benzo(a)pyrene	5.0 mg/kg	5.3 mg/kg	5.7 mg/kg	77 mg/kg	10 mg/kg	21 mg/kg
Cadmium	22 mg/kg	150 mg/kg	3.9 mg/kg	410 mg/kg	220 mg/kg	880 mg/kg
Chromium VI	21 mg/kg	21 mg/kg	170 mg/kg	49 mg/kg	21 mg/kg	250 mg/kg
Lead	200 mg/kg	310 mg/kg	80 mg/kg	2300 mg/kg	630 mg/kg	1300 mg/kg

Summary Table for the Generic Assessment Criteria for Human Health Risk Assessment Land Quality Management (LQM) S4ULs.

All GAC are based on sandy loam soils with a pH 7.

		LQM Generic Assessment Criteria (mg/kg) Dry weight soil						
	Contaminant	SOM	Res +	Res -	Allot.	Comm.	POS _{resi}	POS _{park}
Metals	Inorganic Arsenic	6%	37	40	43	640	79	170
	Beryllium	6%	1.7	1.7	35	12	2.2	63
	Boron	6%	290	11,000	45	240,000	21,000	46,000
	Cadmium	6%	11	85	1.9	190	120	532
	Chromium (III)	6%	910	910	18,000	8,600	1,500	33,000
	Chromium (VI)	6%	6.0	6.0	1.8	33	7.7	220
	Copper	6%	2,400	7,100	520	68,000	12,000	44,000
	Elemental Mercury	6%	1.2	1.2	21	58 (25.8) ^{vap}	16	30 (25.8) ^{vap}
	Inorganic Mercury	6%	40	56	19	1,100	120	240
	Methylmercury	6%	11	15	6.0	320	40	68
	Nickel	6%	180	180	230	980	230	3,400
	Selenium	6%	250	430	88	12,000	1,100	1,800
	Vanadium	6%	410	1,200	91	9,000	2,000	5,000
	Zinc	6%	3,700	40,000	620	730,000	81,000	170,000
BTEX Compounds	Benzene	1%	0.087	0.38	0.017	27	72	90
		2.5%	0.17	0.70	0.034	47	72	100
		6%	0.37	1.4	0.075	90	73	110
	Toluene	1%	130	880 (869) ^{vap}	22	56,000 (869) ^{vap}	56,000	87,000 (869) ^{vap}
		2.5%	290	1,900	51	110,000 (1,920) ^{vap}	56,000	95,000 (1,920) ^{vap}
		6%	660	3,900	120	180,000 (4,360) ^{vap}	56,000	100,000 (4,360) ^{vap}
	Ethylbenzene	1%	47	83	16	5,700 (518) ^{vap}	24,000	17,000 (518) ^{vap}
		2.5%	110	190	39	13,000 (1,220) ^{vap}	24,000	22,000 (1,220) ^{vap}
		6%	260	440	91	27,000 (2,840) ^{vap}	25,000	27,000 (2,840) ^{vap}
	o-xylene	1%	60	88	28	6,600 (478) ^{sol}	41,000	17,000 (478) ^{sol}
		2.5%	140	210	67	15,000 (1,120) ^{sol}	42,000	24,000 (1,120) ^{sol}
		6%	330	480	160	33,000 (2,620) ^{sol}	43,000	33,000 (2,620) ^{sol}
	m-xylene	1%	59	82	31	6,200 (625) ^{vap}	41,000	17,000 (625) ^{vap}
		2.5%	140	190	74	14,000 (1,470) ^{vap}	42,000	24,000 (1,470) ^{vap}
		6%	320	450	170	31,000 (3,460) ^{vap}	43,000	32,000 (3,460) ^{vap}
	p-xylene	1%	56	79	29	5,900 (576) ^{sol}	41,000	17,000 (576) ^{sol}
		2.5%	130	180	69	14,000 (1,350) ^{sol}	42,000	23,000 (1,350) ^{sol}
		6%	310	430	160	30,000 (3,170) ^{sol}	43,000	31,000 (3,170) ^{sol}

NOTES

^{sol/vap} = solubility / vapour limit (potentially use if free product identified, although highly conservative).

f = oral, dermal and inhalation exposures compared to oral HCV.

All GAC are based on sandy loam soils with a pH 7.

All GAC are based on sandy loam soils with a pH 7.			LQM Generic Assessment Criteria (mg/kg) Dry weight soil					
Contaminant		SOM	Res +	Res -	Allot.	Comm.	POS _{resi}	POS _{park}
Polycyclic Aromatic Hydrocarbons (PAHs)	Acenaphthene	1%	210	3,000 (57.1) ^{sol}	34	84,000 (57.0) ^{sol}	15,000	29,000
		2.5%	510	4,700 (141) ^{sol}	85	97,000 (141) ^{sol}	15,000	30,000
		6%	1,100	6,000 (336) ^{sol}	200	100,000	15,000	30,000
	Acenaphthylene	1%	170	2,900 (86.1) ^{sol}	28	83,000 (86.1) ^{sol}	15,000	29,000
		2.5%	420	4,600 (212) ^{sol}	69	97,000 (212) ^{sol}	15,000	30,000
		6%	920	6,000 (506) ^{sol}	160	100,000	15,000	30,000
	Anthracene	1%	2,400	31,000 (1.17) ^{vap}	380	520,000	74,000	150,000
		2.5%	5,400	35,000	950	540,000	74,000	150,000
		6%	11,000	37,000	2,200	540,000	74,000	150,000
	Benz(a)anthracene	1%	7.2	11	2.9	170	29	49
		2.5%	11	14	6.5	170	29	56
		6%	13	15	13	180	29	62
	Benzo(a)pyrene (only)	1%	2.2	3.2	0.97	35	5.7	11
		2.5%	2.7	3.2	2.0	35	5.7	12
		6%	3.0	3.2	3.5	36	5.7	13
	Benzo(b)fluoranthene	1%	2.6	3.9	0.99	44	7.1	13
		2.5%	3.3	4.0	2.1	44	7.2	15
		6%	3.7	4.0	3.9	45	7.2	16
	Benzo(ghi)perylene	1%	320	360	290	3,900	640	1,400
		2.5%	340	360	470	4,000	640	1,500
		6%	350	360	640	4,000	640	1,600
	Benzo(k)fluoranthene	1%	77	110	37	1,200	190	370
		2.5%	93	110	75	1,200	190	410
		6%	100	110	130	1,200	190	440
	Chrysene	1%	15	30	4.1	350	57	93
		2.5%	22	31	9.4	350	57	110
		6%	27	32	19	350	57	120
	Dibenzo(ah)anthracene	1%	0.24	0.31	0.14	3.5	0.57	1.1
		2.5%	0.28	0.32	0.27	3.6	0.58	1.3
		6%	0.3	0.32	0.43	3.6	0.58	1.4
	Fluoranthene	1%	280	1,500	52	23,000	3,100	6,300
		2.5%	560	1,600	130	23,000	3,100	6,300
		6%	890	1,600	290	23,000	3,100	6,400
	Fluorene	1%	170	2,800 (36.0) ^{sol}	27	63,000 (30.9) ^{sol}	9,900	20,000
		2.5%	400	3,800 (76.5) ^{sol}	67	68,000	9,900	20,000
		6%	860	4,500 (183) ^{sol}	160	71,000	9,900	20,000
	Indeno(123-cd)pyrene	1%	27	45	9.5	500	82	150
		2.5%	36	46	21	510	82	170
		6%	41	46	39	510	82	180
	Naphthalene	1%	2.3 ^f	2.3 ^f	4.1 ^f	190 ^f (76.4) ^{sol}	4,900 ^f	1,200 ^f (76.4) ^{sol}
		2.5%	5.6 ^f	5.6 ^f	10 ^f	460 ^f (183) ^{sol}	4,900 ^f	1,900 ^f (183) ^{sol}
		6%	13 ^f	13 ^f	24 ^f	1,100 ^f (432) ^{sol}	4,900 ^f	3,000
	Phenanthrene	1%	95	1,300 (36.0) ^{sol}	15	22,000	3,100	6,200
		2.5%	220	1,500	38	22,000	3,100	6,200
		6%	440	1,500	90	22,000	3,100	6,300
	Pyrene	1%	620	3,700	110	54,000	7,400	15,000
		2.5%	1,200	3,800	270	54,000	7,400	15,000
		6%	2,000	3,800	620	54,000	7,400	15,000
Coal Tar (B(a)P as surrogate marker)	1%	0.79	1.2	0.32	15	2.2	4.4	
	2.5%	0.98	1.2	0.67	15	2.2	4.7	
	6%	1.1	1.2	1.2	15	2.2	4.8	

NOTES

^{sol} / ^{vap} = solubility / vapour limit (potentially use if free product identified, although highly conservative).

^f = naphthalene is based on comparison of inhalation exposure with TDI_{inhal} for localised effect.

All GAC are based on sandy loam soils with a pH 7.

LQM Generic Assessment Criteria (mg/kg) Dry weight soil

Contaminant	SOM	Res +	Res -	Allot.	Comm.	POS _{resi}	POS _{park}
Aliphatic							
EC 5-6	1%	42	42	730	3,200 (304) ^{sol}	570,000(304) ^{sol}	95,000 (304) ^{sol}
EC>6-8	1%	100	100	2,300	7,800 (144) ^{sol}	600,000	150,000 (144) ^{sol}
EC>8-10	1%	27	27	320	2,000 (78) ^{sol}	13,000	14,000 (78) ^{vap}
EC>10-12	1%	130 (48) ^{vap}	130 (48) ^{vap}	2,200	9,700 (48) ^{sol}	13,000	21,000 (48) ^{vap}
EC>12-16	1%	1,100 (24) ^{sol}	1,100 (24) ^{sol}	11,000	59,000 (24) ^{sol}	13,000	25,000 (24) ^{sol}
EC>16-35	1%	65,000 (8.48) ^{f, sol}	65,000 (8.48) ^{f, sol}	260,000 ^f	160,000 ^f	250,000 ^f	450,000 ^f
EC>35-44	1%	65,000 (8.48) ^{f, sol}	65,000 (8.48) ^{f, sol}	260,000 ^f	160,000 ^f	250,000 ^f	450,000 ^f
Aliphatic							
EC 5-6	2.5%	78	78	1,700	5,900 (558) ^{sol}	590,000	130,000 (558) ^{sol}
EC>6-8	2.5%	230	230	5,600	17,000 (322) ^{sol}	610,000	220,000 (322) ^{sol}
EC>8-10	2.5%	65	65	770	4,800 (190) ^{vap}	13,000	18,000 (190) ^{vap}
EC>10-12	2.5%	330 (118) ^{vap}	330 (118) ^{vap}	4,400	23,000 (118) ^{vap}	13,000	23,000 (118) ^{vap}
EC>12-16	2.5%	2,400 (59) ^{sol}	2,400 (59) ^{sol}	13,000	82,000 (59) ^{sol}	13,000	25,000 (59) ^{sol}
EC>16-35	2.5%	92,000 (21) ^{f, sol}	92,000 (21) ^{f, sol}	270,000 ^f	1,700,000 ^f	250,000 ^f	480,000 ^f
EC>35-44	2.5%	92,000 (21) ^{f, sol}	92,000 (21) ^{f, sol}	270,000 ^f	1,700,000 ^f	250,000 ^f	480,000 ^f
Aliphatic							
EC 5-6	6%	160	160	3,900	12,000 (1,150) ^{sol}	600,000	180,000 (1,150) ^{sol}
EC>6-8	6%	530	530	13,000	40,000 (736) ^{sol}	620,000	320,000 (736) ^{sol}
EC>8-10	6%	150	150	1,700	11,000 (451) ^{vap}	13,000	21,000 (451) ^{vap}
EC>10-12	6%	760 (283) ^{vap}	760 (283) ^{vap}	7,300	47,000 (283) ^{vap}	13,000	24,000 (283) ^{vap}
EC>12-16	6%	4,300 (142) ^{sol}	4,400 (142) ^{sol}	13,000	90,000 (142) ^{sol}	13,000	26,000 (142) ^{sol}
EC>16-35	6%	110,000 ^f	110,000 ^f	270,000 ^f	1,800,000 ^f	250,000 ^f	490,000 ^f
EC>35-44	6%	110,000 ^f	110,000 ^f	270,000 ^f	1,800,000 ^f	250,000 ^f	490,000 ^f
Aromatic							
EC5-7(benzene as non-threshold)	1%	70	370	13	26,000 (1,220) ^{sol}	56,000	76,000 (1,220) ^{sol}
EC>7-8(toluene)	1%	130	860	22	56,000 (869) ^{vap}	56,000	87,000 (869) ^{vap}
EC>8-10	1%	34	47	8.6	3,500 (613) ^{vap}	5,000	7,200 (613) ^{vap}
EC>10-12	1%	74	250	13	16,000 (364) ^{sol}	5,000	9,200 (364) ^{sol}
EC>12-16	1%	140	1,800	23	36,000 (169) ^{sol}	5,100	10,000
EC>16-21	1%	260 ^f	1,900 ^f	46 ^f	28,000 ^f	3,800 ^f	7,600 ^f
EC>21-35	1%	1,100 ^f	1,900 ^f	370 ^f	28,000 ^f	3,800 ^f	7,800 ^f
EC>35-44	1%	1,100 ^f	1,900 ^f	370 ^f	28,000 ^f	3,800 ^f	7,800 ^f
Aromatic							
EC5-7(benzene as non-threshold)	2.5%	140	690	27	46,000 (2,260) ^{sol}	56,000	84,000 (2,260) ^{sol}
EC>7-8(toluene)	2.5%	290	1,800	51	110,000 (1,920) ^{sol}	56,000	95,000 (1,920) ^{sol}
EC>8-10	2.5%	83	110	21	8,100 (1,500) ^{vap}	5,000	8,500 (1,500) ^{vap}
EC>10-12	2.5%	180	590	31	28,000 (899) ^{sol}	5,000	9,700 (899) ^{sol}
EC>12-16	2.5%	330	2,300 (419) ^{sol}	57	37,000	5,100	10,000
EC>16-21	2.5%	540 ^f	1,900 ^f	110 ^f	28,000 ^f	3,800 ^f	7,700 ^f
EC>21-35	2.5%	1,500 ^f	1,900 ^f	820 ^f	28,000 ^f	3,800 ^f	7,800 ^f
EC>35-44	2.5%	1,500 ^f	1,900 ^f	820 ^f	28,000 ^f	3,800 ^f	7,800 ^f
Aromatic							
EC5-7(benzene as non-threshold)	6%	300	1,400	57	86,000 (4,710) ^{sol}	56,000	92,000 (4,710) ^{sol}
EC>7-8(toluene)	6%	660	3,900	120	180,000 (4,360) ^{vap}	56,000	100,000 (4,360) ^{vap}
EC>8-10	6%	190	270	51	17,000 (3,580) ^{vap}	5,000	9,300 (3,580) ^{vap}
EC>10-12	6%	380	1,200	74	34,000(2,150) ^{sol}	5,000	10,000
EC>12-16	6%	660	2,500	130	38,000	5,100	10,000
EC>16-21	6%	930 ^f	1,900 ^f	260 ^f	28,000 ^f	3,800 ^f	7,800 ^f
EC>21-35	6%	1,700 ^f	1,900 ^f	1,600 ^f	28,000 ^f	3,800 ^f	7,900 ^f
EC>35-44	6%	1,700 ^f	1,900 ^f	1,600 ^f	28,000 ^f	3,800 ^f	7,900 ^f
Aliphatic	1%	1,600 ^f	1,900 ^f	1,200 ^f	28,000 ^f	3,800 ^f	7,800 ^f
+Aromatic	2.5%	1,800 ^f	1,900 ^f	2,100 ^f	28,000 ^f	3,800 ^f	7,800 ^f
>EC44	6%	1,900 ^f	1,900 ^f	3,000 ^f	28,000 ^f	3,800 ^f	7,900 ^f

NOTES

^{sol}/^{vap} = solubility / vapour limit (potentially use if free product identified, although highly conservative).

^f = oral, dermal and inhalation exposures compared to oral HCV.

All GAC are based on sandy loam soils with a pH 7.

		LQM Generic Assessment Criteria (mg/kg) Dry weight soil						
Contaminant		SOM	Res +	Res -	Allot.	Comm.	POS _{resi}	POS _{park}
Chloalkanes and Alkenes & Explosives	1,2 Dichloroethane (DCA)	1%	7.1E-03	9.2E-03	4.6E-03	0.67	29	21
		2.5%	1.1E-02	1.3E-02	8.3E-03	0.97	29	24
		6%	1.9E-02	2.3E-02	1.6E-02	1.7	29	28
	1,1,1 Trichloroethane (TCA)	1%	8.8	9.0	48	660	140,000	57,000 (1,425) ^{vap}
		2.5%	18	18	110	1,300	140,000	76,000 (2,915) ^{vap}
		6%	39	40	240	3,000	140,000	100,000 (6,392) ^{vap}
	1,1,2,2-Tetrachloroethanes (PCA)	1%	1.6	3.9	0.41	270	1,400	1,800
		2.5%	3.4	8.0	0.89	550	1,400	2,100
		6%	7.5	17	2.0	1,100	1,400	2,300
	1,1,1,2-Tetrachloroethanes (PCA)	1%	1.2	1.5	0.79	110	1,400	1,500
		2.5%	2.8	3.5	1.9	250	1,400	1,800
		6%	6.4	8.2	4.4	560	1,400	2,100
	Tetrachloroethene (PCE)	1%	0.18	0.18	0.65	19	1,400	810 (424) ^{sol}
		2.5%	0.39	0.40	1.5	42	1,400	1,100 (951) ^{sol}
		6%	0.90	0.92	3.6	95	1,400	1,500
	Tetrachloromethane (carbon tetrachloride)	1%	2.6E-02	2.6E-02	0.45	2.9	890	190
		2.5%	5.6E-02	5.6E-02	1.0	6.3	920	270
		6%	0.13	0.13	2.4	14	950	400
	Trichloroethene (TCE)	1%	1.6E-02	1.7E-02	4.1E-02	1.2	120	70
		2.5%	3.4E-02	3.6E-02	9.1E-02	2.6	120	91
		6%	7.5E-02	8.0E-02	0.21	5.7	120	120
	Trichloromethane (chloroform)	1%	0.91	1.2	0.42	99	2,500	2,600
		2.5%	1.7	2.1	0.83	170	2,500	2,800
		6%	3.4	4.2	1.7	350	2,500	3,100
	Chloroethene (vinyl chloride)	1%	6.4E-04	7.7E-04	5.5E-04	5.9E-02	3.5	4.8
		2.5%	8.7E-04	1.0E-03	1.0E-03	7.7E-02	3.5	5.0
		6%	1.4E-03	1.5E-03	1.8E-03	0.12	3.5	5.4
	2,4,6-Trinitrotoluene (TNT)	1%	1.6	65	0.24	1,000	130	260
		2.5%	3.7	66	0.58	1,000	130	270
		6%	8.1	66	1.4	1,000	130	270
	RDX	1%	120	13,000	17	210,000	26,000	49,000 (18.7) ^{sol}
		2.5%	250	13,000	38	210,000	26,000	51,000
		6%	540	13,000	85	210,000	27,000	53,000
	HMX	1%	5.7	6,700	0.86	110,000	13,000	23,000 (0.35) ^{vap}
		2.5%	13	6,700	1.9	110,000	13,000	23,000 (0.39) ^{vap}
		6%	26	6,700	3.9	110,000	13,000	24,000 (0.48) ^{vap}
Pesticides	Aldrin	1%	5.7	7.3	3.2	170	18	30
		2.5%	6.6	7.4	6.1	170	18	31
		6%	7.1	7.5	9.8	170	18	31
	Dieldrin	1%	0.97	7.0	0.17	170	18	30
		2.5%	2.0	7.3	0.41	170	18	30
		6%	3.5	7.4	0.96	170	18	31
	Atrazine	1%	3.3	610	0.5	9,300	1,200	2,300
		2.5%	7.8	620	1.2	9,400	1,200	2,400
		6%	17.4	620	2.7	9,400	1,200	2,400
	Dichlorvos	1%	3.2E-02	6.4	4.9E-03	140	16	26
		2.5%	6.6E-02	6.5	1.0E-02	140	16	26
		6%	0.14	6.6	2.2E-02	140	16	27
	Endosulfans (2 isomers)	1%	7.4	160 (3.0E-03) ^{vap}	1.2	5,600 (3.0E-03) ^{vap}	1,200	2,300
		2.5%	18	280 (7.0E-03) ^{vap}	2.9	7,400 (7.0E-03) ^{vap}	1,200	2,400
		6%	41	410 (1.6E-02) ^{vap}	6.8	8,400 (1.6E-02) ^{vap}	1,200	2,500
	Hexachlorocyclohexane (3 isomers), inc Lindane	1%	8.5E-02	3.7	1.3E-02	65	8.1	15
		2.5%	0.2	3.8	3.2E-02	65	8.1	15
		6%	0.46	3.8	7.7E-02	65	8.1	16

NOTES

^{sol} / ^{vap} = solubility / vapour limit (potentially use if free product identified, although highly conservative).

All GAC are based on
sandy loam soils with a pH
7.

All GAC are based on sandy loam soils with a pH 7.			LQM Generic Assessment Criteria (mg/kg) Dry weight soil					
Contaminant		SOM	Res +	Res -	Allot.	Comm.	POS _{resi}	POS _{park}
Chlorobenzenes	Chlorobenzene	1%	0.46	0.46	5.9	56	11,000	1,300 (675) ^{sol}
		2.5%	1.0	1.0	14	130	13,000	2,000 (1,520) ^{sol}
		6%	2.4	2.4	32	290	14,000	2,900
	Dichlorobenzenes (3 isomers)	1%	23	24	94	2,000 (571) ^{sol}	90,000	24,000 (571) ^{sol}
		2.5%	55	57	230	4,800 (1,370) ^{sol}	95,000	36,000 (1,370) ^{sol}
		6%	130	130	540	11,000 (3,240) ^{sol}	98,000	51,000 (3,270) ^{sol}
	Trichlorobenzenes (3 isomers)	1%	2.6	2.6	55	220	15,000	1,700 (318) ^{vap}
		2.5%	6.4	6.4	140	530	17,000	2,600 (786) ^{vap}
		6%	15	15	320	1,300	19,000	4,000 (1,880) ^{vap}
	Tetrachlorobenzenes (3 isomers)	1%	0.66	0.75	0.38	49 (39.4) ^{vap}	78	110 (39) ^{vap}
		2.5%	1.6	1.9	0.90	120 (98.1) ^{vap}	79	120
		6%	3.7	4.3	2.2	240 (235) ^{vap}	79	130
	Pentachlorobenzene	1%	5.8	19	1.2	640 (43.0) ^{sol}	100	190
		2.5%	12	30	3.1	770 (107) ^{sol}	100	190
		6%	22	38	7.0	830	100	190
	Hexachlorobenzene	1%	1.8 (0.20) ^{vap}	4.1 (0.20) ^{vap}	0.47	110 (0.20) ^{vap}	16	30
		2.5%	3.3 (0.50) ^{vap}	5.7 (0.50) ^{vap}	1.1	120	16	30
		6%	4.9	6.7 (1.2) ^{vap}	2.5	120	16	30
Chlorophenol	Chlorophenols (4 congeners)	1%	0.87 ^g	94	0.13 ^g	3,500	620	1,100
		2.5%	2.0	150	0.30	4,000	620	1,100
		6%	4.5	210	0.70	4,300	620	1,100
	Pentachlorophenol	1%	0.22	27 (16.4) ^{vap}	3.0E-02	400	60	110
		2.5%	0.52	29	8.0E-02	400	60	120
		6%	1.2	31	0.19	400	60	120
Others	Carbon Disulphide	1%	0.14	0.14	4.8	11	11,000	1,300
		2.5%	0.29	0.29	10	22	11,000	1,900
		6%	0.62	0.62	23	47	11,000	2,700
	Hexachlorobutadiene	1%	0.29	0.32	0.25	31	25	48
		2.5%	0.7	0.78	0.61	66	25	50
		6%	1.6	1.8	1.4	120	25	51
	Phenol	1%	280	750	66	760 ^{dir} (31,000)	760 ^{dir} (11,000)	760 ^{dir} (8,600)
		2.5%	550	1,300	140	1,500 ^{dir} (35,000)	1,500 ^{dir} (11,000)	1,500 ^{dir} (9,700)
		6%	1,100	2,300	280	3,200 ^{dir} (37,000)	3,200 ^{dir} (11,000)	3,200 ^{dir} (11,000)

NOTES

^{sol / vap} = solubility / vapour limit (potentially use if free product identified, although highly conservative).

^{dir} = S4uls based on threshold protective of direct skin contact with phenol (brackets long term exposure for illustration purposes).

^g = derived based on 2,3,4,6-tetrachlorophenol.

Appendix G

HazWaste Online Output Sheets

Waste Classification Report



7PU7M-J2SS3-TMW3E

Job name

LKC 20 1984

Description/Comments

Project

LKC 20 1984

Site

James Street North, Radcliffe

Related Documents

#	Name	Description
1	HWOL_21-08911-20210326 103100.hwol	.hwol file used to create the Job

Waste Stream Template

Example waste stream template for contaminated soils

Classified by

Name: Colin Crompton	Company: LK Group	HazWasteOnline™ Training Record:	
Date: 09 Apr 2021 19:37 GMT	Unit 29, Eton Business Park	Course	Date
Telephone: 0161 763 7200	Eton Hill Rd, Radcliffe	Hazardous Waste Classification	07 Oct 2020
	Greater Manchester	Advanced Hazardous Waste Classification	08 Oct 2020
	M26 2ZS		

Report

Created by: Colin Crompton
Created date: 09 Apr 2021 19:37 GMT

Job summary

#	Sample Name	Depth [m]	Classification Result	Hazard properties	Page
1	Ws101-19/03/2021-0.0	0.0-0.3	Non Hazardous		2
2	Ws102-19/03/2021-0.0	0.0-0.3	Non Hazardous		4
3	Ws103-19/03/2021-0.0	0.0-0.2	Non Hazardous		6
4	Ws103-19/03/2021-0.5	0.5-1.0	Non Hazardous		8

Appendices	Page
Appendix A: Classifier defined and non CLP determinands	9
Appendix B: Rationale for selection of metal species	10
Appendix C: Version	10

Classification of sample: Ws101-19/03/2021-0.0

 **Non Hazardous Waste**
Classified as **17 05 04**
in the List of Waste

Sample details

Sample Name:	LoW Code:
Ws101-19/03/2021-0.0	Chapter:
Sample Depth:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
0.0-0.3 m	Entry:
Moisture content:	17 05 04 (Soil and stones other than those mentioned in 17 05 03)
37%	
(wet weight correction)	

Hazard properties

None identified

Determinands

Moisture content: 37% Wet Weight Moisture Correction applied (MC)

#	Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
	CLP index number	EC Number	CAS Number									
1	arsenic { arsenic trioxide }				21	mg/kg	1.32	17.468	mg/kg	0.00175 %	✓	
	033-003-00-0	215-481-4	1327-53-3									
2	cadmium { cadmium oxide }				0.45	mg/kg	1.142	0.324	mg/kg	0.0000324 %	✓	
	048-002-00-0	215-146-2	1306-19-0									
3	chromium in chromium(III) compounds { chromium(III) oxide (worst case) }				23	mg/kg	1.462	21.178	mg/kg	0.00212 %	✓	
		215-160-9	1308-38-9									
4	chromium in chromium(VI) compounds { chromium(VI) compounds, with the exception of barium chromate and of compounds specified elsewhere in this Annex }				<0.5	mg/kg	2.27	<1.135	mg/kg	<0.000113 %		<LOD
	024-017-00-8											
5	copper { dicopper oxide; copper (I) oxide }				64	mg/kg	1.126	45.396	mg/kg	0.00454 %	✓	
	029-002-00-X	215-270-7	1317-39-1									
6	lead { lead chromate }			1	330	mg/kg	1.56	324.286	mg/kg	0.0208 %	✓	
	082-004-00-2	231-846-0	7758-97-6									
7	mercury { mercury dichloride }				0.23	mg/kg	1.353	0.196	mg/kg	0.0000196 %	✓	
	080-010-00-X	231-299-8	7487-94-7									
8	nickel { nickel chromate }				23	mg/kg	2.976	43.126	mg/kg	0.00431 %	✓	
	028-035-00-7	238-766-5	14721-18-7									
9	selenium { nickel selenate }				0.79	mg/kg	2.554	1.271	mg/kg	0.000127 %	✓	
	028-031-00-5	239-125-2	15060-62-5									
10	zinc { zinc chromate }				220	mg/kg	2.774	384.497	mg/kg	0.0384 %	✓	
	024-007-00-3	236-878-9	13530-65-9									
11	pH				8	pH		8	pH	8pH		
			PH									
12	naphthalene				3.6	mg/kg		2.268	mg/kg	0.000227 %	✓	
	601-052-00-2	202-049-5	91-20-3									
13	acenaphthylene				0.16	mg/kg		0.101	mg/kg	0.0000101 %	✓	
		205-917-1	208-96-8									
14	acenaphthene				7.8	mg/kg		4.914	mg/kg	0.000491 %	✓	
		201-469-6	83-32-9									

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	CLP index number	EC Number	CAS Number							
15	fluorene				4 mg/kg		2.52 mg/kg	0.000252 %	✓	
		201-695-5	86-73-7							
16	phenanthrene				46 mg/kg		28.98 mg/kg	0.0029 %	✓	
		201-581-5	85-01-8							
17	anthracene				9.9 mg/kg		6.237 mg/kg	0.000624 %	✓	
		204-371-1	120-12-7							
18	fluoranthene				52 mg/kg		32.76 mg/kg	0.00328 %	✓	
		205-912-4	206-44-0							
19	pyrene				46 mg/kg		28.98 mg/kg	0.0029 %	✓	
		204-927-3	129-00-0							
20	benzo[a]anthracene				22 mg/kg		13.86 mg/kg	0.00139 %	✓	
	601-033-00-9	200-280-6	56-55-3							
21	chrysene				21 mg/kg		13.23 mg/kg	0.00132 %	✓	
	601-048-00-0	205-923-4	218-01-9							
22	benzo[b]fluoranthene				24 mg/kg		15.12 mg/kg	0.00151 %	✓	
	601-034-00-4	205-911-9	205-99-2							
23	benzo[k]fluoranthene				8.4 mg/kg		5.292 mg/kg	0.000529 %	✓	
	601-036-00-5	205-916-6	207-08-9							
24	benzo[a]pyrene; benzo[def]chrysene				22 mg/kg		13.86 mg/kg	0.00139 %	✓	
	601-032-00-3	200-028-5	50-32-8							
25	indeno[123-cd]pyrene				14 mg/kg		8.82 mg/kg	0.000882 %	✓	
		205-893-2	193-39-5							
26	dibenz[a,h]anthracene				2.6 mg/kg		1.638 mg/kg	0.000164 %	✓	
	601-041-00-2	200-181-8	53-70-3							
27	benzo[ghi]perylene				12 mg/kg		7.56 mg/kg	0.000756 %	✓	
		205-883-8	191-24-2							
28	vanadium { divanadium pentaoxide; vanadium pentoxide }				31 mg/kg	1.785	34.865 mg/kg	0.00349 %	✓	
	023-001-00-8	215-239-8	1314-62-1							
Total:								0.0943 %		

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
•	Determinand defined or amended by HazWasteOnline (see Appendix A)
•	Speciated Determinand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
ND	Not detected
CLP: Note 1	Only the metal concentration has been used for classification

Classification of sample: Ws102-19/03/2021-0.0

 **Non Hazardous Waste**
Classified as **17 05 04**
in the List of Waste

Sample details

Sample Name:	LoW Code:
Ws102-19/03/2021-0.0	Chapter:
Sample Depth:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
0.0-0.3 m	Entry:
Moisture content:	17 05 04 (Soil and stones other than those mentioned in 17 05 03)
17%	
(wet weight correction)	

Hazard properties

None identified

Determinands

Moisture content: 17% Wet Weight Moisture Correction applied (MC)

#	Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
	CLP index number	EC Number	CAS Number									
1	 arsenic { arsenic trioxide }				12	mg/kg	1.32	13.15	mg/kg	0.00132 %	✓	
	033-003-00-0	215-481-4	1327-53-3									
2	 cadmium { cadmium oxide }				0.2	mg/kg	1.142	0.19	mg/kg	0.000019 %	✓	
	048-002-00-0	215-146-2	1306-19-0									
3	 chromium in chromium(III) compounds { chromium(III) oxide (worst case) }				20	mg/kg	1.462	24.262	mg/kg	0.00243 %	✓	
		215-160-9	1308-38-9									
4	 chromium in chromium(VI) compounds { chromium(VI) compounds, with the exception of barium chromate and of compounds specified elsewhere in this Annex }				<0.5	mg/kg	2.27	<1.135	mg/kg	<0.000113 %		<LOD
	024-017-00-8											
5	 copper { dicopper oxide; copper (I) oxide }				34	mg/kg	1.126	31.773	mg/kg	0.00318 %	✓	
	029-002-00-X	215-270-7	1317-39-1									
6	 lead { lead chromate }			1	99	mg/kg	1.56	128.17	mg/kg	0.00822 %	✓	
	082-004-00-2	231-846-0	7758-97-6									
7	 mercury { mercury dichloride }				0.13	mg/kg	1.353	0.146	mg/kg	0.0000146 %	✓	
	080-010-00-X	231-299-8	7487-94-7									
8	 nickel { nickel chromate }				19	mg/kg	2.976	46.936	mg/kg	0.00469 %	✓	
	028-035-00-7	238-766-5	14721-18-7									
9	 selenium { nickel selenate }				0.7	mg/kg	2.554	1.484	mg/kg	0.000148 %	✓	
	028-031-00-5	239-125-2	15060-62-5									
10	 zinc { zinc chromate }				72	mg/kg	2.774	165.783	mg/kg	0.0166 %	✓	
	024-007-00-3	236-878-9	13530-65-9									
11	 pH				7.7	pH		7.7	pH	7.7 pH		
			PH									
12	 naphthalene				0.24	mg/kg		0.199	mg/kg	0.0000199 %	✓	
	601-052-00-2	202-049-5	91-20-3									
13	 acenaphthylene				0.19	mg/kg		0.158	mg/kg	0.0000158 %	✓	
		205-917-1	208-96-8									
14	 acenaphthene				0.15	mg/kg		0.125	mg/kg	0.0000124 %	✓	
		201-469-6	83-32-9									

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	CLP index number	EC Number	CAS Number							
15	fluorene	201-695-5	86-73-7		0.16 mg/kg		0.133 mg/kg	0.0000133 %	✓	
16	phenanthrene	201-581-5	85-01-8		1.2 mg/kg		0.996 mg/kg	0.0000996 %	✓	
17	anthracene	204-371-1	120-12-7		0.43 mg/kg		0.357 mg/kg	0.0000357 %	✓	
18	fluoranthene	205-912-4	206-44-0		2.5 mg/kg		2.075 mg/kg	0.000208 %	✓	
19	pyrene	204-927-3	129-00-0		2.7 mg/kg		2.241 mg/kg	0.000224 %	✓	
20	benzo[a]anthracene	601-033-00-9	200-280-6		1.5 mg/kg		1.245 mg/kg	0.000125 %	✓	
21	chrysene	601-048-00-0	205-923-4		1.4 mg/kg		1.162 mg/kg	0.000116 %	✓	
22	benzo[b]fluoranthene	601-034-00-4	205-911-9		1.9 mg/kg		1.577 mg/kg	0.000158 %	✓	
23	benzo[k]fluoranthene	601-036-00-5	205-916-6		0.77 mg/kg		0.639 mg/kg	0.0000639 %	✓	
24	benzo[a]pyrene; benzo[def]chrysene	601-032-00-3	200-028-5		1.8 mg/kg		1.494 mg/kg	0.000149 %	✓	
25	indeno[123-cd]pyrene	205-893-2	193-39-5		1.2 mg/kg		0.996 mg/kg	0.0000996 %	✓	
26	dibenz[a,h]anthracene	601-041-00-2	200-181-8		0.25 mg/kg		0.208 mg/kg	0.0000208 %	✓	
27	benzo[ghi]perylene	205-883-8	191-24-2		1 mg/kg		0.83 mg/kg	0.000083 %	✓	
28	vanadium { divanadium pentaoxide; vanadium pentoxide }	023-001-00-8	215-239-8		24 mg/kg	1.785	35.561 mg/kg	0.00356 %	✓	
Total:								0.0417 %		

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
•	Determinand defined or amended by HazWasteOnline (see Appendix A)
•	Speciated Determinand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
ND	Not detected
CLP: Note 1	Only the metal concentration has been used for classification

Classification of sample: Ws103-19/03/2021-0.0

 **Non Hazardous Waste**
Classified as **17 05 04**
in the List of Waste

Sample details

Sample Name:	LoW Code:
Ws103-19/03/2021-0.0	Chapter:
Sample Depth:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
0.0-0.2 m	Entry:
Moisture content:	17 05 04 (Soil and stones other than those mentioned in 17 05 03)
17%	
(wet weight correction)	

Hazard properties

None identified

Determinands

Moisture content: 17% Wet Weight Moisture Correction applied (MC)

#	Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
	CLP index number	EC Number	CAS Number									
1	 arsenic { arsenic trioxide }				15	mg/kg	1.32	16.438	mg/kg	0.00164 %	✓	
	033-003-00-0	215-481-4	1327-53-3									
2	 cadmium { cadmium oxide }				0.45	mg/kg	1.142	0.427	mg/kg	0.0000427 %	✓	
	048-002-00-0	215-146-2	1306-19-0									
3	 chromium in chromium(III) compounds { chromium(III) oxide (worst case) }				16	mg/kg	1.462	19.409	mg/kg	0.00194 %	✓	
		215-160-9	1308-38-9									
4	 chromium in chromium(VI) compounds { chromium(VI) compounds, with the exception of barium chromate and of compounds specified elsewhere in this Annex }				<0.5	mg/kg	2.27	<1.135	mg/kg	<0.000113 %		<LOD
	024-017-00-8											
5	 copper { dicopper oxide; copper (I) oxide }				45	mg/kg	1.126	42.052	mg/kg	0.00421 %	✓	
	029-002-00-X	215-270-7	1317-39-1									
6	 lead { lead chromate }			1	130	mg/kg	1.56	168.304	mg/kg	0.0108 %	✓	
	082-004-00-2	231-846-0	7758-97-6									
7	 mercury { mercury dichloride }				0.18	mg/kg	1.353	0.202	mg/kg	0.0000202 %	✓	
	080-010-00-X	231-299-8	7487-94-7									
8	 nickel { nickel chromate }				19	mg/kg	2.976	46.936	mg/kg	0.00469 %	✓	
	028-035-00-7	238-766-5	14721-18-7									
9	 selenium { nickel selenate }				0.5	mg/kg	2.554	1.06	mg/kg	0.000106 %	✓	
	028-031-00-5	239-125-2	15060-62-5									
10	 zinc { zinc chromate }				170	mg/kg	2.774	391.432	mg/kg	0.0391 %	✓	
	024-007-00-3	236-878-9	13530-65-9									
11	 pH				8	pH		8	pH	8pH		
			PH									
12	 naphthalene				1.8	mg/kg		1.494	mg/kg	0.000149 %	✓	
	601-052-00-2	202-049-5	91-20-3									
13	 acenaphthylene				2	mg/kg		1.66	mg/kg	0.000166 %	✓	
		205-917-1	208-96-8									
14	 acenaphthene				0.35	mg/kg		0.291	mg/kg	0.0000291 %	✓	
		201-469-6	83-32-9									

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	CLP index number	EC Number	CAS Number							
15	fluorene	201-695-5	86-73-7		0.78 mg/kg		0.647 mg/kg	0.0000647 %	✓	
16	phenanthrene	201-581-5	85-01-8		8.7 mg/kg		7.221 mg/kg	0.000722 %	✓	
17	anthracene	204-371-1	120-12-7		3.4 mg/kg		2.822 mg/kg	0.000282 %	✓	
18	fluoranthene	205-912-4	206-44-0		15 mg/kg		12.45 mg/kg	0.00125 %	✓	
19	pyrene	204-927-3	129-00-0		14 mg/kg		11.62 mg/kg	0.00116 %	✓	
20	benzo[a]anthracene	601-033-00-9	200-280-6		9.4 mg/kg		7.802 mg/kg	0.00078 %	✓	
21	chrysene	601-048-00-0	205-923-4		8.5 mg/kg		7.055 mg/kg	0.000705 %	✓	
22	benzo[b]fluoranthene	601-034-00-4	205-911-9		13 mg/kg		10.79 mg/kg	0.00108 %	✓	
23	benzo[k]fluoranthene	601-036-00-5	205-916-6		4.6 mg/kg		3.818 mg/kg	0.000382 %	✓	
24	benzo[a]pyrene; benzo[def]chrysene	601-032-00-3	200-028-5		12 mg/kg		9.96 mg/kg	0.000996 %	✓	
25	indeno[123-cd]pyrene	205-893-2	193-39-5		8.6 mg/kg		7.138 mg/kg	0.000714 %	✓	
26	dibenz[a,h]anthracene	601-041-00-2	200-181-8		1.9 mg/kg		1.577 mg/kg	0.000158 %	✓	
27	benzo[ghi]perylene	205-883-8	191-24-2		6.9 mg/kg		5.727 mg/kg	0.000573 %	✓	
28	vanadium { divanadium pentaoxide; vanadium pentoxide }	023-001-00-8	215-239-8		27 mg/kg	1.785	40.006 mg/kg	0.004 %	✓	
Total:								0.0759 %		

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
•	Determinand defined or amended by HazWasteOnline (see Appendix A)
•	Speciated Determinand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
ND	Not detected
CLP: Note 1	Only the metal concentration has been used for classification

Classification of sample: Ws103-19/03/2021-0.5



Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample Name:	LoW Code:
Ws103-19/03/2021-0.5	Chapter:
Sample Depth:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
0.5-1.0 m	Entry:
Moisture content:	17 05 04 (Soil and stones other than those mentioned in 17 05 03)
20%	
(wet weight correction)	

Hazard properties

None identified

Determinands

Moisture content: 20% Wet Weight Moisture Correction applied (MC)

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
	CLP index number	EC Number	CAS Number								
1	•	pH			8.1 pH		8.1	pH	8.1 pH		
			PH								
Total:									0%		

Key

- User supplied data
- Determinand defined or amended by HazWasteOnline (see Appendix A)

Appendix A: Classifier defined and non CLP determinands

■ **chromium(III) oxide (worst case)** (EC Number: 215-160-9, CAS Number: 1308-38-9)

Description/Comments: Data from C&L Inventory Database

Data source: <https://echa.europa.eu/information-on-chemicals/cl-inventory-database/-/discli/details/33806>

Data source date: 17 Jul 2015

Hazard Statements: Acute Tox. 4 H332 , Acute Tox. 4 H302 , Eye Irrit. 2 H319 , STOT SE 3 H335 , Skin Irrit. 2 H315 , Resp. Sens. 1 H334 , Skin Sens. 1 H317 , Repr. 1B H360FD , Aquatic Acute 1 H400 , Aquatic Chronic 1 H410

■ **pH** (CAS Number: PH)

Description/Comments: Appendix C4

Data source: WM3 1st Edition 2015

Data source date: 25 May 2015

Hazard Statements: None.

■ **acenaphthylene** (EC Number: 205-917-1, CAS Number: 208-96-8)

Description/Comments: Data from C&L Inventory Database

Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>

Data source date: 17 Jul 2015

Hazard Statements: Acute Tox. 4 H302 , Acute Tox. 1 H330 , Acute Tox. 1 H310 , Eye Irrit. 2 H319 , STOT SE 3 H335 , Skin Irrit. 2 H315

■ **acenaphthene** (EC Number: 201-469-6, CAS Number: 83-32-9)

Description/Comments: Data from C&L Inventory Database

Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>

Data source date: 17 Jul 2015

Hazard Statements: Eye Irrit. 2 H319 , STOT SE 3 H335 , Skin Irrit. 2 H315 , Aquatic Acute 1 H400 , Aquatic Chronic 1 H410 , Aquatic Chronic 2 H411

■ **fluorene** (EC Number: 201-695-5, CAS Number: 86-73-7)

Description/Comments: Data from C&L Inventory Database

Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>

Data source date: 06 Aug 2015

Hazard Statements: Aquatic Acute 1 H400 , Aquatic Chronic 1 H410

■ **phenanthrene** (EC Number: 201-581-5, CAS Number: 85-01-8)

Description/Comments: Data from C&L Inventory Database

Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>

Data source date: 06 Aug 2015

Hazard Statements: Acute Tox. 4 H302 , Eye Irrit. 2 H319 , STOT SE 3 H335 , Carc. 2 H351 , Skin Sens. 1 H317 , Aquatic Acute 1 H400 , Aquatic Chronic 1 H410 , Skin Irrit. 2 H315

■ **anthracene** (EC Number: 204-371-1, CAS Number: 120-12-7)

Description/Comments: Data from C&L Inventory Database

Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>

Data source date: 17 Jul 2015

Hazard Statements: Eye Irrit. 2 H319 , STOT SE 3 H335 , Skin Irrit. 2 H315 , Skin Sens. 1 H317 , Aquatic Acute 1 H400 , Aquatic Chronic 1 H410

■ **fluoranthene** (EC Number: 205-912-4, CAS Number: 206-44-0)

Description/Comments: Data from C&L Inventory Database

Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>

Data source date: 21 Aug 2015

Hazard Statements: Acute Tox. 4 H302 , Aquatic Acute 1 H400 , Aquatic Chronic 1 H410

■ **pyrene** (EC Number: 204-927-3, CAS Number: 129-00-0)

Description/Comments: Data from C&L Inventory Database; SDS Sigma Aldrich 2014

Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>

Data source date: 21 Aug 2015

Hazard Statements: Skin Irrit. 2 H315 , Eye Irrit. 2 H319 , STOT SE 3 H335 , Aquatic Acute 1 H400 , Aquatic Chronic 1 H410

■ **indeno[123-cd]pyrene** (EC Number: 205-893-2, CAS Number: 193-39-5)

Description/Comments: Data from C&L Inventory Database

Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>

Data source date: 06 Aug 2015

Hazard Statements: Carc. 2 H351

■ **benzo[ghi]perylene** (EC Number: 205-883-8, CAS Number: 191-24-2)

Description/Comments: Data from C&L Inventory Database; SDS Sigma Aldrich 28/02/2015
Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>
Data source date: 23 Jul 2015
Hazard Statements: Aquatic Acute 1 H400 , Aquatic Chronic 1 H410

Appendix B: Rationale for selection of metal species

arsenic {arsenic trioxide}

Reasonable case CLP species based on hazard statements/molecular weight and most common (stable) oxide of arsenic. Industrial sources include: smelting; main precursor to other arsenic compounds (edit as required)

cadmium {cadmium oxide}

Reasonable case CLP species based on hazard statements/molecular weight, very low solubility in water. Industrial sources include: electroplating baths, electrodes for storage batteries, catalysts, ceramic glazes, phosphors, pigments and nematocides. (edit as required) Worst case compounds in CLP: cadmium sulphate, chloride, fluoride & iodide not expected as either very soluble and/or compound's industrial usage not related to site history (edit as required)

chromium in chromium(III) compounds {chromium(III) oxide (worst case)}

Reasonable case species based on hazard statements/molecular weight. Industrial sources include: tanning, pigment in paint, inks and glass (edit as required)

chromium in chromium(VI) compounds {chromium (VI) compounds, with the exception of barium chromate and of compounds specified elsewhere in this Annex}

Worst case species based on hazard statements/molecular weight (edit as required)

copper {dicopper oxide; copper (I) oxide}

Reasonable case CLP species based on hazard statements/molecular weight and insolubility in water. Industrial sources include: oxidised copper metal, brake pads, pigments, antifouling paints, fungicide. (edit as required) Worst case copper sulphate is very soluble and likely to have been leached away if ever present and/or not enough soluble sulphate detected. (edit as required)

lead {lead chromate}

Worst case CLP species based on hazard statements/molecular weight (edit as required)

mercury {mercury dichloride}

Worst case CLP species based on hazard statements/molecular weight (edit as required)

nickel {nickel chromate}

Worst case CLP species based on hazard statements/molecular weight (edit as required)

selenium {nickel selenate}

Worst case CLP species based on hazard statements/molecular weight (edit as required)

zinc {zinc chromate}

Worst case CLP species based on hazard statements/molecular weight (edit as required)

vanadium {divanadium pentaoxide; vanadium pentoxide}

worst case/most likely scenario

Appendix C: Version

HazWasteOnline Classification Engine: WM3 1st Edition v1.1, May 2018
HazWasteOnline Classification Engine Version: 2021.77.4714.9046 (18 Mar 2021)
HazWasteOnline Database: 2021.77.4714.9046 (18 Mar 2021)

This classification utilises the following guidance and legislation:

WM3 v1.1 - Waste Classification - 1st Edition v1.1 - May 2018

CLP Regulation - Regulation 1272/2008/EC of 16 December 2008

1st ATP - Regulation 790/2009/EC of 10 August 2009

2nd ATP - Regulation 286/2011/EC of 10 March 2011

3rd ATP - Regulation 618/2012/EU of 10 July 2012

4th ATP - Regulation 487/2013/EU of 8 May 2013

Correction to 1st ATP - Regulation 758/2013/EU of 7 August 2013

5th ATP - Regulation 944/2013/EU of 2 October 2013

6th ATP - Regulation 605/2014/EU of 5 June 2014

WFD Annex III replacement - Regulation 1357/2014/EU of 18 December 2014

Revised List of Waste 2014 - Decision 2014/955/EU of 18 December 2014

7th ATP - Regulation 2015/1221/EU of 24 July 2015

8th ATP - Regulation (EU) 2016/918 of 19 May 2016

9th ATP - Regulation (EU) 2016/1179 of 19 July 2016

10th ATP - Regulation (EU) 2017/776 of 4 May 2017

HP14 amendment - Regulation (EU) 2017/997 of 8 June 2017

13th ATP - Regulation (EU) 2018/1480 of 4 October 2018

14th ATP - Regulation (EU) 2020/217 of 4 October 2019

15th ATP - Regulation (EU) 2020/1182 of 19 May 2020

The Chemicals (Health and Safety) and Genetically Modified Organisms (Contained Use)(Amendment etc.) (EU Exit)

Regulations 2019 - UK: 2019 No. 720 of 27th March 2019

The Chemicals (Health and Safety) and Genetically Modified Organisms (Contained Use)(Amendment etc.) (EU Exit)

Regulations 2020 - UK: 2020 No. 1567 of 16th December 2020

The Waste and Environmental Permitting etc. (Legislative Functions and Amendment etc.) (EU Exit) Regulations 2020 - UK:

2020 No. 1540 of 16th December 2020

POPs Regulation 2019 - Regulation (EU) 2019/1021 of 20 June 2019

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