

LITTLEBOROUGH FIRE STATION LITTLEBOROUGH

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

Job Number: LKC 21 1310

Date: 12th November 2021

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Prepared By	Rachel Wylie Hannah Moss	Reviewed By	Paul Quimby

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EXECUTIVE SUMMARY

Site Details

Site Location:	To the east of Whitelees Road in Littleborough. Centred at approximate National Grid Reference 393380E 416670N.
Site Area:	3,400m ²
Current Land Use:	Active fire station with training tower.
Proposed Development:	Extension and refurbishment of existing fire station.
Purpose of Report:	Contamination and Geotechnical Assessment.

Preliminary Risk Assessment

PRA Details:	Undertaken by LKC in July 2021. Ref: LKC 21 1310.
History:	Tenter ground 1851, Field boundary 1930-1956, fire station 1960-2021.
Geology / Hydrogeology:	Till in the central and northern part (diamicton) (Secondary Aquifer). Head deposits in the south (Secondary B Aquifer). Woodhead Hill Rock (sandstone), Lower Coal Measures and coal seam in south (Secondary A Aquifer).
Mining:	Probable coal mining at shallow depth, possible mine entries.
Relevant Environmental Setting:	No surface or groundwater abstraction within 100m. Not within Source Protection Zone.
Preliminary Conceptual Model: PL=Pollutant Linkage	PL1 Direct Contact (Human Health): Low Risk (asbestos, heavy metals, PAHs), Moderate Risk (hydrocarbons, fire retardants, ethylene, glycol). PL2 Inhalation of Vapours: Moderate/Low Risk (volatile contaminants). PL3 Gas: Moderate Risk (hazardous and ground gas). PL4 Controlled waters: Moderate Risk (mobile contaminants). PL5 Sulphate Attack: Moderate/Low Risk (sulphate). PL6 Water Pipelines: Moderate/Low Risk (organic contaminants). PL7 Phytotoxic: Very low Risk.
Recommendations:	Site Investigation was recommended to further assess the identified pollutant linkages.

Ground Investigation Work Undertaken

Date of Investigation:	2 nd September 2021
Intrusive Investigation Work Undertaken:	5no. window sample boreholes (WS101-WS105). 2no. mechanically excavated soakaway pits (SA101-SA102). 2no. hand dug foundation pits (FTP1-FTP2). 3no. rotary boreholes (RH1-RH3).
Monitoring Wells:	Installed in WS101, WS103 and WS104.
Soil Sampling:	5no. samples tested for metals / metalloids, pH, water soluble sulphate, speciated PAHs, SOM and asbestos screen. 1no. samples tested for metals / metalloids, pH, water soluble sulphate, cyanide suite, phenol, TPHCWG, BTEX, MTBE, speciated PAHs, SOM and asbestos screen. 1no. samples tested for PFOS /PFAS, glycol, surfactants as MBAS.
Groundwater Sampling:	1no. sample tested for metals / metalloids, pH, water soluble sulphate, cyanide suite, phenol, TPHCWG, BTEX, MTBE, speciated PAHs, SOM and asbestos screen. 1no. sample tested for TPHCWG, BTEX, MTBE and SOM. 1no. sample tested for surfactants.
Insitu and Laboratory Geotechnical Testing:	SPTs, shear vanes, plasticity, BRE SD1 Short Suite.

Ground Conditions and Geotechnical Assessment

General Ground conditions	- Based on WS101-WS105 and SA101-SA102. Maximum investigation depth 5.45mbgl. - Made Ground to 0.45-1.25mbgl. Natural superficial deposits comprise CLAY. - In-situ testing typically shows an increase in s_u with depth. - Organic CLAY was recorded within WS103 between 1.20 and 2.00mbgl. - Bedrock was potentially encountered at depths of between 3.50-4.00mbgl in WS104 and WS105. - Groundwater encountered at 3.00mbgl within WS102 and WS103.
Allowable Bearing Pressure	- At 1mbgl in the firm CLAY, an s_u of 30kPa can be realised, returning an ABC of 62kN/m² for a strip foundation. - At 2mbgl an s_u of 50kPa can be realised, returning an ABC of 103kN/m² for a strip foundation.
Anticipated Foundation Type	- Strip and pad foundations to clay strata.
Other Considerations	- Consideration of effects of trees also needs to be considered. - Temporary supports of excavations may be required. - Detailed design should be carried out by structural engineer. - Concrete Requirements DS1-AC-1. - Soakaways are not likely to be suitable on site.

Contamination Risk Assessment

The table below shows a summary of the risk assessments undertaken for each pollutant linkage, the revised conceptual model and recommendation for either remediation and / or further investigation.

Pollutant Linkage		Risk	Recommendations
1	Contaminants posing a risk to site users and offsite receptors via dermal contact, ingestion and inhalation (of soil, dust, fibres)	Low	- ACM not identified in area of proposed extension or soft landscaping. - No elevated heavy metals, PAHs, petroleum, hydrocarbons, PFOS/PFAS, Glycol or MBAS identified. - Recommendations: No remediation required
2	Volatile contaminants posing a risk to site users and offsite receptors via the inhalation of vapours.	Low	- No 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	- No significant risk anticipated given ground conditions encountered on site and no significant sources. - Recommendations: No further assessment required.
4	Mobile contamination posing a risk to controlled waters via the migration through permeable strata.	Low	- No elevated contaminants identified in groundwater or soils. - Recommendations: No remediation required.
5	Sulphate posing a risk to building via direct contact (sulphate attack).	Low	- No elevated sulphate identified. - Recommendations: No remediation required. Concrete requirements should be confirmed by a 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 unlikely 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.

Recommendations and Remedial Strategy

The table below shows the remediation and validation requirements for the site. This information should be documented in a Site Completion Report for submission to the Local Authority.

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 C733¹.	Log of work undertaken including photographs. Details of any sampling undertaken and validation of any potential additional remedial work.
	1, 2, 3, 4, 5, 6, 7	No remediation anticipated with respect to PL1, PL2 (inhalation of vapours), PL3 (gas), PL4 (controlled waters), PL5 (sulphate attack), PL6 (potable water) and PL7 (phytotoxicity).	PL1, PL2, PL3, PL4, P7 - N/A PL5 - Concrete requirements should be confirmed by a structural engineer. PL6 - A Water Pipeline Assessment is undertaken once the location and depth of new potable water pipes are known. It is unlikely that barrier pipe will be required.

¹ CIRIA (2014). "Asbestos in Soil and Made Ground: A Guide to Understanding and Managing Risks". C733.

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1 Introduction

1.1 Background

LK Consult Ltd (LKC) has been commissioned by Greater Manchester Combined Authority to carry out a Phase 2 Geo-Environmental Investigation, Risk Assessment and Remediation Strategy for Littleborough Fire Station, Littleborough. The investigation was undertaken in support of a future planning application for an extension to the existing fire station.

The following work has previously been undertaken:

- Preliminary Risk Assessment (PRA) report, undertaken by LKC (Ref: LKC 21 1310, dated 2nd July 2021).
- Desk Based Coal Mining Risk Assessment (CMRA), undertaken by LKC (Ref: LKC 21 1310, dated July 2021).
- Report on Coal Mining Related Site Investigative Works, undertaken by The Land Consultancy (T253 SFK(TLV1169) rep MT LK Consult 280921, dated October 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)² the site may be developed for a commercial 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. Figure 2 indicates the proposed development.

Location	To the east of Whitelees Road in Littleborough. Centred at approximate National Grid Reference 393380E 416670N.
Area	3,400m ² .
Topography	150 metres above ordnance datum (AOD). Landscaped areas are approximately 0.5m lower.
Land Use	Active fire station with training tower. <u>Surrounding Area</u> North: Residential houses. East: Residential houses. West: Residential houses and commercial buildings. South: Residential houses.
Proposed Development	Extension and refurbishment of existing fire station.

Table 1-1. Summary of site details.

² "National Planning Policy Framework." Ministry of Housing, Communities and Local Government. July 2021.

2 Introduction

2.1 Summary of Existing Information

A PRA report (Ref: LKC 21 1310-01, dated 2nd July 2021) has previously been undertaken by LKC and is summarised in Section 2.2-2.6.

2.2 Site History

The site history is summarised in Table 2-1.

Site Features	Location on Site	Dates Present		Comments	
		From	To		
Tenter Ground	E	1851	1851	Tenter grounds were used for drying newly manufactured cloth or textiles. Present on eastern perimeter and extends offsite to the east. No longer present by 1891 mapping.	
Field boundary	E	1930	1956	Likely site used as allotment gardens.	
Fire station	Whole site	1960	2021	Building in W of site, access road from the NE to yard/car park area surrounded by a cutting. Tank noted on SE part of site. One other small structure present adjacent to the tank. Tank no longer present by 1989 mapping.	
Surrounding Area Features	Distance (m)	Direction	Dates Present		Comments
			From	To	
Reservoir	110	NE	1851	1970	No longer present by 1976 mapping.
Reservoir	130	E	1851	2006	No longer present by 2021 mapping.
Pond	85	W	1851	1968	No longer present by 1970 mapping.
Coal pit	160	SW	1851	1851	No longer present by 1891 mapping.
Drain	155	SE	1891	1985	Flowing south. Indicated to be within a cutting by 1960 mapping. No longer present by 1990 mapping.
Reservoir	200	SW	1893	1985	No longer present by 1990 mapping.
Orchard	15	N	1893	1893	No longer present by 1894 mapping.
Refuse heaps	200	SSE	1938	1956	No longer present by 1960 mapping.
Glass house	10	S	1930	1956	No longer present by 1960 mapping.
Allotment gardens	Adjacent	E	1960	1968	With associated glass houses. No longer present by 1970 mapping.
Cutting	Adjacent	S	1960	1961	No longer present by 1968 mapping.
Cutting	40	S	1960	1968	Marsh indicated in central part of cutting. No longer present by 1970 mapping.
Cutting	160	S	1960	1978	No longer present by 1985 mapping.
Cutting	115	SE	1960	1961	No longer present by 1968 mapping.
Allotment gardens	40	NW	1960	1961	No longer present by 1968 mapping.
Domestic garage cluster	Adjacent	E	1970	2021	
Electricity sub-station	5	N	1970	2021	

Table 2-1: Summary of significant historical features.

2.3 Environmental Setting

The environmental setting is summarised in Table 2-2.

Categories			Details
Geology	Artificial		- No BGS recorded artificial.
	Superficial		- Till (diamicton) in the central and northern part of the site. - Head Deposits in the south.
	Bedrock		- Woodhead Hill Rock (sandstone). - Lower Coal Measures mapped to the south. - Lower Foot Coal Seam subcropping on site. Bassey Coal Seam subcropping 49.8m NE.
	BGS Logs (<50m)		- None available.
Hydro-geology	Aquifer Designation	- Superficial	- Secondary Aquifer – undifferentiated, associated with Till. - Secondary B Aquifer associated with Head Deposits.
		- Bedrock	- Secondary A Aquifer.
	Source Protection Zone (SPZ)		- Site not within an SPZ.
	Groundwater Abstractions (100m)		- None.
Hydrology	Surface Watercourses (100m)		- None.
	Flooding risk		- Flood Zone 1.
	Surface Water Abstractions (100m)		- None.
	Discharge Consents		- None.
	Pollution Incidents		- None.
Minerals & Mining	Coal Mining		- Within a Coal Reporting Area. - Within a Development High Risk Area. See Table 2-3.
	Surface Mineral Extractions (250m)		- None.
	Cheshire Brine Compensation District		- Not within Compensation District. - Not within Consultation Area.
	Non-Coal Mining Area		- Not within an area of conclusive metalliferous mining.
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		- Low to very low hazard.
Landfill Sites (250m)	Known / Registered		- None.
	Potentially Infilled Land (non-water and water), based on Envirocheck Report		- 3no. features: 95m W, 136m NE and 157m SW.
	Potentially infilled sites, based on LKC historical review		- 11no. features: See Table 2-1.
Radon Potential			- <1% of homes above Action Level. No protective measures are necessary in the construction of new dwellings or extensions.
Designated Sites (50m)			- None.
Contemporary Trade Directory (50m)			- None.
Fuel Station Entries (50m)			- None.
Unexploded Ordnance Risk (UXO)	Zetica Risk Map		- Low.

Table 2-2: Summary of the environmental setting continued.

As the site is within a Development High Risk Area. A Coal Authority Consultants Coal Mining Report is presented in Appendix C. A separate Coal Mining Risk Assessment (CMRA) has been carried out under separate cover. The risks identified in the CMRA are summarised in Table 2-3.

Coal Mining Issue	Potential Risk
Underground coal mining (recorded at shallow depths)	X
Underground coal mining (probable at shallow depths)	✓
Mine entries (shafts / adits)	?
Coal mining geology (fissures)	X
Record of past mine gas emissions	X
Recorded coal mining surface hazard	X
Surface mining (opencast workings)	X

Table 2-3: Summary of coal mining potential risks.

✓ = Risk identified; X = No risk identified; ? = Possible risk identified

2.4 Site Reconnaissance

The site comprises of an active fire station with a training tower (south of site). The station comprises of office spaces and fire engine storage space. The ground on site is predominantly hardstanding (tarmac and concrete) with some areas of soft landscaping (garden plots and lawn).

The areas of soft landscaping were noted to be approximately 0.5m lower than the hardstanding ground. Manhole covers are present across the hardstanding ground in the south.

Destroyed vehicles were present in the car park adjacent to the training tower. No underground storage tanks or usage of firefighting foam from anecdotal information.

There were no visual or olfactory contamination identified.

2.5 Contamination Sources / Pathways and Receptors

Potential contamination sources are detailed in Table 2-4.

Potential Source	Contaminants
Onsite	
Shallow Made Ground below some or all of site (e.g. site levelling)	- Assuming predominantly reworked natural soils with possible ash and clinker: heavy metals, sulphates, PAHs³. - Not expected to be a significant source of gas given anticipated depth and nature of Made Ground.
Allotment	- Assuming the use of ash and clinker for drainage: heavy metals, sulphates, PAHs. - Significant pesticide use not anticipated.
Fire station, training tower, training activities and associated tank.	- Historic fuel storage and training on cars: fuels, oils, ethylene glycol, heavy metals. - Fire retardants (e.g. Perfluorooctane Sulfonate (PFOs) and Polyfluoroalkyl substances (PFAs)) are considered possible.
Car park	- Hardwood surface and no signs of spills / leaks: No significant contamination source anticipated.

Table 2-4: Potential contamination sources

³ Defra (2002). "Potential Contaminants for the Assessment of Land". R&D Publication CLR 8.

Potential Source	Contaminants
Surrounding Area	
Surrounding land uses (garage cluster, allotment gardens, orchard)	- Not expected to be as significant as sources identified on site.
Electricity substation (pre 1980s)	- Polychlorinated biphenyl (PCBs) and transistor oils. - Significant migration of contamination to the site considered unlikely as PCBs have relatively low mobility.
Landfills / offsite potentially infilled features within 250m	- Given size, distance and age of features, there is not considered to be a significant source of hazardous gas.
Underlying Geology	
Underlying Pennine Lower Coal Measures	- Ground Gas (principally carbon dioxide and methane).

Table 2-4 (continued): Potential contamination sources

Potential receptors are detailed in Table 2-5.

Receptors	
Human Health	- Future site users (including site works and visitors). - Offsite land users. - As the proposed development is for commercial / industrial use, the most sensitive receptors (children) have not been included in this assessment.
Controlled Waters	- Secondary A Aquifer. - 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.

Pathways		
Soil	Human Health ⁴ (commercial land use with soft landscaping)	- Ingestion of soil. - Ingestion of soil-derived indoor dust. - 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. - Omitted: ingestion of contaminated vegetables and ingestion of soil attached to vegetables.
	- Windblown dust and fibres to adjacent receptors.	
	- Direct contact with receptors (building foundations, services).	
	- Root uptake.	
Water	- Surface run-off over impermeable surface.	
	- Infiltration into the ground, through potentially contaminated material (contamination possibly going into solution).	

Table 2-6: Potential pathways

⁴ EA (2008). "Updated Technical Background to the CLEA Model". Science Report – SC050021/SR3.

Pathways	
Water and Gas	- Migration through potentially permeable strata and preferential pathways. - Superficial (Till) likely to be low permeability. - Head Deposits (sand and gravel) likely to be relatively permeable. - Bedrock (sandstone) likely to be relatively permeable. - Preferential pathways: services, possible shallow worked coal seams.
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 LCRM⁵ 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 C552⁶.

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 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.

The conceptual model is based on the future use of the site (post development), in line with proposed development scheme.

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

⁵ Land Contamination Risk Management (LCRM) <https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm>

⁶ CIRIA (2001). "Contaminated land risk assessment: A guide to good practice". C552.

per HSE guidance⁷) 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.

⁷ 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. - Windblown dust.	- Future site users. - Offsite receptors.	- ACM. - Heavy metals. - PAHs.	Unlikely (given site conditions identified and as new landscaping not proposed)	Medium	Low	No further assessment required.
			- Petroleum hydrocarbons. - Ethylene glycol. - Fire retardants.	Low (given location of proposed extension and hardstanding in area of current building)	Medium	Moderate / Low (moderate assumed until ground conditions confirmed)	Targeted intrusive investigation required. Soil analysis of CoC, subject to ground conditions encountered.
2	- Inhalation of vapours. - Migration via permeable strata and preferential pathways.	- Future site users. - Offsite receptors.	- Volatile contaminants (TPHCWG).	Low (given site history, site conditions and proposed end use)	Medium	Moderate / Low (moderate assumed until ground conditions confirmed)	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.	- Future site users. - Buildings. - Offsite land users.	- Ground gas (carbon dioxide, methane).	Low Likelihood (given limited gas source and pathway)	Severe	Moderate	Intrusive investigation to confirm ground conditions. If significant gas source and pathway identified, gas monitoring or gas protection measures required.
4	- Surface run-off. - Migration via permeable strata and preferential pathways. - Perched waters migration.	- Groundwater (Secondary A Aquifer).	- Mobile contaminants such as metals, PAHs, hydrocarbons, PFOS and PFAS.	Likely (mobile contamination anticipated with possible pathway)	Medium	Moderate	Intrusive investigation required. Groundwater sampling. Analysis for CoC.
5	- Sulphate attack on concrete.	- Building structure.	- Sulphate.	Likely (given site history, site conditions, and direct contact / pathway)	Mild	Moderate / Low (moderate assumed until ground conditions confirmed)	Low density intrusive investigation required. Soil analysis for CoC.
6	- Ingestion of tainted water supply.	- Future site users. - Water pipes.	- Organic contaminants such as petroleum hydrocarbons, naphthalene.	Low Likelihood (given site history, site conditions and made ground not expected at pipeline depth)	Medium	Moderate / Low (low risk assumed given anticipated limited made ground and contamination)	Low density intrusive investigation required. Soil analysis CoC, depending on ground conditions encountered.
7	- Direct contact (plant uptake).	- Flora.	- Phytotoxic contaminants such as heavy metals.	Low (given site history, site conditions and proposed end use)	Minor	Very Low	No further assessment required.

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 2nd September and 13th October 2021 comprised the following:

- 5no. window sample boreholes drilled to 4.38-5.45 metres below ground level (mbgl) (ref. WS101 to WS105).
- 3no. rotary boreholes drilled to 40mbgl (ref. RH1 to RH3).
- 2no. foundation pits (hand excavated) to 1.20mbgl (ref. FTP1-FTP2).
- 2no. soakaway pits (using JCB) excavated to 1.60-1.80mbgl (ref. SA101 to SA102).

The rotary boreholes were drilled to assess the risk associated with coal mining. A separate mining risk assessment report has been produced with the findings of the mining investigation and further recommendations.

All site investigation locations are shown in Figure 3.

The locations were chosen to allow a good spread across the site as well as target areas of concern. Table 3-1 details the targeted and general coverage (non-targeted) site investigation locations.

Site Investigation Locations	Rationale
WS101, WS102	Proposed area of extension.
WS105	General site coverage.
WS103	General site coverage and close to area of car breaking activities.
WS104	Training tower area and possible underground tank area.
SA101 and SA102	Requested soakaway test locations.
FTP1 and FTP2	Foundation pits on existing building to expose foundations.
RBH101, RBH102 and RBH103	Undertaken as part of coal mining investigation.

Table 3-1: Summary of sampling locations.

The number of site investigation points corresponds to approximately one location per 22m square centres. This is considered to be a conservative sampling density and is in line with BS10175⁸ for a 'detailed investigation'.

All profile logs are provided in Appendix B and are in line with BS14688-1⁹ and BS5930¹⁰.

⁸ British Standard (2017). "Investigation of Potentially Contaminated Sites – Code of Practice." BS10175:2017.

⁹ British Standards (2002) Geotechnical investigation and testing – Identification and Classification of Soil. Part 1: Identification and description. BS EN ISO 14688-1:2002.

¹⁰ British Standard (2015). "Code of Practice for Ground Investigations". BS5930:2015.

3.2 Well Installations

3no. (WS101, WS103 and WS104) of the boreholes were installed with monitoring wells for groundwater sampling. Monitoring wells were installed in accordance with BS10175 and CIRIA C665¹¹ 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 investigation¹².

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 C665¹³ 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 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 3-2 shows the soil testing undertaken.

¹¹ CIRIA (2007). "Assessing Risks Posed by Hazardous Ground Gases to Buildings." CIRIA C665.

¹² EA (2000). "Technical Aspects of Site Investigation. Volumes 1 & 2 Text Supplements Research and Development Technical Report." P5-065/Tr.

¹³ CIRIA (2007). "Assessing Risks Posed by Hazardous Ground Gases to Buildings." CIRIA C665.

Suites and Contaminants	No. Samples	Location & Depth	Justification
Metals / metalloids, pH, water soluble sulphate, speciated PAHs, SOM and asbestos screen.	5	WS101 0.0-0.4m WS102 0.0-0.5m WS103 0.1-1.0m WS105 0.3-0.7m SA101 0.0-0.5m	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 ash and coal) and no TVOCs identified from the PID tests.
Metals / metalloids, pH, water soluble sulphate, cyanide suite, phenol, TPHCWG, BTEX, MTBE, speciated PAHs, SOM and asbestos screen.	1	WS104 0.5-1.0m	Although no visual/olfactory evidence of contamination was identified (with the exception of some ash), due to location of former the former tank, a detailed suite has been undertaken.
Ethylene glycol, PFAS / PFOS, Surfactants as MBAS	1	WS104 0.15-0.5m	Tested due to the close proximity of location to training tower and car breaking area where contaminants may be have been used.

Table 3-2. 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; TPHCWG=carbon banded and aromatic/aliphatic split petroleum hydrocarbons; PAH=polycyclic aromatic hydrocarbons, BTEX=benzene, toluene, ethylbenzene and xylenes; MTBE=Methyl tert-butyl ether, SOM=Soil Organic Matter, PFAS=Perfluoroalkyl Substances; PFOS=Perfluorooctane sulfonate, MBAS=Methylene Blue Active Substances.

3.3.2 Water Sampling

To establish the condition of shallow groundwater LKC undertook two groundwater samples.

The groundwater samples were collected a minimum of 1 week after drilling had finished and following well development. Sample collection was undertaken using a low flow sampling pump using thin walled tubing to encourage laminar flow and minimise the potential loss of volatiles during sampling. The borehole was purged of all standing water and the sample collected from the recharged water. The sample was collected in glass and plastic bottles and a glass vial. A water meter was used to test the pH, temperature and conductivity before sampling until equilibrium conditions were met, as per BS10175¹⁴ guidelines.

All water samples were placed in glass bottles, plastic bottles and septum topped vials and stored in ice packed cool boxes. The samples were sent to Chemtest on the same day for analysis. The sampling suite is presented in Table 3-3.

Sampling was carried out in accordance with BS5930¹⁵ and BS5667-11¹⁶.

Many of the tests are UKAS or MCERTS accredited and further details are given in the Certificate of Analysis presented in Appendix E. Table 3-3 shows the groundwater / leachate testing undertaken.

¹⁴ British Standard (2017). "Investigation of Potentially Contaminated Sites – Code of Practice." BS10175:2017.

¹⁵ British Standard (2015). "Code of Practice for Ground Investigations". BS5930:2015.

¹⁶ British Standard (2009). "Water Quality – Sampling. Part 11: Guidance on Sampling of Groundwaters". BS ISO 5667-11:2009.

Suites and Contaminants	No. Samples	Location	Justification
Metals / metalloids, pH, sulphate, cyanide suite, TPHCWG, BTEX, MTBE, speciated PAHs, phenol and hardness.	1	WS101 (G)	Detailed suite undertaken confirm the absence of contamination.
TPHCWG, BTEX, MTBE and hardness.	1	WS103 (G)	Undertaken as evidence of contamination identified in the soil from this location.
PFAS / PFOS	1	WS103 (G)	Undertaken given locations proximity to training tower where specific contaminants may have been used.
Surfactants	1	WS103 (G)	Undertaken given locations proximity to area where car breaking occurs on site.

Table 3-3. Summary of groundwater sampling tests undertaken.

Notes:

G=Groundwater Sample

Metal/metalloids=arsenic, cadmium, chromium, (total and hexavalent), copper, lead, mercury, nickel, selenium, vanadium, zinc and boron; TPHCWG=carbon banded and aromatic/aliphatic split petroleum hydrocarbons; PAH=polycyclic aromatic hydrocarbons, BTEX=benzene, toluene, ethylbenzene and xylenes; MTBE=Methyl tert-butyl ether, PFAS=Perfluoroalkyl Substances; PFOS=Perfluorooctane sulfonate, MBAS=Methylene Blue Active Substances.

3.4 Geotechnical Testing

3.4.1 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.
- Shear Vane (SV) tests and Pocket Penetrometer (PP) readings giving undrained shear strength (s_u) were performed in the window sample boreholes and trial pits at approximately 1m intervals, within the natural clay strata.

Shear vanes tests were not always possible due to the friable or gravel rich nature of some of the clay deposits.

The SPT, PP and SV readings are provided within the profile logs (Appendix B).

3.4.2 Laboratory Geotechnical Testing

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

Many of the tests are UKAS accredited and further details are given in the laboratory report presented in Appendix D. Table 3-4 shows the geotechnical testing undertaken.

Suites and Contaminants	No. Samples	Location	Justification
Atterberg Limits (plasticity testing)	4	SA101 0.5-1.6m WS101 1.0-2.0m WS102 0.5-1.0m WS102 1.8-2.0m	A selection of clay samples across the site were tested for Atterberg Limits to assess their shrinkability potential associated with current and proposed trees.
BRE SD1 Short Suite	3	WS101 0.0-0.4m WS101 0.5-1.0m WS102 0.5-1.0m	To aid in concrete classification.

Table 3-4. Summary of geotechnical testing undertaken.

3.5 Soakaway Tests

Soakaway tests were undertaken in SA101-SA102 in accordance with BRE Digest 365¹⁷.

The trial pits were machine excavated to dimensions of 0.6m wide, 2.0m long and between 1.6-1.8m depth. The arisings were logged in accordance with BS14688-1¹⁸ and BS5930.

A slotted standpipe was placed vertically in the pit and gravel was backfilled into the bottom of the pit to prevent the sides falling in during water influx.

The pits were filled from a water bowser and the drop in level timed and recorded using a dipmeter inside the temporary standpipe.

¹⁷ BRE (2003) 'Soakaway Design' British Research Establishment BRE Digest 365 2003

¹⁸ British Standards (2002). Geotechnical investigation and testing – Identification and Classification of Soil. Part 1: Identification and description. BS EN ISO 14688-1:2002.

4 Ground Conditions

4.1 Geology – Generalised Sequence

The ground conditions beneath the site comprised made ground underlain by natural strata comprising variably silty sandy gravelly CLAY, clayey gravelly SAND and clayey GRAVEL. A summary section of the logs is provided in Plate 4-1, with additional comments below.

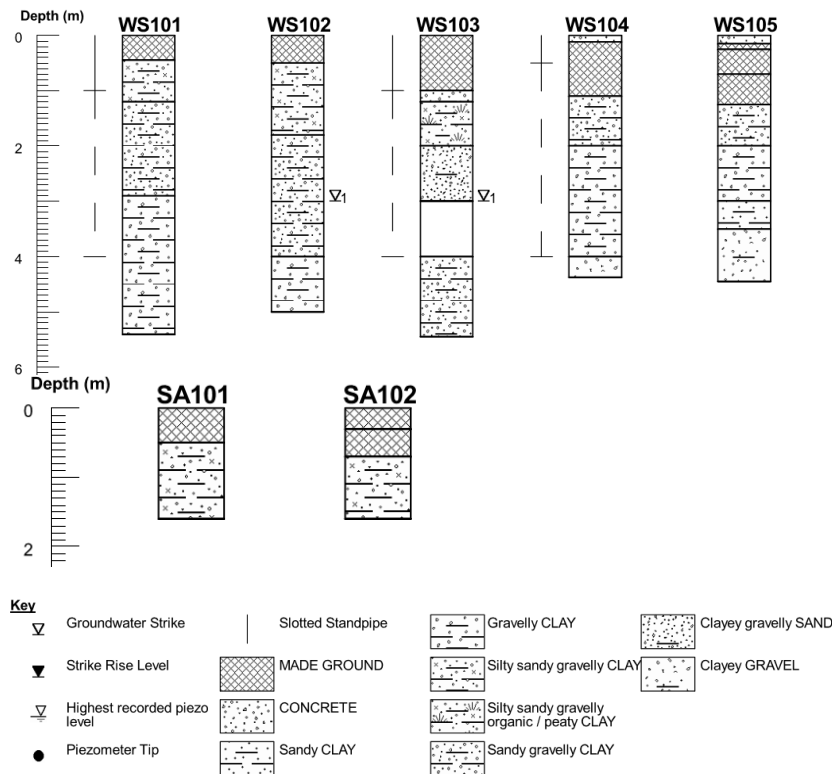


Plate 4-1: Summary of ground conditions.

Additional information on ground conditions:

- Made Ground was recorded to depths of 0.45-1.25mbgl and generally consisted of variably sandy gravelly silt with clinker and slightly gravelly sandy silty clay. WS104 and WS105 were noted to have a hardstanding layer of tarmacadam. Exceptions to this were:
 - WS104 0.15-1.10mbgl – sandy silty GRAVEL with brick, ash, clinker and rare clay inclusions.
 - WS105 0.15-0.45mbgl and SA102 0.00-0.30mbgl – sandy GRAVEL (MOT)
 - WS105 0.45-0.70mbgl – gravelly clayey SAND with clay inclusions and rare brick fragments
 - WS105 0.70-1.25mbgl – gravelly sandy CLAY with rare clinker and brick fragments
 - A land drain was encountered in SA102 at 0.40mbgl.
- Slight surfactant type odour noted in WS104 0.15-1.00mbgl.
- Slight organic odour noted in WS105 1.25-2.00mbgl.
- Foundation pits observed concrete footing stepping out 0.20mbgl in both pits at 1.20mbgl. A clay pipe was encountered in FTP1 0.50mbgl.

- Natural strata below the made ground consisted generally of soft to stiff consistency gravelly/sandy CLAY.
- Probable weathered bedrock was encountered at WS104 and WS105 from 3.50-4.00mbgl.

Appendix B shows the full profile of logs and foundation pits.

The rotary logs identified topsoil over clay to a maximum depth of 9mbgl. Coal Measures Strata was recorded to a depth of 40mbgl in each borehole. Intact coal seams were encountered within each borehole at depths of between 17m and 31.5mbgl.

4.2 Groundwater

4.2.1 Groundwater Levels

No groundwater was present in the soakaway pits. Results of the groundwater depths within the boreholes 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	1.0-4.0 (C/G)	2	2.23	2.32	4.04	Y	N
WS102	3.0	-	-	-	-	-	N	N
WS103	3.0	1.0-4.0 (C/S)	2	3.85	3.90	4.01	Y	N
WS104	Dry	0.5-4.0 (MG/C/G)	2	2.45	Dry	2.48	N	N
WS105	Dry	-	-	-	-	-	N	N

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

Response Zones:

MG=Made Ground; G= Gravel; S=Sand; C=Clay.

4.2.2 Permeability Tests

Soakaway tests were also carried out within clay strata. The results of the soakaways are presented in Appendix F and summarised in Table 4-2.

BRE365¹⁹ indicates that the calculation of the soil infiltration rate is made from the time taken for the water level to fall from 75% to 25% effective storage depth in each pit.

$$\text{Soil infiltration rate, } f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$$

Where:

V_{p75-25} = the effective storage volume of water in the trial pit between 75% and 25% effective depth.

a_{p50} = the internal surface area of the trial pit up to 50% effective depth including the base area.

t_{p75-25} = the time for the water level to fall from 75% to 25% effective depth.

Due to the slow rate at which water drained, three tests were not carried out and were terminated before the required effective depth.

¹⁹ BRE (2003) 'Soakaway Design' British Research Establishment BRE Digest 365 2003

TP	Test No.	Strata at Test Level	Time for outflow between 75% and 25% (mins)	Soil infiltration rate (m/s)
SA101	1	Gravelly slightly sandy Clay	Not reached	Test Failed
SA102	1	Gravelly slightly sandy Clay	Not reached	Test Failed

Table 4-2: Summary of soakaway tests and permeability.

Based on the above, it is unlikely that soakaways will be feasible for this site.

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 4-3 and provided within the profile logs in Appendix B.

Approximate Depth (mbgl)	SPT 'N' Values				
	WS101	WS102	WS103	WS104	WS105
1-2	16 (CI)	7 (CI)	-	3 (CI)	5 (MG)
2-3	10 (CI)	12 (CI)	4 (CI)	16 (CI)	12 (CI)
3-4	15 (CI)	10 (CI)	37 (NR)	17 (CI)	15 (CI)
4-5	18 (CI)	17 (CI)	5 (CI)	50 (G)	15 (G)
5-6	50 (CI)	-	15 (CI)	-	-
GW Level	2.26-2.35	3.00	3.00-3.90	2.45	-

Table 4-3: Summary of SPT (N) values.

Notes:

MG = Madeground; G= Gravel; CI=Clay; NR=No Recovery.

Groundwater level based on strikes during investigation and monitoring data.

4.3.2 Shear Vanes and Pocket Penetrometer Readings

Hand shear vane and pocket penetrometer readings, recording undrained shear strength (s_u), were taken within the clay strata. The results are summarised in Table 4-4 and provided within the profile logs in Appendix B.

The gravel rich content of clay in WS102 between 3.0-4.0mbgl meant no reading was able to be taken.

Approximate Depth (mbgl)	Average Undrained Shear Strength (kN/m ²)						
	SA101	SA102	WS101	WS102	WS103	WS104	WS105
0-1	-	-	114	61.3	40.85	30.65	-
1-2	12-22	21-34	44.96	91.97	32.7	88.9	49.05
2-3	-	-	117.36	-	60	126.12	122.63
3-4	-	-	116.49	-	80	98.1	-
4-5	-	-	167.58	98.1	134.88	-	-
GW Level	-	-	2.26-2.35	3.00	3.00-3.90	2.45	-

Table 4-4: Summary of average hand shear vane and pocket penetrometer readings.

Notes:

Groundwater level based on strikes during investigation and monitoring data.

Shear vane readings can be influenced by coarse material including silt.

4.4 Geotechnical Laboratory Testing

4.4.1 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 (%)
WS101	1.7-2.0	14	40	14	26	CI	64	16.64
WS102	0.5-1.0	19	48	16	34	CI	88	29.92
WS102	1.8-2.0	11	44	15	29	CI	58	16.82
SA101	0.5-1.6	13	42	14	28	CI	44	12.32

Table 4-5: Summary of plasticity index testing.

The modified plasticity index is between 12% and 30%. This characterises the clay as having a low to medium volume change potential.

4.4.2 Sulphate and pH

Water soluble sulphate and pH tests were carried out on soil and groundwater samples. Full results are presented in Appendix C (soils) and Appendix E (groundwater) and summarised in Table 4-6.

Strata	pH		Sulphate	
	Soil	Groundwater	Soil (g/l)	Groundwater (mg/l)
Made Ground	6.8-8.1	7.7	<0.01-0.38	36
Natural	6.7-7.2		<0.01	

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

5 Geotechnical Assessment

5.1 Proposed Development

It is understood that the investigation was undertaken in support of a future planning application for commercial use for an extension and refurbishment of an existing fire station.

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 up to 1.25mbgl over natural cohesive superficial deposits of CLAY. Organic CLAY was encountered at a depth of between 1.20-2.00mbgl within WS103. It is believed that bedrock may have been encountered at the locations of WS104 and WS105 at depths of between 3.50m and 4.00mbgl.

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 may be encountered on site. These should be excavated from below the proposed development foot print with the resulting void backfilled.

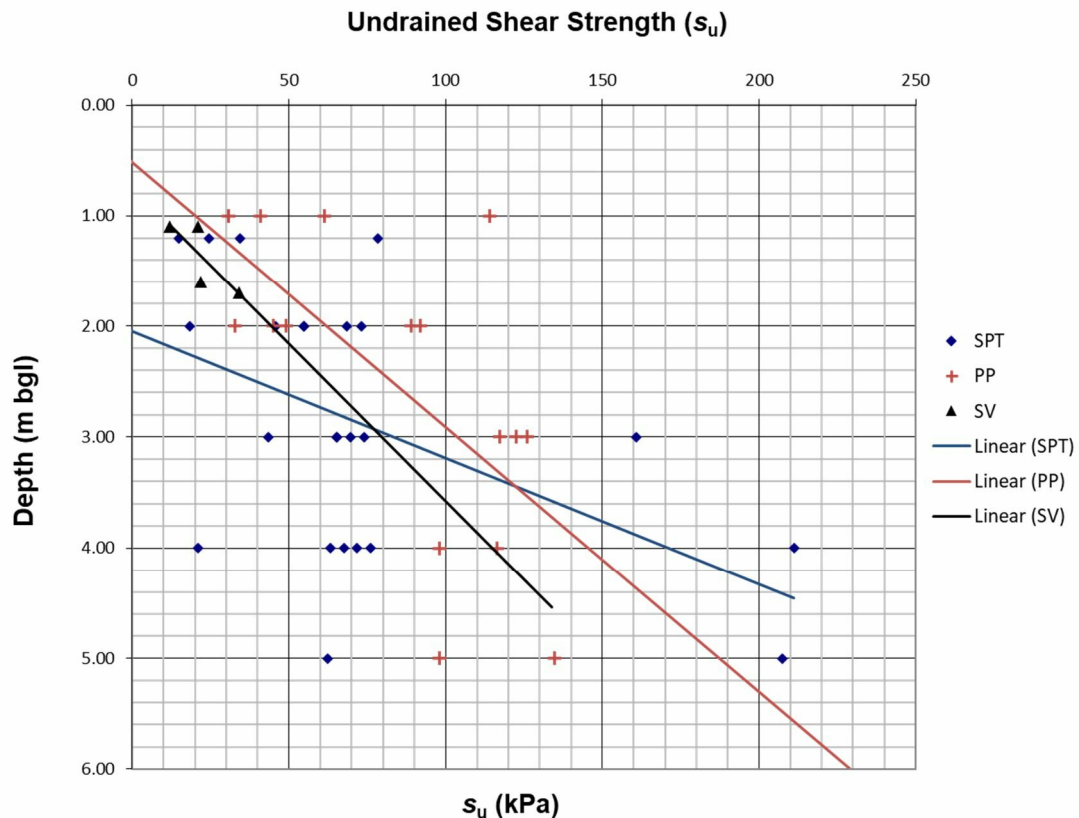
The near surface soils may potentially be disturbed by weathering and site traffic. Precautions should be taken to avoid this, as excessive disturbance may result in more onerous floor slab design, road cap thickness and increased amount of site disposal etc.

5.4 Foundation Conditions and Bearing Capacity

5.4.1 General

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

Strength of the natural cohesive material has been assessed using in-situ testing by SPT, PP and SV. The results of the testing have been plotted against depth as is shown in Graph 5-1 below:



Graph 5-1: Summary of s_u vs depth from in-situ SPT, PP and SV testing.

From Graph 5-1 it can be seen that the strength of the cohesive deposits typically increase with depth in all three types of in-situ testing.

A conservative s_u of 30kPa is assigned to the cohesive material from a depth of c. 1.2mbgl for the natural superficial deposits, returning an allowable bearing capacity (ABC) of 62kN/m² for strip/trench fill foundations.

5.4.2 Strip Foundations

Strip foundations should be constructed at least 150mm in to the underlying firm CLAY. At this depth an allowable bearing capacity of 62kN/m² has been calculated using a Factor of safety of 2.5 and an undrained shear strength (s_u) of 30kN/m² taken from Graph 5-1.

Should foundations be taken to 2.00mbgl by deep strip/trench, then an ABC of 103kN/m² could be achieved, utilising an s_u of 50kPa.

Atterberg Limits determinations, summarised in Table 4-5 show the clay to be of intermediate plasticity and as such the sides of the foundations may require protection using clay board or similar.

Foundation depths should take account of the presence of existing and proposed trees with foundations deepened locally in accordance with the requirements of NHBC Standards for a clay of low to medium plasticity. It is recommended that at working drawing stage a foundation schedule is prepared for the development taking account of the soil plasticity and the locations of trees.

5.4.3 Pad Foundations

Based upon the s_u obtained from the in-situ and laboratory testing of the Glacial Till material, an assessment has been made on a pad foundation supporting column loads. For preliminary assessment purposes, two sizes of pad (1m^2 and 2m^2) have been considered at depths of 1m and 2mbgl. The bearing capacity assessment has been made in line with combination 1 (partial factors on Actions) and Combination 2 (partial factors on materials), results are shown in Table 5-1.

Pad Size	Pad Depth (mbgl)	Allowable Load (kN)
1m^2 (1.00m x 1.00m)	1.00	77
	2.00	133
2m^2 (1.42m x 1.42m)	1.00	163
	2.00	275

Table 5-1: Summary of pad Allowable Load.

The pads show an ABC of 77kN for a 1m^2 pad and 163kN for a 2m^2 pad foundation placed at a depth of 1mbgl in the target stratum of firm CLAY (Glacial Till). Strip foundations supporting cladding walls should be able to support loadings of 62kN/m^2 .

The above is for assessment purposes only, foundation design should be undertaken by a specialist contractor.

5.5 Ground Floor Slabs

Due to the presence of varying thickness' upto 1.25m depth of Made Ground across the site it is considered that suitable preparation of the sub-grade, by a combination of excavation and re-compaction, a ground bearing floor slab should prove suitable for the proposed buildings.

Floor slabs should be designed by a suitably experienced structural engineer.

5.6 Pavement Construction

Untreated Made Ground is considered unsuitable as a sub-grade due to its potential variability and potentially low strength/high compressibility. It should be removed to a depth of 0.5m below formation level and sorted to remove any unsuitable or deleterious materials. The sub formation should be rolled and suitable excavated material can then be replaced, up to formation level, in fully compacted thin layers. Any deficit should be made up with suitable imported fill compacted as above. Following this treatment an overall design CBR of 2-5% should be available, although this will require confirmation at a later date through in-situ CBR tests.

5.7 Drainage

The presence of substantial depths of Made Ground (up to 1.25m thickness) across the site may result in settlement. It is therefore recommended that drain runs are designed using steeper gradients and flexible joints to allow for some differential settlement.

The soil infiltration tests did not show suitable soakage potential. It is not recommended that soakaways are used for disposal of surface water runoff.

5.8 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).

5.9 Excavations

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

Groundwater seepage was recorded in two of the Trial Holes, evident of isolated perched water in the CLAY. Generally trial pits were stable.

Due to the variability of the Made Ground it is considered that all excavations are supported or battered back in accordance with guidance contained in CIRIA R97²⁰. Groundwater seepages were noted in two of the exploratory holes, however, these were minor and it is considered that conventional sump pumping should be adequate.

5.10 Construction Activity and Inspection

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

- Due to the variability of the soils at the site 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;

²⁰ CIRIA Report 97 – Trenching Practice – Second Edition (2001 revision)

- » 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 (LCRM²¹). 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^{22,23}. The recent change to the contaminated land guidance has changed the evaluation of risk from 'minimal' (referred to as Health Criteria values (HCVs))²⁴ 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 S4ULs²⁵. 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^{26,27,28,29}.

If contaminants are not present as C4SLs and S4ULs then LKC will use ATRISK SSVs or CL:AIRE GACs³⁰. 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

²¹ Land Contamination Risk Management (LCRM) <https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm>

²² Defra (2014). "SP1010: Development of Category 4 Screening Levels and Assessment of Land Affected by Contamination – Policy Companion Document."

²³ CL:AIRE (2013). "SP1010: Development of Category 4 Screening Levels and Assessment of Land Affected by Contamination – Final project Report."

²⁴ EA (2008). "Human Health Toxicological Assessment of Contaminants in Soils." Science Report – SC050021/SR2.

²⁵ LQM (2014). "The LQM/CIEH S4ULs for Human Health Risk Assessment."

²⁶ EA (2008). "Updated Technical Background to the CLEA Model." Science Report – SC050021/SR3.

²⁷ EA (2008). "Human Health Toxicological Assessment of Contaminants in Soils." Science Report – SC050021/SR2.

²⁸ EA (2008). "A Review of Body Weight and Height Data used within the Contaminated Land Exposure Assessment Model (CLEA)." Project SC050021/Technical Review 1.

²⁹ EA (2009). "Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values." Science report SC050021/SR7.

³⁰ CL:AIRE (2009). "The Soil Generic Assessment Criteria for Human Health Risk Assessment."

PAHs^{31,32} and naphthalene the most volatile and soluble³³. 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 negligible³⁴. For B(a)P to be used as a surrogate marker it should follow the profile described by the HPA (2008)³⁵ and CL:AIRE (2013). Naphthalene will be treated separately using the LQM S4ULs.

The proposed development is for an extension to the existing fire station building, therefore the assessment criteria for commercial has been used.

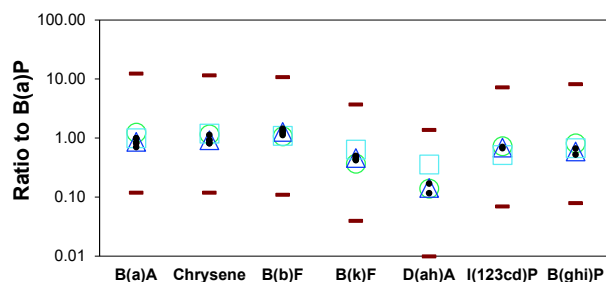
All criteria have been generated using the CLEA V1.06 model³⁶ based either on 1%, 2.5% and 6% Soil Organic matter (SOM). Results will be compared to the nearest appropriate SOM.

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.*³⁷, 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 6 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)

³¹ EA (2002). "Contaminants in Soils: Collation of Toxicological Data and Intake Values for Humans. Benzo[a]pyrene." R&D Publication TOX2.

³² USEPA (1984). "Health Effects Assessment of Polycyclic Aromatic Hydrocarbons (PAHs). EPA 540/1-86-013."

³³ EA (2003). "Review of the Fate and Transport of Selected Contaminants in the Soil Environment." Draft technical report P5- 079/TR1.

³⁴ CL:AIRE (2013). "SP1010: Development of Category 4 Screening Levels and Assessment of Land Affected by Contamination – Final project Report."

³⁵ HPA (2010). "HPA Contaminated Land Information Sheet: Risk Assessment Approaches for Polycyclic Aromatic Hydrocarbons (PAHs)." Version 3.

³⁶ EA (2008). "CLEA Software (Version 1.05) Handbook." Science Report – SC050021/SR4.

³⁷ 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.

Other Contaminants with no C4SLs, LQM S4ULs, ATRISK SSVs or CL:AIRE GACs

- PFOS/PFAS – There are no UK assessment criteria available. Therefore, as an initial screen, assessment criteria derived by the US and other International States have been used. These have been summarised by the ITRC³⁸, and are presented in Appendix G. The assessment criteria is based on residential use only; therefore, are considered to be conservative. The Australian assessment criteria includes two residential scenarios, the 'residential with minimal opportunity for soil access' has been used.
- MBAS – historically used as an indicator for the level of contaminants within firefighting foams and from vehicle washing. Although these are not widely tested since the development of PFAS testing, some tests were carried out as a comparison to previous investigation work. There are no current assessment criteria available for MBAS. Therefore, further qualitative assessment will be considered where they are above Limits of Detection.

6.2.2 Soil Results Comparison against Assessment Criteria

All analysis sheets are presented in Appendix C.

Results have been compared to the relevant assessment criteria and no elevated contaminants were identified.

Asbestos was identified, as detailed in Table 6-1.

Sample Location	ID	Type
WS104 (0.15-0.5m)	Chrysotile	Fibres/Clumps

Table 6-1: Details of asbestos identified.

6.2.3 Hazard Quotient

To examine the potential additivity of toxicological effects between the petroleum hydrocarbon fractions, a Hazard Index (HI) as described by the Environment Agency³⁹ technical report was calculated for the samples. This should be undertaken when there are no elevated petroleum hydrocarbons, when compared to assessment criteria of individual fractions. A HI was calculated for WS104 0.5-1.0m (See Appendix H). A HI was not calculated for the remaining samples as no or minimal petroleum hydrocarbons fractions were present.

HI results are presented in Table 6-2.

Sample Location	Hazard Index	Further consideration required?
WS104 (0.5-1.0m)	0.11	N

Table 6-2: Summary of Hazard Index

³⁸ <https://pfas-1.itrcweb.org/fact-sheets/>

³⁹ EA (2005). "The UK Approach for Evaluating Human Health Risks from Petroleum Hydrocarbons in Soils." Science report P5-080/TR3.

6.2.4 *Direct Contact Risk – Pollutant Linkage 1*

Metals, PAHs, Glycol

No elevated concentrations of heavy metals, PAHs or ethylene glycol have been identified in any soil sample when compared against relevant criteria.

The probability of these contaminants affecting site users is therefore considered unlikely. With a medium consequence, the risk is considered to be low and no remediation is recommended.

Petroleum Hydrocarbons

A sample taken from WS104 identified low concentrations of heavy end hydrocarbons, but none were above assessment criteria. The hazard index of this sample was less than one.

LKC considers the probability of hydrocarbon contamination affecting site users (via ingestion and dermal contact) as unlikely. Given a medium consequence a low risk is considered appropriate and no remediation is recommended.

Asbestos

Asbestos (chrysotile) was identified in WS104. The asbestos was identified as free fibres/clumps. The made ground beneath the tarmacadam was granular and contained frequent brick fragments which was different to ground conditions identified across the rest of the site. The asbestos is likely associated with the demolition type material identified in this sampling location.

No other samples tested contained asbestos, therefore the sample is considered to be localised to the area around WS104. The location is not within an area of soft landscaping or where development is to take place, and as it to remain in an area covered by concrete and should not affect site users.

The probability is considered to be unlikely. With a medium consequence the risk is assumed to be low and no remediation is recommended.

Additional consideration should also be given to the risk to workers and offsite receptors during groundworks and construction. This is discussed further in Section 9.

PFAS / PFOS and Surfactants as MBAS

The majority of results for PFAS are below detection limits. Total PFOS concentration was 1.33 µg/kg. This indicates some short term / localised use on site in the area of WS104, which is located adjacent to the existing training tower on site. When compared to available assessment criteria (2mg/kg) no exceedances are recorded.

Although the assessment criteria used for PFOS are not UK derived, they are considered to be conservative given the land use. The main pathway associated with PFOS and human health is ingestion and the bioaccumulation in the body. Given the current and proposed use of the site, is it not anticipated that site users will have significant exposure to made ground on site to allow ingestion of the contaminants in the soil given that this location is within any soft landscaping. Also, given the site use,

the receptors frequently using site are not anticipated to be the most sensitive (i.e. children).

Although a detectable concentration of MBAS was identified in WS104, this is not considered to pose a significant risk to site users as detailed above (limited exposure and relatively low sensitivity of the receptor).

Therefore, the probability of PFOS/PFAS and MBAS is considered to be unlikely. With a medium consequence, the risk is low and no remediation is required.

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 was not carried out as part of this assessment. The PRA identified a moderate risk and recommended gas monitoring depending on ground conditions identified.

No significant depths organic / putrescible material was encountered on site. Made ground was approximately 1m thick and comprised brick, ash and clinker. Limited amounts of slightly organic material was identified in WS104 (0.75m thick).

Rotary logs have identified intact coal seams at between 17.0 and 31.5mbgl. As the coal is in intact and proof drilling and grouting has been recommended for the site, LKC consider that a significant risk of migration from any residual ground gas is unlikely.

Given the ground conditions encountered, LKC considers the probability of gas posing a risk to site users as unlikely. The consequence is severe, which gives a moderate / low risk. Given the known ground conditions, LKC considers there to be a low risk and no further action is required with respect to pollutant linkage 3.

6.4 Controlled Water Assessment

LKC considers the Secondary A Aquifer as the primary receptor.

Metals, PAHs, Glycol and TPHCWG

LKC have compared results above Limits of Detection (LOD). Where relevant the review of priority substances takes precedence considering threshold values for groundwater cannot be used 'as part of site-specific investigations'. The hierarchy is as follows:

- 2016 private water supply standards (UKDWS potable)⁴⁰.

⁴⁰ Statutory Instruments (2016). "The Private Water Supplies Regulation 2016." No. 614

- » 2001 Environment Agency Values for Environmental Quality Standards (EQS) and UK Drinking Water Standard (UKDWS)⁴¹.

No elevated contaminants were identified when compared against criteria.

The probability of metals, PAHs, glycol and petroleum hydrocarbons posing a risk to controlled waters is considered to be unlikely. With a moderate consequence, the risk is low and no remediation is required.

PFAS (PFOA and PFOS), Surfactants as MBAS

The CL:AIRE Technical Bulletin for Managing Risk and Liabilities associated with Per- and Polyfluoroalkyl Substances (PFASs)⁴² has been reviewed and includes a summary of a number of different assessment criteria for determining the risk of PFOS and PFOA. These are as summarised below with a comparison to the water results:

- » UK Technical Advisory Group (UK TAG): The concentration of PFOS in groundwater below which the danger of deterioration in the quality of the receiving groundwater is avoided is an annual mean of **1µg/l** (derived from 75% of the WFD threshold, where that threshold is used for the protection of groundwater as a long-term drinking resource).

All groundwater samples are below the UK TAG assessment criteria.

- » Guidance on the Water Supply Regulations specific to PFOS and PFOA concentrations in drinking water (2021) produced by the Drinking Water Inspectorate – Tier 3 (wholesomeness at **0.1ug/l** above which measures to reduce concentrations must be implemented).

The results of PFOS and PFOA were below 0.1ug/l.

- » Detectable levels of other PFAS were identified in the groundwater, where there are no UK guideline values. All were below 0.1ug/l with the exception of PFHxA at 0.102ug/l. ITRC⁴³ have summarised international screening values and Canada has a drinking water standard of 0.2 ug/l. Therefore, the concentration identified on site does not exceed this value and is not considered to pose a significant risk to controlled waters.

No specific criteria is available for surfactants as MBAS in groundwater. Results show low levels within groundwater sample from WS103 (0.37mg/l). Although above LOD considering there are no potable groundwater abstractions have been identified within influencing distance of site, site mainly being hardstood / covered, the concentration is not considered to pose a significant risk.

Based on the above, LKC considers the probability of the above contaminants on site affecting the Secondary A Aquifer as unlikely. Given the medium consequence, a low risk is anticipated (Pollutant Linkage 4) and no remediation is required.

⁴¹ EA (2002). "Environment Agency technical advice to third parties on Pollution of Controlled Waters for Part IIA of the Environment Protection Act 1990."

⁴² CL:AIRE Technical Bulletin for Managing Risk and Liabilities associated with Per- and Polyfluoroalkyl Substances (PFASs). TP19. February 2019.

⁴³ <https://pfas-1.itrcweb.org/fact-sheets/>

6.5 Additional Risk Assessments

6.5.1 Concrete (Pollutant Linkage 5)

As stated in Section 5, sulphate resistant concrete will 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 contamination⁴⁴. 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: cresols, ethers, nitrobenzene, ketones, aldehydes and amines.

The following elevated contaminants were identified:

» Elevated petroleum hydrocarbons in the southwest of site (WS104).

No other elevated contaminants were identified and WS104 is not located with the footprint of the proposed extension therefore the elevation is not considered to pose significant risk.

Once details of the pipeline location and depths are known a UU Risk Assessment should be undertaken.

At this stage, the probability of organic contaminants affecting potable water pipes is unlikely. Given the consequence is considered to be medium, the risk (pollutant linkage 6) is anticipated to be low risk and no remediation is likely to be required (subject to further risk assessment).

6.5.3 Phytotoxicity (Pollutant Linkage 7)

Soil results were compared to phytotoxic guideline values as outlined in BS3882⁴⁵.

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 6-3.

⁴⁴ UU(2011). "United Utilities Water Supplementary Guidance for the Selection of Water Pipes in Land Potentially Affected by Contamination."

⁴⁵ BS (2015). "Specifications for Topsoil and Requirements for Use." BS3882:2015.

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.

Littleborough Fire Station, Littleborough
Phase 2 Geo-Environmental Investigation, Risk Assessment and Remediation Strategy

Pollutant Linkage	Pathway	Receptor	Contaminant	Probability	Consequence	Risk	Assessment
PL1	-Dermal contact. -Inhalation of soil, fibres and dust. -Ingestion of soils, dust. -Windblown dust.	-Current site users. -Future site users -Site users. -Offsite receptors.	ACM Heavy metals PAHs Petroleum hydrocarbons Ethylene Glycol PFOS/PFAS Surfactants as MBAS	Unlikely	Medium	Low	-ACM identified, however not in area of proposed extension and will remain buried beneath concrete surface. No ACM identified anywhere else on site. -No elevated PAHs, heavy metals, petroleum hydrocarbons or glycol identified on site. -No significant concentrations PFOS/PFAS or MBAS concentrations identified. -Recommendation*1 *2: No remediation required.
PL2	-Inhalation of vapours. -Migration through permeable strata and preferential pathways.	-Current site users -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 site users. -Future site users. -Buildings. -Offsite land users.	Carbon dioxide and methane	Unlikely	Severe	Moderate / Low	-No significant risk given ground conditions encountered on site and no significant sources anticipated. Low risk considered appropriate. -Recommendation: No further assessment required.
PL4	-Surface Run-off. -Migration through permeable strata and preferential pathways -Perched waters migration.	-Groundwater (Secondary Aquifer).	Mobile contaminants: -None identified	Unlikely	Medium	Low	-No significantly elevated mobile contaminants identified in soils or groundwater. -Recommendation: No remediation required.
PL5	-Sulphate attack on concrete.	-Building structure.	-Sulphate.	Unlikely	Mild	Very Low	-No elevated sulphate identified in soils or groundwater. -Recommendation: No remediation required. Concrete requirements should be confirmed by a structural engineer.
PL6	-Ingestion of tainted water supply.	-Future site users (via potable water).	Organic Contaminants: -None identified at pipeline depth	Unlikely	Medium	Low	-No elevated contaminants identified. -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: No remediation required.

Table 6-3: Revised Contamination Conceptual Model.

Notes *1 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.

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 HazwasteOnline™. This is a web-based facility that allows an assessment waste as either hazardous or non-hazardous waste based on relevant guidance and legislation^{46, 47, 48, 49, 50, 51, 52, 53, 54}.

HazwasteOnline™. 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. The HazwasteOnline™ output sheets are provided in Appendix I.

Asbestos fibres were identified in the sample from WS104. Further sampling, to quantify the asbestos, would be required prior to any disposal of made ground materials from this area.

⁴⁶ EA (2018). "Guidance on the Classification and Assessment of Waste (1st Edition v1.1)". Technical Guidance WM3.

⁴⁷ CLP Regulation - Regulation 1272/2008/EC of 16 December 2008.

⁴⁸ 1st ATP - Regulation 790/2009/EC of 10 August 2009

⁴⁹ Correction to 1st ATP - Regulation 758/2013/EU of 7 August 2013

⁵⁰ WFD Annex III replacement - Regulation 1357/2014/EU of 18 December 2014

⁵¹ Revised List of Wastes 2014 - Decision 2014/955/EU of 18 December 2014

⁵² 13th ATP - Regulation (EU) 2018/1480 of 4 October 2018

⁵³ POPs Regulation 2004 - Regulation 850/2004/EC of 29 April 2004

⁵⁴ 2nd ATP to POPs Regulation - Regulation 757/2010/EU of 24 August 2010

8 Conclusions

8.1 Geotechnical

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

Proposed Development	- Proposed extension and refurbishment of an existing fire station.
General Ground conditions / Geotechnical Testing	- Based on WS101-WS105 and SA101-SA102. - Maximum investigation depth 5.45mbgl. - Made Ground to 0.45-1.25mbgl. - Natural superficial deposits comprise organic CLAY. - In-situ testing typically shows an increase in s_u with depth. - Organic CLAY was recorded within WS103 between 1.20 and 2.00mbgl. - Bedrock was potentially encountered at depths of between 3.50-4.00mbgl in WS104 and WS105. - Groundwater encountered at 3.00mbgl within WS102 and WS103.
Shear Strength and Allowable Bearing Capacity	- At 1mbgl in the firm CLAY, an s_u of 30kPa can be realised, returning an ABC of 62kN/m² for a strip foundation. - At 2mbgl an s_u of 50kPa can be realised, returning an ABC of 103kN/m² for a strip foundation.
Anticipated Foundation Type	- Traditional shallow foundations, such as pads or strip, 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 identified at 3.00mbgl at the locations of WS102 and WS103. - Suitable drainage should be considered in the proposed development layout.
Concrete Requirements	- Based on BRE Digest 2005 ⁵⁵ – DS-1 AC-1 recommended.
Services	- Services – consideration to the presence of services running through the site. Services may need to re-routed.
Temporary support of excavation	- May be required; however, trial pits 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.
Permeability	- Permeability test results indicate that soakaways are unlikely to be suitable on site.

Table 8-1: Geotechnical Observations and Conclusions Table.

⁵⁵ BRE (2005). "Concrete in Aggressive Ground." Special Digest 1.

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).

Pollutant Linkage		Risk	Recommendations
1	Contaminants posing a risk to site users and offsite receptors via dermal contact, ingestion and inhalation (of soil, dust, fibres)	Low	- ACM not identified in area of proposed extension or soft landscaping. - No elevated heavy metals, PAHs, petroleum, hydrocarbons, PFOS/PFAS, Glycol or MBAS identified. Recommendations: No remediation required
2	Volatile contaminants posing a risk to site users and offsite receptors via the inhalation of vapours.	Low	- No 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	- No significant risk anticipated given ground conditions encountered on site and no significant sources. Recommendations: No further assessment required.
4	Mobile contamination posing a risk to controlled waters via the migration through permeable strata.	Low	- No elevated contaminants identified in groundwater or soils. Recommendations: No remediation required.
5	Sulphate posing a risk to building via direct contact (sulphate attack).	Low	- No elevated sulphate identified. Recommendations: No remediation required. Concrete requirements should be confirmed by a 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 unlikely 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.

A HazWasteOnline assessment classifies the soils tested on site as Non Hazardous Waste. Asbestos fibres were identified in the sample from WS104. Further sampling, to quantify the asbestos, would be required prior to any disposal of made ground materials from this area.

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.

9.1 Remediation and Validation Recommendations

Table 9-1 details the 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 C733⁵⁶.	Log of work undertaken including photographs. Details of any sampling undertaken and validation of any potential additional remedial work.
	1, 2, 3, 4, 5, 6, 7	No remediation anticipated with respect to PL1, PL2 (inhalation of vapours), PL3 (gas), PL4 (controlled waters), PL5 (sulphate attack), PL6 (potable water) and PL7 (phytotoxicity).	PL1, PL2, PL3, PL4, P7 - N/A PL5 - Concrete requirements should be confirmed by a structural engineer. PL6 - A Water Pipeline Assessment is undertaken once the location and depth of new potable water pipes are known. It is unlikely that barrier pipe will be required.

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

Notes: See Table 6-3 for pollutant linkage (PL) details.

⁵⁶ CIRIA (2014). "Asbestos in Soil and Made Ground: A Guide to Understanding and Managing Risks". C733.

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.
	<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 ⁵⁷): 5,000 tonnes (c. 2,500m³) <u>treatment</u> of crushed concrete / stone. 1,000 tonnes (c. 500³) <u>use</u> of non-hazardous soil 5,000 tonnes (c. 2,500m³) <u>use</u> of clays, sand, gravel, brick, concrete, stone etc. 50,000 tonnes (c. 25,000m³) <u>use</u> of 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 before 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> Although no contamination was identified in the soils on site, the existing made ground is not expected to be a suitable growing medium given the nature of the soil and the undesirable material present (abundant glass, brick fragments, clinker and ceramics). A topsoil cover of approximately 150mm is recommended to any new 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 guidance⁵⁸) should be adopted by all workers involved with site enabling and construction works.

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

Notes: See Table 6-3 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.

⁵⁷ <https://www.gov.uk/guidance/waste-exemptions-using-waste>

⁵⁸ 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 / Site won	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 BS3882⁵⁹). 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 without plant uptake criteria. Appropriate remedial target criteria are presented in Appendix G.

9.3 Site Completion Report

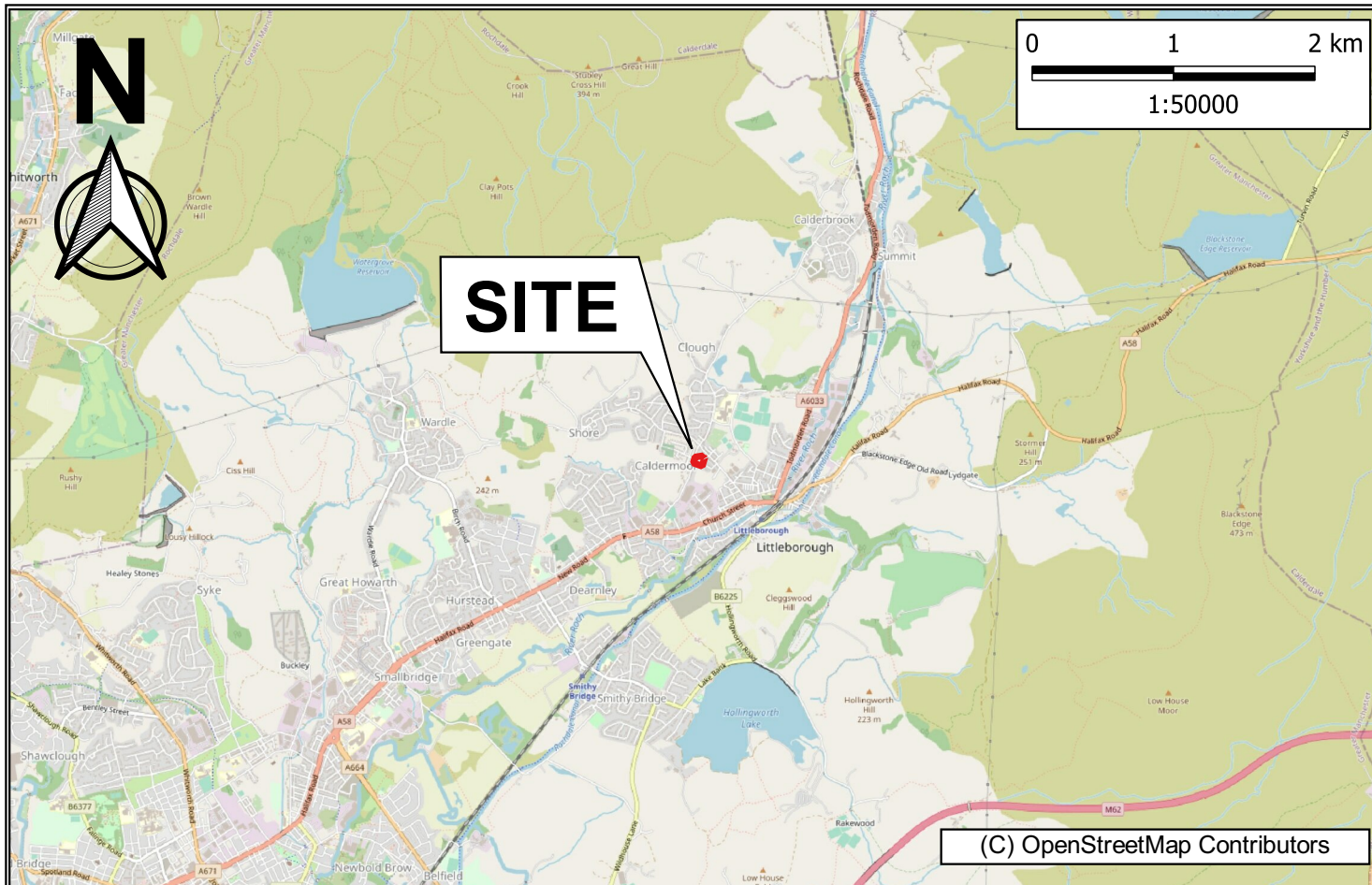
It is recommended that any remediation carried out on the site is validated by a third party and suitable documentary evidence provided in a Site Completion Report, such as photographs, consignment documents and analytical results. This should include as a minimum:

- » Provision of waste transfer documents.
- » Verification testing of all imported soil for 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.

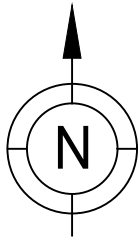
The Site Completion Report will assist the Local Authority in the discharge of any future relevant planning condition.

⁵⁹ BS (2015). "Specifications for Topsoil and Requirements for use." BS3882:2015.

Figures



Client: Bradshaw Gass & Hope LLP				Title: Site Location & Boundary Plan			
Site: Littleborough Fire Station				Scale (see scale bar): 1:50,000 & 1:2,500 @ A4			
Job No.: LKC 21 1310	Drawn By: HM	Checked By: MT	Drawn: July 2021	Figure: 1	Revision:		



KEY



Site Boundary



Proposed Extension Area



RETAINED CONSTRUCTION



NEW CONSTRUCTION

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:

Bradshaw, Gass & Hope LLP

Site:

Littleborough Fire Station, Littleborough

Title:

Proposed Site Use

Job No.:

LKC 21 1310

Scale (See Scale Bar):

See Scale Bar

Figure:

2

Revision:

Drawn By:

AC

Checked By:

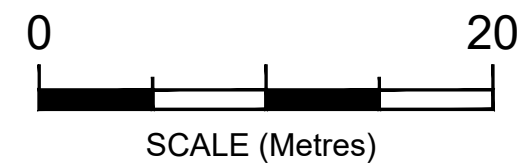
MT

Drawn:

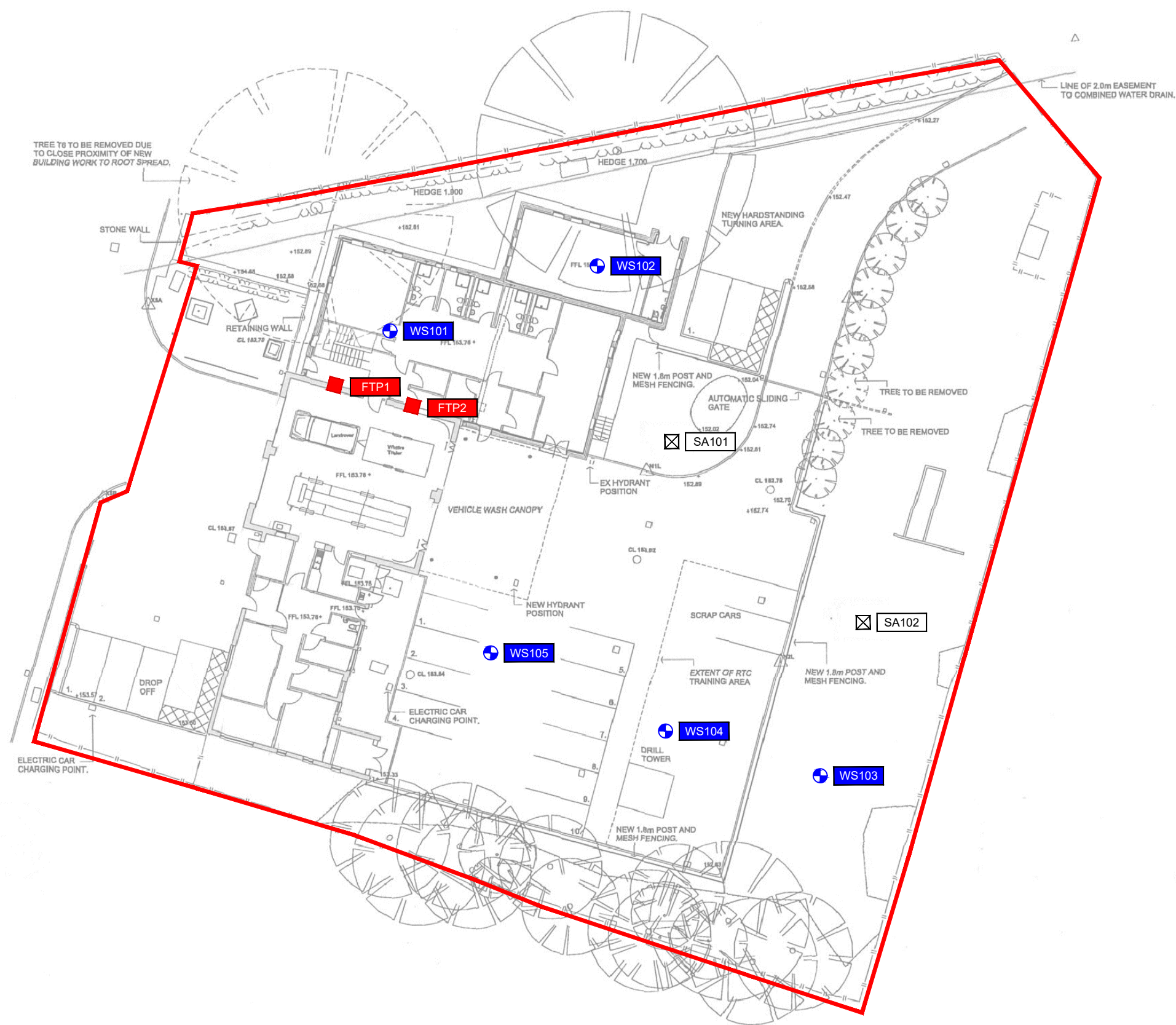
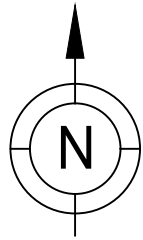
Jul 2021

Extract from: Bradshaw Gass & Hope LLP

Drawing Ref: Proposed Plans, No.1978.34.302, Rev:P4 (07/06/2021)



SCALE (Metres)



KEY

- Site Boundary
- Window Sample Borehole (WS)
- Soakaway Test (SA)
- Foundation Trial Pit (FTP)

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.



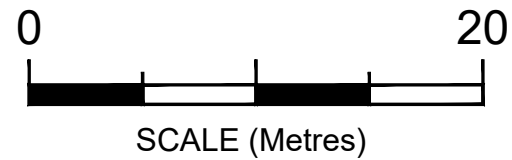
Client:
Bradshaw, Gass & Hope LLP

Site:
Littleborough Fire Station, Littleborough

Title:
Site Investigation Location Plan

Job No.:	Scale (See Scale Bar):	Figure:	Revision:
LKC 21 1310	See Scale Bar	4	
Drawn By:	Checked By:	Drawn:	
AC	FP	Nov 2021	

Extract from: Bradshaw Gass & Hope LLP
Drawing Ref: Proposed Site Plan, No.1978.34.203, Rev:P5



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 552⁶⁰. 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.

⁶⁰ 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

Trial Pit Logs

Excavation Method

Drive-in Windowless Sample
driven to 5.41mbgl.

Dimensions
Location

393362 E 416686 N

Ground Level (mOD)
Dates

02/09/2021

Client

Greater Manchester Combined Authority

Project Contractor
Job
Number

LKC 21 1310

Sheet

1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.00-0.40	ES1 PID=0.3ppm				(0.45)	MADE GROUND: Dark grey slightly gravelly sandy SILT with occasional rootlets and rare clinker. Sand is fine to medium. Gravel is fine to medium and subangular comprising mudstone.			
0.50-1.00	ESB2 PID=0.2ppm				0.45				
1.00	PP 114kPa				(0.75)	Firm becoming stiff consistency high strength orangish brown and grey slightly gravelly sandy silty CLAY with rare rootlets. Sand is fine to medium. Gravel is fine to medium and subangular to angular comprising sandstone and mudstone. Increasing gravel content with depth.			
1.20-1.65	SPT N=16 D3		8,15/4,4,4,4		1.20	Firm consistency medium to high strength dark grey gravelly sandy CLAY with occasional coal fragments. Sand is fine to medium. Gravel is fine to medium and subangular to angular comprising sandstone and mudstone.			
1.70-2.00	B4								
2.00	PP 44.96kPa								
2.00-2.45	SPT N=10 D5		2,2/2,3,2,3		(1.70)	Very sandy below 2.00mbgl.			
2.00-2.45									
2.50-2.70	B6					Bands of gravel between 2.50-2.70mbgl.			
3.00	PP 117.36kPa								
3.00-3.45	SPT N=15 D7		4,4/4,3,4,4		2.90	Stiff to very stiff consistency high to very high strength brown slightly gravelly CLAY. Gravel is fine to coarse and subangular to subrounded comprising sandstone and mudstone.			
3.00-3.45									
4.00	PP 116.49kPa								
4.00-4.45	SPT N=18 D8		5,4/3,5,4,6		(2.51)	Very stiff consistency below 4.00mbgl. Wet strata below 4.00mbgl.			
4.00-4.45									
5.00	PP 167.58kPa								
5.00-5.41	SPT 50/260 D9		10,11/15,15,13,7		5.41	Complete at 5.41m			
5.00-5.41									

Remarks

SPT refusal at 5.41mbgl on very hard consistency CLAY.
Wet strata below 4.00mbgl.
Borehole stable.

Scale (approx)

1:40

Logged By

HM

Figure No.

LKC 21 1310.WS101

Excavation Method

Drive-in Windowless Sampler

Dimensions
Location

393381 E 416694 N

Ground Level (mOD)
Dates

02/09/2021

Client

Greater Manchester Combined Authority

Project Contractor
Job
Number
LKC 21 1310

Sheet

1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-0.50	ES1 PID=0.4ppm				(0.50)	MADE GROUND: Dark grey slightly gravelly sandy SILT with occasional rootlets and rare clinker. Sand is fine to medium. Gravel is fine to medium and subangular comprising mudstone.		
0.50-1.00	ESB2 PID=0.2ppm				0.50			
1.00	PP 61.31kPa							
1.20-1.65	SPT N=7		2,2/2,1,2,2		(1.30)	Firm to stiff consistency medium strength orangish brown and grey mottled slightly gravelly sandy silty CLAY with occasional sand bands and coal fragments. Sand is fine to medium. Gravel is fine to medium and subangular comprising sandstone and mudstone. Becoming darker brown with less grey mottling with depth.		
1.20-1.65	D3					Becoming stiff consistency and darker brown with more orange mottling below 1.20mbgl.		
1.80-2.00	ESB3 PID=0.1ppm				1.80			
2.00	PP 91.97kPa							
2.00-2.45	SPT N=12		2,1/2,3,3,4			Soft to firm consistency dark grey gravelly sandy CLAY. Sand is fine to medium. Gravel is fine to medium and subangular to subrounded comprising sandstone and mudstone. Becoming very gravelly with depth.		
2.00-2.45	D4					Very gravelly CLAY with occasional gravel bands below 2.00mbgl.		
3.00-3.45	D5				(2.20)			
3.00-3.45	SPT N=10		Water strike(1) at 3.00m. 2,2/2,2,3,3			Limited recovery between 3.00-4.00mbgl. Wet strata below 3.00mbgl.		
4.00-4.45	SPT N=17				4.00			
4.00-4.45	D6		2,3/4,4,4,5		(1.00)	Stiff consistency high strength brown slightly gravelly CLAY. Gravel is fine to medium and subrounded comprising mudstone.		
5.00	PP 98.1kPa				5.00	SPT at 5.00mbgl not possible due to collapse of borehole at 4.00mbgl.		
						Complete at 5.00m		

Remarks

Borehole collapse from 4.00mbgl.(gravel band).
Wet strata below 3.00mbgl.
Pocket Penetrometer not possible at 3.00-4.00mbgl due to granular nature of strata and limited recovery.

Scale
(approx)

1:40

Logged
By

HM

Figure No.

LKC 21 1310.WS102

Excavation Method

Drive-in Windowless Sample
driven to 5.45mbgl.

Dimensions
Location

393396 E 416646 N

Ground Level (mOD)
Dates

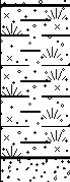
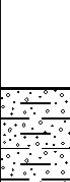
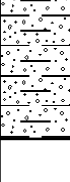
02/09/2021

Client

Greater Manchester Combined Authority

Project Contractor
Job
Number
LKC 21 1310

Sheet
1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.10-1.00	ES1				(1.00)	Dark greyish brown slightly gravelly sandy silty CLAY with occasional rootlets. Sand is fine to medium. Gravel is fine to medium and angular to subrounded comprising sandstone, slate and mudstone.			
1.00	PP 40.85kPa				1.00 (0.20)				
1.20-1.60	ESB2				1.20	Firm consistency medium strength brown and yellow mottled gravelly sandy CLAY with low cobble content and occasional coal fragments. Sand is fine to medium. Gravel is fine to coarse and angular to subrounded comprising sandstone, slate and mudstone.			
1.70-2.00	B3				(0.80)				
2.00	PP 32.7kPa				2.00	Soft consistency low strength dark grey slightly gravelly sandy silty organic CLAY with wood debris. Sand is fine to medium. Gravel is fine to medium and subangular comprising sandstone.			
2.00-2.45	SPT N=4		1,1/1,1,1,1						
2.00-2.50	B4				(1.00)	Brown slightly clayey gravelly SAND with occasional coal fragments. Sand is fine to coarse. Gravel is fine to medium and rounded to subangular comprising sandstone.			
3.00-3.45	SPT N=37		Water strike(1) at 3.00m. 6,7/17,7,7,6		3.00	NO RECOVERY due to probable sandstone cobble impeding recovery.		▽1	
					(1.00)				
4.00-4.45	SPT N=5		1,1/1,1,1,2		4.00	Stiff consistency high strength brownish grey slightly gravelly slightly sandy CLAY. Sand is fine to medium. Gravel is fine to medium and subrounded to subangular comprising sandstone and mudstone.			
					(1.45)				
5.00	PP 134.88kPa								
5.00-5.45	SPT N=15		2,2/3,4,4,4						
5.00-5.45	D5				5.45	Complete at 5.45m			

Remarks

Groundwater strike at 3.00mbgl.
Borehole stable.
Location accurate to 3.00-5.00m.

Scale
(approx)

1:40

Logged
By

HM

Figure No.

LKC 21 1310.WS103

Excavation Method

Drive-in Windowless Sample
driven to 4.38mbgl.

Dimensions
Location

393384 E 416655 N

Ground Level (mOD)
Dates

02/09/2021

Client

Greater Manchester Combined Authority

Project Contractor
Job
Number

LK 21 1310

Sheet
1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.15-0.50	ES1 PID=6.2ppm				0.12	MADE GROUND: Tarmacadam.			
0.50-1.00	ES2 PID=6.0ppm				(0.98)	MADE GROUND: Dark brown sandy silty GRAVEL with frequent brick fragments, ash, clinker, rare clay inclusions. Sand is fine to coarse. Gravel is fine to coarse and subangular to subrounded comprising sandstone and mudstone. Slight possible surfactant type odour.			
1.00	PP 30.65kPa				1.10	Soft consistency low strength greyish brown and yellow mottled slightly gravelly sandy CLAY. Sand is fine to medium. Gravel is fine to medium and subrounded comprising sandstone.			
1.20-1.65	SPT N=3		1,0/1,0,1,1		(0.90)				
1.20-1.60	ES3 PID=2.5ppm								
1.70-2.00	B4				2.00	Firm to stiff consistency high strength brownish grey and orange mottled gravelly CLAY with occasional coal fragments. Gravel is fine to coarse and rounded to subangular comprising sandstone and mudstone. Increasing gravel content with depth.			
2.00	PP 88.9kPa		2,2/4,4,4,4						
2.00-2.45	SPT N=16								
2.00-2.45	D5								
2.50-3.00	B6				(2.00)				
3.00	PP 126.12kPa		4,4/5,4,4,4						
3.00-3.45	SPT N=17								
4.00	PP 98.1kPa		5,4/13,13,20,4		4.00	Sandstone cobble at 3.80-3.85mbgl.			
4.00-4.38	SPT 50/230				(0.38)	Very dense dark grey very clayey GRAVEL with occasional clay inclusions. Gravel is fine to coarse and angular to subangular comprising mudstone (probable extremely weathered MUDSTONE bedrock).			
4.00-4.30	B7				4.38	SPT refusal at 4.38mbgl on very dense GRAVEL (probable extremely weathered MUDSTONE bedrock).			
						Complete at 4.38m			

Remarks

SPT refusal at 4.38mbgl on very dense GRAVEL (probable extremely weathered MUDSTONE bedrock).
Borehole dry and stable.
Location accurate to 3.00-5.00m.

Scale
(approx)

1:40

Logged
By

HM

Figure No.

LK 21 1310.WS104

Excavation Method

Drive-in Windowless Sample
driven to 4.45mbgl.

Dimensions
Location

393376 E 416659 N

Ground Level (mOD)
Dates

02/09/2021

Client

Greater Manchester Combined Authority

Project Contractor
Job
Number
LKC 21 1310

Sheet

1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.30-0.70	ES1 PID=0.6ppm				(0.15) (0.45) (0.25)	MADE GROUND: Tarmacadam.		
0.70-1.20	ES2 PID=0.5ppm				(0.45) 0.70 (0.55)	MADE GROUND: Grey sandy GRAVEL. Sand is fine to coarse. Gravel is fine to medium and subangular comprising limestone (MOT).		
1.20-1.65	SPT N=5		1,1/2,1,1,1		1.25	MADE GROUND: Brown gravelly clayey SAND with occasional clay inclusions and rare brick fragments. Sand is fine to coarse. Gravel is fine to coarse and subangular to subrounded comprising sandstone.		
1.30-1.60	ES3 PID=0.3ppm					MADE GROUND: Brown and grey mottled gravelly sandy CLAY with rare clinker and brick fragments. Sand is fine to medium. Gravel is fine to coarse and subangular to subrounded comprising sandstone.		
1.70-2.00	B4				(0.75)	Soft to firm consistency medium strength yellowish brown and grey mottled slightly gravelly sandy CLAY. Sand is fine to medium. Gravel is fine to medium and subangular to rounded comprising sandstone and mudstone. Slight organic odour.		
2.00	PP 49.05kPa		2,1/2,3,3,4		2.00	Stiff consistency high strength brown gravelly CLAY. Gravel is fine to medium and subrounded to subangular comprising sandstone.		
2.00-2.45	SPT N=12							
2.00-2.45	D5							
2.50-3.00	B6				(1.00)			
3.00	PP 122.63kPa		3,3/3,4,4,4		3.00	Firm consistency high strength dark grey very sandy CLAY. Sand is fine to medium.		
3.00-3.45	SPT N=15				(0.50)			
3.00-3.45	D7							
3.40-4.00	B8				3.50	Medium dense dark grey very clayey GRAVEL. Gravel is fine to medium and angular to subangular comprising mudstone (probable extremely weathered MUDSTONE bedrock).		
4.00-4.45	SPT N=15		3,4/5,4,2,4		(0.95)			
					4.45	Complete at 4.45m		

Remarks

Borehole not continued beyond 4.45mbgl due to damage to drilling equipment.
Borehole dry and stable.
Location accurate to 3.00-5.00m.

Scale
(approx)

1:40

Logged
By

HM

Figure No.

LKC 21 1310.WS105

Excavation Method

Machine excavated to 1.6mbgl.

Dimensions

2.0m x 0.6m x 1.6m

Ground Level (mOD)

156.00

Client

Greater Manchester Combined Authority

**Job
Number**
LKC 21 1310

Location (Handheld GPS)

3933385 E 416675 N

Dates

02/09/2021-
03/09/2021

Project Contractor
Sheet

1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-0.50	ES1 PID=<0.01ppm				(0.50)	MADE GROUND: Dark brown gravelly sandy SILT with occasional rootlets within 0.1mbgl, rare concrete and brick fragments. Sand is fine to medium. Gravel is fine to medium, subangular to subrounded comprising mixed lithologies.		
0.50-1.60	B2			155.50	0.50	Land drain encountered at 0.4mbgl. Soft consistency grey mottled brown gravelly slightly sandy silty CLAY. Sand is fine to medium. Gravel is fine to medium, subangular to subrounded comprising mudstone and sandstone.		
1.10	SV 12kPa				(1.10)			
1.60	SV 22kPa			154.40	1.60	Complete at 1.60m		


Remarks

Elevation estimated using www.freemaptools.com/elevation-finder.htm
Grid reference accurate for 3-5 meters.
Pit was stable and dry.
Soakaway test carried out within pit, see separate sheet.
Clay strata noted to contain a high gravel content and to be friable.

Scale (approx)

1:20

Logged By

RW

Figure No.

LKC 21 1310.SA101

Excavation Method

Machine excavated to 1.8mbgl.

Dimensions

2.0m x 0.6m x 1.8m

Ground Level (mOD)

156.00

Client

Greater Manchester Combined Authority

**Job
Number**
LKC 21 1310

Location (Handheld GPS)

393397 E 416663 N

Dates

02/09/2021-
03/09/2021

Project Contractor
Sheet

1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.30-0.70	ES1 PID=<0.01ppm			155.70	(0.30)	MADE GROUND: Grey silty GRAVEL (MOT) with occasional rootlets. Gravel is fine to medium, subangular to angular comprising limestone.		
0.70-1.80	B2			155.30	(0.40)	MADE GROUND: Dark brown gravelly sandy SILT with occasional rootlets, rare ash and brick fragments. Sand is fine to medium. Gravel is fine to medium, subangular to subrounded comprising mixed lithologies. Land drain encountered at 0.4mbgl.		
1.10	SV 21kPa				(0.90)	Soft consistency grey mottled brown gravelly slightly sandy silty CLAY. Sand is fine to medium. Gravel is fine to medium, subangular to subrounded comprising mudstone and sandstone.		
1.70	SV 34kPa			154.40	1.60	Complete at 1.80m		


Remarks

Elevation estimated using www.freemaptools.com/elevation-finder.htm
Grid reference accurate for 3-5 meters.
Pit was stable and dry.
Soakaway test carried out within pit, see separate sheet.
Clay strata noted to contain a high gravel content and to be friable.

Scale (approx)

1:20

Logged By

RW

Figure No.

LKC 21 1310.SA102

Excavation Method

Hand excavated trial pit

Dimensions

1.20m x 0.25m x 0.5m

Ground Level (mOD)

156.00

Client

Greater Manchester Combined Authority

**Job
Number**
LKC 21 1310

Location (Handheld GPS)

393362 E 416679 N

Dates

13/10/2021

Project Contractor
Sheet

1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						MADE GROUND: Brown gravelly silty SAND with low cobble content and occasional brick and coal fragments. Sand is fine to coarse. Gravel is fine to medium, subangular to subrounded and comprised of sandstone. Cobbles are subangular and comprised of sandstone.		
					(0.75)			
				155.25	0.75	100mm clay pipe encountered during excavation 0.40 m from wall.		
					(0.45)	MADE GROUND: Orange and grey mottled gravelly sandy CLAY with occasional brick and coal fragments. Sand is fine to coarse. Gravel is fine to medium, subangular to subrounded and comprised of sandstone. Probable reworked natural.		
				154.80	1.20	Complete at 1.20m		∇1


Remarks

Location is from handheld GPS and is accurate to 3-5m.
Elevation estimated using www.freemaptools.com/elevation-finder.htm
Trial pit stable.
Water encountered at 1.20mbgl beside concrete footing.
Concrete footing encountered at 1.20 mbgl stepping out 0.20m.
Thickness of footing not determined due to depth and presence of groundwater.

Scale (approx)

1:25

Logged By

FP

Figure No.

LKC 21 1310.FTP1

Excavation Method

Hand excavated trial pit.

Dimensions

1.20m x 0.25m x 0.50m

Ground Level (mOD)

156.00

Client

Greater Manchester Combined Authority

**Job
Number**
LKC 21 1310

Location (Handheld GPS)

393368 E 416678 N

Dates

13/10/2021

Project Contractor
Sheet
1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						MADE GROUND: Brown gravelly silty SAND with low cobble content, occasional roots, brick and coal fragments. Sand is fine to coarse. Gravel is fine to medium, subangular to subrounded and comprised of sandstone, coal and brick. Cobbles are subangular and comprised of sandstone.		
				155.30	0.70	Firm consistency orange and grey mottled gravelly sandy CLAY with occasional brick and coal fragments. Sand is fine to coarse. Gravel is fine to medium, subangular to subrounded and comprised of sandstone. Uppermost 0.20m of the clay is dry and friable. (Probably due to roots.) CLAY becomes softer with depth.		
				154.80	1.20	Complete at 1.20m		


Remarks

Location is from handheld GPS and is accurate to 3-5m.
Grid reference estimated using www.gridreferencefinder.com
Trial pit is stable.
Water encountered perched on concrete footing.
Concrete footing encountered at 1.20 mbgf stepping out 0.20m.
Thickness of footing not determined due to depth and presence of groundwater.

Scale (approx)

1:25

Logged By

FP

Figure No.

LKC 21 1310.FTP2

Appendix C

Certificates of Analysis – Soil



Amended Report

Report No.:	21-30529-2		
Initial Date of Issue:	28-Sep-2021	Date of Re-Issue:	28-Sep-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 Michelle Thorniley		
Project	LKC 21 1310 Littleborough Fire Station		
Quotation No.:	Q21-24270	Date Received:	03-Sep-2021
Order No.:		Date Instructed:	09-Sep-2021
No. of Samples:	9		
Turnaround (Wkdays):	5	Results Due:	15-Sep-2021
Date Approved:	28-Sep-2021	Subcon Results Due:	30-Sep-2021
Approved By:			
Details:	Glynn Harvey, Technical Manager		

Results - Soil

Project: LKC 21 1310 Littleborough Fire Station

Client: LK Consult	Chemtest Job No.:				21-30529	21-30529	21-30529	21-30529	21-30529	21-30529	21-30529	21-30529
Quotation No.: Q21-24270	Chemtest Sample ID.:				1272202	1272203	1272204	1272205	1272207	1272209	1272210	1272212
Order No.:	Client Sample Ref.:				ES1	ES2	ES1	ES1	ES1	ES1	ES2	ES1
	Client Sample ID.:				WS101	WS101	WS102	WS104	WS103	WS104	WS104	WS104
	Sample Location:				WS101	WS101	WS102	WS102	WS103	WS104	WS104	WS104
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.00	0.50	0.00	0.50	0.10	0.15	0.50	0.30
	Bottom Depth (m):				0.40	1.00	0.50	1.00	1.00	0.50	1.00	0.70
	Date Sampled:				02-Sep-2021	02-Sep-2021	02-Sep-2021	02-Sep-2021	02-Sep-2021	02-Sep-2021	02-Sep-2021	02-Sep-2021
	Asbestos Lab:				COVENTRY		COVENTRY		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		No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	15	11	9.8	11	8.5	8.7	15	5.0
Soil Colour	N	2040		N/A	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown
Glycols	N	2780	mg/kg	1.0						< 1.0		
MBAS	N	N/A	mg/kg	0.20						0.98		
Other Material	N	2040		N/A	Stones and Roots	Stones and Roots	Stones and Roots	Stones and Roots	Stones	Stones	Stones	Stones
Soil Texture	N	2040		N/A	Sand	Sand	Sand	Clay	Sand	Sand	Sand	Sand
Chromatogram (TPH)	N			N/A							See Attached	
PFBS	SN		µg/kg	1.00						See Attached		
PFPS	SN		µg/kg	1.00						See Attached		
PFHxS	SN		µg/kg	1.00						See Attached		
PFHpS	SN		µg/kg	1.00						See Attached		
PFOS	SN		µg/kg	1.00						See Attached		
PFDS	SN		µg/kg	1.00						See Attached		
PFBA	SN		µg/kg	3.00						See Attached		
PFHxA	SN		µg/kg	2.00						See Attached		
PFHpA	SN		µg/kg	1.00						See Attached		
PFOA	SN		µg/kg	1.00						See Attached		
PFNA	SN		µg/kg	1.00						See Attached		
PFDA	SN		µg/kg	1.00						See Attached		
PFDoA	SN		µg/kg	1.00						See Attached		
pH	M	2010		4.0	7.0	7.2	6.8	7.4	6.7		7.9	8.1
Boron (Hot Water Soluble)	M	2120	mg/kg	0.40							< 0.40	
Magnesium (Water Soluble)	N	2120	g/l	0.010	< 0.010	< 0.010		0.038				
Sulphate (2:1 Water Soluble) as SO4	M	2120	g/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010		0.049	< 0.010
Chloride (Water Soluble)	M	2220	g/l	0.010	< 0.010	< 0.010		< 0.010				
Nitrate (Water Soluble)	N	2220	g/l	0.010	< 0.010	< 0.010		< 0.010				
Cyanide (Free)	M	2300	mg/kg	0.50							< 0.50	
Cyanide (Total)	M	2300	mg/kg	0.50							< 0.50	
Arsenic	M	2450	mg/kg	1.0	12		7.9		5.3		3.3	5.5
Cadmium	M	2450	mg/kg	0.10	0.26		0.15		< 0.10		< 0.10	< 0.10
Chromium	M	2450	mg/kg	1.0	15		9.5		18		12	13
Copper	M	2450	mg/kg	0.50	29		22		25		14	18

Results - Soil

Project: LKC 21 1310 Littleborough Fire Station

Client: LK Consult	Chemtest Job No.:				21-30529	21-30529	21-30529	21-30529	21-30529	21-30529	21-30529	21-30529
Quotation No.: Q21-24270	Chemtest Sample ID.:				1272202	1272203	1272204	1272205	1272207	1272209	1272210	1272212
Order No.:	Client Sample Ref.:				ES1	ES2	ES1	ES1	ES1	ES1	ES2	ES1
	Client Sample ID.:				WS101	WS101	WS102	WS104	WS103	WS104	WS104	WS104
	Sample Location:				WS101	WS101	WS102	WS102	WS103	WS104	WS104	WS104
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.00	0.50	0.00	0.50	0.10	0.15	0.50	0.30
	Bottom Depth (m):				0.40	1.00	0.50	1.00	1.00	0.50	1.00	0.70
	Date Sampled:				02-Sep-2021	02-Sep-2021	02-Sep-2021	02-Sep-2021	02-Sep-2021	02-Sep-2021	02-Sep-2021	02-Sep-2021
	Asbestos Lab:				COVENTRY		COVENTRY		COVENTRY		COVENTRY	COVENTRY
Determinand	Accred.	SOP	Units	LOD								
Mercury	M	2450	mg/kg	0.10	0.34		0.19		< 0.10		< 0.10	< 0.10
Nickel	M	2450	mg/kg	0.50	16		11		22		12	16
Lead	M	2450	mg/kg	0.50	100		57		35		19	11
Selenium	M	2450	mg/kg	0.20	0.49		0.32		0.27		< 0.20	< 0.20
Vanadium	U	2450	mg/kg	5.0	24		14		20		16	13
Zinc	M	2450	mg/kg	0.50	70		47		52		26	36
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50		< 0.50		< 0.50		< 0.50	< 0.50
Organic Matter	M	2625	%	0.40	7.9		8.7		4.9		8.6	1.2
Diesel Present	N	2670		N/A							False	
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0							< 1.0	
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0							< 1.0	
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0							< 1.0	
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0							< 1.0	
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0							< 1.0	
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0							< 1.0	
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0							< 1.0	
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0							< 1.0	
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0							< 5.0	
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0							< 1.0	
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0							< 1.0	
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0							< 1.0	
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0							< 1.0	
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0							< 1.0	
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0							73	
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0							3000	
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0							61	
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0							3200	
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0							3200	
Benzene	M	2760	µg/kg	1.0							< 1.0	
Toluene	M	2760	µg/kg	1.0							< 1.0	
Ethylbenzene	M	2760	µg/kg	1.0							< 1.0	
m & p-Xylene	M	2760	µg/kg	1.0							< 1.0	
o-Xylene	M	2760	µg/kg	1.0							< 1.0	
Methyl Tert-Butyl Ether	M	2760	µg/kg	1.0							< 1.0	
Perfluorooctyl sulfonate (PFOS) (Subcon)	SN		µg/kg	N/A						See Attached		
Naphthalene	M	2800	mg/kg	0.10	< 0.10		0.14		< 0.10		< 0.10	< 0.10

Results - Soil

Project: LKC 21 1310 Littleborough Fire Station

Client: LK Consult	Chemtest Job No.:					21-30529	21-30529	21-30529	21-30529	21-30529	21-30529	21-30529	21-30529
Quotation No.: Q21-24270	Chemtest Sample ID.:					1272202	1272203	1272204	1272205	1272207	1272209	1272210	1272212
Order No.:	Client Sample Ref.:					ES1	ES2	ES1	ES1	ES1	ES1	ES2	ES1
	Client Sample ID.:					WS101	WS101	WS102	WS104	WS103	WS104	WS104	WS104
	Sample Location:					WS101	WS101	WS102	WS102	WS103	WS104	WS104	WS104
	Sample Type:					SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):					0.00	0.50	0.00	0.50	0.10	0.15	0.50	0.30
	Bottom Depth (m):					0.40	1.00	0.50	1.00	1.00	0.50	1.00	0.70
	Date Sampled:					02-Sep-2021	02-Sep-2021	02-Sep-2021	02-Sep-2021	02-Sep-2021	02-Sep-2021	02-Sep-2021	02-Sep-2021
	Asbestos Lab:					COVENTRY		COVENTRY		COVENTRY		COVENTRY	COVENTRY
Determinand	Accred.	SOP	Units	LOD									
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10			0.41		< 0.10		< 0.10	< 0.10
Acenaphthene	M	2800	mg/kg	0.10	< 0.10			0.10		< 0.10		< 0.10	< 0.10
Fluorene	M	2800	mg/kg	0.10	< 0.10			0.23		< 0.10		< 0.10	< 0.10
Phenanthrene	M	2800	mg/kg	0.10	1.3			3.0		0.24		< 0.10	< 0.10
Anthracene	M	2800	mg/kg	0.10	0.32			1.4		0.12		< 0.10	< 0.10
Fluoranthene	M	2800	mg/kg	0.10	2.2			8.1		0.48		< 0.10	0.89
Pyrene	M	2800	mg/kg	0.10	2.0			6.8		0.46		< 0.10	0.82
Benzo[a]anthracene	M	2800	mg/kg	0.10	1.2			3.9		0.25		< 0.10	0.55
Chrysene	M	2800	mg/kg	0.10	1.1			3.7		0.34		< 0.10	0.64
Benzo[b]fluoranthene	M	2800	mg/kg	0.10	1.6			4.5		0.38		< 0.10	0.94
Benzo[k]fluoranthene	M	2800	mg/kg	0.10	0.55			2.0		0.13		< 0.10	0.33
Benzo[a]pyrene	M	2800	mg/kg	0.10	1.2			4.0		0.30		< 0.10	0.78
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10	0.85			2.7		< 0.10		< 0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	0.14			0.68		< 0.10		< 0.10	< 0.10
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10	0.80			2.1		< 0.10		< 0.10	< 0.10
Total Of 16 PAH's	N	2800	mg/kg	2.0	13			44		2.7		< 2.0	5.0
Total Phenols	M	2920	mg/kg	0.10								< 0.10	

Results - Soil

Project: LKC 21 1310 Littleborough Fire Station

Client: LK Consult	Chemtest Job No.:		21-30529		
Quotation No.: Q21-24270	Chemtest Sample ID.:		1272215		
Order No.:	Client Sample Ref.:		ES1		
	Client Sample ID.:		SA101		
	Sample Location:		SA101		
	Sample Type:		SOIL		
	Top Depth (m):		0.00		
	Bottom Depth (m):		0.50		
	Date Sampled:		02-Sep-2021		
	Asbestos Lab:		COVENTRY		
Determinand	Accred.	SOP	Units	LOD	
ACM Type	U	2192		N/A	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected
Moisture	N	2030	%	0.020	15
Soil Colour	N	2040		N/A	Brown
Glycols	N	2780	mg/kg	1.0	
MBAS	N	N/A	mg/kg	0.20	
Other Material	N	2040		N/A	Stones and Roots
Soil Texture	N	2040		N/A	Sand
Chromatogram (TPH)	N			N/A	
PFBS	SN		µg/kg	1.00	
PFPS	SN		µg/kg	1.00	
PFHxS	SN		µg/kg	1.00	
PFHpS	SN		µg/kg	1.00	
PFOS	SN		µg/kg	1.00	
PFDS	SN		µg/kg	1.00	
PFBA	SN		µg/kg	3.00	
PFHxA	SN		µg/kg	2.00	
PFHpA	SN		µg/kg	1.00	
PFOA	SN		µg/kg	1.00	
PFNA	SN		µg/kg	1.00	
PFDA	SN		µg/kg	1.00	
PFDoA	SN		µg/kg	1.00	
pH	M	2010		4.0	7.4
Boron (Hot Water Soluble)	M	2120	mg/kg	0.40	
Magnesium (Water Soluble)	N	2120	g/l	0.010	
Sulphate (2:1 Water Soluble) as SO4	M	2120	g/l	0.010	< 0.010
Chloride (Water Soluble)	M	2220	g/l	0.010	
Nitrate (Water Soluble)	N	2220	g/l	0.010	
Cyanide (Free)	M	2300	mg/kg	0.50	
Cyanide (Total)	M	2300	mg/kg	0.50	
Arsenic	M	2450	mg/kg	1.0	12
Cadmium	M	2450	mg/kg	0.10	0.32
Chromium	M	2450	mg/kg	1.0	16
Copper	M	2450	mg/kg	0.50	34

Results - Soil

Project: LKC 21 1310 Littleborough Fire Station

Client: LK Consult	Chemtest Job No.:		21-30529		
Quotation No.: Q21-24270	Chemtest Sample ID.:		1272215		
Order No.:	Client Sample Ref.:		ES1		
	Client Sample ID.:		SA101		
	Sample Location:		SA101		
	Sample Type:		SOIL		
	Top Depth (m):		0.00		
	Bottom Depth (m):		0.50		
	Date Sampled:		02-Sep-2021		
	Asbestos Lab:		COVENTRY		
Determinand	Accred.	SOP	Units	LOD	
Mercury	M	2450	mg/kg	0.10	0.25
Nickel	M	2450	mg/kg	0.50	21
Lead	M	2450	mg/kg	0.50	110
Selenium	M	2450	mg/kg	0.20	0.49
Vanadium	U	2450	mg/kg	5.0	25
Zinc	M	2450	mg/kg	0.50	87
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50
Organic Matter	M	2625	%	0.40	8.7
Diesel Present	N	2670		N/A	
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	
Benzene	M	2760	µg/kg	1.0	
Toluene	M	2760	µg/kg	1.0	
Ethylbenzene	M	2760	µg/kg	1.0	
m & p-Xylene	M	2760	µg/kg	1.0	
o-Xylene	M	2760	µg/kg	1.0	
Methyl Tert-Butyl Ether	M	2760	µg/kg	1.0	
Perfluorooctyl sulfonate (PFOS) (Subcon)	SN		µg/kg	N/A	
Naphthalene	M	2800	mg/kg	0.10	< 0.10

Results - Soil

Project: LKC 21 1310 Littleborough Fire Station

Client: LK Consult	Chemtest Job No.:		21-30529		
Quotation No.: Q21-24270	Chemtest Sample ID.:		1272215		
Order No.:	Client Sample Ref.:		ES1		
	Client Sample ID.:		SA101		
	Sample Location:		SA101		
	Sample Type:		SOIL		
	Top Depth (m):		0.00		
	Bottom Depth (m):		0.50		
	Date Sampled:		02-Sep-2021		
	Asbestos Lab:		COVENTRY		
Determinand	Accred.	SOP	Units	LOD	
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10
Acenaphthene	M	2800	mg/kg	0.10	< 0.10
Fluorene	M	2800	mg/kg	0.10	< 0.10
Phenanthrene	M	2800	mg/kg	0.10	0.54
Anthracene	M	2800	mg/kg	0.10	0.15
Fluoranthene	M	2800	mg/kg	0.10	1.4
Pyrene	M	2800	mg/kg	0.10	1.3
Benzo[a]anthracene	M	2800	mg/kg	0.10	0.62
Chrysene	M	2800	mg/kg	0.10	0.62
Benzo[b]fluoranthene	M	2800	mg/kg	0.10	1.1
Benzo[k]fluoranthene	M	2800	mg/kg	0.10	0.37
Benzo[a]pyrene	M	2800	mg/kg	0.10	0.76
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10	< 0.10
Total Of 16 PAH's	N	2800	mg/kg	2.0	6.9
Total Phenols	M	2920	mg/kg	0.10	

TPH Chromatogram on Soil Sample: 1272210

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TPH Interpretation

Job	Sample	Matrix	Location	Sample Ref	Sample ID	Sample Depth (m)	Gasoline / Diesel Present	TPH Interpretation
21-30529	1272210	S	WS104	ES2	WS104	0.50	No	N/A

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.
2300	Cyanides & Thiocyanate in Soils	Free (or easily liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Alkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
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.
2670	Total Petroleum Hydrocarbons (TPH) in Soils by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO*TPH C8–C40	Dichloromethane extraction / GC-FID
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8, >C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35–C44 Aromatics: >C5–C7, >C7–C8, >C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35–C44	Dichloromethane extraction / GCxGC FID detection
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2780	Glycols, Aldehydes, Amines, Ethers and Ketones	Glycols, Aldehydes, Amines, Ethers and Ketones	GCMS detection
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
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and Trimethylphenols Note: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.

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 30 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



Unit 7-8 Hawarden Business Park
Manor Road (off Manor Lane)
Hawarden
Deeside
CH5 3US
Tel: (01244) 528700
Fax: (01244) 528701
email: hawardencustomerservices@alsglobal.com
Website: www.alsenvironmental.co.uk

Chemtest
Willie Snaith Rd
Newmarket
Suffolk
CB8 7SQ

Attention: Chemtest Subcontracting

CERTIFICATE OF ANALYSIS

Date of report Generation: 16 September 2021
Customer: Chemtest
Sample Delivery Group (SDG): 210910-138
Your Reference: 21-30529
Location:
Report No: 613252
Order Number: 21304

This report has been revised and directly supersedes 613251 in its entirety.

We received 1 sample on Friday September 10, 2021 and 1 of these samples were scheduled for analysis which was completed on Wednesday September 15, 2021. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

Chemical testing (unless subcontracted) performed at ALS Life Sciences Ltd Hawarden.

All sample data is provided by the customer. The reported results relate to the sample supplied, and on the basis that this data is correct.

Incorrect sampling dates and/or sample information will affect the validity of results.

The customer is not permitted to reproduce this report except in full without the approval of the laboratory.

Approved By:

Sonia McWhan

Operations Manager





CERTIFICATE OF ANALYSIS

Validated

SDG: 210910-138
Client Ref.: 21-30529

Report Number: 613252
Location:

Superseded Report: 613251

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
24956849	UKC21 1310 WS104		0.15 - 0.50	02/09/2021

Only received samples which have had analysis scheduled will be shown on the following pages.



CERTIFICATE OF ANALYSIS

Validated

SDG: 210910-138
Client Ref.: 21-30529

Report Number: 613252
Location:

Superseded Report: 613251

Results Legend

- X** Test
- N** No Determination Possible

Sample Types -

- S - Soil/Solid
UNS - Unspecified Solid
GW - Ground Water
SW - Surface Water
LE - Land Leachate
PL - Prepared Leachate
PR - Process Water
SA - Saline Water
TE - Trade Effluent
TS - Treated Sewage
US - Untreated Sewage
RE - Recreational Water
DW - Drinking Water Non-regulatory
UNL - Unspecified Liquid
SL - Sludge
G - Gas
OTH - Other

Lab Sample No(s)

24956849

Customer
Sample Reference

UKC21 1310 WS104

AGS Reference

Depth (m)

0.15 - 0.50

Container

500gTUB

Sample Type

S

Asbestos ID in Solid Samples

All

NDPs: 0
Tests: 1

X

PFAS Solids

All

NDPs: 0
Tests: 1

X

Sample description

All

NDPs: 0
Tests: 1

X



CERTIFICATE OF ANALYSIS

Validated

SDG: 210910-138
Client Ref.: 21-30529

Report Number: 613252
Location:

Superseded Report: 613251

Sample Descriptions

Grain Sizes

very fine	<0.063mm	fine	0.063mm - 0.1mm	medium	0.1mm - 2mm	coarse	2mm - 10mm	very coarse	>10mm
-----------	----------	------	-----------------	--------	-------------	--------	------------	-------------	-------

Lab Sample No(s)	Customer Sample Ref.	Depth (m)	Colour	Description	Inclusions	Inclusions 2
24956849	UKC21 1310 WS104	0.15 - 0.50	Dark Brown	Sand	Stones	Brick

These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.

Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.



CERTIFICATE OF ANALYSIS

Validated

SDG: 210910-138 Report Number: 613252 Superseded Report: 613251
Client Ref.: 21-30529 Location:

Asbestos Identification - Solid Samples

Results Legend

ISO17025 accredited.
M mCERIS accredited.
* Subcontracted test.
(F) Trigger breach confirmed
1-5&*S@ Sample deviation (see appendix)

		Date of Analysis	Analysed By	Comments	Amosite (Brown) Asbestos	Chrysotile (White) Asbestos	Crocidolite (Blue) Asbestos	Fibrous Actinolite	Fibrous Anthophyllite	Fibrous Tremolite	Non-Asbestos Fibre
Cust. Sample Ref.	UKC21 1310 WS104	15/09/2021	James Richards	Fibre bundles in soil	Not Detected (#)	Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Depth (m)	0.15 - 0.50										
Sample Type	SOLID										
Date Sampled	02/09/2021 00:00:00										
Date Received	10/09/2021 08:15:00										
SDG	210910-138										
Original Sample	24956849										
Method Number	TM048										



CERTIFICATE OF ANALYSIS

Validated

SDG: 210910-138
Client Ref.: 21-30529

Report Number: 613252
Location:

Superseded Report: 613251

Table of Results - Appendix

Method No	Reference	Description
PM024	Modified BS 1377	Soil preparation including homogenisation, moisture screens of soils for Asbestos Containing Material
TM048	HSG 248, Asbestos: The analysts' guide for sampling, analysis and clearance procedures	Identification of Asbestos in Bulk Material
TM338	PFAS In Solids	Analysis of perfluoroalkylsulfonates and perfluorocarboxylic acids in Solids

NA = not applicable.

Chemical testing (unless subcontracted) performed at ALS Life Sciences Ltd Hawarden.



CERTIFICATE OF ANALYSIS

Validated

SDG: 210910-138
Client Ref.: 21-30529

Report Number: 613252
Location:

Superseded Report: 613251

Test Completion Dates

Lab Sample No(s)	24956849
Customer Sample Ref.	UKC21 1310 WS10 4
AGS Ref.	
Depth	0.15 - 0.50
Type	Soil/Solid (S)

Asbestos ID in Solid Samples	15-Sep-2021
PFAS Solids	15-Sep-2021
Sample description	13-Sep-2021



CERTIFICATE OF ANALYSIS

SDG:	210910-138	Client Reference:	21-30529	Report Number:	613252
Location:		Order Number:	21304	Superseded Report:	613251

Appendix

1. Results are expressed on a dry weight basis (dried at 35°C) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH₄ by the BRE method, VOC TICs and SVOC TICs.

2. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALS reserve the right to charge for samples received and stored but not analysed.

3. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

4. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

5. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

6. NDP - No determination possible due to insufficient/unsuitable sample.

7. Results relate only to the items tested.

8. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

9. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

10. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

11. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

12. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

13. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

14. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

15. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

16. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

17 Data retention. All records, communications and reports pertaining to the analysis are archived for seven years from the date of issue of the final report.

General

18. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as "mixed hydrocarbons". Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

19. Sample Deviations

If a sample is classed as deviated then the associated results may be compromised.

1	Container with Headspace provided for volatiles analysis
2	Incorrect container received
3	Deviation from method
4	Matrix interference
◆	Sample holding time exceeded in laboratory
@	Sample holding time exceeded due to late arrival of instructions or samples
§	Sampled on date not provided

20. Asbestos

When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as "Not detected". If no asbestos fibre types are found all will be reported as "Not detected" and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of asbestos present is not determined unless specifically requested.

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining.

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace - Where only one or two asbestos fibres were identified.

Respirable Fibres

Respirable fibres are defined as fibres of <3 µm diameter, longer than 5 µm and with aspect ratios of at least 3:1 that can be inhaled into the lower regions of the lung and are generally acknowledged to be most important predictor of hazard and risk for cancers of the lung.

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

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 21 1310
Littleborough Fire Station

Job Number MRN 4066/181
Date of Issue 05 October 2021
Pages 1 of 5

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.
- 5 The results included within the report are representative of the samples submitted for analysis.
- 6 This certificate should not be reproduced, except in full, without the express permission of the laboratory.



Andrew House, Hadfield Street, Dukinfield, Cheshire SK16 4QX Tel: 0161 475 0870
Email: enquiries@murrayrix.com Website: www.murrayrix.com

Also at: London: 020 8523 1999

Murray Rix is the trading name of Murray Rix (Northern) Limited. Registered in England 2878361

MURRAY RIX

Andrew House, Hadfield Street,
Dukinfield, Cheshire SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

LIQUID AND PLASTIC LIMIT

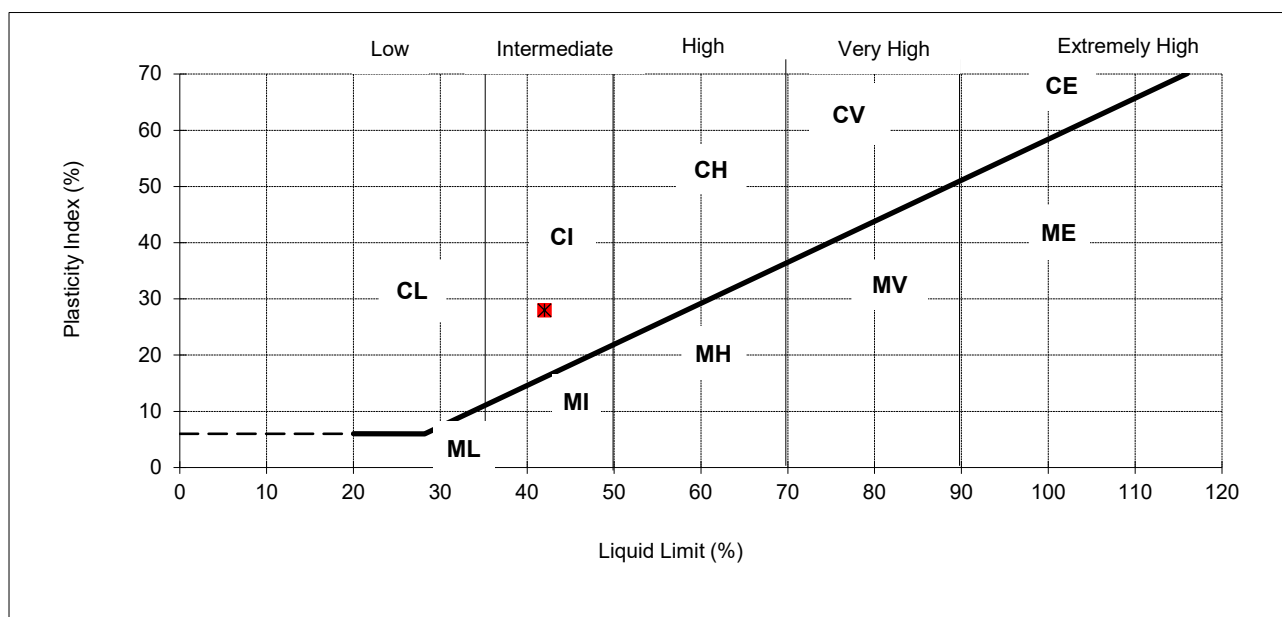
BS 1377: PART 2: 1990 Clause 4.4 ONE POINT METHOD & Clause 5.3
MOISTURE CONTENT METHOD BS 1377: PART 2: 1990 Clause 3.2

CLIENT	LK Consult Ltd
SITE	LKC 21 1310 - Littleborough Fire Station
JOB NUMBER	MRN 4066/181

SAMPLE LABEL	SA101 0.5-1.6m	DATE SAMPLED	Not advised
SAMPLE No.	104212	DATE RECEIVED	13-Sep-21
DATE TESTED	14-Sep-21	SAMPLED BY	Client

MATERIAL	Soft orange brown & grey mottled silty sandy CLAY with abundant gravel
ADVISED SOURCE	Site Investigation Sample

Moisture Content (Natural) (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
13	42	14	28	44



REMARKS

Sample tested after wet sieving

SIGNED

NAME S.J. Hutchings
(Director)

DATE 05-Oct-21

MURRAY RIX

Andrew House, Hadfield Street,
Dukinfield, Cheshire SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

LIQUID AND PLASTIC LIMIT

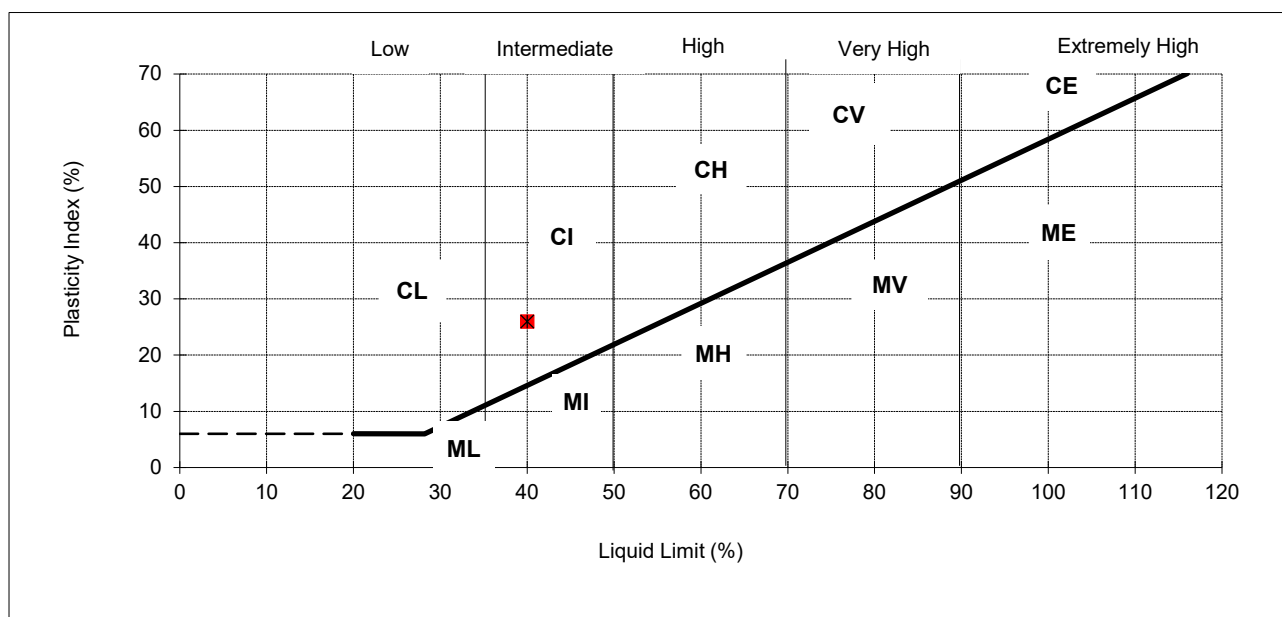
BS 1377: PART 2: 1990 Clause 4.4 ONE POINT METHOD & Clause 5.3
MOISTURE CONTENT METHOD BS 1377: PART 2: 1990 Clause 3.2

CLIENT	LK Consult Ltd
SITE	LKC 21 1310 - Littleborough Fire Station
JOB NUMBER	MRN 4066/181

SAMPLE LABEL	WS101 1.7-2.0m	DATE SAMPLED	Not advised
SAMPLE No.	104213	DATE RECEIVED	13-Sep-21
DATE TESTED	14-Sep-21	SAMPLED BY	Client

MATERIAL	Stiff dark grey silty sandy CLAY with frequent gravel
ADVISED SOURCE	Site Investigation Sample

Moisture Content (Natural) (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
14	40	14	26	64



REMARKS

Sample tested after wet sieving

SIGNED

NAME S.J. Hutchings
(Director)

DATE 05-Oct-21

MURRAY RIX

Andrew House, Hadfield Street,
Dukinfield, Cheshire SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

LIQUID AND PLASTIC LIMIT

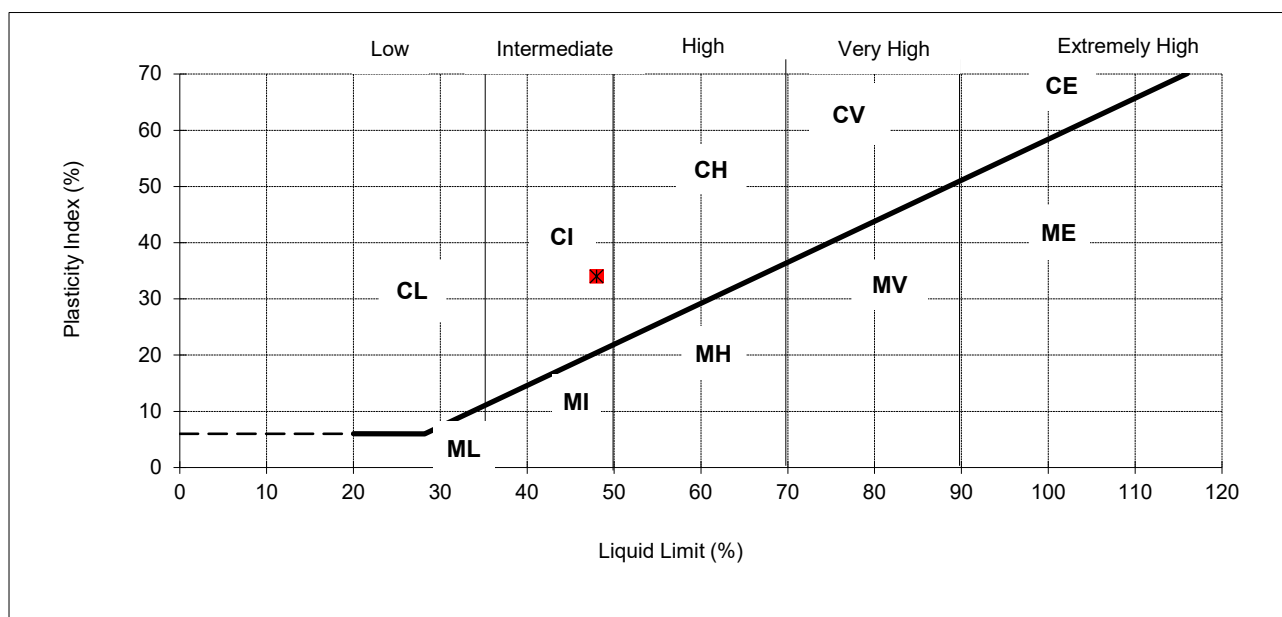
BS 1377: PART 2: 1990 Clause 4.4 ONE POINT METHOD & Clause 5.3
MOISTURE CONTENT METHOD BS 1377: PART 2: 1990 Clause 3.2

CLIENT	LK Consult Ltd
SITE	LKC 21 1310 - Littleborough Fire Station
JOB NUMBER	MRN 4066/181

SAMPLE LABEL	WS102 0.5-1.0m	DATE SAMPLED	Not advised
SAMPLE No.	104214	DATE RECEIVED	13-Sep-21
DATE TESTED	14-Sep-21	SAMPLED BY	Client

MATERIAL	Stiff orange brown & grey mottled silty sandy CLAY
ADVISED SOURCE	Site Investigation Sample

Moisture Content (Natural) (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
19	48	16	34	88



REMARKS

Sample tested after wet sieving

SIGNED

NAME S.J. Hutchings
(Director)

DATE 05-Oct-21

MURRAY RIX

Andrew House, Hadfield Street,
Dukinfield, Cheshire SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

LIQUID AND PLASTIC LIMIT

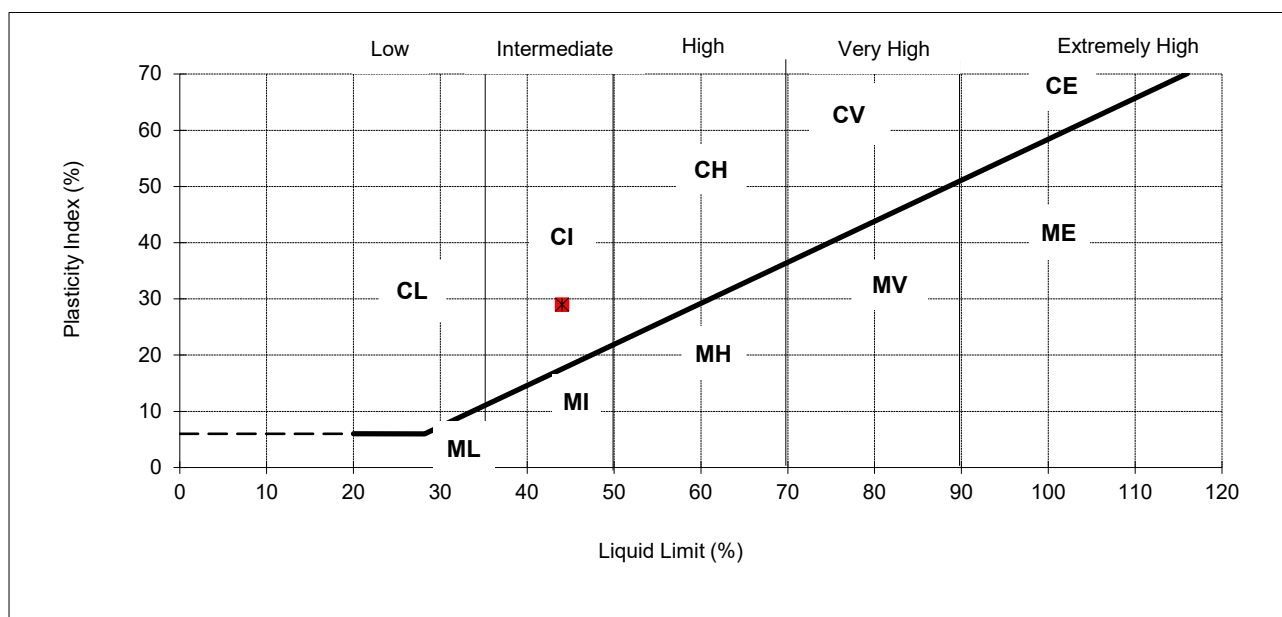
BS 1377: PART 2: 1990 Clause 4.4 ONE POINT METHOD & Clause 5.3
MOISTURE CONTENT METHOD BS 1377: PART 2: 1990 Clause 3.2

CLIENT	LK Consult Ltd
SITE	LKC 21 1310 - Littleborough Fire Station
JOB NUMBER	MRN 4066/181

SAMPLE LABEL	WS102 1.8-2.0m	DATE SAMPLED	Not advised
SAMPLE No.	104215	DATE RECEIVED	13-Sep-21
DATE TESTED	14-Sep-21	SAMPLED BY	Client

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

Moisture Content (Natural) (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
11	44	15	29	58



REMARKS

Sample tested after wet sieving

SIGNED

NAME S.J. Hutchings
(Director)

DATE 05-Oct-21

Appendix E

Certificate of Analysis – Water



2183

Final Report

Report No.: 21-33561-1
Initial Date of Issue: 04-Oct-2021
Client LK Consult
Client Address: Unit 29 Eton Business Park
Eton Hill Road
Radcliffe
Manchester
Lancashire
M26 2ZS
Contact(s): Contaminated Land
Michelle Thorniley
Project LKC 21 1310 Littleborough Fire Station

Quotation No.:		Date Received:	28-Sep-2021
Order No.:	739066	Date Instructed:	29-Sep-2021
No. of Samples:	2		
Turnaround (Wkdays):	5	Results Due:	05-Oct-2021
Date Approved:	04-Oct-2021		

Approved By:



Details: Glynn Harvey, Technical Manager

Results - Water

Project: LKC 21 1310 Littleborough Fire Station

Client: LK Consult	Chemtest Job No.:				21-33561	21-33561
Quotation No.:	Chemtest Sample ID.:				1287418	1287419
Order No.: 739066	Client Sample Ref.:				WS101	WS103
	Sample Location:				Littleborough Fire Station	Littleborough Fire Station
	Sample Type:				WATER	WATER
	Top Depth (m):				2.32	3.89
	Bottom Depth (m):				4.00	3.94
	Date Sampled:				27-Sep-2021	27-Sep-2021
Determinand	Accred.	SOP	Units	LOD		
Diesel Present	N	1670		N/A	False	False
pH	U	1010		N/A	7.7	
Sulphate	U	1220	mg/l	1.0	36	
Cyanide (Total)	U	1300	mg/l	0.050	0.070	
Cyanide (Free)	U	1300	mg/l	0.050	< 0.050	
Calcium	U	1455	mg/l	2.00	19	28
Total Hardness as CaCO3	U	1270	mg/l	15	57	
Arsenic (Dissolved)	U	1455	µg/l	0.20	< 0.20	
Boron (Dissolved)	U	1455	µg/l	10.0	33	
Cadmium (Dissolved)	U	1455	µg/l	0.11	< 0.11	
Chromium (Dissolved)	U	1455	µg/l	0.50	< 0.50	
Copper (Dissolved)	U	1455	µg/l	0.50	0.68	
Nickel (Dissolved)	U	1455	µg/l	0.50	4.8	
Lead (Dissolved)	U	1455	µg/l	0.50	< 0.50	
Selenium (Dissolved)	U	1455	µg/l	0.50	2.3	
Vanadium (Dissolved)	U	1455	µg/l	0.50	< 0.50	
Zinc (Dissolved)	U	1455	µg/l	2.5	3.9	
Mercury Low Level	U	1460	µg/l	0.010	< 0.010	
Chromium (Hexavalent)	U	1490	µg/l	20	< 20	
Dissolved Organic Carbon	U	1610	mg/l	2.0	3.3	5.9
Aliphatic TPH >C5-C6	N	1675	µg/l	0.10	< 0.10	< 0.10
Aliphatic TPH >C6-C8	N	1675	µg/l	0.10	< 0.10	< 0.10
Aliphatic TPH >C8-C10	N	1675	µg/l	0.10	< 0.10	< 0.10
Aliphatic TPH >C10-C12	N	1675	µg/l	0.10	< 0.10	< 0.10
Aliphatic TPH >C12-C16	N	1675	µg/l	0.10	< 0.10	< 0.10
Aliphatic TPH >C16-C21	N	1675	µg/l	0.10	< 0.10	< 0.10
Aliphatic TPH >C21-C35	N	1675	µg/l	0.10	< 0.10	< 0.10
Aliphatic TPH >C35-C44	N	1675	µg/l	0.10	< 0.10	< 0.10
Total Aliphatic Hydrocarbons	N	1675	µg/l	5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	1675	µg/l	0.10	< 0.10	< 0.10
Aromatic TPH >C7-C8	N	1675	µg/l	0.10	< 0.10	< 0.10
Aromatic TPH >C8-C10	N	1675	µg/l	0.10	< 0.10	< 0.10
Aromatic TPH >C10-C12	N	1675	µg/l	0.10	< 0.10	< 0.10
Aromatic TPH >C12-C16	N	1675	µg/l	0.10	< 0.10	< 0.10
Aromatic TPH >C16-C21	N	1675	µg/l	0.10	< 0.10	< 0.10
Aromatic TPH >C21-C35	N	1675	µg/l	0.10	< 0.10	< 0.10
Aromatic TPH >C35-C44	N	1675	µg/l	0.10	< 0.10	< 0.10

Results - Water

Project: LKC 21 1310 Littleborough Fire Station

Client: LK Consult	Chemtest Job No.:				21-33561	21-33561
Quotation No.:	Chemtest Sample ID.:				1287418	1287419
Order No.: 739066	Client Sample Ref.:				WS101	WS103
	Sample Location:				Littleborough Fire Station	Littleborough Fire Station
	Sample Type:				WATER	WATER
	Top Depth (m):				2.32	3.89
	Bottom Depth (m):				4.00	3.94
	Date Sampled:				27-Sep-2021	27-Sep-2021
Determinand	Accred.	SOP	Units	LOD		
Total Aromatic Hydrocarbons	N	1675	µg/l	5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	1675	µg/l	10	< 10	< 10
Benzene	U	1760	µg/l	1.0	< 1.0	< 1.0
Toluene	U	1760	µg/l	1.0	< 1.0	< 1.0
Ethylbenzene	U	1760	µg/l	1.0	< 1.0	< 1.0
m & p-Xylene	U	1760	µg/l	1.0	< 1.0	< 1.0
o-Xylene	U	1760	µg/l	1.0	< 1.0	< 1.0
Methyl Tert-Butyl Ether	N	1760	µg/l	1.0	< 1.0	< 1.0
Surfactants as MBAS	N	1770	mg/l	0.020		0.37
Naphthalene	N	1800	µg/l	0.010	< 0.010	
Acenaphthylene	N	1800	µg/l	0.010	< 0.010	
Acenaphthene	N	1800	µg/l	0.010	< 0.010	
Fluorene	N	1800	µg/l	0.010	< 0.010	
Phenanthrene	N	1800	µg/l	0.010	< 0.010	
Anthracene	N	1800	µg/l	0.010	< 0.010	
Fluoranthene	N	1800	µg/l	0.010	< 0.010	
Pyrene	N	1800	µg/l	0.010	< 0.010	
Benzo[a]anthracene	N	1800	µg/l	0.010	< 0.010	
Chrysene	N	1800	µg/l	0.010	< 0.010	
Benzo[b]fluoranthene	N	1800	µg/l	0.010	< 0.010	
Benzo[k]fluoranthene	N	1800	µg/l	0.010	< 0.010	
Benzo[a]pyrene	N	1800	µg/l	0.010	< 0.010	
Indeno(1,2,3-c,d)Pyrene	N	1800	µg/l	0.010	< 0.010	
Dibenz(a,h)Anthracene	N	1800	µg/l	0.010	< 0.010	
Benzo[g,h,i]perylene	N	1800	µg/l	0.010	< 0.010	
Total Of 16 PAH's	N	1800	µg/l	0.20	< 0.20	
Total Phenols	U	1920	mg/l	0.030	< 0.030	

TPH Interpretation

Job	Sample	Matrix	Location	Sample Ref	Sample ID	Sample Depth (m)	Gasoline / Diesel Present	TPH Interpretation
21-33561	1287418	W	Littleborough Fire Station	WS101		2.32	No	N/A
21-33561	1287419	W	Littleborough Fire Station	WS103		3.89	No	N/A

Test Methods

SOP	Title	Parameters included	Method summary
1010	pH Value of Waters	pH	pH Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1270	Total Hardness of Waters	Total hardness	Calculation applied to calcium and magnesium results, expressed as mg l-1 CaCO ₃ equivalent.
1300	Cyanides & Thiocyanate in Waters	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Continuous Flow Analysis.
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1460	Mercury low-level in Waters by AFS	Mercury	Atomic Fluorescence Spectrometry, with collimated UV source, wavelength 253.7 nm.
1490	Hexavalent Chromium in Waters	Chromium [VI]	Automated colorimetric analysis by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazine.
1610	Total/Dissolved Organic Carbon in Waters	Organic Carbon	TOC Analyser using Catalytic Oxidation
1670	Total Petroleum Hydrocarbons (TPH) in Waters by GC-FID	TPH (C ₆ –C ₄₀); optional carbon banding, e.g. 3-band – GRO, DRO & LRO	Pentane extraction / GC FID detection
1675	TPH Aliphatic/Aromatic split in Waters by GC-FID(cf. Texas Method 1006 / TPH CWG)	Aliphatics: >C ₅ –C ₆ , >C ₆ –C ₈ , >C ₈ –C ₁₀ , >C ₁₀ –C ₁₂ , >C ₁₂ –C ₁₆ , >C ₁₆ –C ₂₁ , >C ₂₁ –C ₃₅ , >C ₃₅ –C ₄₄ Aromatics: >C ₅ –C ₇ , >C ₇ –C ₈ , >C ₈ –C ₁₀ , >C ₁₀ –C ₁₂ , >C ₁₂ –C ₁₆ , >C ₁₆ –C ₂₁ , >C ₂₁ –C ₃₅ , >C ₃₅ –C ₄₄	Pentane extraction / GCxGC FID detection
1760	Volatile Organic Compounds (VOCs) in Waters by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics. (cf. USEPA Method 8260)	Automated headspace gas chromatographic (GC) analysis of water samples with mass spectrometric (MS) detection of volatile organic compounds.
1770	MBAS	MBAS	Spectrophotometry
1800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Waters 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	Pentane extraction / GCMS detection
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.

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 30 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 F

Soakaway Results

Site : Littleborough Fire Station, Littleborough

Client : Greater Manchester Combined Authority

Project Contractor
: LKC

Job Number
LKC 21 1310

Sheet
1 / 2

Location	Date	Level	Location
SA101	02/09/2021	156.00 mOD	E: 3933385 N: 416675

Pit Width (m)	0.60
Pit Depth (m)	1.60
Pit Length (m)	2.00

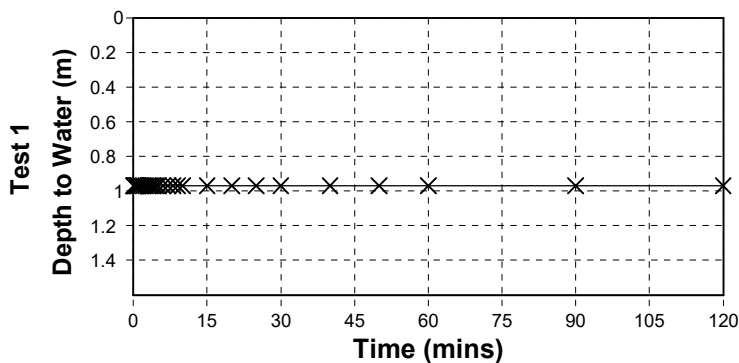
Soil type at test level	Clay
Groundwater	None
Drain discharge depth	None
Sidewall stability	Stable
Stone filled or open pit	Stone filled

	1
Effective depth (m)	0.63
Volume outflowing between 75% & 25% (m3)*	
Mean surface area through which outflow occurs (m2)	
Time for outflow between 75% & 25% (min)	
SOIL INFILTRATION RATE (ms-1), f	Test Failed

Remarks

* Volume outflowing reduced to account for granular backfill used during testing (30 % of free volume assumed).

Elapsed time (hh:mm:ss)	Depth to Water Test 1
00:00:00	0.97
00:00:05	0.97
00:00:10	0.97
00:00:20	0.97
00:00:30	0.97
00:00:40	0.97
00:00:50	0.97
00:01:00	0.97
00:01:30	0.97
00:02:00	0.97
00:02:30	0.97
00:03:00	0.97
00:03:30	0.97
00:04:00	0.97
00:04:30	0.97
00:05:00	0.97
00:06:00	0.97
00:07:00	0.97
00:08:00	0.97
00:09:00	0.97
00:10:00	0.97
00:15:00	0.97
00:20:00	0.97
00:25:00	0.97
00:30:00	0.97
00:40:00	0.97
00:50:00	0.97
01:00:00	0.97
01:30:00	0.97
02:00:00	0.97



Site : Littleborough Fire Station, Littleborough

Client : Greater Manchester Combined Authority

Project Contractor
: LKC

Job Number

LKC 21 1310

Sheet

2 / 2

Location	Date	Level	Location
SA102	02/09/2021	156.00 mOD	E: 393397 N: 416663

Pit Width (m)	0.60
Pit Depth (m)	1.80
Pit Length (m)	2.00

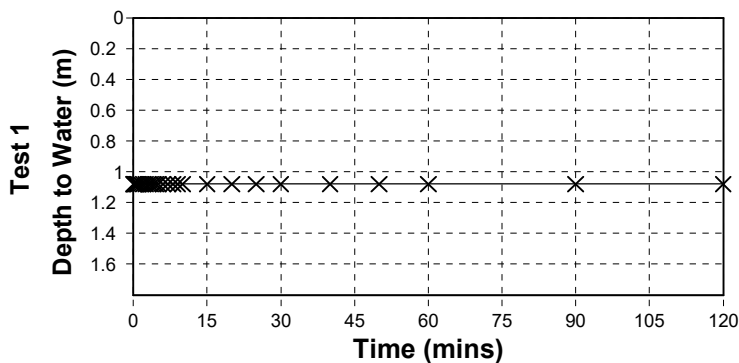
Soil type at test level	Clay
Groundwater	None
Drain discharge depth	None
Sidewall stability	Stable
Stone filled or open pit	Stone filled

	1
Effective depth (m)	0.72
Volume outflowing between 75% & 25% (m3)*	
Mean surface area through which outflow occurs (m2)	
Time for outflow between 75% & 25% (min)	
SOIL INFILTRATION RATE (ms-1), f	Test Failed

Remarks

* Volume outflowing reduced to account for granular backfill used during testing (30 % of free volume assumed).

Elapsed time (hh:mm:ss)	Depth to Water Test 1
00:00:00	1.08
00:00:05	1.08
00:00:10	1.08
00:00:20	1.08
00:00:30	1.08
00:00:40	1.08
00:00:50	1.08
00:01:00	1.08
00:01:30	1.08
00:02:00	1.08
00:02:30	1.08
00:03:00	1.08
00:03:30	1.08
00:04:00	1.08
00:04:30	1.08
00:05:00	1.08
00:06:00	1.08
00:07:00	1.08
00:08:00	1.08
00:09:00	1.08
00:10:00	1.08
00:15:00	1.08
00:20:00	1.08
00:25:00	1.08
00:30:00	1.08
00:40:00	1.08
00:50:00	1.08
01:00:00	1.08
01:30:00	1.08
02:00:00	1.08



Appendix G

Generic Assessment Criteria Values

CATEGORY 4 SCREENING LEVELS

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

Tetrachlorethene (PCE) – 1% SOM	0.31 mg/kg	0.32 mg/kg	2.0 mg/kg	24 mg/kg	3,200 mg/kg	1,400 mg/kg
Tetrachlorethene (PCE) – 2.5% SOM	0.70 mg/kg	0.71 mg/kg	4.8 mg/kg	55 mg/kg	3,300 mg/kg	1,900 mg/kg
Tetrachlorethene (PCE) – 6% SOM	1.6 mg/kg	1.6 mg/kg	11 mg/kg	130 mg/kg	3,400 mg/kg	2,500 mg/kg
Trichlorethene (TCE) – 1% SOM	0.0093 mg/kg	0.0097 mg/kg	0.032 mg/kg	0.73 mg/kg	76 mg/kg	41 mg/kg
Trichlorethene (TCE) – 2.5% SOM	0.020 mg/kg	0.020 mg/kg	0.072 mg/kg	1.5 mg/kg	78 mg/kg	54 mg/kg
Trichlorethene (TCE) – 6% SOM	0.043 mg/kg	0.045 mg/kg	0.16 mg/kg	3.4 mg/kg	79 mg/kg	69 mg/kg
Vinyl Chloride (VC) – 1%SOM	0.0064 mg/kg	0.015 mg/kg	0.0017 mg/kg	1.1 mg/kg	7.8 mg/kg	18 mg/kg
Vinyl Chloride (VC) – 2.5%SOM	0.010 mg/kg	0.019 mg/kg	0.0031 mg/kg	1.4 mg/kg	7.8 mg/kg	19 mg/kg
Vinyl Chloride (VC) – 6%SOM	0.017 mg/kg	0.029 mg/kg	0.0058 mg/kg	2.2 mg/kg	7.8 mg/kg	19 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 (update 2015)	6%	126	181	53	983	231	804
	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 +Aromatic >EC44	1%	1,600 ^f	1,900 ^f	1,200 ^f	28,000 ^f	3,800 ^f	7,800 ^f
	2.5%	1,800 ^f	1,900 ^f	2,100 ^f	28,000 ^f	3,800 ^f	7,800 ^f
	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.

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
	Endosulfanns (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.

January 2020
Table 4-2. Residential soil standards and guidance values for PFAS.

This Table 4-2 belongs with the ITRC PFAS Regulations, Guidance and Advisories Fact Sheet. The values included here are changing rapidly and include residential exposure values. Industrial and commercial values may be available, but are not presented here. The ITRC intends to update this table periodically as new information is gathered. The fact sheet user is encouraged to visit the ITRC PFAS web page (http://pfas-1.itrcweb.org) to access the current version of this file. Please see ITRC Disclaimer http://pfas-1.itrcweb.org/about-itrc/#disclaimer																																											
		Soil Screening Levels and/or Standards for Groundwater and Surface Water Protection (mg/kg)												Human Health Soil Screening Level (mg/kg)																													
		U.S. States										U.S. States										International																					
Agency		USEPA	Alaska	Florida	Maine	Massachusetts			Michigan	Nebraska	North Carolina	Texas	Texas	USEPA	Alaska	Delaware	Florida	Indiana	Iowa	Maine	Massachusetts	Michigan	Minnesota	Nebraska	Nevada	New Hampshire	New Hampshire	North Carolina	Texas	Texas	Vermont	Wisconsin	Australia			Western Australia	British Columbia, Canada	Canada	Denmark	Norway			
Department		Regions	DEC	DEP	DEP	DEP			DEQ	DEE	DEQ	CEQ	CEQ	Regions	DEC	DNREC	FDEP	IDEM	DNR	DEP	DEP	DEQ	PCA	DEE	DEP	DES - EHP		DEQ	CEQ	CEQ	DEC	DNR	HEPA/ DoEE			HEPA/ DoEE	HEPA/ DoEE	DER	2018	HC			
Year		2018	2017	2019	2018	2019			2016	2018	2018	2017	2017	2018	2017	2016	2019	2019	2016	2018	2019	2016	2019	2018	2017	2019		2018	2017	2017	2019	2018	2018			2018	2018	2018	2017	2018	2019	2015	2018
Standard		RSL ^a	CL	PSCTL	RAG	S-1,2,3/ GW-1	S-1/GW-2 S-1/GW-3	S-2,3/ GW-2,3	GSIPC	RG ^d	PSRG	PCL	PCL	RSL ^a	CL ^d		PSCTL	SL ^f	SWS ^h	RAG	S-1 ⁱ	GCC	SRV	RG ^d	BCL	DCRB		PSRG	PCL	PCL	RSL ⁱ	RCL		Residential with garden/ accessible soil	Residential with minimal opportunities for soil access	Public open space	ISL		SSV				
PFAS	CAS RN			Protection of Drinking Water		Protection of Drinking Water	Non-Drinking Water/Surface Water Protection		Drinking Surface Water ^b	Non-drinking Surface Water ^c	Drinking Water		0.5 acre source	30 acre source			Residential									Residential	Maintenance Working		0.5 acre source	30 acre source				Residential with accessible soil	Residential with minimal opportunities for soil access	Public open space			Agricultural/Residential Parkland Land Use				
PFNA	375-95-1	--	--	--	--	0.00032	0.3	0.4	--	--	--	--	0.003	0.0015	--	--	--	--	--	--	0.3	--	--	--	--	--	0.1	0.9	--	0.8	0.7	1.22	--	--	--	40	--	0.08	0.4	--			
PFOA	335-67-1	0.000172	0.0017	0.002	0.0095	0.00072	0.3	0.4	0.35	10	0.00060	0.017	0.003	0.0015	1.26	1.3	16	1.3	--	35	1.7	0.3	6	0.24	0.32	1.56	0.2	1.3	--	0.6	0.5	1.22	1.26	0.1	20	10	4	1	0.7	0.4	0.013		
PFOS	1763-23-1	0.000378	0.003	0.007	0.021	0.002	0.3	0.4	0.00022	0.00024	0.00078	--	0.05	0.025	1.26	1.3	6	1.3	--	1.8	1.7	0.3	3.2	0.041	3.2	1.56	0.1	0.6	--	1.5	1.5	1.22	1.26	0.009	2	1	4	1	2.1	0.4	0.0023		
PFBA	375-22-4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	114	0.4	--
PFBS	375-73-5	0.13	--	--	7.1	--	--	--	--	--	0.91	0.11	0.053	1,300	--	130	--	1,800	1,200	1,700	--	--	5.7	--	125	--	--	250	86	80	--	1260	--	--	--	--	--	300	61	0.4	--		
PFPeA	2706-90-3	--	--	--	--	--	--	--	--	--	--	--	0.00032	0.00016	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.3	0.3	--	--	--	--	--	--	--	--	--	0.8	0.4	--
PFHxS	355-46-4	--	--	--	--	0.0003	0.3	0.4	--	--	--	--	0.002	0.001	--	--	--	--	--	--	0.3	--	0.13	--	--	--	0.1	0.9	--	0.3	0.2	1.22	--	0.009	2	1	4	--	2.3	0.4	--		
PFHxA	307-24-4	--	--	--	--	--	--	--	--	--	--	--	0.00048	0.00024	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.3	0.3	--	--	--	--	--	--	--	--	--	0.8	0.4	--
PFHpA	375-85-9	--	--	--	--	0.0005	0.3	0.4	--	--	--	--	0.0046	0.0023	--	--	--	--	--	--	0.3	--	--	--	--	--	--	--	--	1.5	1.5	1.22	--	--	--	--	--	--	--	--	0.8	0.4	--
PFOSA	754-91-6	--	--	--	--	--	--	--	--	--	--	--	0.92	0.46	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.058	0.03	--	--	--	--	--	--	--	--	--	0.4	--	
PFDA	335-76-2	--	--	--	--	0.0003	0.3	0.4	--	--	--	--	0.022	0.011	--	--	--	--	--	--	0.3	--	--	--	--	--	--	--	--	0.99	0.98	--	--	--	--	--	--	--	--	--	0.4	--	
PFDS	335-77-3	--	--	--	--	--	--	--	--	--	--	--	0.04	0.02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.8	0.8	--	--	--	--	--	--	--	--	--	--	--	
PFLtNA	2058-94-8	--	--	--	--	--	--	--	--	--	--	--	0.018	0.0092	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.8	0.8	--	--	--	--	--	--	--	--	--	--	--	
PFDoA	307-55-1	--	--	--	--	--	--	--	--	--	--	--	0.034	0.017	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.8	0.8	--	--	--	--	--	--	--	--	--	--	--	
PFTtDA	72629-94-8	--	--	--	--	--	--	--	--	--	--	--	0.061	0.03	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.6	0.6	--	--	--	--	--	--	--	--	--	--	--	
PFTeDA	376-06-7	--	--	--	--	--	--	--	--	--	--	--	0.11	0.056	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	0.5	--	--	--	--	--	--	--	--	--	--	--	
6:2 FTS	27619-97-2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.8	0.4	--	
8:2 FTS	39108-34-4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.8	0.4	--

Notes:

a. Regional Screening Levels (RSL) for PFBS as presented in the USEPA Regional Screening Level (RSL) Summary Table (TR-1E-06, HQ=1) November 2014 through May 2018. As of June 2018, values for PFOA and PFOS calculated by the EPA RSL calculator using EPA OW RfDs, HQ of 1, and residential exposure assumptions. Note: RSL users screening sites with multiple contaminants should consult the USEPA (2018) RSL User's Guide and USEPA (1989) Risk Assessment Guidance.

b. Michigan soil GSIPCs for non-drinking surface water are developed to be protective of surface water that is NOT used as drinking water; these soil GSIPCs consider incidental ingestion of surface water and ingestion of fish that inhabit the water.

c. Michigan soil GSIPCs for drinking surface water are developed to be protective of surface water that is used as a drinking water source.

d. Alaska proposed cleanup levels for Human Health - most stringent value is from the "Over 40 Inch Zone".

e. Interim screening level for contaminated sites

f. The recommended approach to summing PFOA and PFOS is: $PFOS/SSV_{HQS} + PFOA/SSV_{HQS} \leq 1$

g. Applies to the individual results for PFOA, PFOS, PFNA, PFBA, PFBS, PFHxS, PFHxA, PFPeA, PFHpA, PFOSA, PFDA, AND 6:2 FTS as well as the sum of concentrations of these 12 PFAS.

h. Indiana Residential Soil Screening Level for Direct Contact for PFBS and PFBA.

i. Nebraska Voluntary Cleanup Program Groundwater and Soil Remediation Goals

j. Iowa Statewide Standards for soil

k. Vermont PFAS criteria are for the individual compounds or sum of the five PFAS - PFHpA, PFHxS, PFNA, PFOS and PFOA.

l. Massachusetts criteria for S-1 soils including sensitive land uses

Regulatory Agency	Standard	Per- and polyfluoroalkyl substances
CEQ = Commission on Environmental Quality	BCL= Basic Comparison Levels	PFAS = per- and polyfluoroalkyl substances
DEC = Department of Environmental Conservation	CL = Cleanup Level	PFOA = perfluorooctanoic acid (C8)
DEE = Department of Energy and Environment	DCRB = Direct Contact Risk-Based concentration	PFOS = perfluorooctane sulfonic acid (C8)
DEM = Department of Environmental Management	GCC = Generic Cleanup Criteria	PFNA = perfluorononanoic acid (C9)
DENR = Department of Environment and Natural Resources	GSIPC = Groundwater Surface Water (GSI) Protection Criteria (GSIPC)	PFBA = perfluorobutyric acid (C4)
DEP = Department of Environmental Protection	PCL = Protective Concentration Level	PFBS = perfluorobutane sulfonic acid (C4)
DES-EHP = Department of Environmental Services-Environmental Health Program	PSCTL = Provisional Soil Cleanup Target Level	PFPeA = perfluoropentanoic acid (C5)
DEQ = Department of Environmental Quality	PSRG = Preliminary Soil Remediation Goal	PFHxS = perfluorohexane sulfonic acid (C6)
DER = Department of Environment Regulation	RAG = Remedial Action Goal	PFHxA = perfluorohexanoic acid (C6)
DoEE = Department of Environment and Energy	RG = Remediation Goal	PFHpA = perfluorohexanoic acid (C7)
DNREC = Department of Natural Resources and Environmental Control	RSL = Regional Screening Level	PFOSA = perfluorooctane sulfonamide (C8)
HC = Health Canada	SL = Screening Level	PFDA = perfluorodecanoic acid (C10)
HEPA = Heads of EPAs Australia and New Zealand	SRV = Soil Reference Value	PFDS = perfluorodecane sulfonate (10)
PCA = Pollution Control Agency	SSV = Soil Screening Value	PFUnA = perfluoroundecanoic acid (C11)
USEPA = United States Environmental Protection Agency	SWS = Statewide Standard	PFDoA = perfluorododecanoic acid (C12)
		PFTtDA = perfluorotetradecanoic acid (C13)
		PFTeDA = perfluorotetradecanoic acid (C14)
		6:2 FTS = 6:2 Fluorotelomer sulfonate
		8:2 FTS = 8:2 Fluorotelomer sulfonate

Appendix H

Hazard Index Spreadsheet

$$HI = \sum_{Fi=1}^{16} HQ_{Fi} = \frac{\text{Measured concentration } Fi \text{ (mg/kg)}}{S4UL \text{ } Fi \text{ (mg/kg)}}$$

where: HI = Hazard Index
 HQ = Hazard Quotient
 Fi = Fraction I
 S4UL = LQM Sutable 4 Use Levels (S4ULs)

Job Littleborough Fire Station
Job No. LKC 21 1310
SOM 6%
Comment

Commercial

	1% S4UL	2.50% S4UL	6% S4UL	Max Soil concn.	HQ (1%SOM)	HQ (2.5%SOM)	HQ (6% SOM)
Aliphatic							
EC5-EC6	3200	5900	12000	1	0.0003125	0.0001695	8.333E-05
EC6-EC8	7800	17000	40000	1	0.0001282	5.882E-05	0.000025
EC8-EC10	2000	4800	11000	1	0.0005	0.0002083	9.091E-05
EC10-EC12	9700	23000	47000	1	0.0001031	4.348E-05	2.128E-05
EC12-EC16	59000	82000	90000	1	1.695E-05	1.22E-05	1.111E-05
EC16-EC21	160000	1700000	1800000	2	0.0000125	1.176E-06	1.111E-06
EC21-EC35							
EC35-EC44	160000	1700000	1800000	1	6.25E-06	5.882E-07	5.556E-07
Aromatic							
EC5-EC7 (benzene)	26000	46000	86000	1	3.846E-05	2.174E-05	1.163E-05
EC7-EC8 (tolulene)	56000	110000	180000	1	1.786E-05	9.091E-06	5.556E-06
EC8-EC10	3500	8100	17000	1	0.0002857	0.0001235	5.882E-05
EC10-EC12	16000	28000	34000	1	0.0000625	3.571E-05	2.941E-05
EC12-EC16	36000	37000	38000	1	2.778E-05	2.703E-05	2.632E-05
EC16-EC21	28000	28000	28000	73	0.0026071	0.0026071	0.0026071
EC21-EC35	28000	28000	28000	3000	0.1071429	0.1071429	0.1071429
EC35-EC44	28000	28000	28000	61	0.0021786	0.0021786	0.0021786

HI	0.11	0.11	0.11
----	------	------	------

Appendix I

HazWasteOnline Output Sheet

Waste Classification Report

HazWasteOnline™ classifies waste as either **hazardous** or **non-hazardous** based on its chemical composition, related legislation and the rules and data defined in the current UK or EU technical guidance (Appendix C) (note that HP 9 Infectious is not assessed). It is the responsibility of the classifier named below to:

- understand the origin of the waste
- select the correct List of Waste code(s)
- confirm that the list of determinands, results and sampling plan are fit for purpose
- select and justify the chosen metal species (Appendix B)
- correctly apply moisture correction and other available corrections
- add the meta data for their user-defined substances (Appendix A)
- check that the classification engine is suitable with respect to the national destination of the waste (Appendix C)



XD7FV-ZS0M0-JM6E6

To aid the reviewer, the laboratory results, assumptions and justifications managed by the classifier are highlighted in **pale yellow**.

Job name

LKC 21 1310

Description/Comments

Project

LKC 21 1310

Site

Littleborough Fire Station

Classified by

Name: **Colin Crompton**
Date: **08 Nov 2021 17:12 GMT**
Telephone: **0161 763 7200**

Company: **LK Group**
Unit 29, Eton Business Park
Eton Hill Rd, Radcliffe
Greater Manchester
M26 2ZS

HazWasteOnline™ provides a two day, hazardous waste classification course that covers the use of the software and both basic and advanced waste classification techniques. Certification has to be renewed every 3 years.

HazWasteOnline™ Certification:

CERTIFIED

Course

Hazardous Waste Classification

Date

08 Oct 2020

Next 3 year Refresher due by Oct 2023

Job summary

#	Sample name	Depth [m]	Classification Result	Hazard properties	Page
1	WS101-02/09/2021-0.00	0.00-0.40	Non Hazardous		2
2	WS101-02/09/2021-0.50	0.50-1.00	Non Hazardous		4
3	WS102-02/09/2021-0.00	0.00-0.50	Non Hazardous		5
4	WS104-02/09/2021-0.50		Non Hazardous		7
5	WS103-02/09/2021-0.10	0.10-1.00	Non Hazardous		10
6	WS104-02/09/2021-0.15	0.15-0.50	Non Hazardous		12
7	WS104-02/09/2021-0.30	0.30-0.70	Non Hazardous		13
8	SA101-02/09/2021-0.00	0.00-0.50	Non Hazardous		15

Related documents

#	Name	Description
1	HWOL_21-30529-20210928 172109.hwol	.hwol file used to create the Job
2	Example waste stream template for contaminated soils	waste stream template used to create this Job

Report

Created by: Colin Crompton

Created date: 08 Nov 2021 17:12 GMT

Appendices	Page
Appendix A: Classifier defined and non CLP determinands	17
Appendix B: Rationale for selection of metal species	18
Appendix C: Version	19

Classification of sample: WS101-02/09/2021-0.00

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

Sample details

Sample name:	LoW Code:
WS101-02/09/2021-0.00	Chapter: 17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Sample Depth:	Entry: 17 05 04 (Soil and stones other than those mentioned in 17 05 03)
0.00-0.40 m	
Moisture content:	
15%	
(wet weight correction)	

Hazard properties

None identified

Determinands

Moisture content: 15% 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	13.467	mg/kg	0.00135 %	✓	
	033-003-00-0	215-481-4	1327-53-3									
2	cadmium { cadmium oxide }				0.26	mg/kg	1.142	0.252	mg/kg	0.0000252 %	✓	
	048-002-00-0	215-146-2	1306-19-0									
3	chromium in chromium(III) compounds { chromium(III) oxide (worst case) }				15	mg/kg	1.462	18.635	mg/kg	0.00186 %	✓	
		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 }				29	mg/kg	1.126	27.753	mg/kg	0.00278 %	✓	
		029-002-00-X	215-270-7	1317-39-1								
6	lead { lead chromate }			1	100	mg/kg	1.56	132.584	mg/kg	0.0085 %	✓	
		082-004-00-2	231-846-0	7758-97-6								
7	mercury { mercury dichloride }				0.34	mg/kg	1.353	0.391	mg/kg	0.0000391 %	✓	
		080-010-00-X	231-299-8	7487-94-7								
8	nickel { nickel chromate }				16	mg/kg	2.976	40.477	mg/kg	0.00405 %	✓	
		028-035-00-7	238-766-5	14721-18-7								
9	selenium { nickel selenate }				0.49	mg/kg	2.554	1.064	mg/kg	0.000106 %	✓	
		028-031-00-5	239-125-2	15060-62-5								
10	zinc { zinc chromate }				70	mg/kg	2.774	165.062	mg/kg	0.0165 %	✓	
		024-007-00-3	236-878-9	13530-65-9								
11	pH				7	pH		7	pH	7pH		
12	naphthalene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
		601-052-00-2	202-049-5	91-20-3								
13	acenaphthylene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
			205-917-1	208-96-8								
14	acenaphthene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
			201-469-6	83-32-9								
15	fluorene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
			201-695-5	86-73-7								
16	phenanthrene				1.3	mg/kg		1.105	mg/kg	0.000111 %	✓	
			201-581-5	85-01-8								

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	CLP index number	EC Number	CAS Number							
17	anthracene	204-371-1	120-12-7		0.32 mg/kg		0.272 mg/kg	0.0000272 %	✓	
18	fluoranthene	205-912-4	206-44-0		2.2 mg/kg		1.87 mg/kg	0.000187 %	✓	
19	pyrene	204-927-3	129-00-0		2 mg/kg		1.7 mg/kg	0.00017 %	✓	
20	benzo[a]anthracene	601-033-00-9	200-280-6		1.2 mg/kg		1.02 mg/kg	0.000102 %	✓	
21	chrysene	601-048-00-0	205-923-4		1.1 mg/kg		0.935 mg/kg	0.0000935 %	✓	
22	benzo[b]fluoranthene	601-034-00-4	205-911-9		1.6 mg/kg		1.36 mg/kg	0.000136 %	✓	
23	benzo[k]fluoranthene	601-036-00-5	205-916-6		0.55 mg/kg		0.468 mg/kg	0.0000468 %	✓	
24	benzo[a]pyrene; benzo[def]chrysene	601-032-00-3	200-028-5		1.2 mg/kg		1.02 mg/kg	0.000102 %	✓	
25	indeno[123-cd]pyrene	205-893-2	193-39-5		0.85 mg/kg		0.723 mg/kg	0.0000723 %	✓	
26	dibenz[a,h]anthracene	601-041-00-2	200-181-8		0.14 mg/kg		0.119 mg/kg	0.0000119 %	✓	
27	benzo[ghi]perylene	205-883-8	191-24-2		0.8 mg/kg		0.68 mg/kg	0.000068 %	✓	
28	vanadium { divanadium pentaoxide; vanadium pentoxide }	023-001-00-8	215-239-8		24 mg/kg	1.785	36.418 mg/kg	0.00364 %	✓	
Total:								0.0401 %		

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: WS101-02/09/2021-0.50



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

Sample details

Sample name:	LoW Code:
WS101-02/09/2021-0.50	Chapter: 17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Sample Depth:	Entry: 17 05 04 (Soil and stones other than those mentioned in 17 05 03)
0.50-1.00 m	
Moisture content:	
11%	
(wet weight correction)	

Hazard properties

None identified

Determinands

Moisture content: 11% 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				7.2 pH		7.2 pH	7.2 pH		
			PH							
Total:								0%		

Key

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

Classification of sample: WS102-02/09/2021-0.00

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

Sample details

Sample name:	LoW Code:
WS102-02/09/2021-0.00	Chapter: 17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Sample Depth:	Entry: 17 05 04 (Soil and stones other than those mentioned in 17 05 03)
0.00-0.50 m	
Moisture content:	
9.8%	
(wet weight correction)	

Hazard properties

None identified

Determinands

Moisture content: 9.8% 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 }				7.9	mg/kg	1.32	9.408	mg/kg	0.000941 %	✓	
	033-003-00-0	215-481-4	1327-53-3									
2	cadmium { cadmium oxide }				0.15	mg/kg	1.142	0.155	mg/kg	0.0000155 %	✓	
	048-002-00-0	215-146-2	1306-19-0									
3	chromium in chromium(III) compounds { chromium(III) oxide (worst case) }				9.5	mg/kg	1.462	12.524	mg/kg	0.00125 %	✓	
		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 }				22	mg/kg	1.126	22.342	mg/kg	0.00223 %	✓	
	029-002-00-X	215-270-7	1317-39-1									
6	lead { lead chromate }			1	57	mg/kg	1.56	80.196	mg/kg	0.00514 %	✓	
	082-004-00-2	231-846-0	7758-97-6									
7	mercury { mercury dichloride }				0.19	mg/kg	1.353	0.232	mg/kg	0.0000232 %	✓	
	080-010-00-X	231-299-8	7487-94-7									
8	nickel { nickel chromate }				11	mg/kg	2.976	29.53	mg/kg	0.00295 %	✓	
	028-035-00-7	238-766-5	14721-18-7									
9	selenium { nickel selenate }				0.32	mg/kg	2.554	0.737	mg/kg	0.0000737 %	✓	
	028-031-00-5	239-125-2	15060-62-5									
10	zinc { zinc chromate }				47	mg/kg	2.774	117.607	mg/kg	0.0118 %	✓	
	024-007-00-3	236-878-9	13530-65-9									
11	pH				6.8	pH		6.8	pH	6.8 pH		
12	naphthalene				0.14	mg/kg		0.126	mg/kg	0.0000126 %	✓	
	601-052-00-2	202-049-5	91-20-3									
13	acenaphthylene				0.41	mg/kg		0.37	mg/kg	0.000037 %	✓	
		205-917-1	208-96-8									
14	acenaphthene				0.1	mg/kg		0.0902	mg/kg	0.00000902 %	✓	
		201-469-6	83-32-9									
15	fluorene				0.23	mg/kg		0.207	mg/kg	0.0000207 %	✓	
		201-695-5	86-73-7									
16	phenanthrene				3	mg/kg		2.706	mg/kg	0.000271 %	✓	
		201-581-5	85-01-8									

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	CLP index number	EC Number	CAS Number							
17	anthracene	204-371-1	120-12-7		1.4 mg/kg		1.263 mg/kg	0.000126 %	✓	
18	fluoranthene	205-912-4	206-44-0		8.1 mg/kg		7.306 mg/kg	0.000731 %	✓	
19	pyrene	204-927-3	129-00-0		6.8 mg/kg		6.134 mg/kg	0.000613 %	✓	
20	benzo[a]anthracene	601-033-00-9	200-280-6	56-55-3	3.9 mg/kg		3.518 mg/kg	0.000352 %	✓	
21	chrysene	601-048-00-0	205-923-4	218-01-9	3.7 mg/kg		3.337 mg/kg	0.000334 %	✓	
22	benzo[b]fluoranthene	601-034-00-4	205-911-9	205-99-2	4.5 mg/kg		4.059 mg/kg	0.000406 %	✓	
23	benzo[k]fluoranthene	601-036-00-5	205-916-6	207-08-9	2 mg/kg		1.804 mg/kg	0.00018 %	✓	
24	benzo[a]pyrene; benzo[def]chrysene	601-032-00-3	200-028-5	50-32-8	4 mg/kg		3.608 mg/kg	0.000361 %	✓	
25	indeno[123-cd]pyrene	205-893-2	193-39-5		2.7 mg/kg		2.435 mg/kg	0.000244 %	✓	
26	dibenz[a,h]anthracene	601-041-00-2	200-181-8	53-70-3	0.68 mg/kg		0.613 mg/kg	0.0000613 %	✓	
27	benzo[ghi]perylene	205-883-8	191-24-2		2.1 mg/kg		1.894 mg/kg	0.000189 %	✓	
28	vanadium { divanadium pentaoxide; vanadium pentoxide }	023-001-00-8	215-239-8	1314-62-1	14 mg/kg	1.785	22.543 mg/kg	0.00225 %	✓	
Total:								0.0307 %		

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: WS104-02/09/2021-0.50

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

Sample details

Sample name:	LoW Code:
WS104-02/09/2021-0.50	Chapter:
Moisture content:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
15%	Entry:
(wet weight correction)	17 05 04 (Soil and stones other than those mentioned in 17 05 03)

Hazard properties

None identified

Determinands

Moisture content: 15% 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 }				3.3 mg/kg	1.32	3.704 mg/kg	0.00037 %	✓	
	033-003-00-0	215-481-4	1327-53-3							
2	boron { diboron trioxide; boric oxide }				<0.4 mg/kg	3.22	<1.288 mg/kg	<0.000129 %		<LOD
	005-008-00-8	215-125-8	1303-86-2							
3	cadmium { cadmium oxide }				<0.1 mg/kg	1.142	<0.114 mg/kg	<0.0000114 %		<LOD
	048-002-00-0	215-146-2	1306-19-0							
4	chromium in chromium(III) compounds { chromium(III) oxide (worst case) }				12 mg/kg	1.462	14.908 mg/kg	0.00149 %	✓	
		215-160-9	1308-38-9							
5	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									
6	copper { dicopper oxide; copper (I) oxide }				14 mg/kg	1.126	13.398 mg/kg	0.00134 %	✓	
	029-002-00-X	215-270-7	1317-39-1							
7	lead { lead chromate }			1	19 mg/kg	1.56	25.191 mg/kg	0.00161 %	✓	
	082-004-00-2	231-846-0	7758-97-6							
8	mercury { mercury dichloride }				<0.1 mg/kg	1.353	<0.135 mg/kg	<0.0000135 %		<LOD
	080-010-00-X	231-299-8	7487-94-7							
9	nickel { nickel chromate }				12 mg/kg	2.976	30.358 mg/kg	0.00304 %	✓	
	028-035-00-7	238-766-5	14721-18-7							
10	selenium { nickel selenate }				<0.2 mg/kg	2.554	<0.511 mg/kg	<0.0000511 %		<LOD
	028-031-00-5	239-125-2	15060-62-5							
11	zinc { zinc chromate }				26 mg/kg	2.774	61.309 mg/kg	0.00613 %	✓	
	024-007-00-3	236-878-9	13530-65-9							
12	TPH (C6 to C40) petroleum group		TPH		3200 mg/kg		2720 mg/kg	0.272 %	✓	
13	confirm TPH has NOT arisen from diesel or petrol				☒					
14	tert-butyl methyl ether; MTBE; 2-methoxy-2-methylpropane				<0.001 mg/kg		<0.001 mg/kg	<0.0000001 %		<LOD
	603-181-00-X	216-653-1	1634-04-4							
15	benzene				<0.001 mg/kg		<0.001 mg/kg	<0.0000001 %		<LOD
	601-020-00-8	200-753-7	71-43-2							
16	toluene				<0.001 mg/kg		<0.001 mg/kg	<0.0000001 %		<LOD
	601-021-00-3	203-625-9	108-88-3							
17	ethylbenzene				<0.001 mg/kg		<0.001 mg/kg	<0.0000001 %		<LOD
	601-023-00-4	202-849-4	100-41-4							

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
	CLP index number	EC Number	CAS Number								
18	xylene 601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-38-3 [3] 1330-20-7 [4]		<0.002 mg/kg		<0.002 mg/kg	<0.0000002 %			<LOD
19	cyanides { salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex } 006-007-00-5				<0.5 mg/kg	1.884	<0.942 mg/kg	<0.0000942 %			<LOD
20	pH PH				7.9 pH		7.9 pH	7.9 pH			
21	naphthalene 601-052-00-2	202-049-5	91-20-3		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
22	acenaphthylene 205-917-1	208-96-8			<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
23	acenaphthene 201-469-6	83-32-9			<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
24	fluorene 201-695-5	86-73-7			<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
25	phenanthrene 201-581-5	85-01-8			<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
26	anthracene 204-371-1	120-12-7			<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
27	fluoranthene 205-912-4	206-44-0			<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
28	pyrene 204-927-3	129-00-0			<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
29	benzo[a]anthracene 601-033-00-9	200-280-6	56-55-3		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
30	chrysene 601-048-00-0	205-923-4	218-01-9		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
31	benzo[b]fluoranthene 601-034-00-4	205-911-9	205-99-2		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
32	benzo[k]fluoranthene 601-036-00-5	205-916-6	207-08-9		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
33	benzo[a]pyrene; benzo[def]chrysene 601-032-00-3	200-028-5	50-32-8		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
34	indeno[123-cd]pyrene 205-893-2	193-39-5			<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
35	dibenz[a,h]anthracene 601-041-00-2	200-181-8	53-70-3		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
36	benzo[ghi]perylene 205-883-8	191-24-2			<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
37	vanadium { divanadium pentaoxide; vanadium pentoxide } 023-001-00-8	215-239-8	1314-62-1		16 mg/kg	1.785	24.279 mg/kg	0.00243 %	✓		
38	monohydric phenols P1186				<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
Total:									0.289 %		

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

Supplementary Hazardous Property Information

HP 3(i): Flammable "flammable liquid waste: liquid waste having a flash point below 60°C or waste gas oil, diesel and light heating oils having a flash point > 55°C and <= 75°C"

Force this Hazardous property to non hazardous because Flammability of soils is unlikely to result in a hazardous classification in soils (AGS Waste Classification – A Practitioner's Guide).

Hazard Statements hit:

Flam. Liq. 3; H226 "Flammable liquid and vapour."

Because of determinand:

TPH (C6 to C40) petroleum group: (conc.: 0.272%)

Classification of sample: WS103-02/09/2021-0.10

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

Sample details

Sample name:	LoW Code:
WS103-02/09/2021-0.10	Chapter: 17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Sample Depth:	Entry: 17 05 04 (Soil and stones other than those mentioned in 17 05 03)
0.10-1.00 m	
Moisture content:	
8.5%	
(wet weight correction)	

Hazard properties

None identified

Determinands

Moisture content: 8.5% 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 }				5.3	mg/kg	1.32	6.403	mg/kg	0.00064 %	✓	
	033-003-00-0	215-481-4	1327-53-3									
2	cadmium { cadmium oxide }				<0.1	mg/kg	1.142	<0.114	mg/kg	<0.0000114 %		<LOD
	048-002-00-0	215-146-2	1306-19-0									
3	chromium in chromium(III) compounds { chromium(III) oxide (worst case) }				18	mg/kg	1.462	24.072	mg/kg	0.00241 %	✓	
		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 }				25	mg/kg	1.126	25.755	mg/kg	0.00258 %	✓	
	029-002-00-X	215-270-7	1317-39-1									
6	lead { lead chromate }			1	35	mg/kg	1.56	49.953	mg/kg	0.0032 %	✓	
	082-004-00-2	231-846-0	7758-97-6									
7	mercury { mercury dichloride }				<0.1	mg/kg	1.353	<0.135	mg/kg	<0.0000135 %		<LOD
	080-010-00-X	231-299-8	7487-94-7									
8	nickel { nickel chromate }				22	mg/kg	2.976	59.912	mg/kg	0.00599 %	✓	
	028-035-00-7	238-766-5	14721-18-7									
9	selenium { nickel selenate }				0.27	mg/kg	2.554	0.631	mg/kg	0.0000631 %	✓	
	028-031-00-5	239-125-2	15060-62-5									
10	zinc { zinc chromate }				52	mg/kg	2.774	131.994	mg/kg	0.0132 %	✓	
	024-007-00-3	236-878-9	13530-65-9									
11	pH				6.7	pH		6.7	pH	6.7 pH		
12	naphthalene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
	601-052-00-2	202-049-5	91-20-3									
13	acenaphthylene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
		205-917-1	208-96-8									
14	acenaphthene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
		201-469-6	83-32-9									
15	fluorene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
		201-695-5	86-73-7									
16	phenanthrene				0.24	mg/kg		0.22	mg/kg	0.000022 %	✓	
		201-581-5	85-01-8									

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	CLP index number	EC Number	CAS Number							
17	anthracene	204-371-1	120-12-7		0.12 mg/kg		0.11 mg/kg	0.000011 %	✓	
18	fluoranthene	205-912-4	206-44-0		0.48 mg/kg		0.439 mg/kg	0.0000439 %	✓	
19	pyrene	204-927-3	129-00-0		0.46 mg/kg		0.421 mg/kg	0.0000421 %	✓	
20	benzo[a]anthracene	601-033-00-9	200-280-6		0.25 mg/kg		0.229 mg/kg	0.0000229 %	✓	
21	chrysene	601-048-00-0	205-923-4		0.34 mg/kg		0.311 mg/kg	0.0000311 %	✓	
22	benzo[b]fluoranthene	601-034-00-4	205-911-9		0.38 mg/kg		0.348 mg/kg	0.0000348 %	✓	
23	benzo[k]fluoranthene	601-036-00-5	205-916-6		0.13 mg/kg		0.119 mg/kg	0.0000119 %	✓	
24	benzo[a]pyrene; benzo[def]chrysene	601-032-00-3	200-028-5		0.3 mg/kg		0.274 mg/kg	0.0000274 %	✓	
25	indeno[123-cd]pyrene	205-893-2	193-39-5		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
26	dibenz[a,h]anthracene	601-041-00-2	200-181-8		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
27	benzo[ghi]perylene	205-883-8	191-24-2		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
28	vanadium { divanadium pentaoxide; vanadium pentoxide }	023-001-00-8	215-239-8		20 mg/kg	1.785	32.669 mg/kg	0.00327 %	✓	
Total:								0.0318 %		

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: WS104-02/09/2021-0.15



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

Sample details

Sample name:	LoW Code:	
WS104-02/09/2021-0.15	Chapter:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Sample Depth:	Entry:	17 05 04 (Soil and stones other than those mentioned in 17 05 03)
0.15-0.50 m		
Moisture content:		
8.7%		
(wet weight correction)		

Hazard properties

None identified

Determinands

Moisture content: 8.7% 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	ethanediol; ethylene glycol				<1 mg/kg		<1 mg/kg	<0.0001 %		<LOD
	603-027-00-1	203-473-3	107-21-1							
Total:								0.0001 %		

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
<LOD	Below limit of detection
ND	Not detected

Classification of sample: WS104-02/09/2021-0.30

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

Sample details

Sample name:	LoW Code:
WS104-02/09/2021-0.30	Chapter:
Sample Depth:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
0.30-0.70 m	Entry:
Moisture content:	17 05 04 (Soil and stones other than those mentioned in 17 05 03)
5%	
(wet weight correction)	

Hazard properties

None identified

Determinands

Moisture content: 5% 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 }				5.5	mg/kg	1.32	6.899	mg/kg	0.00069 %	✓	
	033-003-00-0	215-481-4	1327-53-3									
2	cadmium { cadmium oxide }				<0.1	mg/kg	1.142	<0.114	mg/kg	<0.0000114 %		<LOD
	048-002-00-0	215-146-2	1306-19-0									
3	chromium in chromium(III) compounds { chromium(III) oxide (worst case) }				13	mg/kg	1.462	18.05	mg/kg	0.00181 %	✓	
		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 }				18	mg/kg	1.126	19.253	mg/kg	0.00193 %	✓	
	029-002-00-X	215-270-7	1317-39-1									
6	lead { lead chromate }			1	11	mg/kg	1.56	16.3	mg/kg	0.00105 %	✓	
	082-004-00-2	231-846-0	7758-97-6									
7	mercury { mercury dichloride }				<0.1	mg/kg	1.353	<0.135	mg/kg	<0.0000135 %		<LOD
	080-010-00-X	231-299-8	7487-94-7									
8	nickel { nickel chromate }				16	mg/kg	2.976	45.239	mg/kg	0.00452 %	✓	
	028-035-00-7	238-766-5	14721-18-7									
9	selenium { nickel selenate }				<0.2	mg/kg	2.554	<0.511	mg/kg	<0.0000511 %		<LOD
	028-031-00-5	239-125-2	15060-62-5									
10	zinc { zinc chromate }				36	mg/kg	2.774	94.876	mg/kg	0.00949 %	✓	
	024-007-00-3	236-878-9	13530-65-9									
11	pH				8.1	pH		8.1	pH	8.1 pH		
			PH									
12	naphthalene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
	601-052-00-2	202-049-5	91-20-3									
13	acenaphthylene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
		205-917-1	208-96-8									
14	acenaphthene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
		201-469-6	83-32-9									
15	fluorene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
		201-695-5	86-73-7									
16	phenanthrene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
		201-581-5	85-01-8									

#	Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
	CLP index number	EC Number	CAS Number									
17	anthracene	204-371-1	120-12-7		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
18	fluoranthene	205-912-4	206-44-0		0.89	mg/kg		0.845	mg/kg	0.0000845 %	✓	
19	pyrene	204-927-3	129-00-0		0.82	mg/kg		0.779	mg/kg	0.0000779 %	✓	
20	benzo[a]anthracene	601-033-00-9	200-280-6	56-55-3	0.55	mg/kg		0.523	mg/kg	0.0000523 %	✓	
21	chrysene	601-048-00-0	205-923-4	218-01-9	0.64	mg/kg		0.608	mg/kg	0.0000608 %	✓	
22	benzo[b]fluoranthene	601-034-00-4	205-911-9	205-99-2	0.94	mg/kg		0.893	mg/kg	0.0000893 %	✓	
23	benzo[k]fluoranthene	601-036-00-5	205-916-6	207-08-9	0.33	mg/kg		0.314	mg/kg	0.0000314 %	✓	
24	benzo[a]pyrene; benzo[def]chrysene	601-032-00-3	200-028-5	50-32-8	0.78	mg/kg		0.741	mg/kg	0.0000741 %	✓	
25	indeno[123-cd]pyrene	205-893-2	193-39-5		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
26	dibenz[a,h]anthracene	601-041-00-2	200-181-8	53-70-3	<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
27	benzo[ghi]perylene	205-883-8	191-24-2		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
28	vanadium { divanadium pentaoxide; vanadium pentoxide }	023-001-00-8	215-239-8	1314-62-1	13	mg/kg	1.785	22.047	mg/kg	0.0022 %	✓	
Total:										0.0224 %		

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: SA101-02/09/2021-0.00

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

Sample details

Sample name:	LoW Code:
SA101-02/09/2021-0.00	Chapter:
Sample Depth:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
0.00-0.50 m	Entry:
Moisture content:	17 05 04 (Soil and stones other than those mentioned in 17 05 03)
15%	
(wet weight correction)	

Hazard properties

None identified

Determinands

Moisture content: 15% 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	13.467	mg/kg	0.00135 %	✓	
	033-003-00-0	215-481-4	1327-53-3									
2	cadmium { cadmium oxide }				0.32	mg/kg	1.142	0.311	mg/kg	0.0000311 %	✓	
	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	19.877	mg/kg	0.00199 %	✓	
		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	32.538	mg/kg	0.00325 %	✓	
	029-002-00-X	215-270-7	1317-39-1									
6	lead { lead chromate }			1	110	mg/kg	1.56	145.843	mg/kg	0.00935 %	✓	
	082-004-00-2	231-846-0	7758-97-6									
7	mercury { mercury dichloride }				0.25	mg/kg	1.353	0.288	mg/kg	0.0000288 %	✓	
	080-010-00-X	231-299-8	7487-94-7									
8	nickel { nickel chromate }				21	mg/kg	2.976	53.126	mg/kg	0.00531 %	✓	
	028-035-00-7	238-766-5	14721-18-7									
9	selenium { nickel selenate }				0.49	mg/kg	2.554	1.064	mg/kg	0.000106 %	✓	
	028-031-00-5	239-125-2	15060-62-5									
10	zinc { zinc chromate }				87	mg/kg	2.774	205.148	mg/kg	0.0205 %	✓	
	024-007-00-3	236-878-9	13530-65-9									
11	pH				7.4	pH		7.4	pH	7.4 pH		
			PH									
12	naphthalene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
	601-052-00-2	202-049-5	91-20-3									
13	acenaphthylene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
		205-917-1	208-96-8									
14	acenaphthene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
		201-469-6	83-32-9									
15	fluorene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
		201-695-5	86-73-7									
16	phenanthrene				0.54	mg/kg		0.459	mg/kg	0.0000459 %	✓	
		201-581-5	85-01-8									

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	CLP index number	EC Number	CAS Number							
17	anthracene	204-371-1	120-12-7		0.15 mg/kg		0.128 mg/kg	0.0000128 %	✓	
18	fluoranthene	205-912-4	206-44-0		1.4 mg/kg		1.19 mg/kg	0.000119 %	✓	
19	pyrene	204-927-3	129-00-0		1.3 mg/kg		1.105 mg/kg	0.000111 %	✓	
20	benzo[a]anthracene	601-033-00-9	200-280-6	56-55-3	0.62 mg/kg		0.527 mg/kg	0.0000527 %	✓	
21	chrysene	601-048-00-0	205-923-4	218-01-9	0.62 mg/kg		0.527 mg/kg	0.0000527 %	✓	
22	benzo[b]fluoranthene	601-034-00-4	205-911-9	205-99-2	1.1 mg/kg		0.935 mg/kg	0.0000935 %	✓	
23	benzo[k]fluoranthene	601-036-00-5	205-916-6	207-08-9	0.37 mg/kg		0.315 mg/kg	0.0000314 %	✓	
24	benzo[a]pyrene; benzo[def]chrysene	601-032-00-3	200-028-5	50-32-8	0.76 mg/kg		0.646 mg/kg	0.0000646 %	✓	
25	indeno[123-cd]pyrene	205-893-2	193-39-5		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
26	dibenz[a,h]anthracene	601-041-00-2	200-181-8	53-70-3	<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
27	benzo[ghi]perylene	205-883-8	191-24-2		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
28	vanadium { divanadium pentaoxide; vanadium pentoxide }	023-001-00-8	215-239-8	1314-62-1	25 mg/kg	1.785	37.935 mg/kg	0.00379 %	✓	
Total:								0.0465 %		

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

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

• **TPH (C6 to C40) petroleum group** (CAS Number: TPH)

Description/Comments: Hazard statements taken from WM3 1st Edition 2015; Risk phrases: WM2 3rd Edition 2013
Data source: WM3 1st Edition 2015
Data source date: 25 May 2015
Hazard Statements: Flam. Liq. 3 H226 , Asp. Tox. 1 H304 , STOT RE 2 H373 , Muta. 1B H340 , Carc. 1B H350 , Repr. 2 H361d , Aquatic Chronic 2 H411

• **confirm TPH has NOT arisen from diesel or petrol**

Description/Comments: Chapter 3, section 4b requires a positive confirmation for benzo[a]pyrene to be used as a marker in evaluating Carc. 1B; H350 (HP 7) and Muta. 1B; H340 (HP 11)
Data source: WM3 1st Edition 2015
Data source date: 25 May 2015
Hazard Statements: None.

• **ethylbenzene** (EC Number: 202-849-4, CAS Number: 100-41-4)

CLP index number: 601-023-00-4
Description/Comments:
Data source: Commission Regulation (EU) No 605/2014 – 6th Adaptation to Technical Progress for Regulation (EC) No 1272/2008. (ATP6)
Additional Hazard Statement(s): Carc. 2 H351
Reason for additional Hazards Statement(s):
03 Jun 2015 - Carc. 2 H351 hazard statement sourced from: IARC Group 2B (77) 2000

• **salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex**

CLP index number: 006-007-00-5
Description/Comments: Conversion factor based on a worst case compound: sodium cyanide
Data source: Commission Regulation (EC) No 790/2009 - 1st Adaptation to Technical Progress for Regulation (EC) No 1272/2008. (ATP1)
Additional Hazard Statement(s): EUH032 >= 0.2 %
Reason for additional Hazards Statement(s):
14 Dec 2015 - EUH032 >= 0.2 % hazard statement sourced from: WM3, Table C12.2

• **monohydric phenols** (CAS Number: P1186)

Description/Comments: Combined hazards statements from harmonised entries in CLP for phenol, cresols and xylenols (604-001-00-2, 604-004-00-9, 604-006-00-X)
Data source: CLP combined data
Data source date: 26 Mar 2019
Hazard Statements: Acute Tox. 3 H301 , Acute Tox. 3 H311 , Acute Tox. 3 H331 , Skin Corr. 1B H314 , Skin Corr. 1B H314 >= 3 % , Skin Irrit. 2 H315 1 E conc. < 3 % , Eye Irrit. 2 H319 1 E conc. < 3 % , Muta. 2 H341 , STOT RE 2 H373 , Aquatic Chronic 2 H411

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) Worse 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

boron {diboron trioxide; boric oxide}

Reasonable case CLP species based on hazard statements/ molecular weight, physical form and low solubility. Industrial sources include: fluxing agent for glass/enamels; additive for fibre optics, borosilicate glass (edit as required)

cyanides {salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex}

Harmonised group entry used as most reasonable case as complex cyanides and those specified elsewhere in the annex are not likely to be present in this soil: [Note conversion factor based on a worst case compound: sodium cyanide] (edit as required)

Appendix C: Version

HazWasteOnline Classification Engine: **WM3 1st Edition v1.1, May 2018**

HazWasteOnline Classification Engine Version: 2021.293.4891.9295 (20 Oct 2021)

HazWasteOnline Database: 2021.293.4891.9295 (20 Oct 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

Based across the UK with
offices in Manchester,
London, Liverpool and Glasgow.

Manchester (Head Office)

Unit 29,
Eton Business Park
Eton Hill Rd, Radcliffe
M26 2ZS

t: 0161 763 7200
e: info@thelkgroup.com

London

2 Falcon Gate
Welwyn Garden City
Hertfordshire
AL7 1TW

t: 01707 909059
e: info@thelkgroup.com

Glasgow

Wright Business Centre
1 Lonmay Road
Glasgow
G33 4EL

t: 0141 773 6269
e: info@thelkgroup.com

Liverpool

The Corn Exchange
Fenwick Street
Liverpool
L2 7QL

t: 0151 235 8716
e: info@thelkgroup.com



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