BARNS LANE
DUNHAM MASSEY

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

Job Number: LKC 19 1314
Date: September 2019
Client: Edgefold Homes Ltd

INCREASING LAND VALUE

LK GROUP

LK Consult Document Verification			
Site Address	Barns Lane, Dunham Massey, Altrincham, Cheshire, WA14 5SJ		
Report Title	Final Phase 2 Geo-Environmental Investigation, Risk Assessment and Remediation Strategy		
Job Number	LKC 19 1314	**Document Ref.**	CL-602-LKC 19 1314-02
Date Issued	September 2019	**Report Version**	R0
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Revision Record			
Revision No.	**Date**	**Nature of Revision**	**Approved By**

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1 Introduction

1.1 Background

LK Consult Ltd (LKC) has been commissioned by Edgefold Homes Ltd to carry out a Phase 2 Geo-Environmental Investigation, Risk Assessment and Remediation Strategy for land at Barns Lane, Dunham Massey. The investigation was undertaken in support of a future planning application to develop the site for residential end use.

The following work has previously been undertaken:

- Preliminary Risk Assessment (PRA) report, undertaken by LKC (Ref: LKC 19 1314, dated August 2019).

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.

1.2 Site Details

A summary of the site details is presented in Table 1-1. Figures 1 and 2 indicate the site location and boundary. Figure 3 indicates the proposed development.

Location	At the corner of Barns Lane and Sawpit Street, Dunham Massey, Altrincham, Cheshire. Centred at approximate National Grid Reference 372440E 388663N (nearest 5m).
Approximate Area	0.57Ha.
Topography	20 metres Above Ordnance Datum (AOD). Site is approximately level.
Current Land Use	Site Vacant former nursery with three existing buildings, a large yard and car parking. Surrounding Area North: Sawpit Street and farmland. East: Barns Lane/Sawpit Street, farmland and residential properties. South: Barns Lane and farmland. West: Residential property and farmland.
Proposed Development	Residential properties with gardens, car parking and access road.

Table 1-1: Summary of site details.

2 Previous Work

2.1 Summary of Existing Information

A PRA report (Ref: CL-602-LKC 19 1314-01, dated August 2019) has previously been undertaken by LKC and is summarised in Section 2.2-2.7.

2.2 Site History

The site history is summarised in Table 2-1.

Site Features	Location	Map Dates Present	Comments
Undeveloped Farmland	Whole Site	1875-1954	- Annotated on 1898 mapping as belonging to Barnslane Farm. - By 1910 mapping, site is annotated as part of 'The Nursery'.
Field Boundary	N	1875-1954	
Unreferenced Building	S	1968-present	Appears to be associated with the adjacent Barnslane Farm on 1968 mapping.
Power Cables	N	1968-present	
Nursery/Landscaper's Yard	Whole site	1999-present	- Same site boundary as current shown by 1999 mapping. - Second shed/barn building shown in north of the site and office building present in north east corner. - Anecdotally, the site was used by a landscaping company for storage and maintenance of vehicles and as a nursery.
Surrounding Area Features	**Distance / Location**	**Map Dates Present**	**Comments**
Farmland	Adj. NW	1875-present	
Barnslane Farm	20m S	1875-1992	- Farmyard has extended to be adjacent to site boundary by 1910 mapping. - From site reconnaissance, the adjacent site is now a residential property with gardens.
Railway Line	80m S	1875-present	

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		- None recorded on the database.
	Superficial		- Shirdley Hill Sand Formation. - Peat is indicated approximately 500m to the north.
	Bedrock		- Wilmslow Sandstone Formation. - Fault approximately 75m to the north east, striking north west to south east.
	BGS Logs		- BH Ref: SJ78NW/83, 350m SW: topsoil to 0.35mbgl, grey medium sand to 1mbgl, soft to firm silty slightly sandy clay to 5.9mbgl, loose very clayey very silty sand to 8.8mbgl, firm silty clay with some thin layers of fine sandy silt to 9.5mbgl.
Hydro-geology	Aquifer Designation	- Superficial	- Secondary A Aquifer.
		- Bedrock	- Principal Aquifer.
	Source Protection Zone (SPZ)		- Site is not within an SPZ.
	Groundwater Abstractions		- None within 250m. - Nearest 655m NE, borehole at Peterhouse Farm, Warburton for general agriculture use.
Hydrology	Nearest Surface Water		- Pond, 98m NE. - River Bollin, 750m S.
	Water Quality Data		- 843m S, River Bollin – River Quality C.
	Flooding		- No risk from rivers or sea. - Potential for groundwater flooding for property situated below ground level.
	Surface Water Abstractions		- None within 250m. - Nearest is 852m S, abstraction from River Bollin for agricultural spray irrigation.
	Discharge Consents		- One within 250m: 102m NE, Nursery Cottage, Sewage discharges to a tributary of Caldwell Brook. Authorisation revoked.
	Pollution Incidents		- None within 250m. - Nearest is 793m S, 6th March 1992, River Bollin, no pollution found, River Bollin.
Minerals & Mining	Coal Report		- Not within coal reporting area.
	Coal Mining Development High Risk Area (DHRA)		- Not within DHRA.
	Surface Extractions		- No mineral extraction within 500m of the site.
	Cheshire Brine Compensation District		- Within Cheshire Brine Compensation District but not within a Consultation Area. - No brine extraction features within 250m.
	Mining Instability / Non-Coal Mining Area		- No hazard

Table 2-2: Summary of the environmental setting.

Categories		Details
Ground Stability (onsite)	Collapsible Ground	- Very low hazard.
	Compressible Ground	- No hazard.
	Ground Dissolution	- No hazard.
	Landslide	- Very low hazard.
	Running Sand	- Low hazard.
	Shrinking / Swelling Clay	- No hazard.
Landfill Sites	Known / Registered	- None within 250m. - Nearest is 676m NW – Moss Brow Farm. Deposited waste included inert waste. Domestic waste type. Operational 1971-1992.
	Potential	- None within 250m.
Radon		- Probability of <1% of homes above Action Level. No further action required.
Designated Sites		- Within area of Adopted Green Belt.
Contemporary Trade Directory		- None within 100m. - Nearest 138m W (road haulage services).
Fuel Station Entries		- None within 100m.
Unexploded Bomb Risk (UXO)		- Low.

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

2.4 Site Reconnaissance

A site reconnaissance was carried out on 24th June 2019.

Relevant features identified on site are summarised below:

- The site is accessed through a large gate off Barns Lane.
- The site currently comprises a vacant former plant nursery and landscaping company yard (Panflora Nurseries) with three existing buildings, a large yard and car parking.
- A strip of existing woodland is also present along most of the northern boundary of the site.
- The existing buildings comprise a two storey office building in the north eastern corner, a large single storey garage/workshop building in the south and barn in the centre of the site.
- Two above ground diesel tanks are present within a brick bund adjacent to the north of the garage building. No evidence of significant spillages or leaks noted.
- Anecdotally, an interceptor is present to the north of the diesel tanks and there is a number of drains running across the west of the site.
- The area to the south of the open sided shed is occupied by a concrete yard with storage bays along the southern boundary. A pile of waste tyres were present to the south of the concrete bays.
- Overhead power lines run above the western boundary from south west to north east.
- The area below the power lines is gravelled and appears to have been used for storage. For example, a pile of empty containers labelled as white line spraying paint was present.
- A tarmacadam hardstanding car park and site is present in between the buildings in the east of the site. The remainder of the hardstanding on site, to the north of the open shed, is compacted gravel.
- A majority of the barn building is open sided and has a concrete floor slab slightly raised above the surrounding ground. The southern part of this barn building is understood to be used for pesticide storage.

- The workshop building in the south was vacant at the time of the walkover and was noted to have a concrete floor in good condition. No hydrocarbon staining was noted on the floor.
- Suspected asbestos containing material was noted on the exterior of some of the buildings.
- Anecdotally, due to running sand below the site, significant quantities of demolition rubble including concrete blocks were imported to form a development platform.
-
- No access restrictions were noted but it is assumed that work below the overhead lines will be limited.

The surrounding area comprises farmland to the north west and beyond Barns Lane to the south. Residential properties are present to the south west and north east.

2.5 Contamination Sources / Pathways and Receptors

Potential contamination sources are detailed in Table 2-3.

Source	Contaminants
Onsite landscaping yard and nursery agricultural land	- Use/maintenance of machinery: hydrocarbons, oils. - On site fuel storage tanks: diesel. - Storage / use of pesticides, insecticides and herbicides: organophosphates, organochlorides, chlorophenols, aldrin, dieldrin, atrazine and DDT.
Onsite made ground and imported demolition material.	- Ash and clinker (e.g. from hearths and boilers, often historically used for site raising / levelling): Heavy metals, sulphates and PAHs[1]. - Asbestos containing materials (ACM) from demolition rubble imported. - If significant depth of organic / putrescible material: Hazardous gas (principally carbon dioxide and methane).
Surrounding area	- No significant contamination sources within influencing distance of the site.
Peat (identified in local area from BGS mapping)	- Ground gas (carbon dioxide and methane).

Table 2-3: Potential contamination sources.

Potential receptors are detailed in Table 2-4.

Receptors	
Human Health	- Future site users (including residents, visitors and site workers). - Offsite land users.
Controlled Waters	- Secondary A Aquifer (superficial deposits). - Principal Aquifer (bedrock). - Surface water is not considered to be a significant receptor.
Buildings and structures.	
Potable water pipes.	
Flora within future gardens and landscaping.	

Table 2-4: Potential receptors.

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

Potential pathways are detailed in Table 2-5.

Pathways		
Soil	Human Health[2] (residential land use: houses with private gardens)	- Ingestion of soil. - Ingestion of soil-derived indoor dust. - Ingestion of contaminated vegetables. - Ingestion of soil attached to vegetables . - Dermal contact with soil. - Dermal contact with soil-derived indoor dust. - Inhalation of soil-derived outdoor dust. - Inhalation of soil-derived indoor dust. - Inhalation of vapours outside. - Inhalation of vapours inside.
	- Windblown dust and fibres to adjacent receptors.	
	- Direct contact with receptors (building foundations, services).	
	- Root uptake.	
Water	- Surface run-off over impermeable surface.	
	- Site is predominantly hardstood; therefore, infiltration is likely to be limited.	
	- Migration through potentially permeable strata and preferential pathways. - Superficial (sand) is likely to be relatively permeable. - Bedrock (sandstone) likely to be relatively permeable. - Preferential pathways: services and drains.	
Gas	- Migration through potentially permeable strata and preferential pathways. - Superficial (sand) is likely to be relatively permeable. - Bedrock (sandstone) likely to be relatively permeable. - Preferential pathways: services and drains.	
	- Migration into buildings (e.g. via services) and accumulation of gases in confined spaces (potentially causing explosion if methane is present).	

Table 2-5: Potential pathways

2.6 LKC Preliminary Contamination Conceptual Model

The preliminary contamination conceptual model using contaminant-pathway-receptor linkages based on guidance in CLR11[3] has been summarised in Table 2-6.

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 C552[4].

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.

[2] EA (2008). "Updated Technical Background to the CLEA Model". Science Report – SC050021/SR3.
[3] EA (2004). "Model Procedures for the Management of Land Contamination." R&D Publication CLR 11.
[4] CIRIA (2001). "Contaminated land risk assessment: A guide to good practice". C552.

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 per HSE guidance[5]) 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.

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

Pollutant Linkage	Pathway	Receptor	Contaminant (source)	Probability	Consequence	Risk	Assessment & Recommendations
PL1	- Dermal contact. - Inhalation of soil, fibres and dust. - Ingestion of soils, dust, vegetables, soil attached to vegetables. - Windblown dust.	- Future site users. - Offsite receptors.	- ACM (potentially in made ground). - Heavy metals, PAHs (made ground).	Likely	Medium	**Moderate**	- Likely probability given anticipated made ground and imported fill used to form development platform. - Potential pathway to receptors in gardens / landscaping. - **Recommendation:** Intrusive investigation required to include soil sampling.
			- Heavy end hydrocarbons, (onsite diesel tanks, onsite nursery).	Likely	Medium	**Moderate**	- Likely probability of hydrocarbons given the identified sources on site. - **Recommendation:** Intrusive investigation required included targeted sampling around diesel tanks.
			- Pesticides (onsite nursery)	Low likelihood	Medium	**Moderate / Low**	- Low probability as, although pesticide use and storage identified onsite, compounds are generally non-persistent in the environment. - **Recommendation:** Confirmatory pesticide testing required.
PL2	- Inhalation of vapours. - Migration through permeable strata and preferential pathways.	- Future site users. - Offsite receptors.	- Volatile contaminants such as hydrocarbons, solvents, (made ground, onsite diesel tanks).	Low likelihood	Medium	**Moderate / Low**	- Low likelihood as localised sources of volatile contaminants identified onsite but only limited spillages anticipated. - **Recommendation:** No testing required unless evidence of volatile contaminants identified in the ground.
PL3	- Inhalation of gas. - Migration through permeable strata and preferential pathways. - Explosion in confined spaces.	- Future site users. - Buildings. - Offsite land users.	- Ground gas: - Methane, carbon dioxide (peat) - Hazardous Gas: - Methane, carbon dioxide (made ground).	Low likelihood	Severe	**Moderate**	- Low likelihood as viable sources of gas identified to date are made ground and peat indicated to be in proximity. - **Recommendation:** Further assessment once ground conditions on site are known.
PL4	- Surface run-off. - Migration through permeable strata and preferential pathways. - Perched waters migration.	- Groundwater (Principal and Secondary A Aquifer).	- Mobile contaminants such as metals, PAHs, hydrocarbons (made ground, onsite diesel tanks, onsite nursery).	Likely	Medium	**Moderate**	- Likely probability as a number of potential sources of mobile contamination identified on site. - Anticipated that the site is underlain by permeable strata. - Underlying bedrock is designated as Principal Aquifer. - **Recommendation:** Groundwater sampling required.
PL5	- Sulphate attack on concrete.	- Building structure.	- Sulphate (ash in made ground).	Likely	Mild	**Moderate / Low**	- Likely probability of ash is anticipated in made ground which would be in contact with concrete in the ground. - **Recommendation:** Intrusive investigation required as part of PL1.
PL6	- Ingestion of tainted water supply.	- Future site users. - Water pipes.	- Organic contaminants such as hydrocarbons, solvents (made ground, onsite diesel tanks, onsite nursery).	Likely	Medium	**Moderate**	- Likely probability as potential sources of organic contamination identified. - Risk is considered moderate at this stage. - **Recommendation:** Sampling required if made ground present at pipeline installation depths.
PL7	- Direct contact (plant uptake).	- Flora.	- Phytotoxic contaminants (made ground).	Likely	Minor	**Very Low**	- Likely probability as contamination considered possible, which may be taken up by flora in soft landscaping / gardens. - **Recommendation:** Investigation work as part of PL1.

Table 2-6: 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 19th and 24th July 2019 and comprised the following:

- 8no. window sample boreholes drilled to 5.45 metres below ground level (mbgl) (ref. WS101 to WS108).
- 7no. trial pits (using JCB) excavated to 1.8-2.7mbgl (ref. TP101 to TP107).
- 1no. hand pits (using hand auger / spade) excavated to 1.0mbgl (ref. HD101).

A hand dug pit was undertaken in the north east corner of the site as it was unsafe to work underneath the overhead power cables with a drilling rig or JCB.

The locations were chosen to allow a good spread across the site as well as target areas of concern. WS104 was undertaken in the area of a diesel tank.

The number of site investigation points corresponds to approximately one location per 18.9m square centres. This is considered to be a conservative sampling density and is in line with BS10175[6] for a 'main investigation'.

All site investigation locations are shown in Figure 4.

All profile logs are provided in Appendix B and are in line with BS14688-1[7] and BS5930[8].

3.2 Well Installations

4no. (WS103, WS104, WS107f and WS108) of the boreholes were installed with monitoring wells for gas and groundwater monitoring and groundwater sampling. Monitoring wells were installed in accordance with BS10175 and CIRIA C665[9] 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.

[6] British Standard (2017). "Investigation of Potentially Contaminated Sites – Code of Practice." BS10175:2017.
[7] British Standards (2002) Geotechnical investigation and testing – Identification and Classification of Soil. Part 1: Identification and description. BS EN ISO 14688-1:2002.
[8] British Standard (2015). "Code of Practice for Ground Investigations". BS5930:2015.
[9] CIRIA (2007). "Assessing Risks Posed by Hazardous Ground Gases to Buildings." CIRIA C665.

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 investigation[10].

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 C665[11] 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 3-1 shows the soil testing undertaken.

[10] EA (2000). "Technical Aspects of Site Investigation. Volumes 1 & 2 Text Supplements Research and Development Technical Report." P5-065/Tr.
[11] 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.	10	TP102 0.5m TP103 0.4m TP104 0.3m TP105 0.5m TP106 0.5m WS101 0.4-1.0m WS103 0.3-0.8m WS106 0.2-0.8m WS107f 0.0-0.9m WS108 0.3-1.3m	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 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.	5	TP101 0.5m WS102 0.25-1.0m WS104 0.2-0.6m WS105 0.6-1.6m HD101 0.4-0.8m	Evidence of hydrocarbon contamination (visual / olfactory) identified in or close to WS104 & HD101 therefore detailed suite undertaken to confirm contamination risk and extent. Detailed suite undertaken in other locations to confirm absence of hydrocarbon contamination and allow waste classification to be carried out.
Metals / metalloids, pH, water soluble sulphate, cyanide suite, phenol, TPHCWG, BTEX, MTBE, speciated PAHs, VOCs, SVOCs, SOM and asbestos screen.	1	TP107 0.5m	PID readings identified TVOC >10ppm in samples from TP107, therefore detailed suite including VOCs and SVOCs undertaken.
TPHCWG, BTEX, MTBE and SOM.	5	TP107 1.0m TP107 1.5m WS104 0.6-1.6m WS104 2.9-3.9m HD101 0.8-1.0m	Samples tested to confirm the extent of hydrocarbon contamination observed in nearby locations.

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

Notes:
If asbestos present during screen identification and quantification will be undertaken.
Metal/metalloids=arsenic, cadmium, chromium, (total and hexavalent), copper, lead, mercury, nickel, selenium, vanadium, zinc and boron; TPHCWG=carbon banded and aromatic/aliphatic split petroleum hydrocarbons; PAH=polycyclic aromatic hydrocarbons, BTEX=benzene, toluene, ethylbenzene and xylenes; MTBE=Methyl tert-butyl ether, VOC=Volatile organic Compounds, SVOC= Semi Volatile Organic Compounds, SOM=Soil Organic Matter.

3.3.2 *Water Sampling*

To establish the condition of groundwater LKC undertook 4 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 disposable bailer. 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 BS10175[12] guidelines.

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

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 3-2.

Sampling was carried out in accordance with BS5930[13] and BS5667-11[14].

Many of the tests are UKAS or MCERTS accredited and further details will be provided in the full report. Table 3-2 shows the groundwater testing undertaken.

Suites and Contaminants	No. Samples	Location	Justification
Metals / metalloids, pH, sulphate, cyanide suite, TPHCWG, BTEX, MTBE, speciated PAHs, phenol and hardness.	3	WS103 WS107f WS108	Detailed suite undertaken across the site to confirm the absence of contamination.
Metals / metalloids, pH, sulphate, cyanide suite, TPHCWG, BTEX, MTBE, speciated PAHs, phenol, VOCs, SVOCs and hardness.	1	WS104	Detailed suite undertaken in the area of the diesel tanks on site (WS104) due to evidence of hydrocarbons identified during the investigation and within the soil analysis results.

Table 3-2: Summary of groundwater sampling tests undertaken.
Notes:
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, VOC=Volatile organic Compounds, SVOC= Semi Volatile Organic Compounds.

3.4 Gas Monitoring

All the installed boreholes have been monitored for gas on three occasions over two months.

Monitoring is being undertaken using a Geotechnical Instruments GA5000 in accordance with the monitoring protocol outlined in CIRIA C665[15] (flow rate measured first). The monitoring will aim to be undertaken over a range of weather conditions (including low and falling barometric pressure and heavy rain) to demonstrate worst-case conditions.

In addition, a photoionisation detector (PID) was used to record total volatile organic compounds (TVOCs) during the monitoring visits.

The gas monitoring results (including PID results) are reproduced in full in Appendix F.

3.5 Geotechnical Testing

3.5.1 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:

[13] British Standard (2015). "Code of Practice for Ground Investigations". BS5930:2015.
[14] British Standard (2009). "Water Quality – Sampling. Part 11: Guidance on Sampling of Groundwaters". BS ISO 5667-11:2009.
[15] CIRIA (2007). "Assessing Risks Posed by Hazardous Ground Gases to Buildings." CIRIA C665.

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

The SPT and shear vane readings are provided within the profile logs (Appendix B).

3.5.2 *Laboratory Geotechnical Testing*

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

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

Suites and Contaminants	No. Samples	Location	Justification
pH and water-soluble sulphate	6	WS101 1.2-2.0m WS103 0.8-1.8m WS107f 1.0-2.0m TP102 1.5m TP104 1.5m TP105 1.5m	Additional samples of natural ground taken across the site to assess the pH and sulphate for geotechnical purposes.
Atterberg Limits (plasticity testing)	3	WS103 2.8-4.8m WS104 2.9-4.9m WS108 2.9-4.9m	A selection of clay samples across the site were tested for Atterberg Limits to assess their shrinkability potential associated with current and proposed trees.
Particle Size Distribution (PSD)	4	WS101 1.0-3.0m WS106 0.8-2.8m TP101 1.5-2.0m TP103 1.5-2.0m	PSD undertaken to confirm grading of granular material.

Table 3-3. Summary of geotechnical testing undertaken.

4 Ground Conditions

4.1 Geology – Generalised Sequence

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

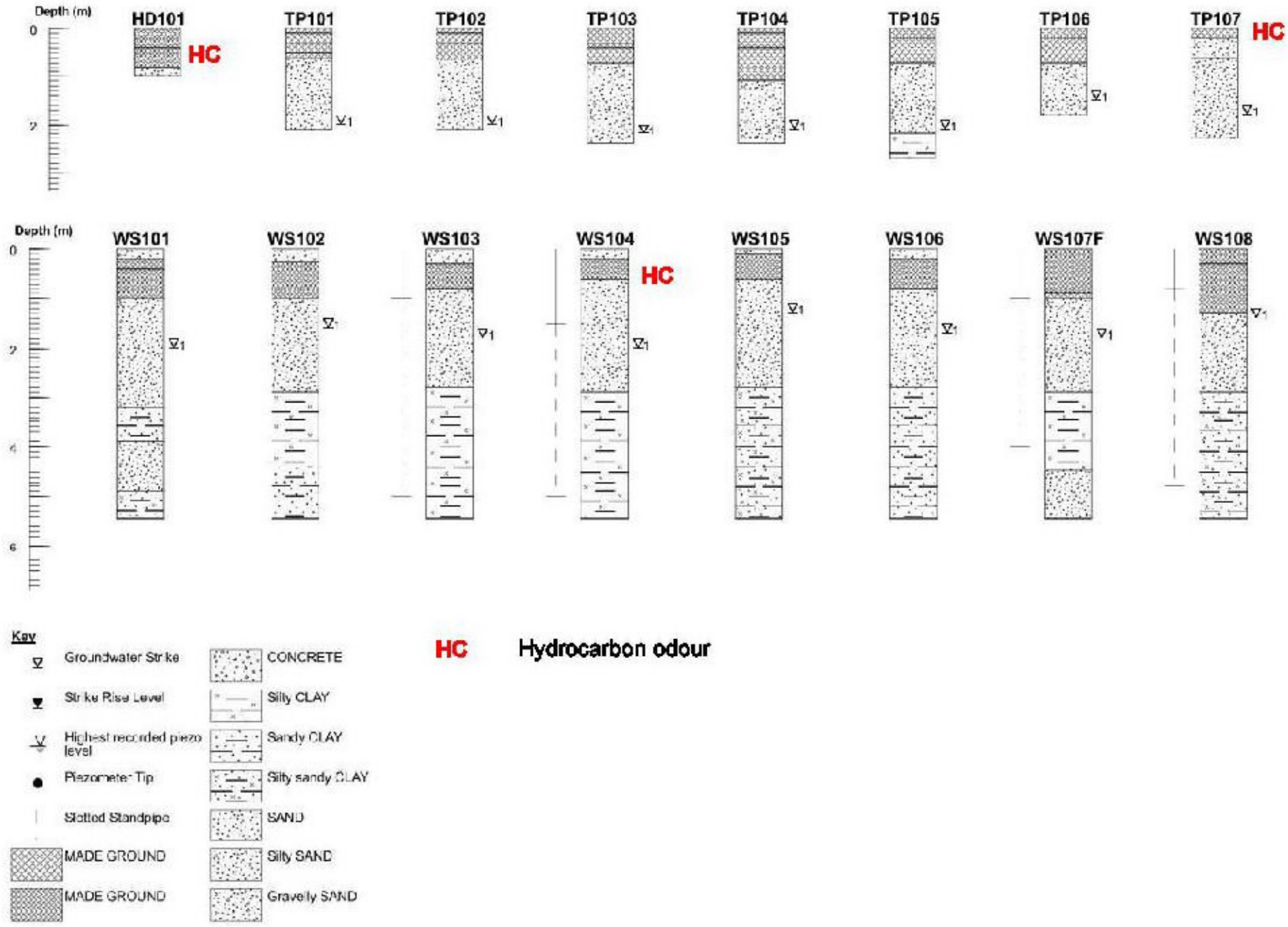


Plate 4-1: Summary of ground conditions.

Additional information on ground conditions:

- Made ground was recorded from depths of 0.2-1.3mbgl and generally consisted of gravelly sand / clay with brick, ash and clinker.
- Visual / olfactory evidence of hydrocarbon identified in WS104 at 0.2-2.9mbgl, HD101 0.4-0.8mbgl and TP107 0.2-0.6mbgl.
- No visual / olfactory evidence of hydrocarbons or volatile contaminants in the remainder of the locations across the site.
- All of the trial pits were described as unstable / collapsing.

4.2 Groundwater

4.2.1 Groundwater Levels

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

Results are summarised in Table 4-1.

BH/TP	Water Strike Depths (mbgl)	Well Response Zone (mbgl)	No. of Monitoring Visits	Monitoring Depths (mbgl)			Sample Taken?	Evidence of Contam?
				Min	Max	Base		
WS101	2.0	N/A	-	-	-	-	-	N
WS102	1.6	N/A	-	-	-	-	-	N
WS103	1.8	1.0-5.0 (S/C)	3	0.76	0.92	4.66	Y	N
WS104	2.0	1.5-5.0 (S/C)	3	0.58	0.81	4.68	Y	Y
WS105	1.3	N/A	-	-	-	-	-	N
WS106	1.7	N/A	-	-	-	-	-	N
WS107F	1.8	1.0-4.0 (S/C)	3	1.04	1.31	2.89	Y	N
WS108	1.4	0.8-4.8 (MG/S/C)	3	1.05	1.24	3.65	Y	N
TP101	2.0	N/A					N	N
TP102	2.0	N/A					N	N
TP103	2.2	N/A					N	N
TP104	2.1	N/A					N	N
TP105	2.1	N/A					N	N
TP106	1.5	N/A					N	N
TP107	1.8	N/A					N	N

Table 4-1: Summary of water strike depths within boreholes and trial pits.
Response Zones:
MG=Made Ground; S=Sand; C=Clay.

4.3 In-Situ Geotechnical Testing

4.3.1 Standard Penetration Tests

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

Approximate Depth (mbgl)	SPT 'N' Values					
	WS101	WS102	WS103	WS104	WS105	WS106
1-2	24 (S)	13 (S)	14 (S)	16 (S)	18 (S)	15 (S)
2-3	22 (S)	11 (S)	2 (S)	4 (S)	13 (S)	14 (S)
3-4	10 (C)	12 (C)	12 (C)	15 (C)	20 (C)	20 (C)
4-5	14 (S)	12 (C)	12 (C)	19 (C)	20 (C)	23 (C)
5-6	15 (C)	13 (C)	13 (C)	10 (C)	13 (C)	16 (C)
GW Level	2.0	1.6	0.76 - 1.8	0.58 - 2.0	1.3	1.7

Approximate Depth (mbgl)	SPT 'N' Values	
	WS107F	WS108
1-2	28 (S)	19 (MG/S)
2-3	16 (S)	11 (S)
3-4	18 (C)	13 (C)
4-5	14 (C)	11 (C)
5-6	14 (S)	8 (C)
GW Level	1.04 - 1.8	1.05 - 1.4

Table 4-2: Summary of SPT (N) values.
Notes:
MG= Made Ground; S=Sand; C=Clay.
Groundwater level based on strikes during investigation and monitoring data.

4.3.2 Pocket Penetrometer

Pocket Penetrometer readings, recording undrained shear strength (C_u), were taken within the clay strata. The results are summarised in Table 4-3 and provided within the profile logs in Appendix B.

Approximate Depth (mbgl)	Average Undrained Shear Strength (C_u)					
	WS101	WS102	WS103	WS104	WS105	WS106
2-3	-	28.3	49.05	36.79	36.79	24.53
3-4	36.79	-	61.31	61.31	85.84	36.79
4-5	49.05	73.58	73.58	73.58	85.84	49.05
GW Level	2.0	1.6	0.76 - 1.8	0.58 - 2.0	1.3	1.7

Approximate Depth (mbgl)	Average Undrained Shear Strength (C_u)	
	WS107F	WS108
2-3	36.79	61.31
3-4	61.31	49.05
4-5	-	61.31
GW Level	1.04 - 1.8	1.05 - 1.4

Table 4-3: Summary of average pocket penetrometer readings.
Notes:
Groundwater level based on strikes during investigation and monitoring data.

4.3.3 *Geotechnical Laboratory Testing*

4.3.4 *Particle Size Distribution*

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

Location	Depth (mbgl)	Material	Percent passing through sieve		
			63mm	2mm	0.063mm
WS101	1.0-3.0	Brown silty fine to coarse SAND with rare gravel.	100	98	26
WS106	0.8-2.8	Brown silty fine to coarse SAND with rare gravel.	100	98	19
TP101	1.5-2.0	Brown silty fine to coarse SAND with rare gravel.	100	96	19
TP103	1.5-2.0	Brown silty fine to coarse SAND with rare gravel.	100	99	16

Table 4-4: Summary of particle size distribution results.
Notes:
% passing: 63mm = cobble / gravel boundary; 2mm = gravel / sand boundary; 0.063mm = sand / silt boundary

4.3.5 *Atterberg Limits*

Representative samples of natural clay were subjected to Atterberg Limits (plasticity) and Moisture Content testing. Results are presented in Appendix E 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 (%)
WS103	2.8-4.8	21	37	14	23	CL	95	21.85
WS104	2.9-4.9	22	40	15	25	CL	92	23
WS108	2.9-4.9	25	39	13	26	CL	94	24.4

Table 4-5: Summary of plasticity index testing.

The modified plasticity index is between 21% and 25%. This characterises the clay as having a medium volume change potential.

4.3.6 *Sulphate and pH*

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

Strata	pH	Sulphate (g/l)
Made Ground	7.2-11.1	<0.01-0.39
Natural	7.9-9.5	<0.01

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

5 Geotechnical Assessment

Final foundation design will need to be confirmed once loadings of proposed buildings are known and details of ground works (i.e. potential cut and fill exercises) are known.

A preliminary foundation assessment is summarised in Table 5-1.

Proposed Development	-Demolition of two existing buildings and construction of 8no. two storey houses with private gardens, car parking and access road.
General Ground conditions / Geotechnical Testing	-Maximum investigation depth 5.45mbgl. -Made Ground to 0.2-1.3mbgl. -Medium dense silty gravelly SAND to 2.2-3.2mbgl. SPTs N=13-28 at 1mbgl, N=2-22 at 2mbgl. -Firm silty or sandy CLAY to >5.45mbgl. SPTs N=8-23 below 3mbgl. -No bedrock encountered. -Groundwater strikes encountered between 1.4mbgl and 2.2mbgl.
Allowable Bearing Pressure	Due to high variability of sand strata and shallow groundwater allowable bearing pressures are between 10-110kN/m^2 at 2mbgl.
Anticipated Foundation Type	-Strip foundations are unlikely to be suitable due to the variability of the sand strata and shallow groundwater. -Foundation options that may be feasible are piled foundations and a raft foundation solution. -Piled foundations may require deeper geotechnical investigation to identify a consistent bearing strata. In addition, to facilitate piling removal of below ground obstructions such as the concrete blocks identified in the east of the site would be required. -A raft foundation is an expensive option but would be suitable for the site based on ground conditions encountered. -Further advice should be taken from a qualified and competent structural engineer.
Concrete Requirements	-Based on BRE Digest 2005[16] – DS-1 AC-1 recommended.
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 medium volume change potential has been calculated for the site.
Services	-Services – consideration to the presence of services running through the site. Services may need to re-routed.
Temporary support of excavation	-Likely to be required based on the instability of trial pits undertaken.
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.

Table 5-1: Preliminary Foundation Assessment.
Notes:
SPT=Standard Penetration Test N Values.

[16] BRE (2005)."Concrete in Aggressive Ground." Special Digest 1.

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 (CLR11[17]). 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[18,19]. The recent change to the contaminated land guidance has changed the evaluation of risk from 'minimal' (referred to as Health Criteria values (HCVs))[20] 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 S4ULs[21]. 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[22,23,24,25].

If contaminants are not present as C4SLs and S4ULs then LKC will use ATRISK SSVs or CL:AIRE GACs[26]. 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

[17] EA (2004). "Model Procedures for the Management of Land Contamination." R&D Publication CLR 11.
[18] Defra (2014). "SP1010: Development of Category 4 Screening Levels and Assessment of Land Affected by Contamination – Policy Companion Document."
[19] CL:AIRE (2013). "SP1010: Development of Category 4 Screening Levels and Assessment of Land Affected by Contamination – Final project Report."
[20] EA (2008). "Human Health Toxicological Assessment of Contaminants in Soils." Science Report – SC050021/SR2.
[21] LQM (2014). "The LQM/CIEH S4ULs for Human Health Risk Assessment."
[22] EA (2008). "Updated Technical Background to the CLEA Model." Science Report – SC050021/SR3.
[23] EA (2008). "Human Health Toxicological Assessment of Contaminants in Soils." Science Report – SC050021/SR2.
[24] EA (2008). "A Review of Body Weight and Height Data used within the Contaminated Land Exposure Assessment Model (CLEA)." Project SC050021/Technical Review 1.
[25] EA (2009). "Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values." Science report SC050021/SR7.
[26] CL:AIRE (2009). "The Soil Generic Assessment Criteria for Human Health Risk Assessment."

PAHs[27,28] and naphthalene the most volatile and soluble[29]. 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 negligible[30]. For B(a)P to be used as a surrogate marker it should follow the profile described by the HPA (2008)[31] and CL:AIRE (2013). Naphthalene will be treated separately using the LQM S4ULs.

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

All criteria have been generated using the CLEA V1.06 model[32] based either on 1%, 2.5% and 6% Soil Organic matter (SOM). Results will be compared to the nearest appropriate SOM.

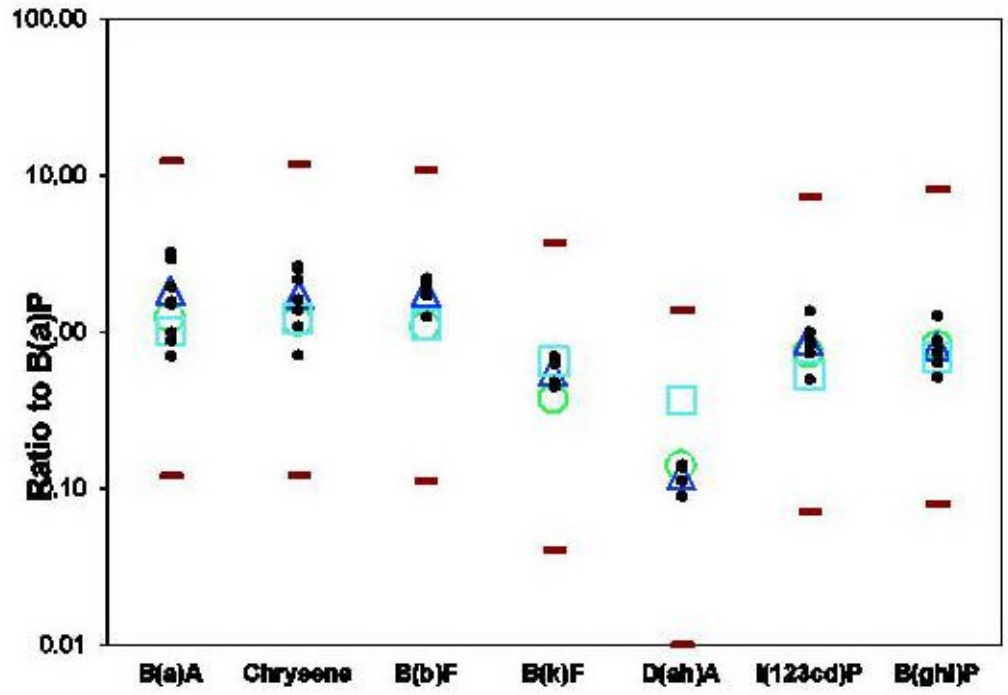
A summary of the generic assessment criteria is provided in Appendix G.

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*[33], 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.

[27] EA (2002). "Contaminants in Soils: Collation of Toxicological Data and Intake Values for Humans. Benzo[a]pyrene." R&D Publication TOX2.
[28] USEPA (1984). "Health Effects Assessment of Polycyclic Aromatic Hydrocarbons (PAHs). EPA 540/1-86-013."
[29] EA (2003). "Review of the Fate and Transport of Selected Contaminants in the Soil Environment." Draft technical report P5- 079/TR1.
[30] CL:AIRE (2013). "SP1010: Development of Category 4 Screening Levels and Assessment of Land Affected by Contamination – Final project Report."
[31] HPA (2010). "HPA Contaminated Land Information Sheet: Risk Assessment Approaches for Polycyclic Aromatic Hydrocarbons (PAHs)." Version 3.
[32] EA (2008). "CLEA Software (Version 1.05) Handbook." Science Report – SC050021/SR4.
[33] 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.



Graph 6-1: The ratio of PAH to B(a)P in soil for all available data at the site based on 8 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)

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

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

6.2.2 *Soil Results Comparison against Assessment Criteria*

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

Contaminant	Units	No. of samples	Elevated Results	Sample Location	Criteria (1%/2.5%/6%)	Source of Criteria
PAHs						
Benzo(a)pyrene	mg/kg	15	5.4	WS101 0.4-1.0m	5	C4SL
			8	WS103 0.3-0.8m		
			12	TP103 (0.4m)		
TPHs						
Aliphatic C8-10	mg/kg	11	43	TP107 (0.5m)	27/65/150	S4UL
Aromatic C10-12		11	140	TP107 (0.5m)	74/180/380	S4UL
GENERAL						
pH	pH	19	Range 7.2 to 11.1			
SOM	%	19	Range <0.4 to 11			
Asbestos	N/A	19	Detected (see Table 6-2)			

Table 6-1: Summary of elevated and pertinent analytical results.
Notes:
Only results that exceeded assessment criteria have been shown and results from **all depths** are noted.
Results have been compared to the nearest appropriate SOM.

Asbestos was identified, as detailed in Table 6-2.

Sample Location	ID	Type	Total Asbestos (%)
TP103 (0.4m)	Amosite	Fibres/Clumps	0.002
TP104 (0.3m)	Chrysotile	Fibres/Clumps	<0.001
TP105 (0.5m)	Chrysotile	Cement, Fibres/Clumps, Board	1.3

Table 6-2: 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 Agency[34] 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 0.2-0.6m (See Appendix H). A HI was not calculated for the remaining samples as no or minimal petroleum hydrocarbons fractions were present.

The HI result for the sample from WS104 was 1.35 therefore further consideration should be given to this as it indicates a potential risk to human health in the proposed development from additive effects of petroleum hydrocarbon fractions.

6.2.4 *Direct Contact Risk – Pollutant Linkage 1*

Elevated PAHs have been identified on site, given the number and location of elevated samples, the contamination is considered to be site wide.

The source of the contamination is expected to the ash noted in the made ground.

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

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

Asbestos including amosite was identified in three samples of made ground and, based on the ground conditions, the possibility of further asbestos in made ground cannot be ruled out. Therefore the probability of asbestos affected site users is considered to be likely in gardens and soft landscaping. With a medium consequence, the risk is moderate and remediation is recommended. Also construction workers should be vigilant for any suspected ACM during groundworks.

Although no elevated heavy end petroleum hydrocarbons (>C12) were identified compared to relevant GAC, a potential risk from the additive effect of petroleum hydrocarbon fractions was identified in WS104.

The contamination in WS104 is predominately heavy-end petroleum hydrocarbons (>C12) which is likely to be associated with weathered diesel. The principal pathways associated with these hydrocarbon fractions are ingestion (of soil, dust and homegrown produce), dermal contact (indoor and outdoor).

LKC considers the probability of hydrocarbon contamination affecting site users (via ingestion and dermal contact) as likely in the south west of the site. Given a medium

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

consequence a moderate risk is considered appropriate and localised remediation is recommended.

The risk associated with the inhalation of vapours from petroleum hydrocarbons is discussed in Section 5.2.6 below.

No pesticide concentrations were detected above laboratory detection limits.

6.2.5 *Risk from Inhalation of Vapours – Pollutant Linkage 2*

Elevated aliphatic petroleum hydrocarbon (C8-10) and aromatic (C10-C12) were identified in soils in TP107 in the west of the site close to the above ground diesel tanks. The contamination is considered to be relatively localised.

The contamination also corresponds to the presence of hydrocarbon odours noted in samples from this area and elevated PID results up to 77ppm.

These contaminants may pose a risk to site users via the inhalation of vapours.

At this stage, the probability of vapours posing a risk to site users in this localised area is considered to be likely. With a medium consequence, the risk is expected to be moderate and remediation is recommended.

6.3 Gas Risk Assessment

One gas monitoring visit has been undertaken on the study site to date. Gas monitoring results, to date, are presented in Appendix F. Following guidance set out in CIRIA C665[35] and BS8485[36] peak methane and carbon dioxide concentrations have been used in the gas risk assessment. In addition, and as per guidance, flow rates were measured first.

All gas concentrations, flow, pressure and groundwater levels are shown on Table 6-3.

[35] CIRIA (2007). "Assessing Risks Posed by Hazardous Ground Gases to Buildings." CIRIA C665.
[36] BSI (2015). "Code of Practice for the Characterisation and Remediation from Ground Gas in Affected Developments." BS8485:2015.

Boreholes	Visit	CH_4 (%v/v)	CO_2 (%v/v)	O_2 (%v/v)	H_2S (ppm)	CO (ppm)	Flow (l/h)	Groundwater (mbgl)	Pressure (mb)
WS103	1	**3.8**	**11.3**	0.2	<1	2	0.7	0.76	1006 (v)
	2	**1.2**	**9.2**	5.7	2	2	<0.1	0.80	1006 (f)
	3	**0.5**	**11.8**	0.0	<1	<1	-1.6	0.92	1013 (f)
WS104	1	**13.9**	**11.8**	3.5	<1	336	0.2	0.58	1006 (v)
	2	**16.4**	**12.3**	3.1	<1	2	<0.1	0.66	1006 (f)
	3	**20.5**	**12.9**	1.0	<1	<1	<0.1	0.81	1013 (f)
WS107F	1	<0.1	2.6	13.4	<1	39	1.4	1.04	1010 (v)
	2	0.1	2.9	13.4	<1	<1	-1.4	1.17	1006 (f)
	3	<0.1	2.8	14.4	<1	<1	-0.6	1.31	1013 (f)
WS108	1	**1.5**	**9.4**	0.2	<1	1	<0.1	1.05	1005 (v)
	2	**3.1**	**11.3**	0.1	<1	4	<0.1	1.07	1006 (f)
	3	**3.2**	**11.0**	0.2	<1	<1	-0.1	1.24	1013 (f)

Table 6-3: Summary of gas monitoring.

Notes:
If concentrations / flow is zero, then equipment detection limits are assumed.
Table shows peak concentrations of CH_4, CO_2, O_2, H_2S and CO.
Bold where CO_2 exceeds 5%v/v and CH_4 exceeds 1%v/v.
Atmospheric pressure (over past 24hrs): r=rising, f=falling, s=steady, v=variable

Elevated methane (>10%v/v) was recorded in WS104 on every visit but hydrocarbon contamination was also identified in this location. Therefore, the elevated methane recorded during the gas monitoring is considered to be, at least partly, due to cross interference known to occur when gas monitoring is undertaken on boreholes with hydrocarbon contamination. The methane result from WS104 will not be used to derive the gas screening values or considered further in the risk assessment.

Elevated methane (>1%v/v) and carbon dioxide (>5%v/v) was recorded in a majority of locations over several monitoring visits. The source of the gas is considered likely to be made ground and organic soils including peat, although not encountered in the exploratory locations, known to exist in proximity to the site.

Gas Screening Value

In accordance with CIRIA C665[37], a Gas Screening Value (GSV) may be calculated. Assuming worst-case scenario maximum gas concentrations and flow for each borehole have been used to calculate the GSV. The GSV can be used to determine the characteristic situation (CS).

Table 6-4 shows the maximum GSV for each borehole and the appropriate characteristic situation (based on GSV only). An overall site assessment has also been included (worst case values across the site).

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

Boreholes	Max GSV (l/hr)	CS / TL
WS103	0.083	CS2 / Amber 1
WS104	0.026	CS1 / Green
WS107f	0.041	CS1 / Green
WS108	0.011	CS1 / Green
WS103, WS104, WS107f and WS108	0.18	CS2 / Amber 1

Table 6-4: Summary of worst-case Gas Screening Values (GSV).
Notes:
CS – Characteristic Situation; TL= Traffic Light.

Given that, on a majority of visits and in several boreholes, carbon dioxide was recorded >5%v/v and methane was >1%v/v, LKC considered that a CS2/Amber 1 designation is suitable for this site.

The gas can potentially migrate into buildings, accumulate in confined spaces and cause explosions (methane) and asphyxiation. LKC consider the probability of carbon dioxide and methane gas affecting site users and buildings as likely. Assuming a severe consequence, there is a moderate risk associated with Pollutant Linkage 3 and remediation is required

6.4 Controlled Waters Assessment

LKC considers the Principal Aquifer as the primary receptor.

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:

- River Basin District Standards[38] and updated Water Framework Directive[39] for Annual Average / Maximum Allowable Concentration Environmental Quality Standards (AA-MAC-EQS) for priority substances (surface water risk).
- 2001 Environment Agency Values for Environmental Quality Standards (EQS) and UK Drinking Water Standard (UKDWS)[40].
- 2009 UK Drinking Water Standard (UKDWS)[41].
- Resource Protection Values (RPVs)[42].
- Minimal Reporting Values (MRVs).

With regards to hydrocarbon mixtures (TPHCWG) for UKDWS, LKC will use the CL:AIRE guidance on petroleum hydrocarbons in groundwater[43] based on WHO guidelines.

Elevated contaminants above limits of detection are presented in Table 6-5 below and all analysis sheets are presented in Appendix D.

[38] Defra (2010). "The River Basin Districts Typology, Standards and Groundwater Threshold Values". Water Framework Directive (England and Wales) Directions 2010.
[39] Defra (2015). " Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015".
[40] EA (2002). "Environment Agency technical advice to third parties on Pollution of Controlled Waters for Part IIA of the Environment Protection Act 1990."
[41] Statutory Instruments (2009). "The Private Water Supplies Regulation 2009." No. 3101
[42] SEPA (2010). "Assigning Groundwater Assessment Criteria for Pollutant Inputs." WAT-PS-10-01.
[43] CL:AIRE (2017). "Petroleum Hydrocarbons in Groundwater: Guidance on Assessing Petroleum Hydrocarbons Using Existing Hydrological Risk Assessment Methodologies."

Contaminant	Units	No. of samples	Elevated Result	Location	Assessment Criteria	Source of Criteria
Metals						
Nickel	µg/l	4	23	WS103	20	EQS
TPH						
Aro >EC10-EC12	µg/l	4	150	WS104	90	WHO
Aro >EC12-EC16	µg/l	4	470	WS104	90	WHO
Aro >EC16-EC21	µg/l	4	160	WS104	90	WHO
Aro >EC21-EC35	µg/l	4	170	WS104	90	WHO
Ali >EC12-EC16	µg/l	4	630	WS104	300	WHO
General						
pH	pH	4	Range 8.4 to 8.7			
Hardness	mg/l $CaCO_3$	4	Range 300 to 900			

Table 6-5: Summary of elevated groundwater results.

Notes:
EQS (2001) and AA / MAC-EQS (2010) = surface water criteria.
UKDWS (2001, 2009) and WHO (2017) = Groundwater criteria (potable supply).
Results above LODs presented.

No free product was observed in any of the water samples collected or detected during dipping of the wells.

The elevated nickel identified in WS103 is only a very marginal exceedance and given no other exceedences of metals were recorded in any other groundwater samples this is not considered to pose a significant risk to controlled waters.

The hydrocarbon contamination identified in the groundwater in WS104 is likely to from spillages in the former re-fuelling area adjacent to the above ground diesel tanks or from leaks from shallow drains or the interceptor also in this area.

Based on the ground conditions encountered during the intrusive investigation in WS104, the hydrocarbon impact was noted in the made ground and underlying natural sand deposits but did not extend deeper into the natural clay. This suggests that significant vertical migration of contaminated water has not occurred meaning that a pathway to the Principal Aquifer in this area does not exist or is limited. The diesel contamination was not identified in any other location indicating that lateral migration of contaminated perched water has also not occurred.

Based on the above, LKC considers the probability of contaminants on site affecting the Principal Aquifer as a low likelihood. Given the medium consequence, a moderate/low risk is anticipated (Pollutant Linkage 4) and localised remediation is required.

Remediation is recommended in the area around the above ground diesel tanks for human health purposes and this is likely to require the excavation and disposal or treatment of excavated soils. Along with dewatering of excavations and treatment or disposal of impacted perched water in this area, this will constitute source removal which should be sufficient to mitigate the risk from the hydrocarbon contamination to controlled waters.

6.5 Additional Risk Assessments

6.5.1 Concrete (Pollutant Linkage 5)

As stated in Section 5, sulphate resistant concrete will not be required at the site. The concentrations of soluble sulphate in the soil when contrasted to BRE Digest 2005[44] categorise the concrete requirement 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.

[44] BRE (2005)."Concrete in Aggressive Ground." Special Digest 1.

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 contamination[45]. Only contaminants of concern, based on the preliminary conceptual model and ground conditions encountered, were analysed.

The following elevated contaminants were identified:

- Elevated petroleum hydrocarbons in the south west of the site.

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

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

Barrier pipe may be required for potable water pipes laid in the south west of the site given the hydrocarbon contamination identified.

At this stage, the probability of organic contaminants affecting potable water pipes is a low likelihood. Given the consequence is considered to be medium, the risk (pollutant linkage 6) is anticipated to be low / moderate risk. A moderate risk is assumed for the south west of the site and barrier pipe may be required dependent on further risk assessment.

6.5.3 *Phytotoxicity (Pollutant Linkage 7)*

Soil results were compared to phytotoxic guideline values as outlined in BS3882[46].

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 2-6) 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 6-5.

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.

[45] UU(2011). "United Utilities Water Supplementary Guidance for the Selection of Water Pipes in Land Potentially Affected by Contamination."
[46] BS (2015). "Specifications for Topsoil and Requirements for Use." BS3882:2015.

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.

Pollutant Linkage	Pathway	Receptor	Contaminant (source)	Probability	Consequence	Risk	Assessment & Recommendations
PL1	- Dermal contact. - Inhalation of soil, fibres and dust. - Ingestion of soils, dust, vegetables, soil attached to vegetables. - Windblown dust.	- Future site users. - Offsite receptors.	- ACM (potentially in made ground). - PAHs (made ground).	Likely	Medium	Moderate	- Likely probability as elevated PAHs and asbestos identified in made ground. - Potential pathway to receptors in gardens / landscaping. - Recommendation: Remediation required likely to comprise the removal of made ground or a clean capping layer.
			- Heavy end hydrocarbons, (onsite diesel tanks, onsite nursery).	Likely	Medium	Moderate (localised)	- Likely probability of hydrocarbons in localised area around above ground diesel tanks. - Recommendation: Localised remediation required.
			- Pesticides (onsite nursery)	Unlikely	Medium	Low	- No pesticide concentrations recorded above laboratory detection limits. - Recommendation: No remediation required.
PL2	- Inhalation of vapours. - Migration through permeable strata and preferential pathways.	- Future site users. - Offsite receptors.	- Volatile contaminants such as hydrocarbons, solvents, (made ground, onsite diesel tanks).	Likely	Medium	Moderate (localised)	- Likely probability of volatile contamination in localised area around the above ground diesel tanks. - Recommendation: Localised remediation required.
PL3	- Inhalation of gas. - Migration through permeable strata and preferential pathways. - Explosion in confined spaces.	- Future site users. - Buildings. - Offsite land users.	- Ground gas: - Methane, carbon dioxide (peat) - Hazardous Gas: - Methane, carbon dioxide (made ground).	Likely	Severe	High	- Worst case GSVs place the site within a CS2/Amber 1 scenario. - Carbon dioxide and methane recorded above 5%v/v and 1%v/v respectively. - Recommendation: Gas protection measures required in new buildings.
PL4	- Surface run-off. - Migration through permeable strata and preferential pathways. - Perched waters migration.	- Groundwater (Principal and Secondary A Aquifer).	- Mobile contaminants such as metals, PAHs, hydrocarbons (made ground, onsite diesel tanks, onsite nursery).	Low likelihood	Medium	Moderate / Low (localised)	- Low probability of impact to the underlying aquifers in the area around the above ground diesel tanks. - Evidence of hydrocarbon contamination within the perched water in a localised area but no indication of significant vertical migration. - Recommendation: Localised remediation required.
PL5	- Sulphate attack on concrete.	- Building structure.	- Sulphate (ash in made ground).	Unlikely	Mild	Low	- Likely probability of ash is anticipated in made ground which would be in contact with concrete in the ground. - Recommendation: No sulphate resistant concrete required.
PL6	- Ingestion of tainted water supply.	- Future site users. - Water pipes.	- Organic contaminants such as hydrocarbons, solvents (made ground, onsite diesel tanks, onsite nursery).	Likely	Medium	Moderate (localised)	- Likely probability in a localised area in the south west of the site. - Risk is considered moderate at this stage. - Recommendation: Completion of a UU Risk Assessment and liaison with UU. Barrier pipe likely to be required.
PL7	- Direct contact (plant uptake).	- Flora.	- Phytotoxic contaminants (made ground).	Unlikely	Minor	Very Low	- Unlikely probability as no elevated levels of phytotoxic contaminants identified. - Recommendation: No remediation required.

Table 6-5: Revised Contamination Conceptual Model.

7 Waste Disposal Assessment

The soil contamination results as presented in Appendix C have been used to help determine the disposal route should any material be earmarked 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 of contaminant soils and classifies the soils as either hazardous or non-hazardous waste.

It is understood that HazWasteOnline has been designed to cover the European Waste Catalogue code number 17 05 03 "soil and stones containing dangerous substances" and follows current guidance[47,48,49,50,51].

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

Only one sample returned a waste classification of hazardous (TP105 0.5m) and this was based on the asbestos quantification recorded in this sample. All other samples recorded levels of contamination which deemed the material to be non-hazardous.

The output sheet is presented in Appendix I.

Composite samples of made ground from the site have been tested for Waste Acceptance Criteria (WAC) suites. These indicate that the made ground would generally be classified as inert waste. The WAC testing laboratory certificates are provided in Appendix J.

The results of the soil testing and WAC test certificates should be provided to the landfill operator to confirm the disposal destination prior to removal of material from site.

[47] EA (2018). "Guidance on the Classification and Assessment of Waste (1st Edition v1.1)". Technical Guidance WM3.
[48] The Hazardous Waste Directive, (HWD, Council Directive 91/689/EC).
[49] European Waste Catalogue, 2002 (EWC 2002, Commission Decision 2000/532/EC) as amended by Commission Decision 2001/118/EC, 2001/119/EC and Council Decision 2001/573/E.
[50] List of Wastes (England) Regulations 2005.
[51] Approved Supply List (Eighth Edition), 2002. ISBN: 0 7176 2368 8.

8 Conclusions

8.1 Geotechnical

Given the made ground and variability of the underlying sand strata, traditional shallow foundations may not be suitable unless significant engineering works are undertaken to strengthen the ground. Piling may be a more viable foundation option, but deeper geotechnical investigation may be required. Raft foundations are also a feasible option.

Consideration should be given to relic foundation structures, potential shallow groundwater and below ground obstructions.

No sulphate resistant concrete is required (DS-1 AC-1).

Further advice on foundation design should be sought from a structural engineer.

8.2 Contamination Assessment

A revised contamination conceptual model has been produced by LKC which is summarised in Table 8-1 below (more detailed model provided in Section 5).

Pollutant Linkage		Risk	Recommendations
1	Contaminants posing a risk to site users via dermal contact, ingestion and inhalation (of soil, dust, fibres and vegetables).	**Moderate** (ACMs, PAHs)	- **Recommendations:** Remediation required in garden areas. Removal of made ground or capping layer.
		Moderate (localised) Hydrocarbons	- **Recommendations:** Remediation required.
		Low (Metals & pesticides)	- No elevated heavy metal concentrations identified. - No pesticide concentrations above laboratory detection limits. - **Recommendations:** No remediation required.
2	Volatile contaminants posing a risk to site users via the inhalation of vapours.	**Moderate (localised)**	- **Recommendations:** Remediation required.
3	Gas posing a risk to buildings and site users via the migration of gas into building causing explosion and asphyxiation.	**High**	- Site within CS2/Amber 1. - **Recommendations:** Gas protection measures required.
4	Mobile contamination posing a risk to controlled waters via the migration through permeable strata.	**Moderate/Low**	- Elevated TPH fractions in groundwater near to diesel tanks. - **Recommendations:** Remediation required.
5	Sulphate posing a risk to building via direct contact (sulphate attack).	**Low**	- No elevated sulphate concentrations or aggressive ground conditions identified. - **Recommendations:** No remediation required.
6	Organic contaminants posing a risk to water pipes.	**Moderate**	- Organic contamination identified at potable pipe depth of 0.75-1.35mbgl. - **Recommendations:** UU risk assessment to be completed. The site will likely require barrier piping in some areas.
7	Phytotoxic metals posing a risk to flora via root uptake.	**Very Low**	- **Recommendations:** No specific remediation required.

Table 8-1: Summary Risk Table.

Remedial recommendations are presented in Section 9.

9 Recommendations and Remedial Strategy

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

9.1 Remediation and Validation Recommendations

Table 9-1 details the further works and remedial recommendations / requirements.

PL	Remediation Requirements	Validation Requirements
1,2, 4	<u>Post-demolition Investigation</u> Further investigation work may be required below the above ground diesel tanks following removal of the tanks and demolition of the adjacent building to further delineate the identified hydrocarbon contamination.	N/A
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.	Log of work undertaken including photographs. Details of any sampling undertaken and validation of any potential additional remedial work.
2, 4	<u>Excavation of Hydrocarbon Hotspot and Source Removal (Groundwater).</u> A source of contamination impacting local perched groundwater was identified in the area of the above ground diesel tanks and interceptor. Impacted soils (based on visual / olfactory evidence and the use of a PID) should be excavated and removed. Impacted soils should be placed on an impermeable surface to await removal from site (this may be subject to chemical testing to confirm suitable waste facility). Dewatering of impacted perched water should be undertaken during excavation works and extracted water should be treated onsite prior to disposal to foul sewer (discharge consent required) or tinkered offsite for disposal. The work should be done under the supervision and instruction of an environmental consultant. If all impacted ground cannot be removed and contamination remains on the ground, further remediation may need to be considered.	Details of work undertaken including photographs. Confirmatory samples of the remaining in-situ soils. Consignment notes confirming the removal of impacted soil and perched water.

2	<u>Vapour Membrane</u> Elevated light end petroleum hydrocarbons were identified in the south west of the site. If extent of the contamination / nature of the ground (e.g. high groundwater levels) deem it unfeasible to remove the impacted ground it is recommended that houses to be constructed within this include a sub-floor void and vapour resistant membrane.	Plan including foundation design. Validation of the installation of vapour protection measures.
1 and 7	As the made ground is relatively shallow the following options are given: <u>Option 1</u> Removal of all reworked topsoil / made ground from garden and soft landscaping and raise levels (as required) with suitably chemically validated subsoil and topsoil. <u>Option 2</u> If all or some of the made ground remains in place in gardens and soft landscaping areas, an environmental cover system will be required. The environmental cover system should be as follows: **Private Back Gardens: 600mm thick environmental cover system comprising:** <u>**Either**</u> 100mm physical break layer (MOT type 1 material, 20-30mm, minimal fines) and at least 500mm comprising clean inert fill and sufficient topsoil for a growing medium. <u>**Or**</u> geotextile membrane and at least 600mm comprising clean inert fill and sufficient topsoil for a growing medium. **Private Front Gardens / Shared Landscaping: 300mm thick environmental cover system comprising:** <u>**Either**</u> 100mm physical break layer (MOT type 1 material, 20-30mm, minimal fines) and at least 200mm comprising clean inert fill and sufficient topsoil for a growing medium. <u>**Or**</u> geotextile membrane and at least 300mm comprising clean inert fill and sufficient topsoil for a growing medium. The subsoil layer can be replaced by additional topsoil. A diagram of a typical environmental cover system is shown in Appendix K.	<u>Option 1</u> Consignment notes confirming the removal of made ground. Photographic evidence of natural strata. Chemical validation of imported soils: See Table 9-2. <u>Option 2</u> Measuring depth of environmental cover system using a staff and providing photographic evidence. Photographic evidence of the granular physical break or geotextile layer will also be collected. Chemical validation of imported soils: See Table 9-2.
3	<u>Gas Protection Measures</u> Based on current results, gas protection measures in line with CS2 as per UK guidance[52,53]. This should include:	Supply and review of foundation designs.

[52] CIRIA (2007). "Assessing Risks Posed by Hazardous Ground Gases to Buildings." CIRIA C665
[53] BSI (2015). "Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for new buildings." BS8485:2015.

	• Passive subfloor or active subfloor ventilation system. • Methane and carbon dioxide resistant membrane installed as per manufacturer's instructions. • Ventilation of confined spaces within the building. • Well-constructed reinforced suspended, raft or cast in situ ground slab. • Minimum penetration of ground slab by services. • All joints and penetrations to be sealed. Foundation design and gas protection measures should be approved by the Local Authority.	Photographic evidence of sub-floor void, ventilation and suitably sealed gas membrane. Validation of gas protection measures should be in line with CIRIA 735[54]
6	<u>Potable Water Pipes</u> It is recommended that a United Utilities Risk Assessment is undertaken once the location and depth of potable water pipes are known. It is likely that barrier pipe will be required in some areas of the site.	Delivery Notes of Pipe Material. Photographs of the Installed Pipe.
<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 [55]): 5,000 tonnes (*c.* 2,500m^3) <u>treatment</u> of crushed concrete / stone. 1,000 tonnes (*c.* 500^3) <u>use of</u> non-hazardous soil 5,000 tonnes (*c.* 2,500m^3) <u>use of</u> clays, sand, gravel, brick, concrete, stone etc. 50,000 tonnes (*c.* 25,000m^3) <u>use of</u> bitumous material to be used in roadways. A Materials Management Plan (MMP) with recourse to the CL:AIRE Code of Practice may be required if volumes exceed exemption limits. This must be registered **<u>before</u>** material movement starts onsite. If an MMP is required, this needs to be registered by a Qualified Person (QP) and there must be 'certainty of use' for any material re-used onsite or exported to site to ensure there is no 'sham recovery'. For all the above material will need to be tested at the rate and analytical suites presented in Table 9-2.	

[54] CIRIA (2014). "Good Practice on the Testing and Verification of Protection Systems for Building Against Hazardous Ground Gas". CIRIA C735.
[55] https://www.gov.uk/guidance/waste-exemptions-using-waste

Asbestos Management Plan Due to the presence of asbestos containing material, it is recommended that additional precautions are taken during site clearance, earthworks and construction in the area of concern. The presence of asbestos in the made ground at the site presents a potential risk of generation of airborne fibres if this material is disturbed, such as for excavations to construct new foundations. This risk can be managed by careful procedures and site monitoring to reduce the risk of airborne fibres, and it is recommended that an appropriate 'Asbestos Management Strategy' is developed and adopted for all intrusive ground works which disturb the made ground in the area of concern. This should be carried out in line with CIRIA C733[56]. This may include asbestos awareness training for all site staff, provision of suitable personal and respiratory protective equipment and air monitoring. With regards to cement bound asbestos, this can be handpicked, doubled bagged and disposed of appropriately to a licenced landfill. Guidance on removing asbestos cement is described in HSE (2012)[57]. If ACM is identified in soil arisings then soil should be placed directly into covered skips and disposed of at a suitable licenced landfill, after further testing to quantify the extent of asbestos contamination of the soils. It should be considered that blue asbestos is notifiable and must be removed by a licenced contractor.
Health and Safety Considerations 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 guidance[58]) should be adopted by all workers involved with site enabling and construction works.
Piling in Contaminated Land If piling is to be used as the foundation solution this may provide a preferential pathway for contaminants to the Principal Aquifer. Once the method of piling has been determined, good practice for the drilling of piles on contaminated sites should be adhered to, such as guidance provided by the Environment Agency[59].
Asbestos Survey A Pre-Demolition and Major Refurbishment Asbestos Survey should be undertaken, and any ACMs removed and properly disposed of, prior to the demolition of the existing buildings, by a suitably qualified professional.

Table 9-1: Further work, remediation and validation requirements
Notes: See Table 6-1 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.

[56] CIRIA (2014). "Asbestos in Soil and Made Ground: A Guide to Understanding and Managing Risks". C733.
[57] HSE (2012). "Removing Asbestos Cement (AC) Debris)." A11 Asbestos Essential – Non-licenced Tasks.
[58] HSE (1991). "Protection of Workers and the General Public During Development of Contaminated Land" London HMSO.
[59] Environment Agency (2001) Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention.

Material Type	Source	Suite of Analysis	Sampling Rate*
Topsoil	Greenfield	Suite A	1 sample per 50m³
	Brownfield / Unknown	Suite B	
Subsoil	Brownfield / Unknown	Suite B	1 sample per 150m³
	Site won natural material / greenfield	Suite A	
Physical Stone Break Layer	First Generation i.e. quarried sand (subsoil) or stone (break layer)	No testing is required. Certification of material provenance is required.	
	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 BS3882[60]). LKC advise this information is provided by the supplier before material is imported onto site.

Imported material to be used in gardens will be compared against residential with plant uptake criteria (as used in the contamination risk assessment (Section 6-1)).

9.3 Site Completion Reports

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.

All the remediation and validation work should be documented in a Site Completion Report. The following Completion Reports will be provided to satisfy the outstanding contaminated land planning conditions:

- **Pre-construction Phase Completion Report:** Site level reduction details, excavation of hydrocarbon hotspot, details of treatment or disposal of impacted soils and water, validation testing of any site won soil to be used in gardens and installation of geotextile membrane in gardens where made ground remains.
- **Build-phase Construction Completion Report:** Gas membrane validation, validation testing of any imported topsoil, completion of UU potable water supply document and/or discussion with UU.

The aim of the completion reports will be to demonstrate to the Local Authority that the site has been suitably remediated to the extent that construction works may commence and, in accordance with the National Planning Policy Framework (NPPF)[61]:

[60] BS (2015). "Specifications for Topsoil and Requirements for use." BS3882:2015.
[61] DCL (2018). "National Planning Policy Framework." Department of Communities and Local Government.

- The site is suitable for its new use taking account of ground conditions and land instability, including from natural hazards or former activities such as mining, pollution arising from previous uses and any proposals for mitigation including land remediation or impacts on the natural environment arising from that remediation;
- After remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990[62]; and,
- Adequate site investigation information, prepared by a competent person, is presented.

Once the above is satisfied the Local Authority should be able to discharge all the relevant contaminated land conditions.

[62] Defra (2006). "Environmental Protection Act 1990: Part 2A Contaminated land." Defra Circular 01/2006.

Figures

Figure 1: Site Location Plan, Barns Lane, Dunham Massey

Drawn: July 2019 Scale: 1:25,000 @ A4 (see scale bar)

LK CONSULT LIMITED

Extract from: Bowker Sadler Architecture
Drawing Ref: Site Analysis Diagram, No.109, Rev:A (August 2018)

KEY

Site Boundary

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.

LK CONSULT LIMITED

Client: Edgefold Homes Ltd

Site: Barns Lane, Dunham Massey

Title: Site Boundary Plan

Job No.	Scale (See Scale Bar)	Figure	Revision
LKC 19 1314	1:1000 @ A4	2	

Drawn By	Checked By	Drawn
AC	CH	Jul 2019

KEY

Site Boundary

Schedule of Accommodation

8 № 2 storey houses approx each	160 m²
Double Garages	
Single Garages	
Car parking (excluding garages)	250 %
Site Area (excluding ret.office & woodland)	0.496 ha
Gross internal area of dwellinds (excluding garages)	1280 m²

Existing buildings to be removed

LK CONSULT LIMITED

Client: Edgefold Homes Ltd

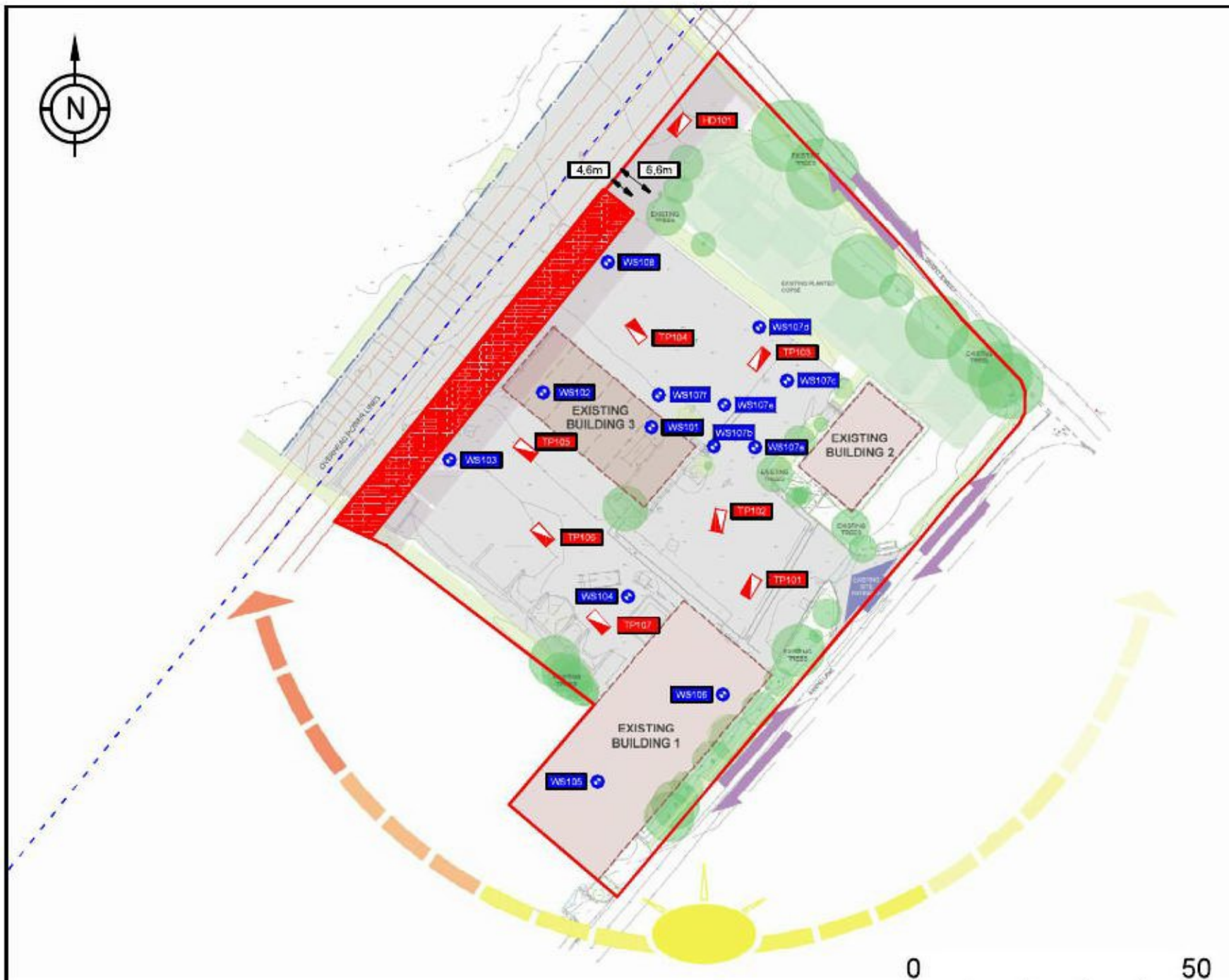
Site: Barns Lane, Dunham Massey

Title: Proposed Site Use

Job No.	Scale (See Scale Bar)	Figure	Revision
LKC 19 1314	1:1000 @ A4	3	

Drawn By	Checked By	Drawn
AC	CH	Jul 2019

Extract from: Bowker Sadler Architecture
Drawing Ref: Sketch Site Plan, No.0114 (04/06/2019)



Extract from: Bowker Sadler Architecture
Drawing Ref: Site Analysis Diagram, No.109, Rev:A (August 2018)

KEY

- Site Boundary
- Window Sample Borehole (WS)
- Trial Pit (TP)
- OH Power Cable Centre Line
- OH Power Cable Buffer Zone

LK CONSULT LIMITED

Client: Edgefold Homes Ltd

Site: Barns Lane, Dunham Massey

Title: Sampling Location Plan

Job No.	Scale (See Scale Bar)	Figure	Revision
LKC 19 1314	1:1000 @ A4	4	

Drawn By:	Checked By:	Drawn:
AC	HF	Jul 2019

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 552[63]. It involves the classification of the:

- Magnitude of the potential consequence (severity) of the risk occurring (Table A).
- Magnitude if 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.

[63] 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 sever harm to a designated receptor is currently happening. - This risk, if realised, is likely to results 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 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.

Appendix B

Profile Logs

Window Sample Logs
Trial Pit Logs

LK CONSULT LTD Eton Business Park, Eton Hill Road, Radcliffe, M26 2ZS Tel: 0161 763 7200 web: www.thelkgroup.com	Site Barns Lane, Dunham Massey	Number WS101
Excavation Method Drive-in Windowless Sampler to 5.45mbgl.	**Dimensions** 150mm to 3.00m	**Ground Level (mOD)**
	Client Edgefold Homes Ltd	**Job Number** LKC 19 1314
Location (Observed measurements)	**Dates** 19-07-2019	**Engineer** LKC
		Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20)	MADE GROUND: CONCRETE.		
					0.20			
					(0.20)	MADE GROUND: Whitish grey SAND and GRAVEL (MOT). Sand is fine to coarse. Gravel is fine to medium, angular to subangular comprising limestone.		
0.40-1.00	D1 PID=<0.1ppm				0.40			
					(0.60)	MADE GROUND: Dark brown gravelly silty SAND with occasional concrete fragments, rare brick fragments and ash. Sand is fine to medium. Gravel is fine to medium, angular to subrounded comprising mudstone and sandstone.		
1.00-2.00	D2 PID=<0.1ppm				1.00			
1.00-3.00	B3 PID=<0.1ppm					Medium dense orangish brown gravelly SAND. Sand is fine to coarse. Gravel is fine, angular to subangular comprising sandstone.		
1.20-1.65	SPT N=24		3,4/5,6,6,7					
			Water strike(1) at 2.00m.					▽1
2.00-2.45	SPT N=22		3,4/5,5,6,6		(2.20)	Strata noted to be damp / wet.		
3.00-3.45	SPT N=10		1,2/2,2,3,3					
3.20-3.90	B4 PID=<0.1ppm				3.20	Firm consistency low strength sandy CLAY. Sand is fine to medium.		
3.50	PP 36.79kPa				(0.70)			
3.90-4.90	B5 PID=<0.1ppm				3.90	Medium dense orangish brown gravelly SAND. Sand is fine to coarse. Gravel is fine, angular to subangular comprising sandstone.		
4.00-4.45	SPT N=14		2,2/3,3,4,4		(1.00)	Strata noted to be wet.		
5.00	PP 49.05kPa				4.90	Firm consistency medium strength slightly sandy silty CLAY. Sand is fine.		
5.00-5.45	SPT N=15		2,3/4,4,3,4		(0.55)			
					5.45	Complete at 5.45m		

Remarks
Water strike at 2.00mbgl.

Scale (approx)	Logged By
1:40	PP

Figure No.
LKC 19 1314.WS101

LK GROUP
LK CONSULT LTD
Eton Business Park, Eton Hill Road, Radcliffe, M26 2ZS
Tel: 0161 763 7200 web: www.thelkgroup.com

Site Barns Lane, Dunham Massey			**Number** WS102
Excavation Method Drive-in Windowless Sampler to 5.45mbgl.	**Dimensions** 150mm to 3.00m	**Ground Level (mOD)**	**Client** Edgefold Homes Ltd	**Job Number** LKC 19 1314
	Location (Observed measurements)	**Dates** 19-07-2019	**Engineer** LKC	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.25) 0.25	MADE GROUND: CONCRETE.		
0.25-1.00	D1 PID=<0.1ppm				(0.75) 1.00	MADE GROUND: Dark grey gravelly SAND with occasional concrete fragments and rare ash. Sand is fine to medium. Gravel is fine to medium, angular to subrounded comprising mudstone and sandstone.		
1.00-2.00 1.00-2.90 1.20-1.65	D2 PID=<0.1ppm B3 PID=<0.1ppm SPT N=13		1,1/2,3,4,4			Medium dense orangish brown gravelly SAND. Sand is fine to coarse. Gravel is fine, angular to subangular comprising sandstone.		
			Water strike(1) at 1.60m.					▽1
2.00-2.45	SPT N=11		2,2/2,3,3,3		(1.90)	Strata noted to be damp.		
2.90-4.40 3.00 3.00-3.45	B4 PID=<0.1ppm PP 28.3kPa SPT N=12		2,3/3,3,3,3		2.90 (1.50)	Firm consistency low strength brown silty CLAY.		
4.00-4.45	SPT N=12		2,2/2,3,3,4					
4.40-5.00	B5 PID=<0.1ppm				4.40 (1.05)	Stiff consistency medium strength brown slightly sandy CLAY.		
5.00 5.00-5.45	PP 73.58kPa SPT N=13		1,2/3,3,4,3		5.45	Complete at 5.45m		

Remarks
Water strike 1.60mbgl.

Scale (approx)	Logged By
1:40	PP

Figure No.
LKC 19 1314.WS102

LK CONSULT LTD

Eton Business Park, Eton Hill Road, Radcliffe, M26 2ZS
Tel: 0161 763 7200 web: www.thelkgroup.com

Site Barns Lane, Dunham Massey			**Number** WS103
Excavation Method Drive-in Windowless Sampler to 5.45mbgl.	**Dimensions** 150mm to 1.00m	**Ground Level (mOD)**	**Client** Edgefold Homes Ltd	**Job Number** LKC 19 1314
	Location (Observed measurements)	**Dates** 19-07-2019	**Engineer** LKC	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
					(0.30)	MADE GROUND: CONCRETE.			
0.30-0.80	D1 PID=1.8ppm				0.30	MADE GROUND: Dark brownish grey slightly gravelly clayey SAND with rare rootlets, brick, ash and slight hydrocarbon odour. Sand is fine to medium. Gravel is fine to medium, rounded to subrounded comprising mudstone and sandstone.			
					(0.50)				
0.80-1.80 0.80-2.80	D2 PID=<0.1ppm B3 PID=<0.1ppm				0.80	Medium dense to very loose orangish brown slightly gravelly SAND. Sand is fine to coarse. Gravel is fine to medium, subrounded to subangular comprising sandstone.			
1.20-1.65	SPT N=14		3,3/3,3,4,4			Strata noted to be damp / wet.			
			Water strike(1) at 1.80m.		(2.00)			▽1	
2.00-2.45	SPT N=2		1,0/1,0,0,1						
2.80-4.80 3.00	B4 PID=<0.1ppm PP 49.05kPa				2.80	Firm consistency medium strength brown silty CLAY.			
3.00-3.45	SPT N=12		2,2/3,3,3,3						
4.00	PP 61.31kPa								
4.00-4.45	SPT N=12		3,3/3,3,3,3		(2.65)				
5.00	PP 73.58kPa								
5.00-5.45	SPT N=13		3,4/3,3,4,3		5.45	Complete at 5.45m			

Remarks
Water strike at 1.80mbgl.

Scale (approx)	Logged By
1:40	PP

Figure No. LKC 19 1314.WS103

LK GROUP	**LK CONSULT LTD** Eton Business Park, Eton Hill Road, Radcliffe, M26 2ZS Tel: 0161 763 7200 web: www.thelkgroup.com	**Site** Barns Lane, Dunham Massey	**Number** **WS104**
Excavation Method Drive-in Windowless Sampler to 5.45mbgl.	**Dimensions** 150mm to 3.00m	**Ground Level (mOD)**	**Client** Edgefold Homes Ltd	**Job Number** LKC 19 1314
	Location (Observed measurements)	**Dates** 19-07-2019	**Engineer** LKC	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
					(0.20) 0.20	MADE GROUND: CONCRETE.			
0.20-0.60	D1 PID=43.2ppm				(0.40) 0.60	MADE GROUND: Black slightly gravelly silty SAND with rare brick fragments, concrete and moderate hydrocarbon odour. Sand is fine to medium. Gravel is fine to medium, rounded to subangular comprising sandstone and mudstone.			
0.60-1.60	DB2 PID=25.7ppm					Medium dense to very loose greyish brown fine to coarse SAND with a slight to moderate hydrocarbon odour.			
1.20-1.65	SPT N=16		2,3/4,4,4,4						
			Water strike(1) at 2.00m.		(2.30)			▽1	
2.00-2.45	SPT N=4		2,1/1,1,1,1						
2.90-3.90	D3 PID=<0.1ppm				2.90	Firm consistency low to medium strength brown silty CLAY.			
2.90-4.90	B4 PID=<0.1ppm								
3.00	PP 36.79kPa								
3.00-3.45	SPT N=15		1,2/3,4,4,4						
4.00	PP 61.31kPa								
4.00-4.45	SPT N=19		4,4/4,5,5,5		(2.55)				
5.00	PP 73.58kPa								
5.00-5.45	SPT N=10		2,2/3,2,2,3		5.45	Complete at 5.45m			

Remarks
Water strike at 2.00mbgl.

Scale (approx)	Logged By
1:40	PP

Figure No.
LKC 19 1314.WS104

LK GROUP
LK CONSULT LTD
Eton Business Park, Eton Hill Road, Radcliffe, M26 2ZS
Tel: 0161 763 7200 web: www.thelkgroup.com

Site
Barns Lane, Dunham Massey

Number
WS105

Excavation Method
Drive-in Windowless Sampler to 5.45mbgl.

Dimensions
150mm to 3.00m

Ground Level (mOD)

Client
Edgefold Homes Ltd

Job Number
LKC 19 1314

Location (Observed measurements)

Dates
19-07-2019

Engineer
LKC

Sheet
1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-0.60	D1 PID=<0.1ppm				(0.10) 0.10	MADE GROUND: CONCRETE.		
					(0.50)	MADE GROUND: Dark brown silty SAND with rare brick fragments and ash. Sand is fine to medium.		
0.60-1.60	BD2 PID=<0.1ppm				0.60	Medium dense orangish brown gravelly SAND. Sand is fine to coarse. Gravel is fine, angular to subangular comprising sandstone.		
1.20-1.65	SPT N=18		2,3/3,4,5,6 Water strike(1) at 1.30m.					▽1
					(2.20)	Strata noted to be damp / wet.		
2.00-2.45	SPT N=13		2,2/3,3,3,4					
2.80-3.80	B3 PID=<0.1ppm				2.80	Firm consistency low to high strength brown slightly sandy silty CLAY. Sand is fine.		
3.00	PP 36.79kPa							
3.00-3.45	SPT N=20		3,3/4,5,5,6					
3.00-3.45	X4							
4.00	PP 85.84kPa							
4.00-4.45	SPT N=20		3,3/5,5,5,5		(2.65)			
4.00-4.45	X5							
5.00	PP 85.84kPa							
5.00-5.45	SPT N=13		3,3/2,5,3,3					
5.00-5.45	X6							
					5.45	Complete at 5.45m		

Remarks
Water strike at 1.30mbgl.

Scale (approx)
1:40

Logged By
PP

Figure No.
LKC 19 1314.WS105

LK GROUP	**LK CONSULT LTD** Eton Business Park, Eton Hill Road, Radcliffe, M26 2ZS Tel: 0161 763 7200 web: www.thelkgroup.com	**Site** Barns Lane, Dunham Massey	**Number** **WS106**
Excavation Method Drive-in Windowless Sampler to 5.45mbgl.	**Dimensions** 150mm to 3.00m	**Ground Level (mOD)**	**Client** Edgefold Homes Ltd	**Job Number** LKC 19 1314
	Location (Observed measurements)	**Dates** 19-07-2019	**Engineer** LKC	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	MADE GROUND: CONCRETE.		
0.20-0.80	D1 PID=<0.1ppm				(0.60) 0.80	MADE GROUND: Black slightly gravelly silty SAND with rare brick fragments and ash. Sand is fine to coarse. Gravel is fine to medium, rounded to subrounded comprising mudstone and sandstone.		
0.80-1.80 0.80-2.80	D2 PID=<0.1ppm B3 PID=<0.1ppm					Medium dense oragnish brown fine to coarse SAND.		
1.20-1.65	SPT N=15		2,2/3,3,4,5					
			Water strike(1) at 1.70m.		(2.00)			▽1
2.00-2.45	SPT N=14		2,2/3,3,4,4			Strata noted to be wet / damp.		
2.80-3.80 3.00 3.00-3.45	B4 PID=<0.1ppm PP 24.53kPa SPT N=20		3,3/4,5,5,6		2.80	Firm consistency low to medium strength brown sandy CLAY with rare bands of sand. Sand is fine to medium.		
4.00 4.00-4.45	PP 36.79kPa SPT N=23		3,3/5,6,6,6		(2.65)			
5.00 5.00-5.45	PP 49.05kPa SPT N=16		2,2/3,4,5,4					
					5.45	Complete at 5.45m		

Remarks
Water strike at 1.70mbgl.

Scale (approx)	Logged By
1:40	PP

Figure No.
LKC 19 1314.WS106

LK CONSULT LTD Eton Business Park, Eton Hill Road, Radcliffe, M26 2ZS Tel: 0161 763 7200 web: www.thelkgroup.com	Site Barns Lane, Dunham Massey	Number WS107F
Excavation Method Drive-in Windowless Sampler to 5.45mbgl.	**Dimensions** 150mm to 3.00m	**Ground Level (mOD)**
	Client Edgefold Homes Ltd	**Job Number** LKC 19 1314
	Location (Observed measurements)	**Dates** 19-07-2019
	Engineer LKC	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.00-0.90	D1 PID=<0.1ppm				(0.90)	MADE GROUND: Reddish brown gravelly clayey SAND with occasional brick (whole and fragments), ash and rare concrete. Sand is fine to coarse. Gravel is fine to medium, angular to subrounded comprising mudstone and sandstone.			
					0.90				
1.00-2.00	D2 PID=<0.1ppm				(0.10)	MADE GROUND: TARMACADAM.			
1.00-2.90	B3 PID=<0.1ppm				1.00	Medium dense light greyish brown slightly gravelly SAND. Sand is fine to coarse. Gravel is fine, angular to subangular comprising sandstone.			
1.20-1.65	SPT N=28		7,7/8,7,6,7						
			Water strike(1) at 1.80m.		(1.90)			▽1	
2.00-2.45	SPT N=16		2,3/4,4,4,4			Strata noted to be damp / wet.			
					2.90				
2.90-3.90	B4 PID=<0.1ppm					Firm consistency low to medium strength brown silty CLAY.			
3.00	PP 36.79kPa								
3.00-3.45	SPT N=18		3,4/4,4,5,5		(1.55)				
4.00	PP 61.31kPa								
4.00-4.45	SPT N=14		3,3/3,3,4,4						
					4.45				
						Medium dense light greyish brown slightly gravelly SAND. Sand is fine to coarse. Gravel is fine, angular to subangular comprising sandstone.			
5.00-5.45	SPT N=14		2,2/3,3,4,4		(1.00)	Strata noted to be damp / wet.			
					5.45				
						Complete at 5.45m			

Remarks
Water strike at 1.80mbgl.

Scale (approx)	Logged By
1:40	PP

Figure No.
LKC 19 1314.WS107F

LK CONSULT LTD Eton Business Park, Eton Hill Road, Radcliffe, M26 2ZS Tel: 0161 763 7200 web: www.thelkgroup.com	Site Barns Lane, Dunham Massey	Number WS108
Excavation Method Drive-in Windowless Sampler to 5.45mbgl.	**Dimensions** 150mm to 3.00m	**Ground Level (mOD)**
	Client Edgefold Homes Ltd	**Job Number** LKC 19 1314
Location (Observed measurements)	**Dates** 19-07-2019	**Engineer** LKC
		Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
					(0.30)	MADE GROUND: Whitish grey SAND and GRAVEL (MOT). Sand is fine to coarse. Gravel is fine to medium, angular to subangular comprising limestone.			
0.30-1.30	D1 PID=<0.1ppm				0.30				
					(1.00)	MADE GROUND: Greyish brown gravelly sandy CLAY with occasional ash, brick fragments and glass. Sand is fine to medium. Gravel is fine to medium, rounded to subrounded comprising mudstone and limestone.			
1.20-1.65 1.30-2.30 1.30-2.90	SPT N=19 D2 PID=<0.1ppm B3 PID=<0.1ppm		9,10/7,6,3,3 Water strike(1) at 1.40m.		1.30	Medium dense greyish brown slightly gravelly SAND. Sand is fine to coarse. Gravel is fine to medium, angular to subangular comprising sandstone.		▽1	
2.00-2.45	SPT N=11		2,2/2,3,3,3		(1.60)	Strata noted to be damp / wet.			
2.90-4.90 3.00 3.00-3.45	B4 PID=<0.1ppm PP 61.31kPa SPT N=13		2,2/3,3,3,4		2.90	Firm to stiff consistency medium strength brown slightly sandy silty CLAY. Sand is fine.			
4.00 4.00-4.45	PP 49.05kPa SPT N=11		2,2/2,3,3,3		(2.55)				
5.00 5.00-5.45	PP 61.31kPa SPT N=8		1,2/2,2,2,2		5.45	Complete at 5.45m			

Remarks Water strike at 1.40mbgl.	Scale (approx) 1:40	Logged By PP
	Figure No. LKC 19 1314.WS108	

LK GROUP	LK CONSULT LTD Eton Business Park, Eton Hill Road, Radcliffe, M26 2ZS Tel: 0161 763 7200 web: www.thelkgroup.com	Site Barns Lane, Dunham Massey	Trial Pit Number HD101
Excavation Method Hand excavation to 1.00mbgl.	Dimensions 0.3x0.3x1.0m	Ground Level (mOD)	Client Edgefold Homes Ltd	Job Number LKC 19 1314
	Location (Observed measurements)	Dates 19-07-2019	Engineer LKC	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-0.40	D1 PID=0.1ppm				(0.40)	MADE GROUND: Greyish brown slightly gravelly clayey SAND with occasional ash, brick fragments and rare concrete. Sand is fine to coarse. Gravel is fine to medium, angular to subrounded comprising mudstone and sandstone.		
0.40-0.80	D2 PID=0.5ppm				0.40 (0.40) 0.80	MADE GROUND: Black slightly gravelly clayey SAND with rare brick fragments, ash and slight hydrocarbon odour. Sand is fine to coarse. Gravel is fine to medium, rounded to subangular comprising mudstone and sandstone.		
0.80-1.00	D3 PID=<0.1ppm				(0.20) 1.00	Yellowish brown fine to coarse SAND.		
						Complete at 1.00m		

Remarks

Hand dug pit dry.

Scale (approx)	Logged By	Figure No.
1:10	PP	LKC 19 1314.HD101

LK CONSULT LTD Eton Business Park, Eton Hill Road, Radcliffe, M26 2ZS Tel: 0161 763 7200 web: www.thelkgroup.com	Site Barns Lane, Dunham Massey	Trial Pit Number TP101
Excavation Method Trial Pit **Dimensions** **Location** **Ground Level (mOD)** **Dates** 24-07-2019	**Client** Edgefold Homes Ltd **Engineer** LKC	**Job Number** LKC 19 1314 **Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					0.10 (0.20)	MADE GROUND: Tarmacadam.		
0.30-0.50	ES1 PID = <0.1ppm				0.30 (0.20)	MADE GROUND: Light grey sandy gravel (hardcore).		
0.50	ES2 PID = 0.1ppm				0.50 0.60	MADE GROUND: Dark grey brown and orange sandy gravel of brick fragments, concrete, occasional ash and rare timber fragments.		
						MADE GROUND: Dark brown slightly sandy silt (possible relic topsoil). Organic odour noted.		
1.20	ES3 PID = 0.1ppm				(1.50)	Light orangish brown slightly silty SAND with rare gravel. Sand is fine to coarse. Gravel is fine, subangular to subrounded comprising sandstone.		
1.50-2.00	B4							
			Water strike(1) at 2.00m.		2.10	Complete at 2.10m		▽1

Plan

Remarks

Groundwater encountered at 2.1mbgl.
Trial pit collapsing from 1.4mbgl.
Trial pit terminated to collapse.

Scale (approx)	Logged By	Figure No.
1:50		LKC 19 1314.TP101

LK GROUP	**LK CONSULT LTD** Eton Business Park, Eton Hill Road, Radcliffe, M26 2ZS Tel: 0161 763 7200 web: www.thelkgroup.com	**Site** Barns Lane, Dunham Massey	**Trial Pit Number** **TP102**
Excavation Method Trial Pit	**Dimensions** / **Location**	**Ground Level (mOD)** / **Dates** 24-07-2019	**Client** Edgefold Homes Ltd **Engineer** LKC
			Job Number LKC 19 1314 **Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					0.10 (0.20) 0.30	MADE GROUND: Tarmacadam. MADE GROUND: Light grey sandy gravel (hardcore).		
0.50 0.50	B2 ES1 PID = <0.1ppm				(0.35) 0.65	MADE GROUND: Dark grey brown and orange sandy gravel of brick fragments, concrete, limestone chippings, occasional ash and rare timber fragments. Localised pockets of black organic sandy clay.		
1.50	ES3 PID = <0.1ppm		Water strike(1) at 2.00m.		(1.45) 2.10	Light orangish brown slightly silty SAND with rare gravel. Sand is fine to coarse. Gravel is fine, subangular to subrounded comprising sandstone. Complete at 2.10m		▽1

Plan

Remarks

Groundwater encountered at 2.0mbgl.
Trial pit collapsing from 1.4mbgl.
Trial pit terminated to collapse.

Scale (approx)	Logged By	Figure No.
1:50		LKC 19 1314.TP101

LK GROUP	LK CONSULT LTD Eton Business Park, Eton Hill Road, Radcliffe, M26 2ZS Tel: 0161 763 7200 web: www.thelkgroup.com	Site Barns Lane, Dunham Massey	Trial Pit Number TP103
Excavation Method Trial Pit	Dimensions	Ground Level (mOD)	Client Edgefold Homes Ltd	Job Number LKC 19 1314
	Location	Dates 24-07-2019	Engineer LKC	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	MADE GROUND: Light grey sandy gravel of limestone.		
					0.30			
0.40	ES1 PID = 0.1ppm				0.40	MADE GROUND: Concrete blocks.		
					(0.30)	MADE GROUND: Light grey brown sandy gravel of brick fragments, concrete fragments, limestone chippings, tarmacadam, occasional ash and rare timber fragments.		
					0.70			
1.00	ES2 PID = <0.1ppm					Dark orangish brown slightly silty SAND with rare gravel. Sand is fine to coarse. Gravel is fine, subangular to subrounded comprising sandstone and quartzite.		
1.50-2.00	B3				(1.70)			
			Water strike(1) at 2.20m.					▽1
					2.40	Complete at 2.40m		

Plan

Remarks

Groundwater encountered at 2.2mbgl.
Trial pit collapsing from 1.7mbgl.
Trial pit terminated to collapse.

Scale (approx)	Logged By	Figure No.
1:50		LKC 19 1314.TP101

LK GROUP	**LK CONSULT LTD** Eton Business Park, Eton Hill Road, Radcliffe, M26 2ZS Tel: 0161 763 7200 web: www.thelkgroup.com	**Site** Barns Lane, Dunham Massey	**Trial Pit Number** **TP104**
Excavation Method Trial Pit	**Dimensions**	**Ground Level (mOD)**	**Client** Edgefold Homes Ltd	**Job Number** LKC 19 1314
	Location	**Dates** 24-07-2019	**Engineer** LKC	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					0.10 (0.30)	MADE GROUND: Light grey sandy gravel of limestone.		
0.30	ES1 PID = 0.1ppm				0.40	MADE GROUND: Dark brown very gravelly clay. Gravel is brick, concrete and rare ash.		
0.60	ES2 PID = <0.1ppm				(0.70)	MADE GROUND: Light orange brown sandy gravel of brick fragments, concrete fragments, whole kerbstones, concrete blocks and tarmacadam fragments.		
					1.10	Dark orangish brown slightly gravelly SAND. Sand is fine to coarse. Gravel is fine, subangular to subrounded comprising sandstone and quartzite.		
1.50	ES3 PID = <0.1ppm				(1.30)			
			Water strike(1) at 2.10m.					▽1
					2.40	Complete at 2.40m		

Plan

Remarks

Groundwater encountered at 2.1mbgl.
Trial pit collapsing from 1.5mbgl.
Trial pit terminated to collapse.

Scale (approx)	Logged By	Figure No.
1:50		LKC 19 1314.TP101

LK CONSULT LTD Eton Business Park, Eton Hill Road, Radcliffe, M26 2ZS Tel: 0161 763 7200 web: www.thelkgroup.com	Site Barns Lane, Dunham Massey	Trial Pit Number TP105
Excavation Method Trial Pit	**Dimensions**	**Ground Level (mOD)**
Client Edgefold Homes Ltd	**Job Number** LKC 19 1314
Location	**Dates** 24-07-2019	**Engineer** LKC	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.15) 0.15	MADE GROUND: Concrete.		
					0.20 (0.50)	MADE GROUND: Light grey brown sandy gravel (hardcore).		
0.50	ES1 PID = 0.2ppm				0.70	MADE GROUND: Dark brown and grey sandy gravelly clay with brick, concrete, metal rebar, waste cable, plastic, timber and rare ash.		
					(1.50)	Dark orangish brown slightly silty SAND with rare gravel. Sand is fine to coarse. Gravel is fine, subangular to subrounded comprising sandstone and quartzite.		
1.50 1.50	B3 ES2 PID = 0.1ppm		Water strike(1) at 2.10m.					▽1
					2.20 (0.50)	Soft dark grey brown sligtly silty CLAY.		
2.50	B4				2.70	Complete at 2.70m		

Plan

Remarks

Groundwater encountered at 2.1mbgl.
Trial pit stable during excavation. Collapsed after 2 minutes of being open from 1.4mbgl.

Scale (approx)	Logged By	Figure No.
1:50		LKC 19 1314.TP101

LK GROUP	LK CONSULT LTD Eton Business Park, Eton Hill Road, Radcliffe, M26 2ZS Tel: 0161 763 7200 web: www.thelkgroup.com	Site Barns Lane, Dunham Massey	Trial Pit Number TP106
Excavation Method Trial Pit	Dimensions	Ground Level (mOD)	Client Edgefold Homes Ltd	Job Number LKC 19 1314
	Location	Dates 24-07-2019	Engineer LKC	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.15) 0.15	MADE GROUND: Concrete.		
					0.20	MADE GROUND: Light grey brown sandy gravel (hardcore).		
					(0.50)			
0.50	ES1 PID = 0.2ppm				0.70	MADE GROUND: Dark brown and black slightly gravelly sandy silt with brick, concrete and quartzite. Slight organic odour.		
1.00-1.50	B2					Light orangish brown slightly silty SAND. Sand is fine to coarse.		
			Water strike(1) at 1.50m.		(1.10)			▽1
					1.80	Complete at 1.80m		

Plan

Remarks

Groundwater encountered at 1.5mbgl.
Trial pit collapsing from 1.5mbgl
Made ground in the north end of the trial pit appeared deeper.

Scale (approx)	Logged By	Figure No.
1:50		LKC 19 1314.TP101

LK GROUP	LK CONSULT LTD Eton Business Park, Eton Hill Road, Radcliffe, M26 2ZS Tel: 0161 763 7200 web: www.thelkgroup.com	Site Barns Lane, Dunham Massey	Trial Pit Number TP107
Excavation Method Trial Pit	Dimensions	Ground Level (mOD)	Client Edgefold Homes Ltd	Job Number LKC 19 1314
	Location	Dates 24-07-2019	Engineer LKC	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.15) 0.15	MADE GROUND: Concrete.		
					0.20 (0.40)	MADE GROUND: Light grey brown sandy gravel (hardcore).		
0.50	ES1 PID = 77.2ppm				0.60	Dark brown and black gravelly silty SAND. Slight hydrocarbon odour.		
1.00	ES2 PID = 10.7ppm					Light orange brown slightly gravelly SAND. Sand is fine to coarse. Gravel is subangular to subrounded of sandstone comprising sandstone. No hydrocarbon odour noted.		
1.50	ES3 PID = 8.1ppm				(1.70)			
			Water strike(1) at 1.80m.					▽1
					2.30	Complete at 2.30m		

Plan

Remarks

Groundwater encountered at 1.8mbgl.
Trial pit collapsing from 1.5mbgl
Trial pit terminated due to collapse.

Scale (approx)	Logged By	Figure No.
1:50		LKC 19 1314.TP101

Appendix C

Certificates of Analysis – Soil

Chemtest
The right chemistry to deliver results
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Amended Report

Report No.:	19-25162-2		
Initial Date of Issue:	31-Jul-2019	**Date of Re-Issue:**	05-Aug-2019
Client	LK Consult		
Client Address:	Unit 29 Eton Business Park Eton Hill Road Radcliffe Manchester Lancashire M26 2ZS		
Contact(s):	Chris Hughes Contaminated Land		
Project	LKC 19 1314 Barns Lane, Dunham Massey		
Quotation No.:		**Date Received:**	26-Jul-2019
Order No.:	737094	**Date Instructed:**	26-Jul-2019
No. of Samples:	12		
Turnaround (Wkdays):	9	**Results Due:**	07-Aug-2019
Date Approved:	05-Aug-2019		
Approved By:	[redacted]		
Details:	Martin Dyer, Laboratory Manager		

Results - Soil

Client: LK Consult		Chemtest Job No.:			19-25162	19-25162	19-25162	19-25162	19-25162	19-25162	19-25162	19-25162	19-25162
Quotation No.:		Chemtest Sample ID.:			864057	864059	864060	864061	864063	864065	864066	864067	864068
		Client Sample ID.:			TP101	TP102	TP102	TP103	TP104	TP104	TP105	TP105	TP106
		Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0.50	0.50	1.50	0.40	0.30	1.50	0.50	1.50	0.50
		Date Sampled:			24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019
		Asbestos Lab:			COVENTRY	COVENTRY		COVENTRY	COVENTRY		COVENTRY		COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**									
ACM Type	U	2192		N/A	-	-		Fibres/Clumps	Fibres/Clumps		Cement, Fibres/Clumps, Board		-
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected	No Asbestos Detected		Amosite	Chrysotile		Chrysotile		No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-	-		Stereo Microscopy	Stereo Microscopy		Screen Visible by Eye		-
Asbestos by Gravimetry	U	2192	%	0.001				0.002	<0.001		1.3		
Total Asbestos	N	2192	%	0.001				0.002	<0.001		1.3		
Moisture	N	2030	%	0.020	20	6.4	17	7.1	7.7	13	9.7	15	25
Soil Colour	N	2040		N/A	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown
Other Material	N	2040		N/A	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones
Soil Texture	N	2040		N/A	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand
Chromatogram (TPH)	N			N/A	See Attached								
pH	M	2010		N/A	7.4	8.1	8.1	8.7	9.1	9.5	10.4	8.6	7.2
Boron (Hot Water Soluble)	M	2120	mg/kg	0.40	1.8								
Sulphate (2:1 Water Soluble) as SO4	M	2120	g/l	0.010	0.30	0.086	< 0.010	1.1	0.27	< 0.010	0.39	< 0.010	0.11
Cyanide (Free)	M	2300	mg/kg	0.50	2.0								
Cyanide (Total)	M	2300	mg/kg	0.50	12								
Arsenic	M	2450	mg/kg	1.0	16	14		12	15		14		16
Cadmium	M	2450	mg/kg	0.10	0.39	0.63		0.48	0.67		0.31		0.27
Chromium	M	2450	mg/kg	1.0	16	7.4		12	13		13		16
Copper	M	2450	mg/kg	0.50	120	18		16	32		47		39
Mercury	M	2450	mg/kg	0.10	0.41	0.12		0.15	< 0.10		0.75		0.43
Nickel	M	2450	mg/kg	0.50	18	11		14	14		15		23
Lead	M	2450	mg/kg	0.50	100	54		59	57		91		86
Selenium	M	2450	mg/kg	0.20	0.46	< 0.20		< 0.20	< 0.20		< 0.20		0.45
Vanadium	U	2450	mg/kg	5.0	21	11		18	19		19		22
Zinc	M	2450	mg/kg	0.50	94	59		75	65		92		50
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50		< 0.50	< 0.50		< 0.50		< 0.50
Organic Matter	M	2625	%	0.40	11	2.1		2.8	2.2		5.5		9.7
Fuel Type	N	2670		N/A	PAH								
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	60								

Results - Soil

Client: LK Consult		Chemtest Job No.:			19-25162	19-25162	19-25162	19-25162	19-25162	19-25162	19-25162	19-25162	19-25162
Quotation No.:		Chemtest Sample ID.:			864057	864059	864060	864061	864063	864065	864066	864067	864068
		Client Sample ID.:			TP101	TP102	TP102	TP103	TP104	TP104	TP105	TP105	TP106
		Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0.50	0.50	1.50	0.40	0.30	1.50	0.50	1.50	0.50
		Date Sampled:			24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019
		Asbestos Lab:			COVENTRY	COVENTRY		COVENTRY	COVENTRY		COVENTRY		COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**									
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0								
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	60								
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	< 1.0								
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	170								
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0								
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	170								
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	230								
Dichlorodifluoromethane	U	2760	µg/kg	1.0									
Chloromethane	M	2760	µg/kg	1.0									
Vinyl Chloride	M	2760	µg/kg	1.0									
Bromomethane	M	2760	µg/kg	20									
Chloroethane	U	2760	µg/kg	2.0									
Trichlorofluoromethane	M	2760	µg/kg	1.0									
1,1-Dichloroethene	M	2760	µg/kg	1.0									
Trans 1,2-Dichloroethene	M	2760	µg/kg	1.0									
1,1-Dichloroethane	M	2760	µg/kg	1.0									
cis 1,2-Dichloroethene	M	2760	µg/kg	1.0									
Bromochloromethane	U	2760	µg/kg	5.0									
Trichloromethane	M	2760	µg/kg	1.0									
1,1,1-Trichloroethane	M	2760	µg/kg	1.0									
Tetrachloromethane	M	2760	µg/kg	1.0									
1,1-Dichloropropene	U	2760	µg/kg	1.0									
Benzene	M	2760	µg/kg	1.0	< 1.0								
1,2-Dichloroethane	M	2760	µg/kg	2.0									
Trichloroethene	N	2760	µg/kg	1.0									
1,2-Dichloropropane	M	2760	µg/kg	1.0									
Dibromomethane	M	2760	µg/kg	1.0									
Bromodichloromethane	M	2760	µg/kg	5.0									
cis-1,3-Dichloropropene	N	2760	µg/kg	10									
Toluene	M	2760	µg/kg	1.0	< 1.0								
Trans-1,3-Dichloropropene	N	2760	µg/kg	10									
1,1,2-Trichloroethane	M	2760	µg/kg	10									
Tetrachloroethene	M	2760	µg/kg	1.0									
1,3-Dichloropropane	U	2760	µg/kg	2.0									

Results - Soil

Client: LK Consult		Chemtest Job No.:			19-25162	19-25162	19-25162	19-25162	19-25162	19-25162	19-25162	19-25162	19-25162
Quotation No.:		Chemtest Sample ID.:			864057	864059	864060	864061	864063	864065	864066	864067	864068
		Client Sample ID.:			TP101	TP102	TP102	TP103	TP104	TP104	TP105	TP105	TP106
		Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0.50	0.50	1.50	0.40	0.30	1.50	0.50	1.50	0.50
		Date Sampled:			24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019
		Asbestos Lab:			COVENTRY	COVENTRY		COVENTRY	COVENTRY		COVENTRY		COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**									
Dibromochloromethane	U	2760	µg/kg	10									
1,2-Dibromoethane	M	2760	µg/kg	5.0									
Chlorobenzene	M	2760	µg/kg	1.0									
1,1,1,2-Tetrachloroethane	M	2760	µg/kg	2.0									
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								
Styrene	M	2760	µg/kg	1.0									
Tribromomethane	U	2760	µg/kg	1.0									
Isopropylbenzene	M	2760	µg/kg	1.0									
Bromobenzene	M	2760	µg/kg	1.0									
1,2,3-Trichloropropane	N	2760	µg/kg	50									
N-Propylbenzene	U	2760	µg/kg	1.0									
2-Chlorotoluene	M	2760	µg/kg	1.0									
1,3,5-Trimethylbenzene	M	2760	µg/kg	1.0									
4-Chlorotoluene	U	2760	µg/kg	1.0									
Tert-Butylbenzene	U	2760	µg/kg	1.0									
1,2,4-Trimethylbenzene	M	2760	µg/kg	1.0									
Sec-Butylbenzene	U	2760	µg/kg	1.0									
1,3-Dichlorobenzene	M	2760	µg/kg	1.0									
4-Isopropyltoluene	U	2760	µg/kg	1.0									
1,4-Dichlorobenzene	M	2760	µg/kg	1.0									
N-Butylbenzene	U	2760	µg/kg	1.0									
1,2-Dichlorobenzene	M	2760	µg/kg	1.0									
1,2-Dibromo-3-Chloropropane	U	2760	µg/kg	50									
1,2,4-Trichlorobenzene	M	2760	µg/kg	1.0									
Hexachlorobutadiene	U	2760	µg/kg	1.0									
1,2,3-Trichlorobenzene	U	2760	µg/kg	2.0									
Carbon Disulphide	N	2760	µg/kg	50									
Methyl Tert-Butyl Ether	M	2760	µg/kg	1.0	19								
N-Nitrosodimethylamine	M	2790	mg/kg	0.50									
Phenol	M	2790	mg/kg	0.50									
2-Chlorophenol	M	2790	mg/kg	0.50									
Bis-(2-Chloroethyl)Ether	M	2790	mg/kg	0.50									
1,3-Dichlorobenzene	M	2790	mg/kg	0.50									
1,4-Dichlorobenzene	N	2790	mg/kg	0.50									
1,2-Dichlorobenzene	M	2790	mg/kg	0.50									
2-Methylphenol	M	2790	mg/kg	0.50									
Bis(2-Chloroisopropyl)Ether	M	2790	mg/kg	0.50									

Results - Soil

Client: LK Consult		Chemtest Job No.:			19-25162	19-25162	19-25162	19-25162	19-25162	19-25162	19-25162	19-25162	19-25162
Quotation No.:		Chemtest Sample ID.:			864057	864059	864060	864061	864063	864065	864066	864067	864068
		Client Sample ID.:			TP101	TP102	TP102	TP103	TP104	TP104	TP105	TP105	TP106
		Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0.50	0.50	1.50	0.40	0.30	1.50	0.50	1.50	0.50
		Date Sampled:			24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019
		Asbestos Lab:			COVENTRY	COVENTRY		COVENTRY	COVENTRY		COVENTRY		COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**									
Hexachloroethane	N	2790	mg/kg	0.50									
N-Nitrosodi-n-propylamine	M	2790	mg/kg	0.50									
4-Methylphenol	M	2790	mg/kg	0.50									
Nitrobenzene	M	2790	mg/kg	0.50									
Isophorone	M	2790	mg/kg	0.50									
2-Nitrophenol	N	2790	mg/kg	0.50									
2,4-Dimethylphenol	N	2790	mg/kg	0.50									
Bis(2-Chloroethoxy)Methane	M	2790	mg/kg	0.50									
2,4-Dichlorophenol	M	2790	mg/kg	0.50									
1,2,4-Trichlorobenzene	M	2790	mg/kg	0.50									
Naphthalene	M	2790	mg/kg	0.50									
4-Chloroaniline	N	2790	mg/kg	0.50									
Hexachlorobutadiene	M	2790	mg/kg	0.50									
4-Chloro-3-Methylphenol	M	2790	mg/kg	0.50									
2-Methylnaphthalene	M	2790	mg/kg	0.50									
4-Nitrophenol	N	2790	mg/kg	0.50									
Hexachlorocyclopentadiene	N	2790	mg/kg	0.50									
2,4,6-Trichlorophenol	M	2790	mg/kg	0.50									
2,4,5-Trichlorophenol	M	2790	mg/kg	0.50									
2-Chloronaphthalene	M	2790	mg/kg	0.50									
2-Nitroaniline	M	2790	mg/kg	0.50									
Acenaphthylene	M	2790	mg/kg	0.50									
Dimethylphthalate	M	2790	mg/kg	0.50									
2,6-Dinitrotoluene	M	2790	mg/kg	0.50									
Acenaphthene	M	2790	mg/kg	0.50									
3-Nitroaniline	N	2790	mg/kg	0.50									
Dibenzofuran	M	2790	mg/kg	0.50									
4-Chlorophenylphenylether	M	2790	mg/kg	0.50									
2,4-Dinitrotoluene	M	2790	mg/kg	0.50									
Fluorene	M	2790	mg/kg	0.50									
Diethyl Phthalate	M	2790	mg/kg	0.50									
4-Nitroaniline	M	2790	mg/kg	0.50									
2-Methyl-4,6-Dinitrophenol	N	2790	mg/kg	0.50									
Azobenzene	M	2790	mg/kg	0.50									
4-Bromophenylphenyl Ether	M	2790	mg/kg	0.50									
Hexachlorobenzene	M	2790	mg/kg	0.50									
Pentachlorophenol	N	2790	mg/kg	0.50									
Phenanthrene	M	2790	mg/kg	0.50									
Anthracene	M	2790	mg/kg	0.50									

Results - Soil

Client: LK Consult		Chemtest Job No.:			19-25162	19-25162	19-25162	19-25162	19-25162	19-25162	19-25162	19-25162	19-25162
Quotation No.:		Chemtest Sample ID.:			864057	864059	864060	864061	864063	864065	864066	864067	864068
		Client Sample ID.:			TP101	TP102	TP102	TP103	TP104	TP104	TP105	TP105	TP106
		Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0.50	0.50	1.50	0.40	0.30	1.50	0.50	1.50	0.50
		Date Sampled:			24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019
		Asbestos Lab:			COVENTRY	COVENTRY		COVENTRY	COVENTRY		COVENTRY		COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**									
Carbazole	M	2790	mg/kg	0.50									
Di-N-Butyl Phthalate	M	2790	mg/kg	0.50									
Fluoranthene	M	2790	mg/kg	0.50									
Pyrene	M	2790	mg/kg	0.50									
Butylbenzyl Phthalate	M	2790	mg/kg	0.50									
Benzo[a]anthracene	M	2790	mg/kg	0.50									
Chrysene	M	2790	mg/kg	0.50									
Bis(2-Ethylhexyl)Phthalate	N	2790	mg/kg	0.50									
Di-N-Octyl Phthalate	M	2790	mg/kg	0.50									
Benzo[b]fluoranthene	M	2790	mg/kg	0.50									
Benzo[k]fluoranthene	M	2790	mg/kg	0.50									
Benzo[a]pyrene	M	2790	mg/kg	0.50									
Indeno(1,2,3-c,d)Pyrene	M	2790	mg/kg	0.50									
Dibenz(a,h)Anthracene	M	2790	mg/kg	0.50									
Benzo[g,h,i]perylene	M	2790	mg/kg	0.50									
Naphthalene	M	2800	mg/kg	0.10	< 0.10	< 0.10		0.46	< 0.10		< 0.10		< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10	< 0.10		0.25	< 0.10		< 0.10		< 0.10
Acenaphthene	M	2800	mg/kg	0.10	< 0.10	< 0.10		0.69	< 0.10		< 0.10		< 0.10
Fluorene	M	2800	mg/kg	0.10	< 0.10	< 0.10		0.67	< 0.10		< 0.10		< 0.10
Phenanthrene	M	2800	mg/kg	0.10	0.48	< 0.10		8.6	1.1		< 0.10		< 0.10
Anthracene	M	2800	mg/kg	0.10	< 0.10	< 0.10		1.8	0.23		< 0.10		< 0.10
Fluoranthene	M	2800	mg/kg	0.10	0.62	< 0.10		15	1.4		< 0.10		< 0.10
Pyrene	M	2800	mg/kg	0.10	0.62	< 0.10		14	1.2		< 0.10		< 0.10
Benzo[a]anthracene	M	2800	mg/kg	0.10	0.20	< 0.10		8.4	0.96		< 0.10		< 0.10
Chrysene	M	2800	mg/kg	0.10	0.20	< 0.10		8.5	1.2		< 0.10		< 0.10
Benzo[b]fluoranthene	M	2800	mg/kg	0.10	< 0.10	< 0.10		15	1.9		< 0.10		< 0.10
Benzo[k]fluoranthene	M	2800	mg/kg	0.10	< 0.10	< 0.10		5.5	0.53		< 0.10		< 0.10
Benzo[a]pyrene	M	2800	mg/kg	0.10	< 0.10	< 0.10		12	1.1		< 0.10		< 0.10
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10	< 0.10	< 0.10		10	1.5		< 0.10		< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10	< 0.10		1.7	0.15		< 0.10		< 0.10
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10	< 0.10	< 0.10		9.0	1.4		< 0.10		< 0.10
Total Of 16 PAH's	N	2800	mg/kg	2.0	2.1	< 2.0		110	13		< 2.0		< 2.0
Demeton-O	N	2820	mg/kg	0.20		< 0.20							< 0.20
Phorate	N	2820	mg/kg	0.20		< 0.20							< 0.20
Demeton-S	N	2820	mg/kg	0.20		< 0.20							< 0.20
Disulfoton	N	2820	mg/kg	0.20		< 0.20							< 0.20
Fenthion	N	2820	mg/kg	0.20		< 0.20							< 0.20
Trichloronate	N	2820	mg/kg	0.20		< 0.20							< 0.20
Prothiofos	N	2820	mg/kg	0.20		< 0.20							< 0.20

Results - Soil

Client: LK Consult		Chemtest Job No.:			19-25162	19-25162	19-25162	19-25162	19-25162	19-25162	19-25162	19-25162	19-25162
Quotation No.:		Chemtest Sample ID.:			864057	864059	864060	864061	864063	864065	864066	864067	864068
		Client Sample ID.:			TP101	TP102	TP102	TP103	TP104	TP104	TP105	TP105	TP106
		Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0.50	0.50	1.50	0.40	0.30	1.50	0.50	1.50	0.50
		Date Sampled:			24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019
		Asbestos Lab:			COVENTRY	COVENTRY		COVENTRY	COVENTRY		COVENTRY		COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**									
Fensulphothion	N	2820	mg/kg	0.20		< 0.20							< 0.20
Sulprofos	N	2820	mg/kg	0.20		< 0.20							< 0.20
Azinphos-Methyl	N	2820	mg/kg	0.20		< 0.20							< 0.20
Coumaphos	N	2820	mg/kg	0.20		< 0.20							< 0.20
Alpha-HCH	N	2840	mg/kg	0.20		< 0.20							< 0.20
Gamma-HCH (Lindane)	N	2840	mg/kg	0.20		< 0.20							< 0.20
Beta-HCH	N	2840	mg/kg	0.20		< 0.20							< 0.20
Delta-HCH	N	2840	mg/kg	0.20		< 0.20							< 0.20
Heptachlor	N	2840	mg/kg	0.20		< 0.20							< 0.20
Aldrin	N	2840	mg/kg	0.20		< 0.20							< 0.20
Heptachlor Epoxide	N	2840	mg/kg	0.20		< 0.20							< 0.20
Gamma-Chlordane	N	2840	mg/kg	0.20		< 0.20							< 0.20
Alpha-Chlordane	N	2840	mg/kg	0.20		< 0.20							< 0.20
Endosulfan I	N	2840	mg/kg	0.20		< 0.20							< 0.20
4,4-DDE	N	2840	mg/kg	0.20		< 0.20							< 0.20
Dieldrin	N	2840	mg/kg	0.20		< 0.20							< 0.20
Endrin	N	2840	mg/kg	0.20		< 0.20							< 0.20
4,4-DDD	N	2840	mg/kg	0.20		< 0.20							< 0.20
Endosulfan II	N	2840	mg/kg	0.20		< 0.20							< 0.20
Endrin Aldehyde	N	2840	mg/kg	0.20		< 0.20							< 0.20
4,4-DDT	N	2840	mg/kg	0.20		< 0.20							< 0.20
Endosulfan Sulphate	N	2840	mg/kg	0.20		< 0.20							< 0.20
Methoxychlor	N	2840	mg/kg	0.20		< 0.20							< 0.20
Endrin Ketone	N	2840	mg/kg	0.20		< 0.20							< 0.20
Total Phenols	M	2920	mg/kg	0.30	< 0.30								

Results - Soil

Client: LK Consult			Chemtest Job No.:		19-25162	19-25162	19-25162
Quotation No.:			Chemtest Sample ID.:		864069	864070	864071
			Client Sample ID.:		TP107	TP107	TP107
			Sample Type:		SOIL	SOIL	SOIL
			Top Depth (m):		0.50	1.00	1.50
			Date Sampled:		24-Jul-2019	24-Jul-2019	24-Jul-2019
			Asbestos Lab:		COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
ACM Type	U	2192		N/A	-	-	-
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-	-	-
Asbestos by Gravimetry	U	2192	%	0.001			
Total Asbestos	N	2192	%	0.001			
Moisture	N	2030	%	0.020	13	19	18
Soil Colour	N	2040		N/A	Brown	Brown	Brown
Other Material	N	2040		N/A	Stones	Stones	Stones
Soil Texture	N	2040		N/A	Sand	Sand	Sand
Chromatogram (TPH)	N			N/A			
pH	M	2010		N/A	7.7		
Boron (Hot Water Soluble)	M	2120	mg/kg	0.40	< 0.40		
Sulphate (2:1 Water Soluble) as SO4	M	2120	g/l	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	2.2		
Cadmium	M	2450	mg/kg	0.10	< 0.10		
Chromium	M	2450	mg/kg	1.0	1.1		
Copper	M	2450	mg/kg	0.50	3.5		
Mercury	M	2450	mg/kg	0.10	< 0.10		
Nickel	M	2450	mg/kg	0.50	1.0		
Lead	M	2450	mg/kg	0.50	7.0		
Selenium	M	2450	mg/kg	0.20	< 0.20		
Vanadium	U	2450	mg/kg	5.0	< 5.0		
Zinc	M	2450	mg/kg	0.50	3.0		
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50		
Organic Matter	M	2625	%	0.40	0.98	0.41	< 0.40
Fuel Type	N	2670		N/A	DIESEL	n/a	n/a
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	43	< 1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	100	< 1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	530	< 1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	480	< 1.0	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	280	< 1.0	< 1.0

Results - Soil

Client: LK Consult		Chemtest Job No.:			19-25162	19-25162	19-25162
Quotation No.:		Chemtest Sample ID.:			864069	864070	864071
		Client Sample ID.:			TP107	TP107	TP107
		Sample Type:			SOIL	SOIL	SOIL
		Top Depth (m):			0.50	1.00	1.50
		Date Sampled:			24-Jul-2019	24-Jul-2019	24-Jul-2019
		Asbestos Lab:			COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	1400	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	26	< 1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	140	< 1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	140	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	87	< 1.0	< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	130	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	530	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	2000	< 10	< 10
Dichlorodifluoromethane	U	2760	µg/kg	1.0	< 1.0		
Chloromethane	M	2760	µg/kg	1.0	< 1.0		
Vinyl Chloride	M	2760	µg/kg	1.0	< 1.0		
Bromomethane	M	2760	µg/kg	20	< 20		
Chloroethane	U	2760	µg/kg	2.0	< 2.0		
Trichlorofluoromethane	M	2760	µg/kg	1.0	< 1.0		
1,1-Dichloroethene	M	2760	µg/kg	1.0	< 1.0		
Trans 1,2-Dichloroethene	M	2760	µg/kg	1.0	< 1.0		
1,1-Dichloroethane	M	2760	µg/kg	1.0	< 1.0		
cis 1,2-Dichloroethene	M	2760	µg/kg	1.0	< 1.0		
Bromochloromethane	U	2760	µg/kg	5.0	< 5.0		
Trichloromethane	M	2760	µg/kg	1.0	< 1.0		
1,1,1-Trichloroethane	M	2760	µg/kg	1.0	< 1.0		
Tetrachloromethane	M	2760	µg/kg	1.0	< 1.0		
1,1-Dichloropropene	U	2760	µg/kg	1.0	< 1.0		
Benzene	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloroethane	M	2760	µg/kg	2.0	< 2.0		
Trichloroethene	N	2760	µg/kg	1.0	< 1.0		
1,2-Dichloropropane	M	2760	µg/kg	1.0	< 1.0		
Dibromomethane	M	2760	µg/kg	1.0	< 1.0		
Bromodichloromethane	M	2760	µg/kg	5.0	< 5.0		
cis-1,3-Dichloropropene	N	2760	µg/kg	10	< 10		
Toluene	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
Trans-1,3-Dichloropropene	N	2760	µg/kg	10	< 10		
1,1,2-Trichloroethane	M	2760	µg/kg	10	< 10		
Tetrachloroethene	M	2760	µg/kg	1.0	< 1.0		
1,3-Dichloropropane	U	2760	µg/kg	2.0	< 2.0		

Results - Soil

Client: LK Consult				Chemtest Job No.:	19-25162	19-25162	19-25162
Quotation No.:				Chemtest Sample ID.:	864069	864070	864071
				Client Sample ID.:	TP107	TP107	TP107
				Sample Type:	SOIL	SOIL	SOIL
				Top Depth (m):	0.50	1.00	1.50
				Date Sampled:	24-Jul-2019	24-Jul-2019	24-Jul-2019
				Asbestos Lab:	COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Dibromochloromethane	U	2760	µg/kg	10	< 10		
1,2-Dibromoethane	M	2760	µg/kg	5.0	< 5.0		
Chlorobenzene	M	2760	µg/kg	1.0	< 1.0		
1,1,1,2-Tetrachloroethane	M	2760	µg/kg	2.0	< 2.0		
Ethylbenzene	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
o-Xylene	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
Styrene	M	2760	µg/kg	1.0	< 1.0		
Tribromomethane	U	2760	µg/kg	1.0	< 1.0		
Isopropylbenzene	M	2760	µg/kg	1.0	< 1.0		
Bromobenzene	M	2760	µg/kg	1.0	< 1.0		
1,2,3-Trichloropropane	N	2760	µg/kg	50	< 50		
N-Propylbenzene	U	2760	µg/kg	1.0	240		
2-Chlorotoluene	M	2760	µg/kg	1.0	< 1.0		
1,3,5-Trimethylbenzene	M	2760	µg/kg	1.0	< 1.0		
4-Chlorotoluene	U	2760	µg/kg	1.0	< 1.0		
Tert-Butylbenzene	U	2760	µg/kg	1.0	< 1.0		
1,2,4-Trimethylbenzene	M	2760	µg/kg	1.0	< 1.0		
Sec-Butylbenzene	U	2760	µg/kg	1.0	< 1.0		
1,3-Dichlorobenzene	M	2760	µg/kg	1.0	< 1.0		
4-Isopropyltoluene	U	2760	µg/kg	1.0	< 1.0		
1,4-Dichlorobenzene	M	2760	µg/kg	1.0	< 1.0		
N-Butylbenzene	U	2760	µg/kg	1.0	< 1.0		
1,2-Dichlorobenzene	M	2760	µg/kg	1.0	< 1.0		
1,2-Dibromo-3-Chloropropane	U	2760	µg/kg	50	< 50		
1,2,4-Trichlorobenzene	M	2760	µg/kg	1.0	< 1.0		
Hexachlorobutadiene	U	2760	µg/kg	1.0	< 1.0		
1,2,3-Trichlorobenzene	U	2760	µg/kg	2.0	< 2.0		
Carbon Disulphide	N	2760	µg/kg	50	< 50		
Methyl Tert-Butyl Ether	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
N-Nitrosodimethylamine	M	2790	mg/kg	0.50	< 0.50		
Phenol	M	2790	mg/kg	0.50	< 0.50		
2-Chlorophenol	M	2790	mg/kg	0.50	< 0.50		
Bis-(2-Chloroethyl)Ether	M	2790	mg/kg	0.50	< 0.50		
1,3-Dichlorobenzene	M	2790	mg/kg	0.50	< 0.50		
1,4-Dichlorobenzene	N	2790	mg/kg	0.50	< 0.50		
1,2-Dichlorobenzene	M	2790	mg/kg	0.50	< 0.50		
2-Methylphenol	M	2790	mg/kg	0.50	< 0.50		
Bis(2-Chloroisopropyl)Ether	M	2790	mg/kg	0.50	< 0.50		

Results - Soil

Client: LK Consult			Chemtest Job No.:		19-25162	19-25162	19-25162
Quotation No.:			Chemtest Sample ID.:		864069	864070	864071
			Client Sample ID.:		TP107	TP107	TP107
			Sample Type:		SOIL	SOIL	SOIL
			Top Depth (m):		0.50	1.00	1.50
			Date Sampled:		24-Jul-2019	24-Jul-2019	24-Jul-2019
			Asbestos Lab:		COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Hexachloroethane	N	2790	mg/kg	0.50	< 0.50		
N-Nitrosodi-n-propylamine	M	2790	mg/kg	0.50	< 0.50		
4-Methylphenol	M	2790	mg/kg	0.50	< 0.50		
Nitrobenzene	M	2790	mg/kg	0.50	< 0.50		
Isophorone	M	2790	mg/kg	0.50	< 0.50		
2-Nitrophenol	N	2790	mg/kg	0.50	< 0.50		
2,4-Dimethylphenol	N	2790	mg/kg	0.50	< 0.50		
Bis(2-Chloroethoxy)Methane	M	2790	mg/kg	0.50	< 0.50		
2,4-Dichlorophenol	M	2790	mg/kg	0.50	< 0.50		
1,2,4-Trichlorobenzene	M	2790	mg/kg	0.50	< 0.50		
Naphthalene	M	2790	mg/kg	0.50	< 0.50		
4-Chloroaniline	N	2790	mg/kg	0.50	< 0.50		
Hexachlorobutadiene	M	2790	mg/kg	0.50	< 0.50		
4-Chloro-3-Methylphenol	M	2790	mg/kg	0.50	< 0.50		
2-Methylnaphthalene	M	2790	mg/kg	0.50	< 0.50		
4-Nitrophenol	N	2790	mg/kg	0.50	< 0.50		
Hexachlorocyclopentadiene	N	2790	mg/kg	0.50	< 0.50		
2,4,6-Trichlorophenol	M	2790	mg/kg	0.50	< 0.50		
2,4,5-Trichlorophenol	M	2790	mg/kg	0.50	< 0.50		
2-Chloronaphthalene	M	2790	mg/kg	0.50	1.4		
2-Nitroaniline	M	2790	mg/kg	0.50	< 0.50		
Acenaphthylene	M	2790	mg/kg	0.50	< 0.50		
Dimethylphthalate	M	2790	mg/kg	0.50	< 0.50		
2,6-Dinitrotoluene	M	2790	mg/kg	0.50	< 0.50		
Acenaphthene	M	2790	mg/kg	0.50	< 0.50		
3-Nitroaniline	N	2790	mg/kg	0.50	< 0.50		
Dibenzofuran	M	2790	mg/kg	0.50	< 0.50		
4-Chlorophenylphenylether	M	2790	mg/kg	0.50	0.98		
2,4-Dinitrotoluene	M	2790	mg/kg	0.50	< 0.50		
Fluorene	M	2790	mg/kg	0.50	< 0.50		
Diethyl Phthalate	M	2790	mg/kg	0.50	< 0.50		
4-Nitroaniline	M	2790	mg/kg	0.50	< 0.50		
2-Methyl-4,6-Dinitrophenol	N	2790	mg/kg	0.50	< 0.50		
Azobenzene	M	2790	mg/kg	0.50	< 0.50		
4-Bromophenylphenyl Ether	M	2790	mg/kg	0.50	< 0.50		
Hexachlorobenzene	M	2790	mg/kg	0.50	2.1		
Pentachlorophenol	N	2790	mg/kg	0.50	< 0.50		
Phenanthrene	M	2790	mg/kg	0.50	< 0.50		
Anthracene	M	2790	mg/kg	0.50	< 0.50		

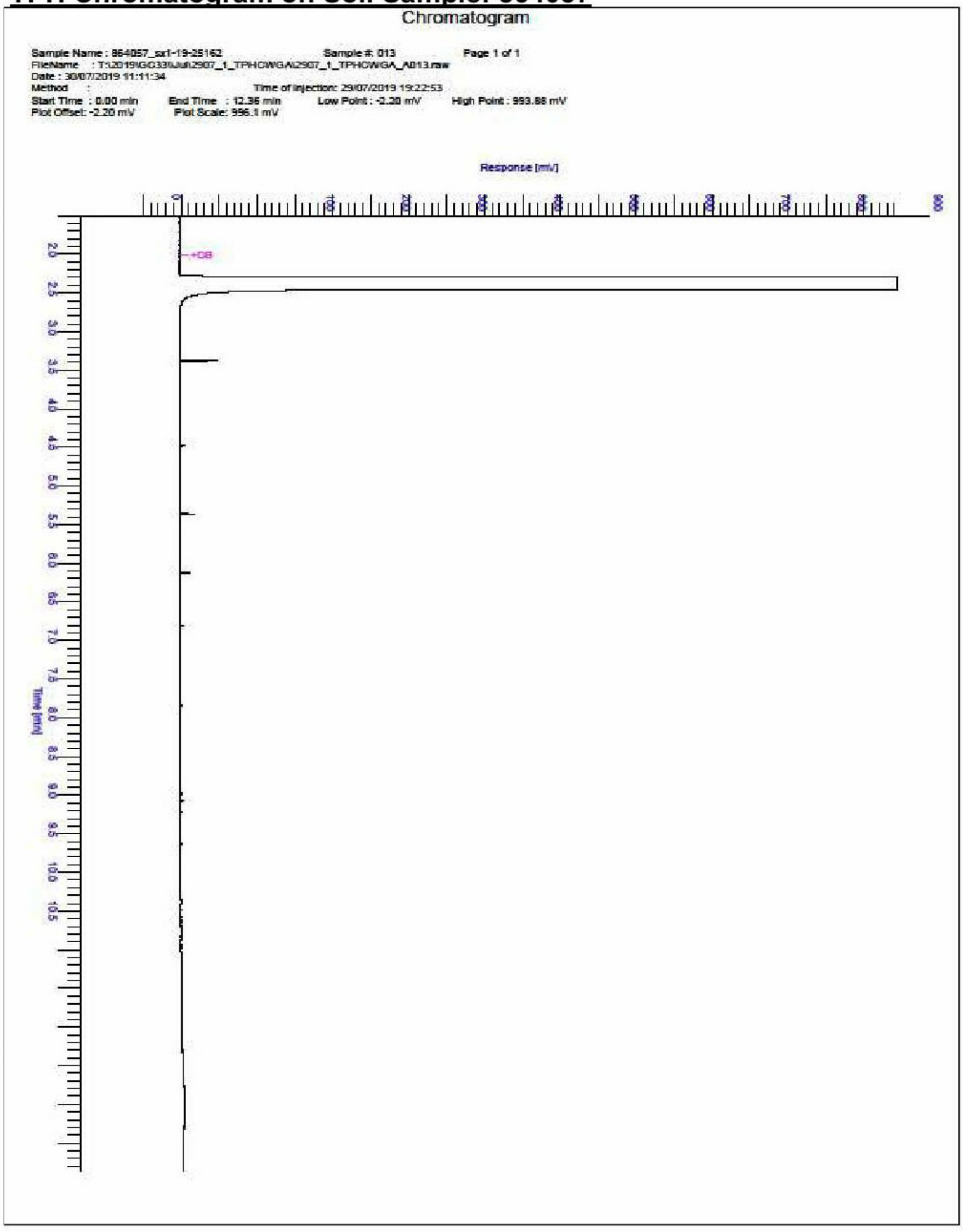
Results - Soil

Client: LK Consult			Chemtest Job No.:		19-25162	19-25162	19-25162
Quotation No.:			Chemtest Sample ID.:		864069	864070	864071
			Client Sample ID.:		TP107	TP107	TP107
			Sample Type:		SOIL	SOIL	SOIL
			Top Depth (m):		0.50	1.00	1.50
			Date Sampled:		24-Jul-2019	24-Jul-2019	24-Jul-2019
			Asbestos Lab:		COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Carbazole	M	2790	mg/kg	0.50	< 0.50		
Di-N-Butyl Phthalate	M	2790	mg/kg	0.50	2.2		
Fluoranthene	M	2790	mg/kg	0.50	< 0.50		
Pyrene	M	2790	mg/kg	0.50	< 0.50		
Butylbenzyl Phthalate	M	2790	mg/kg	0.50	< 0.50		
Benzo[a]anthracene	M	2790	mg/kg	0.50	< 0.50		
Chrysene	M	2790	mg/kg	0.50	< 0.50		
Bis(2-Ethylhexyl)Phthalate	N	2790	mg/kg	0.50	< 0.50		
Di-N-Octyl Phthalate	M	2790	mg/kg	0.50	< 0.50		
Benzo[b]fluoranthene	M	2790	mg/kg	0.50	2.8		
Benzo[k]fluoranthene	M	2790	mg/kg	0.50	< 0.50		
Benzo[a]pyrene	M	2790	mg/kg	0.50	< 0.50		
Indeno(1,2,3-c,d)Pyrene	M	2790	mg/kg	0.50	< 0.50		
Dibenz(a,h)Anthracene	M	2790	mg/kg	0.50	< 0.50		
Benzo[g,h,i]perylene	M	2790	mg/kg	0.50	< 0.50		
Naphthalene	M	2800	mg/kg	0.10			
Acenaphthylene	N	2800	mg/kg	0.10			
Acenaphthene	M	2800	mg/kg	0.10			
Fluorene	M	2800	mg/kg	0.10			
Phenanthrene	M	2800	mg/kg	0.10			
Anthracene	M	2800	mg/kg	0.10			
Fluoranthene	M	2800	mg/kg	0.10			
Pyrene	M	2800	mg/kg	0.10			
Benzo[a]anthracene	M	2800	mg/kg	0.10			
Chrysene	M	2800	mg/kg	0.10			
Benzo[b]fluoranthene	M	2800	mg/kg	0.10			
Benzo[k]fluoranthene	M	2800	mg/kg	0.10			
Benzo[a]pyrene	M	2800	mg/kg	0.10			
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10			
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10			
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10			
Total Of 16 PAH's	N	2800	mg/kg	2.0			
Demeton-O	N	2820	mg/kg	0.20			
Phorate	N	2820	mg/kg	0.20			
Demeton-S	N	2820	mg/kg	0.20			
Disulfoton	N	2820	mg/kg	0.20			
Fenthion	N	2820	mg/kg	0.20			
Trichloronate	N	2820	mg/kg	0.20			
Prothiofos	N	2820	mg/kg	0.20			

Results - Soil

Client: LK Consult		Chemtest Job No.:			19-25162	19-25162	19-25162
Quotation No.:		Chemtest Sample ID.:			864069	864070	864071
		Client Sample ID.:			TP107	TP107	TP107
		Sample Type:			SOIL	SOIL	SOIL
		Top Depth (m):			0.50	1.00	1.50
		Date Sampled:			24-Jul-2019	24-Jul-2019	24-Jul-2019
		Asbestos Lab:			COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Fensulphothion	N	2820	mg/kg	0.20			
Sulprofos	N	2820	mg/kg	0.20			
Azinphos-Methyl	N	2820	mg/kg	0.20			
Coumaphos	N	2820	mg/kg	0.20			
Alpha-HCH	N	2840	mg/kg	0.20			
Gamma-HCH (Lindane)	N	2840	mg/kg	0.20			
Beta-HCH	N	2840	mg/kg	0.20			
Delta-HCH	N	2840	mg/kg	0.20			
Heptachlor	N	2840	mg/kg	0.20			
Aldrin	N	2840	mg/kg	0.20			
Heptachlor Epoxide	N	2840	mg/kg	0.20			
Gamma-Chlordane	N	2840	mg/kg	0.20			
Alpha-Chlordane	N	2840	mg/kg	0.20			
Endosulfan I	N	2840	mg/kg	0.20			
4,4-DDE	N	2840	mg/kg	0.20			
Dieldrin	N	2840	mg/kg	0.20			
Endrin	N	2840	mg/kg	0.20			
4,4-DDD	N	2840	mg/kg	0.20			
Endosulfan II	N	2840	mg/kg	0.20			
Endrin Aldehyde	N	2840	mg/kg	0.20			
4,4-DDT	N	2840	mg/kg	0.20			
Endosulfan Sulphate	N	2840	mg/kg	0.20			
Methoxychlor	N	2840	mg/kg	0.20			
Endrin Ketone	N	2840	mg/kg	0.20			
Total Phenols	M	2920	mg/kg	0.30	< 0.30		

TPH Chromatogram on Soil Sample: 864057



Chemtest
The right chemistry to deliver results

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
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Allkaline 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– C44Aromatics: >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.
2790	Semi-Volatile Organic Compounds (SVOCs) in Soils by GC-MS	Semi-volatile organic compounds(cf. USEPA Method 8270)	Acetone/Hexane extraction / GC-MS
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*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2820	Organophosphorus (O-P) Pesticides in Soils by GC-MS	Organophosphorus pesticide representative suite including Parathion, Malathion etc, plus client specific determinands	Dichloromethane extraction / GC-MS
2840	Organochlorine (O-Cl) Pesticides in Soils by GC-MS	Organochlorine pesticide representative suite including DDT and its metabolites, 'drins' and HCH etc, plus client specific determinands	Dichloromethane extraction / GC-MS
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: 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"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

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

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

Chemtest
The right chemistry to deliver results
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

UKAS TESTING 2183

mCERTS THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME

Final Report

Report No.:	19-24724-1
Initial Date of Issue:	26-Jul-2019
Client	LK Consult
Client Address:	Unit 29 Eton Business Park Eton Hill Road Radcliffe Manchester Lancashire M26 2ZS
Contact(s):	Chris Hughes Contaminated Land
Project	LK 19 1314 Barns Lane, Dunham Massey

Quotation No.:		**Date Received:**	23-Jul-2019
Order No.:	737094	**Date Instructed:**	24-Jul-2019
No. of Samples:	15		
Turnaround (Wkdays):	3	**Results Due:**	26-Jul-2019
Date Approved:	26-Jul-2019		

Approved By:

[redacted]

Details: Martin Dyer, Laboratory Manager

Results - Soil

Client: LK Consult		Chemtest Job No.:	19-24724	19-24724	19-24724	19-24724	19-24724	19-24724	19-24724	19-24724	19-24724
Quotation No.:		Chemtest Sample ID.:	862359	862360	862361	862363	862364	862365	862366	862367	862369
		Client Sample ID.:	WS101	WS101	WS102	WS103	WS103	WS104	WS104	WS104	WS105
		Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):	0.40	1.20	0.25	0.30	0.80	0.20	0.60	2.90	0.60
		Bottom Depth (m):	1.00	2.00	1.00	0.80	1.80	0.60	1.60	3.90	1.60
		Date Sampled:	19-Jul-2019	19-Jul-2019	19-Jul-2019	19-Jul-2019	19-Jul-2019	19-Jul-2019	19-Jul-2019	19-Jul-2019	19-Jul-2019
		Asbestos Lab:	DURHAM		DURHAM	DURHAM		DURHAM	DURHAM	DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**									
ACM Type	U	2192		N/A	-		-	-		-	-	-	-
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected		No Asbestos Detected	No Asbestos Detected		No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-		-	-		-	-	-	-
Moisture	N	2030	%	0.020	6.4	16	8.0	21	19	22	17	19	14
Soil Colour	N	2040		N/A	Brown,	Brown,	Brown,	Brown,	Brown,	Brown,	Brown,	Brown,	Brown,
Other Material	N	2040		N/A	Stones,	Stones,	Stones,	Stones,	Stones,	Stones,	Stones,	Stones,	Stones,
Soil Texture	N	2040		N/A	Sand,	Sand,	Sand,	Clay,	Sand,	Sand,	Sand,	Clay,	Sand,
Chromatogram (TPH)	N			N/A			See Attached			See Attached			See Attached
pH	M	2010		N/A	11.1	7.9	9.3	8.3	8.2	7.3			7.3
Boron (Hot Water Soluble)	M	2120	mg/kg	0.40			< 0.40			0.78			< 0.40
Sulphate (2:1 Water Soluble) as SO4	M	2120	g/l	0.010	0.12	< 0.010	0.083	0.31	< 0.010	0.048			< 0.010
Cyanide (Free)	M	2300	mg/kg	0.50			< 0.50			< 0.50			< 0.50
Cyanide (Total)	M	2300	mg/kg	0.50			< 0.50			< 0.50			< 0.50
Arsenic	M	2450	mg/kg	1.0	14		13	12		13			1.1
Cadmium	M	2450	mg/kg	0.10	0.36		0.54	0.34		0.32			< 0.10
Chromium	M	2450	mg/kg	1.0	12		7.8	19		13			2.5
Copper	M	2450	mg/kg	0.50	23		11	41		37			1.3
Mercury	M	2450	mg/kg	0.10	< 0.10		< 0.10	0.21		0.29			< 0.10
Nickel	M	2450	mg/kg	0.50	17		13	18		13			2.7
Lead	M	2450	mg/kg	0.50	49		32	78		80			2.3
Selenium	M	2450	mg/kg	0.20	< 0.20		< 0.20	0.55		0.42			< 0.20
Vanadium	U	2450	mg/kg	5.0	19		10	31		19			6.4
Zinc	M	2450	mg/kg	0.50	51		44	82		82			11
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50		< 0.50	< 0.50		< 0.50			< 0.50
Organic Matter	M	2625	%	0.40	2.9		0.62	6.4		6.4	< 0.40	1.3	< 0.40
Fuel Type	N	2670		N/A			N/A			DIESEL	PAH	N/A	N/A
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0			< 1.0			< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0			< 1.0			< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0			< 1.0			96	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0			< 1.0			250	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0			< 1.0			370	17	< 1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0			< 1.0			320	7.3	< 1.0	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0			< 1.0			160	67	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0			< 1.0			< 1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0			< 5.0			1200	91	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0			< 1.0			< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0			< 1.0			< 1.0	< 1.0	< 1.0	< 1.0

Results - Soil

Client: LK Consult			Chemtest Job No.:		19-24724	19-24724	19-24724	19-24724	19-24724	19-24724	19-24724	19-24724	19-24724
Quotation No.:			Chemtest Sample ID.:		862359	862360	862361	862363	862364	862365	862366	862367	862369
			Client Sample ID.:		WS101	WS101	WS102	WS103	WS103	WS104	WS104	WS104	WS105
			Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		0.40	1.20	0.25	0.30	0.80	0.20	0.60	2.90	0.60
			Bottom Depth (m):		1.00	2.00	1.00	0.80	1.80	0.60	1.60	3.90	1.60
			Date Sampled:		19-Jul-2019	19-Jul-2019	19-Jul-2019	19-Jul-2019	19-Jul-2019	19-Jul-2019	19-Jul-2019	19-Jul-2019	19-Jul-2019
			Asbestos Lab:		DURHAM		DURHAM	DURHAM		DURHAM	DURHAM	DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**									
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0			< 1.0			< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0			< 1.0			9.9	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0			< 1.0			100	< 1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0			< 1.0			52	< 1.0	< 1.0	< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0			< 1.0			78	3.1	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0			< 1.0			< 1.0	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0			< 5.0			240	< 5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0			< 10			1400	95	< 10	< 10
Benzene	M	2760	µg/kg	1.0			< 1.0			< 1.0	< 1.0	< 1.0	< 1.0
Toluene	M	2760	µg/kg	1.0			< 1.0			< 1.0	< 1.0	8.5	< 1.0
Ethylbenzene	M	2760	µg/kg	1.0			< 1.0			< 1.0	< 1.0	2.6	< 1.0
m & p-Xylene	M	2760	µg/kg	1.0			5.7			< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	M	2760	µg/kg	1.0			3.0			< 1.0	< 1.0	4.9	< 1.0
Methyl Tert-Butyl Ether	M	2760	µg/kg	1.0			< 1.0			< 1.0	< 1.0	< 1.0	< 1.0
Naphthalene	M	2800	mg/kg	0.10	0.56		< 0.10	0.37		< 0.10			< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	0.28		< 0.10	0.11		< 0.10			< 0.10
Acenaphthene	M	2800	mg/kg	0.10	2.0		< 0.10	0.67		< 0.10			< 0.10
Fluorene	M	2800	mg/kg	0.10	2.5		< 0.10	0.92		< 0.10			< 0.10
Phenanthrene	M	2800	mg/kg	0.10	18		0.11	12		< 0.10			< 0.10
Anthracene	M	2800	mg/kg	0.10	5.2		< 0.10	3.8		< 0.10			< 0.10
Fluoranthene	M	2800	mg/kg	0.10	20		0.43	25		< 0.10			< 0.10
Pyrene	M	2800	mg/kg	0.10	16		0.40	21		< 0.10			< 0.10
Benzo[a]anthracene	M	2800	mg/kg	0.10	8.5		< 0.10	12		< 0.10			< 0.10
Chrysene	M	2800	mg/kg	0.10	8.7		< 0.10	11		< 0.10			< 0.10
Benzo[b]fluoranthene	M	2800	mg/kg	0.10	9.3		< 0.10	15		< 0.10			< 0.10
Benzo[k]fluoranthene	M	2800	mg/kg	0.10	3.4		< 0.10	5.6		< 0.10			< 0.10
Benzo[a]pyrene	M	2800	mg/kg	0.10	5.4		< 0.10	8.0		< 0.10			< 0.10
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10	4.6		< 0.10	8.0		< 0.10			< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	0.48		< 0.10	0.89		< 0.10			< 0.10
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10	4.6		< 0.10	7.0		< 0.10			< 0.10
Total Of 16 PAH's	N	2800	mg/kg	2.0	110		< 2.0	130		< 2.0			< 2.0
Total Phenols	M	2920	mg/kg	0.30			< 0.30			< 0.30			< 0.30

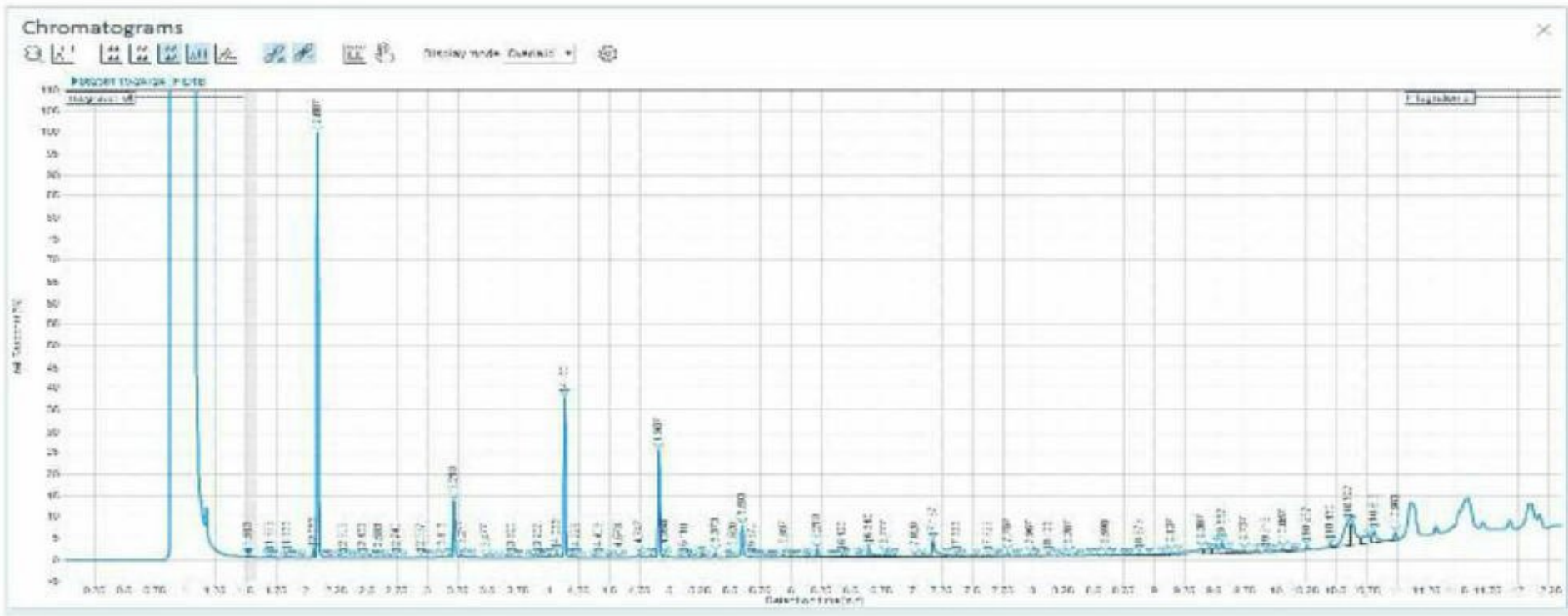
Results - Soil

Client: LK Consult		Chemtest Job No.:			19-24724	19-24724	19-24724	19-24724	19-24724	19-24724
Quotation No.:		Chemtest Sample ID.:			862370	862372	862373	862374	862377	862378
		Client Sample ID.:			WS106	WS107f	WS107f	WS108	HD101	HD101
		Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0.20	0.00	1.00	0.30	0.40	0.80
		Bottom Depth (m):			0.80	0.90	2.00	1.30	0.80	1.00
		Date Sampled:			19-Jul-2019	19-Jul-2019	19-Jul-2019	19-Jul-2019	19-Jul-2019	19-Jul-2019
		Asbestos Lab:			DURHAM	DURHAM		DURHAM	DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
ACM Type	U	2192		N/A	-	-		-	-	-
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected	No Asbestos Detected		No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-	-		-	-	-
Moisture	N	2030	%	0.020	23	9.1	14	24	22	16
Soil Colour	N	2040		N/A	Brown,	Brown,	Brown,	Brown,	Brown,	Brown,
Other Material	N	2040		N/A	Stones, Brick,	Stones,	Stones,	Stones,	Stones,	Stones,
Soil Texture	N	2040		N/A	Sand,	Sand,	Sand,	Clay,	Sand,	Sand,
Chromatogram (TPH)	N			N/A					See Attached	
pH	M	2010		N/A	7.3	9.2	8.1	8.2	7.7	
Boron (Hot Water Soluble)	M	2120	mg/kg	0.40					0.70	
Sulphate (2:1 Water Soluble) as SO4	M	2120	g/l	0.010	0.070	0.097	< 0.010	0.010	0.18	
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	15	11		13	16	
Cadmium	M	2450	mg/kg	0.10	0.37	0.31		0.14	0.41	
Chromium	M	2450	mg/kg	1.0	18	10		41	15	
Copper	M	2450	mg/kg	0.50	49	22		25	49	
Mercury	M	2450	mg/kg	0.10	0.30	0.16		< 0.10	0.36	
Nickel	M	2450	mg/kg	0.50	19	11		49	16	
Lead	M	2450	mg/kg	0.50	98	45		24	180	
Selenium	M	2450	mg/kg	0.20	0.47	< 0.20		< 0.20	0.43	
Vanadium	U	2450	mg/kg	5.0	24	15		43	22	
Zinc	M	2450	mg/kg	0.50	93	38		60	93	
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50		< 0.50	< 0.50	
Organic Matter	M	2625	%	0.40	8.6	0.95		1.3	5.7	0.93
Fuel Type	N	2670		N/A					PAH	PAH
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0					< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0					< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0					< 1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0					< 1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0					< 1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0					3.7	2.7
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0					36	25
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0					< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0					40	28
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0					< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0					< 1.0	< 1.0

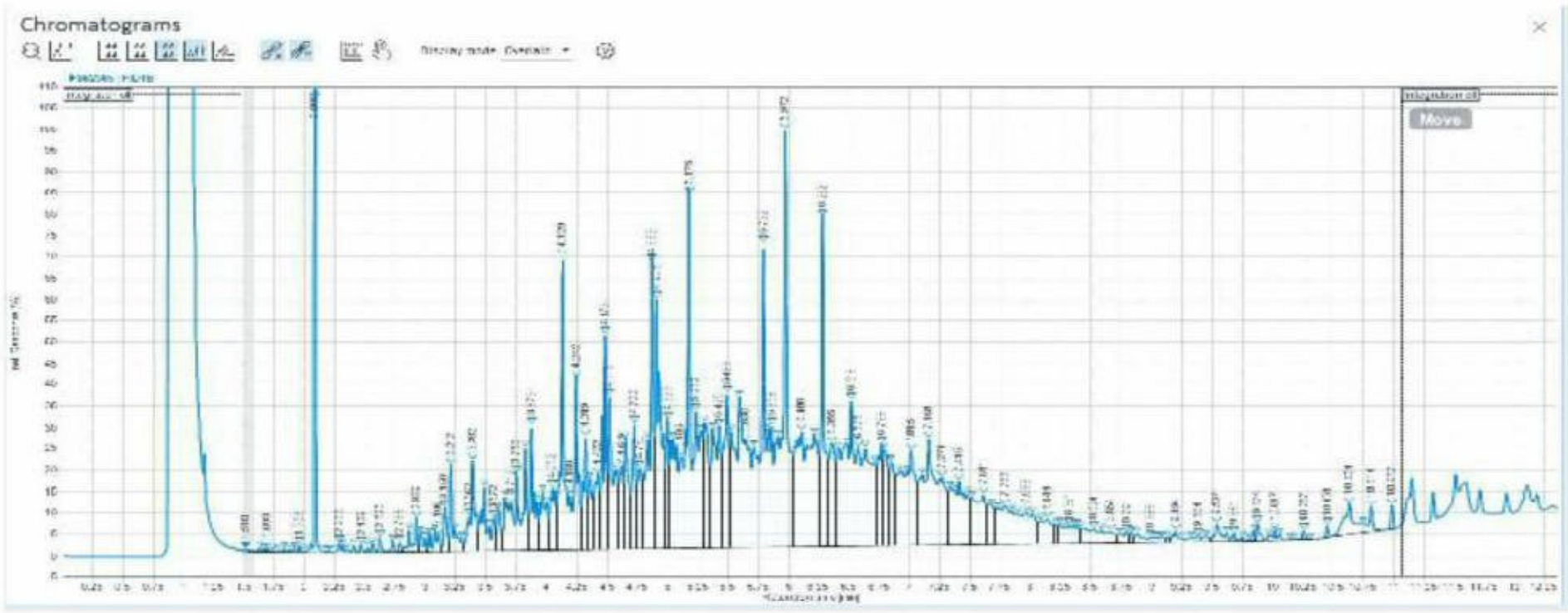
Results - Soil

Client: LK Consult			Chemtest Job No.:		19-24724	19-24724	19-24724	19-24724	19-24724	19-24724
Quotation No.:			Chemtest Sample ID.:		862370	862372	862373	862374	862377	862378
			Client Sample ID.:		WS106	WS107f	WS107f	WS108	HD101	HD101
			Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		0.20	0.00	1.00	0.30	0.40	0.80
			Bottom Depth (m):		0.80	0.90	2.00	1.30	0.80	1.00
			Date Sampled:		19-Jul-2019	19-Jul-2019	19-Jul-2019	19-Jul-2019	19-Jul-2019	19-Jul-2019
			Asbestos Lab:		DURHAM	DURHAM		DURHAM	DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0					< 1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0					< 1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0					< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0					< 1.0	< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0					60	28
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0					< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0					60	28
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0					99	56
Benzene	M	2760	µg/kg	1.0					< 1.0	< 1.0
Toluene	M	2760	µg/kg	1.0					< 1.0	< 1.0
Ethylbenzene	M	2760	µg/kg	1.0					< 1.0	< 1.0
m & p-Xylene	M	2760	µg/kg	1.0					< 1.0	< 1.0
o-Xylene	M	2760	µg/kg	1.0					< 1.0	< 1.0
Methyl Tert-Butyl Ether	M	2760	µg/kg	1.0					< 1.0	< 1.0
Naphthalene	M	2800	mg/kg	0.10	< 0.10	< 0.10		< 0.10	0.19	
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10	0.56		0.28	< 0.10	
Acenaphthene	M	2800	mg/kg	0.10	< 0.10	0.98		0.22	0.14	
Fluorene	M	2800	mg/kg	0.10	< 0.10	1.8		0.60	0.13	
Phenanthrene	M	2800	mg/kg	0.10	< 0.10	13		7.0	4.5	
Anthracene	M	2800	mg/kg	0.10	< 0.10	4.0		2.2	0.75	
Fluoranthene	M	2800	mg/kg	0.10	1.3	12		7.3	5.9	
Pyrene	M	2800	mg/kg	0.10	1.2	9.3		5.0	4.8	
Benzo[a]anthracene	M	2800	mg/kg	0.10	0.19	4.4		2.2	1.7	
Chrysene	M	2800	mg/kg	0.10	0.16	3.8		1.8	1.9	
Benzo[b]fluoranthene	M	2800	mg/kg	0.10	< 0.10	3.3		1.4	1.5	
Benzo[k]fluoranthene	M	2800	mg/kg	0.10	< 0.10	0.98		0.32	0.39	
Benzo[a]pyrene	M	2800	mg/kg	0.10	< 0.10	1.5		0.68	0.88	
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10	< 0.10	1.3		0.34	0.64	
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10	< 0.10		< 0.10	< 0.10	
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10	< 0.10	1.1		0.35	0.56	
Total Of 16 PAH's	N	2800	mg/kg	2.0	2.9	58		30	24	
Total Phenols	M	2920	mg/kg	0.30					< 0.30	

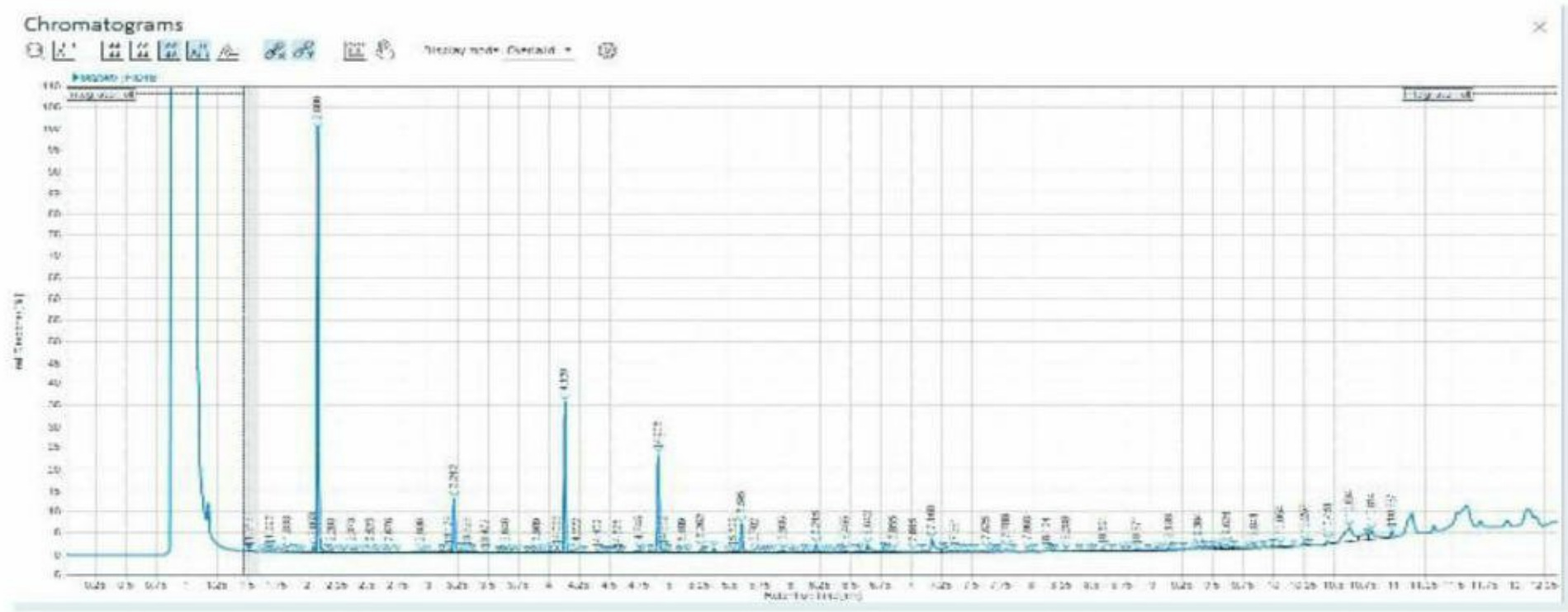
TPH Chromatogram on Soil Sample: 862361



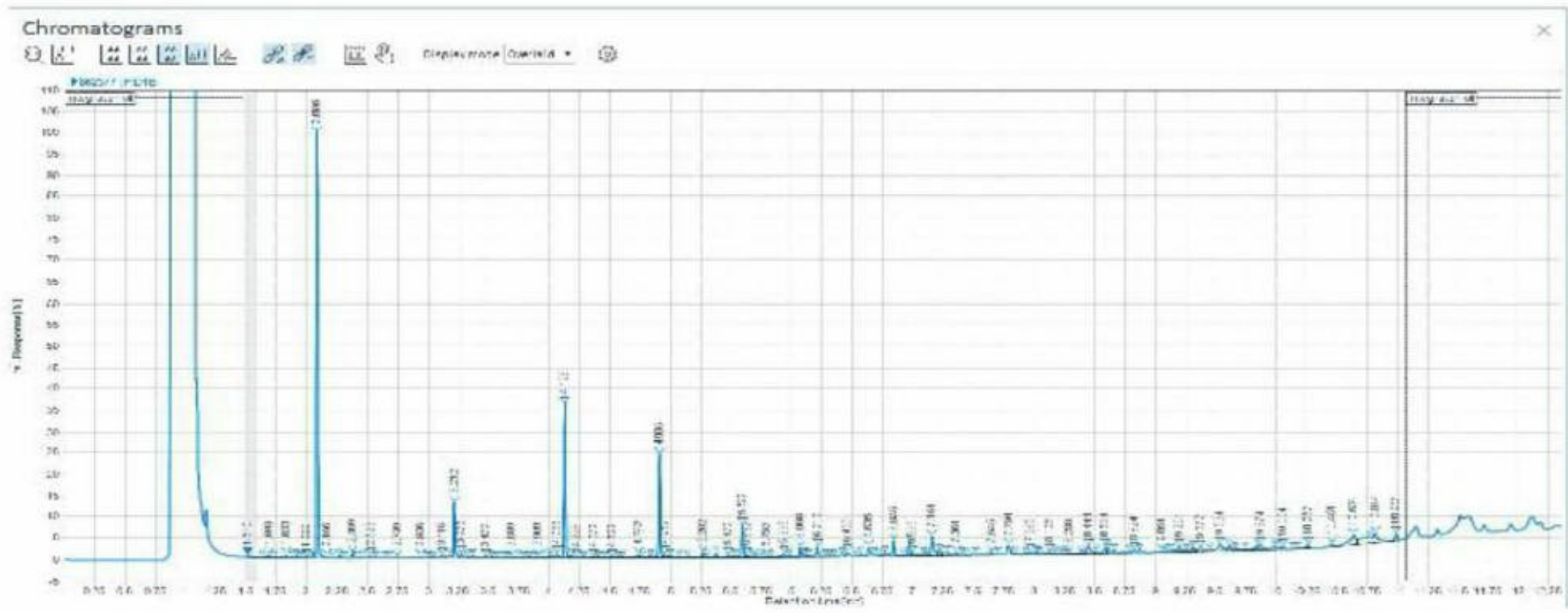
TPH Chromatogram on Soil Sample: 862365



TPH Chromatogram on Soil Sample: 862369



TPH Chromatogram on Soil Sample: 862377



Chemtest
The right chemistry to deliver results

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
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Allkaline 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– C44Aromatics: >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.
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*; Dibenz[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 TrimethylphenolsNote: 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"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

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

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com