NELSON STREET
MANCHESTER

FINAL ADDITIONAL SITE INVESTIGATION AND UPDATED REMEDIATION STRATEGY

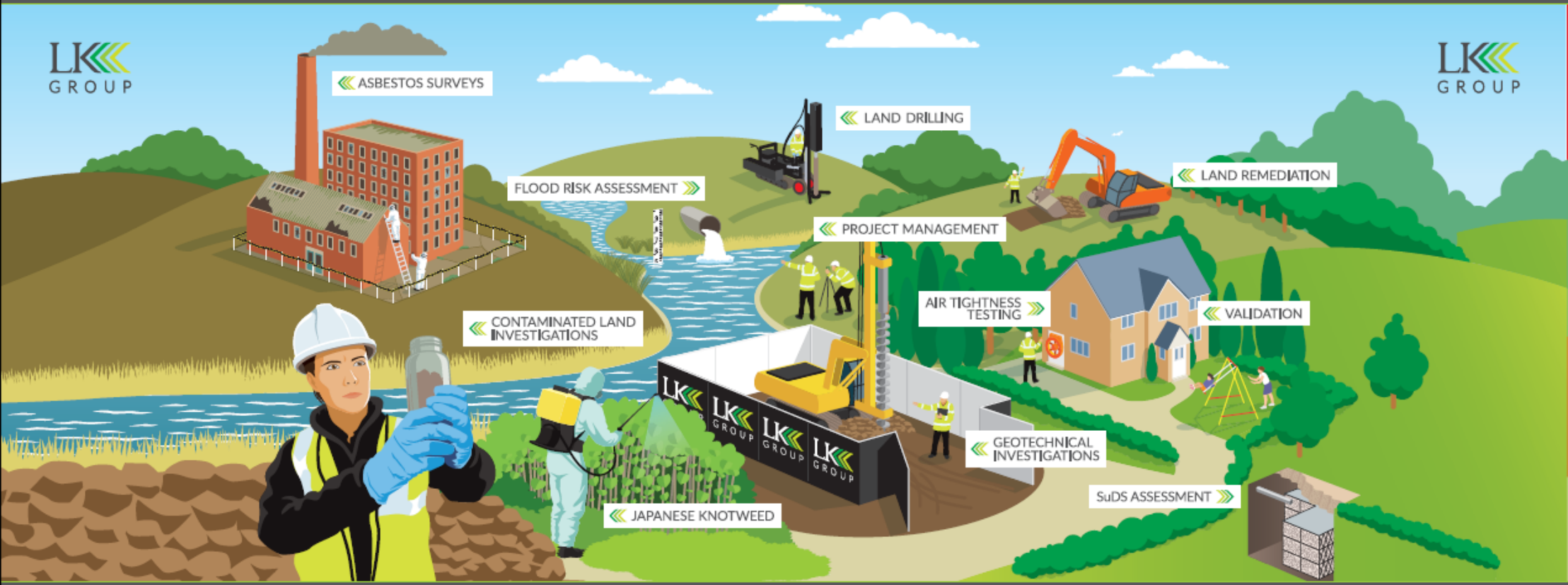
Job Number: LKC 22 1670
Date: September 2023
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Revision No.	**Date**	**Nature of Revision**	**Approved By**

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EXECUTIVE SUMMARY

Site Details

Site Location:	Site is bound by Sawley Road to the north, James Street to the south and Nelson Street to the west. Centred at approximate National Grid Reference 386035E 399525N.
Site Area:	Approximately 4,300m^2.
Current Land Use:	Vacant land.
Proposed Development:	No proposed development at this stage. It is understood that the site may be developed into an educational facility in the future.
Purpose of Report:	Contamination Assessment.

Preliminary Risk Assessment

PRA Details:	Undertaken by EnviroSolution Ltd (ref. CL101_V1, dated 2nd March 2023).
History:	School on site. Surrounding area: terraced housing, various works.
Geology / Hydrogeology:	Glacial Till (Secondary Undifferentiated Aquifer) over Pennie Middle Coal Measures (Secondary A Aquifer).
Mining:	1no. mine shaft is mapped to be located on site. 1no. mine shaft is mapped on the SE site boundary. Part of the site is classified as a 'Development High Risk Area' due to the presence of mine shafts, past shallow coal mine workings and probable shallow coal mine workings.
Relevant Environmental Setting:	Rochdale Canal 110m south. No groundwater abstraction licenses or discharge permits within 300m. No recorded landfills / historic landfill sites. Not within Source Protection Zone.
Recommendations:	The site was classified as moderate risk in terms of contamination and the risk to identified receptors (e.g. human health, controlled waters, buildings). Site investigation was recommended.

Additional Ground Investigation Work Undertaken

Date of Investigation:	25th May 2023.
Intrusive Investigation Work Undertaken:	4no. window sample boreholes (WS107-WS110).
Monitoring Wells:	Installed in all boreholes.
Monitoring:	6no. gas monitoring visits.
Insitu Geotechnical Testing:	SPTs, pocket penetrometer tests.

Contamination Risk Assessment

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

Pollutant Linkage		Risk	Assessment
1	Contaminants posing a risk to future site users and offsite receptors via dermal contact, ingestion and inhalation (of soil, dust, fibres and home-grown produce).	**Moderate** (metals, PAHs, TPH)	- Elevated contaminants identified. - **Recommendations:** Remediation required in soft landscaping areas. Watching brief during earthworks.
		Low (ACM**)**	- No asbestos identified. - **Recommendations:** No remediation required. Watching brief during earthworks.
2	Volatile contaminants posing a risk to future site users and offsite receptors via the inhalation of vapours.	**Moderate / Low**	- Volatile contamination identified. - **Recommendations:** Precautionary remediation to include installing a vapour resistant membrane in proposed buildings, Watching brief during earthworks.
3	Gas posing a risk to buildings and future site users, buildings and offsite land users via the migration of gas into building causing explosion and asphyxiation.	**Moderate**	- Elevated carbon dioxide identified in all monitoring wells and mine shaft located on site. - **Recommendations:** Gas protection measures in line with CS2. Should hazardous ground gases be encountered as part of routine monitoring undertaken as part of coal mining remediation, then further gas monitoring and/ or upgrading of gas protection rating may be required
4	Mobile contamination posing a risk to controlled waters via the migration through permeable strata.	**Low**	- No significant risk to groundwater given the environmental settings and ground conditions encountered. - **Recommendations:** No remediation required. Watching brief during earthworks, particularly for petroleum hydrocarbons.
5	Organic contaminants posing a risk to water pipes.	**Moderate**	- Elevated organic contaminants identified. - **Recommendations:** UU risk assessment to be completed. The site will likely require barrier piping.

Recommendations and Remedial Strategy

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

Phase	Remediation Requirements	Validation Requirements
Pre-Construction (enabling)	<u>Excavation, processing and stockpiling</u> This will include the grubbing out and processing of hardstanding and unsuitable material. Any oversize material, if encountered will be processed and re-used as appropriate. Appropriate site won material will be stockpiled for potential reuse. Additionally, suspect material will be quarantined for characterisation prior to possible offsite disposal.	Log of work undertaken including photographs. Re-use of material will be under U1 and T5. Testing of site won/ imported soil as per Table 6-2.

Phase	Remediation Requirements	Validation Requirements
Pre-Construction (enabling)	Earthworks Site Inspections & Unexpected Contamination A watching brief should be maintained by a suitably qualified and experienced person during enabling works to identify any unusual ground conditions. If any visual or olfactory evidence of contamination be encountered at the site, further assessment of the material may be required. Particular attention should be paid to hydrocarbons, as visual and olfactory evidence of contamination identified during site investigations. Should hazardous ground gases be encountered as part of routine monitoring undertaken as part of coal mining remediation, then further gas monitoring and/ or upgrading of gas protection rating may be required	Log of work undertaken including photographs. Details of any sampling undertaken and validation of any potential additional remedial work. Further assessment of gas risk if hazardous ground gas encountered.
	Segregation and removal of unsuitable materials As part of the watching brief during earthworks, areas of unexpected contamination (including hazardous waste) and geotechnically unsuitable material will be delineated, excavated and removed following suitable testing and verification.	Log of work undertaken including photographs. Consignment notes confirming removal of unsuitable material.
Build-Phase	Vapour Membrane Elevated petroleum hydrocarbon (aromatic C10-12) and VOCs were identified on site. Given the ground conditions encountered, further contamination may be present across the site. It is therefore recommended that buildings are to include a vapour resistant membrane.	Plan including foundation design. Photographic evidence showing installation of membrane.
	Gas Protection Measures In line with CS2 as per UK guidance[1,2]. This is likely to / should include: • 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. Depending on the type of building and foundation design the protection measures can vary. The gas protection measures will be detailed and approved with the Local Authority once the foundation design has been confirmed.	Supply and review of foundation designs. Photographic evidence of sub-floor void, ventilation and suitably sealed gas membrane. Validation of gas protection measures should be in line with CIRIA 735[3]

[1] CIRIA (2007). "Assessing Risks Posed by Hazardous Ground Gases to Buildings." CIRIA C665
[2] BSI (2015). "Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for new buildings." BS8485:2015.
[3] CIRIA (2014). "Good Practice on the Testing and Verification of Protection Systems for Building Against Hazardous Ground Gas". CIRIA C735.

Phase	Remediation Requirements	Validation Requirements
Build-Phase	Environmental Cover System Shared Landscaping: 450mm thick environmental cover system comprising: geotextile membrane and at least 450mm comprising clean inert fill and sufficient topsoil for a growing medium.	Measured thickness of environmental cover system via hand dug pits and staff and/or as-built survey at each layer. Photographic evidence throughout each stage, showing geotextile membrane, subsoil and topsoil installation process and completion. Chemical validation of imported/ site-won soils.: See Table 6-2.
	United Utilities (UU) Risk Assessment UU Potable Water Risk Assessment to be undertaken once the location and depth of potable water pipes are known and following completion of the earthworks. Barrier pipe likely to be required.	To be completed following completion of the remediation earthworks.

The remediation recommended in the table above should be validated to ensure it has been carried out appropriately. This should be documented in a Completion/Validation Report and submitted to the local authority for completion.

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APPENDICES

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1 Introduction

1.1 Background

LK Consult Ltd (LKC) has been commissioned by ISG Ltd to carry out an additional site investigation and provide an updated Remediation Strategy for Nelson Street, Manchester. The investigation was undertaken in support of a future planning application. No proposed development plans are available at this stage however it is understood that the site may be developed into an educational facility in the future.

The additional site investigation was undertaken in order to allow an updated hazardous / ground gas risk assessment for the site. Additional site investigation works at Varley Street (parcel of land adjacent to the east of site) were undertaken by LKC at the same time at this investigation and is reported under separate cover.

The Remediation Strategy is required to determine the work necessary in order to ensure the site is “suitable for use” for the proposed development with regards to potential contaminated land pollutant linkages.

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

Site Location	Site is bound by Sawley Road to the north, James Street to the south and Nelson Street to the west. Centred at approximate National Grid Reference 386035E 399525N.
Approximate Area	Approximately 4,300m^2.
Topography	Approximately 58 metres Above Ordnance Datum (AOD). Site is approximately level.
Current Site Use	Vacant land.
Purpose of Report	Pre-planning.
Proposed Development	No proposed development at this stage. It is understood that the site may be developed into an educational facility in the future.

Table 1-1. Summary of site details.

2 Summary of Previous Work

The following reports have previously been provided for the site and should be read in conjunction with this report:

- 'Phase 1 Environmental Site Assessment Report' for Varley / Nelson Street Manchester, undertaken by EnviroSolution Ltd (ref. CL101_V1, dated 2nd March 2023).
- 'Phase 2 Geo-Environmental Site Assessment Report' for Varley / Nelson Street Manchester, undertaken by EnviroSolution Ltd (ref. CL102_V1, dated 1st April 2022).
- Shallow Mining and Mine Shaft Investigation Works report undertaken by LKC (ref. CL-602-LKC 22 1670-CMSI R1, dated 20th June 2023).

2.1 Summary of Phase 1 Environmental Site Assessment Report

The site history, site description and environmental settings are described in the Phase 1 Site Assessment Report (desk study), with pertinent information summarised below:

- Historical mapping indicates that a school was present on site from 1908 mapping onwards, and was demolished in the 2010s. Prior to the school being present on site, a coal pit was indicated in the north eastern corner of site on 1848 mapping only.
- Terraced housing is shown on land to the north of the site from 1893 mapping and timber yard is present to the north east of the site from 1908 mapping.
- A day nursery is present to the north of the site from 1948 mapping, and a second timber yard is present to the north east.
- By 1956 mapping, the houses, timber yards are no longer present, and the land to the north of the site is a playing field.
- Surrounding historical land uses include several works within 50m to the south and south west (chemical works, cloth works and glass works). The area to the north / north west of the site has been developed for residential housing from 1893 mapping.
- The surrounding works have mainly been redeveloped for residential / commercial use.
- BGS records indicate the site is underlain by superficial Till (Diamicton) and Pennine Upper Coal Measures Formation. 2no. BGS borehole records on site indicate made ground to approximately 2m below ground level (bgl) overlying stiff clay with lenses of sand (4m thick band of sand recorded at 12mbgl). Bedrock was recorded at depths of between 25-27.5mbgl.
- 1no. mine shaft is mapped to be located on site. 1no. mine shaft is mapped on the south eastern site boundary. Part of the site is classified as a 'Development High Risk Area' due to the presence of mine shafts, past shallow coal mine workings and probable shallow coal mine workings.
- Superficial deposits are considered a Secondary Undifferentiated Aquifer and bedrock a Secondary A Aquifer.
- Rochdale Canal is located 110m south of the site. No groundwater abstraction licenses or discharge permits were identified within 300m from the site and the site is not located within a Source Protection Zone.
- No recorded landfills / historic landfill sites were identified within 250m from the site.

The desk study report concludes that "*the site can be classified as moderate risk in terms of contamination and the risk to the identified receptors (e.g. human health, controlled waters, buildings)".* The report recommended site investigation to assess potential pollutant linkages.

2.2 Summary of Phase 2 Geo-Environmental Site Assessment Report

An intrusive investigation was undertaken on 7th March 2022. 5no. window sample boreholes were drilled to depths of 3.00-4.00m below ground level (bgl). The site investigation included in-situ geotechnical testing as well as geotechnical laboratory analysis. Chemical laboratory analysis was undertaken on soil samples collected from investigation locations.

3no. boreholes were installed with monitoring wells to undertake groundwater level monitoring and gas monitoring.

Made ground was recorded to depths of between 0.50-2.10mbgl and generally comprised sandy clayey gavel / gravelly sandy clay with anthropogenic material including brick, glass, concrete, slag and tarmac. A thin layer (0.20-1.10m) of soft grey / brown clay was recorded beneath the made ground, which is underlain by stiff to very stiff brown / orange / grey mottled slightly gravelly clay. No visual / olfactory evidence of contamination (excluding the anthropogenic material described above) was recorded.

A groundwater strike was recorded in 1no. borehole at 3.00mbgl. Groundwater was not encountered in any other investigation location. Groundwater monitoring was undertaken on 3no. occasions. The groundwater level in 1no. monitoring well was recorded between 1.54-1.70mbgl. No groundwater was recorded in the remaining 2no. wells installed. It was concluded that the groundwater strikes and subsequent monitored levels represent perched water.

Soil laboratory analysis results were compared against Generic Assessment Criteria (GAC) for a residential without homegrown produce land-use scenario and against commercial land-use scenario for comparative purposes. When compared against residential without homegrown produce land-use scenario as a conservative approach, elevated contaminants were recorded for heavy metals (arsenic, lead, mercury), petroleum hydrocarbons (aromatic C10-12, C16-21 and C21-35) and PAHs. No asbestos was detected. Remediation was recommended in areas of soft landscaping.

One groundwater sample was collected and compared to UK Drinking Water Standards. Exceedances of arsenic and lead were detected. The risk to receptors was considered to be negligible due to impermeable Diamicton (till) which underlies the site.

Gas monitoring was undertaken on 3no. occasions between 15th March 2022 to 31st March 2022. The worst-case gas screening value (GSV) calculated classified the site as Characteristic Situation 1 (CS1). However the report recommended the site be considered Characteristic Situation 2 based on carbon dioxide concentrations recorded as greater than 5%v/v and that gas protection measures are required in all new buildings on site.

2.3 Summary of Shallow Mining and Mine Shaft Investigation Works Report

The investigation works were undertaken to confirm the ground conditions below the site and allow an assessment of the potential for the site to be affected by shallow coal seams / workings and mine entries.
The coal mining report covers both the Nelson Street site and the adjacent 'Varley Street' site. The summary herein, pertains to the Nelson Street site only.

The investigation works were carried out by LKC in May 2023 and comprised drilling 3no. open hole rotary boreholes to 40mbgl and trial trenching to locate 2no. mine shafts (refer to Figure 2).

Rotary drilling was undertaken to determine the depth of coal seams beneath the site and obtain evidence of unrecorded and recorded mine workings.

Trial trenching was undertaken to locate the mine shaft shown to be located in the eastern area of the site (ref. 386399-001), and to confirm the presence / absence of the mine shaft shown to be located approximately 5m beyond the south eastern site boundary (ref. 386399-002).

Superficial strata comprising sandy clay was recorded in all locations. Depth to rockhead was recorded as between 27.50-28.00mbgl and the depth to intact coal was recorded as between 34.00-34.90mbgl. The thickness of the coal ranged between 0.50-0.70mbgl.

A total of 14no. trenches were excavated to investigate Shaft Ref. 386399-001. Made ground was generally recorded to a maximum depth of 1.80mbgl across most of the area, and comprised horizons of sand and gravel, some horizons of clay, with ash, clinker, whole bricks, brick fragments, rootlets and coal fragments. The made ground was underlain by variably gravelly and sandy clay.

Visual and olfactory of hydrocarbon contamination was identified in Trenches 4, 6, 10 and 11. Pockets of strata with a hydrocarbon odour were noted in Trenches 4 and 6. Perched water was encountered in Trench 10 with a slight hydrocarbon odour, and perched water was encountered in Trench 11 with a slight sheen and hydrocarbon odour.

A circular area of deeper made ground was recoded to 5.50mbgl in Trench 14 which is likely the mine shaft, with no evidence of a concrete cap identified.

A total of 9no. trenches were excavated to investigate Shaft Ref. 386399-002. Made ground was generally recorded to a maximum depth of 1.20mbgl, and comprised horizons of sand and gravel, some horizons of clay, with ash, clinker, brick and tarmacadam fragments. The made ground was underlain by variably gravelly and sandy clay. No evidence of the mine shaft was identified and it is assumed that the mine shaft is located off site. Treatment and stabilisation work was recommended based on the findings of the coal mining investigation.

LKC has been commissioned by ISG Ltd to carry out an additional site investigation and provide an updated Remediation Strategy for the site. The objectives of the additional site investigation are to allow installation of replacement gas monitoring wells to undertake 6no. gas monitoring visits to the site over a period of three months.

3 Further Ground Investigation

3.1 Site Investigation Design and Methodology

An intrusive investigation was undertaken by LKC to install monitoring wells for gas monitoring.

The investigation was carried out on 25th May 2023 and comprised the following:

- 4no. window sample boreholes drilled to 5.45mbgl (ref. WS107 to WS110).

It should be noted that WS101 to WS106 are located on the adjacent Varley Street site and are reported under separate cover.

All site investigation locations are shown in Figure 2.

The window sample boreholes were drilled to confirm the ground conditions beneath the site and to install monitoring wells for a series of gas monitoring visits.

The locations were non-targeted and chosen to allow adequate assessment of ground conditions across the site.

All profile logs are provided in Appendix B and are in line with BS14688-1[4] and BS5930[5].

The number of monitoring wells installed corresponds to approximately one per 33m square centres. This is in line with guidance in CIRIA C665[6] for a 'moderate' gas hazard and a moderate / high sensitivity of end use.

3.2 Well Installations

All of the boreholes were installed with monitoring wells for gas and groundwater monitoring. Monitoring wells were installed in accordance with BS10175 and CIRIA C665[7] and generally comprised approximately 1m plain pipe over a length of slotted pipe surrounded by pea gravel and sealed at the top with bentonite and concrete.

Well installation details are provided in Profile Logs in Appendix B.

3.3 Onsite Testing

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[8] to aid in screening samples for volatile analysis.

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

3.4 Laboratory Testing

3.4.1 Soil Sampling (Contamination)

Soil sampling was not carried out as part of this additional investigation. A summary of the soil sampling carried out by EnviroSolution is provided in Section 2.2 and is further discussed in Section 5.1.1.

3.4.2 Water Sampling / Leaching Testing

Groundwater sampling / leaching testing was not carried out as part of this additional investigation. A summary of the groundwater sampling carried out by EnviroSolution is provided in Section 2.2 and is further discussed in Section 5.4.

3.5 Gas Monitoring

Six gas monitoring visits have been undertaken over a 12-week period in all installed boreholes.

Monitoring is being undertaken using a Geotechnical Instruments GA5000 in accordance with the monitoring protocol outlined in CIRIA C665 (flow rate measured first).

The gas monitoring results are reproduced in full in Appendix C. It should be noted that the gas monitoring results are reported together with the Varley Street site adjacent to the east. Data from WS107, WS108, WS109 and WS110 apply to this report.

3.6 Geotechnical Testing

3.6.1 In-situ Onsite Geotechnical Testing

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

- Standard Penetration Tests (SPTs) were performed in the window sample boreholes at approximately 1m intervals.
- Pocket -penetrometer tests (giving undrained shear strength) were performed in the window sample boreholes.

Laboratory geotechnical testing was not undertaken as part of this investigation.

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

4 Ground Conditions

4.1 Geology – Generalised Sequence

The ground conditions beneath the site comprised made ground underlain by variably gravelly sandy clay. A summary section of the logs is provided in Plate 4-1, with additional comments below. It should be noted that WS101 to WS106 are located on the adjacent Varley Street site and are reported under separate cover.

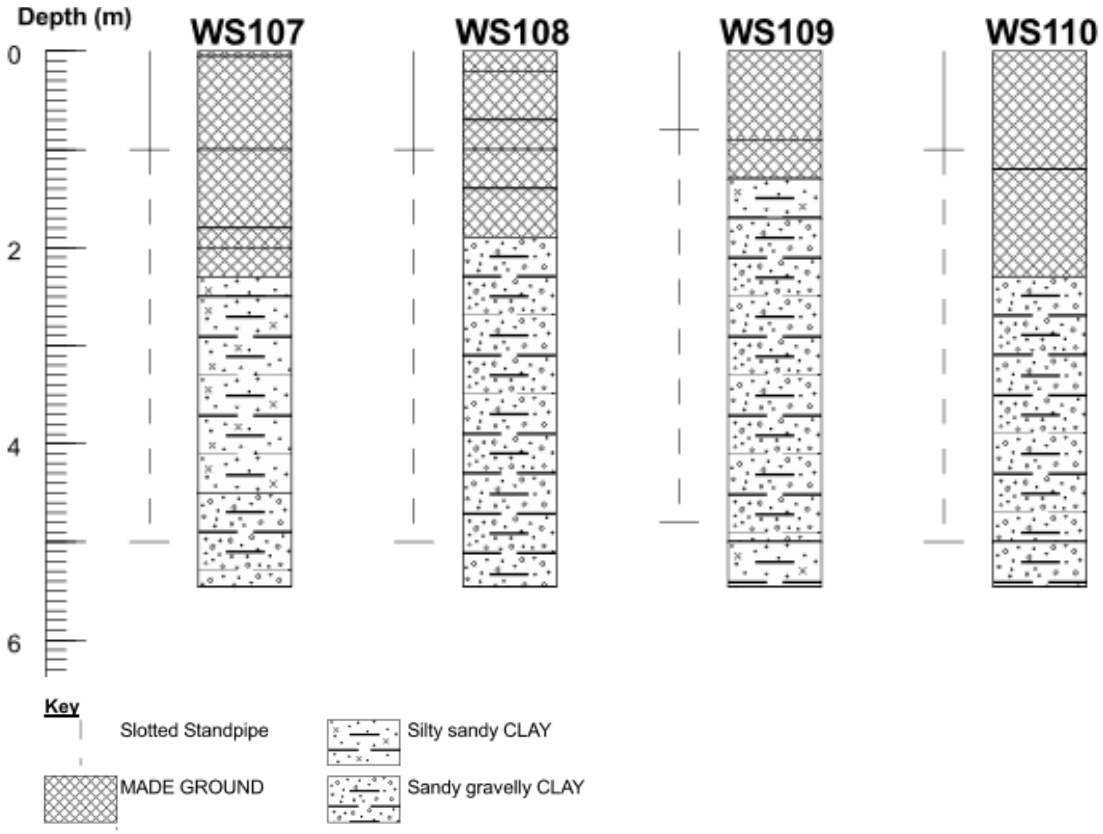


Plate 4-1: Summary of ground conditions.

Additional information on ground conditions:

Made Ground

Made ground was recorded in all boreholes to depths of 1.30-2.30mbgl, which is consistent with the depths recorded by EnviroSolution (0.50-2.10mbgl).

The made ground comprised horizons of sand / sand and gravel / clay with anthropogenic material including ash, brick, coal, concrete, tarmacadam, glass and clinker. Exceptions to this include:

- Predominantly ash and clinker in: WS107 (0.05-1.00mbgl), WS107 (2.00-2.30mbgl), WS108 (0.20-0.70mbgl), WS108 (1.00-1.40mbgl),
- Slightly organic sandy silty clay with brick fragments between WS108 (1.40-1.90mbgl) and WS109 (0.90-1.30mbgl).

Natural Strata

Natural strata comprised stiff to very stiff consistency variably gravelly sandy clay, with occasional bands of sand with depth.

Contamination

With the exception of the anthropogenic material encountered in the made ground (as described above), no further contamination was identified.

There was no visual / olfactory evidence of hydrocarbons or volatile contaminants in any of the borehole locations. The PID recorded a maximum of 1.3ppm TVOC in the samples.

No visible fragments of ACM were identified.

As summarised in Section 2.3, visual and olfactory evidence of hydrocarbon contamination was encountered in 4no. trial trenches which were undertaken as part of the shallow coal mining investigation. The following evidence was observed:

- Small pocket of hydrocarbon contamination encountered at base of brick wall in south western wall of Trench 4;
- Pocket of hydrocarbon contamination encountered at 1.10mbgl in south western wall of Trench 6;
- Perched water slowly seeping from northern wall of Trench 10 at 1.50mbgl with slight hydrocarbon odour;
- Perched water seeping in from side wall of Trench 11 between 0.00-1.80mbgl with slight sheen and hydrocarbon odour.

4.2 Groundwater

4.2.1 Groundwater Levels

Groundwater strikes were recorded during the investigation in boreholes. Groundwater monitoring within the monitoring wells has been undertaken six occasions.

Results are summarised in Table 4-2.

BH	Water Strike Depths (mbgl)	Well Response Zone (mbgl)	No. of Monitoring Visits	Monitoring Depths (mbgl)		
				Min	Max	Base
WS107	Dry	1.0-5.0 (MG/C)	6	2.21	2.57	4.72-4.86
WS108	Dry	1.0-5.0 (MG/C)	6	1.42	4.16	4.85-4.86
WS109	Dry	0.8-4.8 (MG/C)	6	1.18	4.19	4.44-4.47
WS110	Dry	1.0-5.0-(MG/C)	6	2.18	4.40	4.90-4.93

Table 4-2: Summary of water strike depths within boreholes.
Response Zones:
MG=Made Ground; 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 provided within the profile logs in Appendix B.

4.3.2 Pocket Penetrometer Tests

Pocket penetrometer tests, recording undrained shear strength (s_u), were taken within the clay strata. The results are provided within the profile logs in Appendix B.

5 Further Assessment of Pollutant Linkages

5.1 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 (LCRM[9]). Information gathered from the risk assessment has been collated in the contamination conceptual model in Section 5.6.

Where LKC identify a low to very low risk, limited intrusive investigation work, a watching brief (during enabling work) or no investigation work will be recommended. This is decided on a site-specific basis, 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, further works or precautionary remedial measures will be recommended.

5.1.1 Direct Contact Risk – Pollutant Linkage 1

In the EnviroSolution site investigation report soil laboratory analysis results were compared against Generic Assessment Criteria (GAC) for a residential without homegrown produce land-use scenario and against commercial land-use scenario for comparative purposes.

The EnviroSolution site investigation report lists individual PAHs elevated above the GAC separately. 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 PAHs[10,11] and naphthalene the most volatile and soluble[12].

Category 4 Screening Levels (C4SLs) advocate using the B(a)P as a surrogate marker for carcinogenic PAHs, if it falls within appropriate limits and in the absence of coal tar.[13]. In LKC's experience the vast majority of samples pass the assessment to confirm B(a)P is a suitable surrogate marker. This approach will therefore be used for Pollutant Linkage 1. Naphthalene will be treated separately using the LQM S4ULs.

Elevated PAHs (B(a)P used as a surrogate marker) were identified in three samples analysed as part of the EnviroSolution site investigation.

Elevated heavy metals (arsenic, lead and mercury) were identified in five samples analysed. The source of the elevated PAHs and heavy metals is anticipated to be the ash, clinker and coal noted in the made ground.

[9] Land Contamination Risk Management (LCRM) https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm
[10] EA (2002). "Contaminants in Soils: Collation of Toxicological Data and Intake Values for Humans. Benzo[a]pyrene." R&D Publication TOX2.
[11] USEPA (1984). "Health Effects Assessment of Polycyclic Aromatic Hydrocarbons (PAHs). EPA 540/1-86-013."
[12] EA (2003). "Review of the Fate and Transport of Selected Contaminants in the Soil Environment." Draft technical report P5- 079/TR1.
[13] CL:AIRE (2013). "SP1010: Development of Category 4 Screening Levels and Assessment of Land Affected by Contamination – Final project Report."

Elevated mercury was identified when compared to the most stringent form of mercury (elemental mercury GAC of 1.2mg/kg). It is extremely unlikely that mercury is present in this form within a natural soil environment unless there is a specific source within the site's history (such as a hat manufactory, electrolysis plant, etc). No such source has been identified and no evidence of elemental mercury ('quicksilver') was noted in the logs. LKC consider it more reasonable to use inorganic mercury assessment criteria (56mg/kg) due to redox conditions and complexation with natural cations and anions in the soil environment. No concentrations of mercury were reported above the inorganic mercury assessment criteria therefore the risk is considered low.

Elevated aromatic C16-21 and C21-35 were identified in two samples analysed. No visual / olfactory evidence of hydrocarbon was recorded in the site investigation report, and no evidence was observed on the additional investigation undertaken by LKC. However, as detailed in Section 4.1, visual and olfactory evidence of hydrocarbon contamination was recorded during the shallow coal mining investigation undertaken by LKC. It is therefore possible that further small pockets of hydrocarbon contamination may be present across the site.

At the concentrations identified, heavy metals, PAHs, SVOCs and petroleum hydrocarbons are considered to pose a potential risk to future site users in soft landscaped areas. The principal pathways are the ingestion pathways (soil and dust) and dermal contact.

The probability of heavy metals, PAHs and petroleum hydrocarbon contamination affecting site users is likely. With a medium consequence, the risk is considered to be moderate and remediation is recommended. This is to include an environmental cover system in areas of proposed soft landscaping.

Notwithstanding the above recommendation, a watching brief should also be maintained during earthworks. If any unusual ground conditions / unexpected contamination encountered, further assessment may be required.

No asbestos was identified in any of the samples, therefore the probability of asbestos affected site users is considered to be unlikely. With a medium consequence, the risk is low and remediation is not required. However, as a precaution, construction workers should be and vigilant for any suspected ACM during groundworks (discussed further in Section 6).

5.1.2 Risk from Inhalation of Vapours – Pollutant Linkage 2

An assessment of the risk from inhalation of vapours was not included as part of the EnviroSolution site investigation report.

Elevated results have been identified for naphthalene, aromatic C10-12 and SVOCs (dibenzofuran and carbozole) in one location when compared to 1% soil organic matter (SOM). The GAC for naphthalene can be modified based on a linear relation between naphthalene and SOM concentration, however no SOM testing was included in the site investigation report and therefore LKC have adopted the conservative approach., using SOM at 1%.

No visual / olfactory evidence of volatile contamination was recorded in the EnviroSolution report, or during the additional investigation undertaken by LKC (PID recorded a maximum of 1.3ppm TVOC in the samples).

However, visual and olfactory evidence of hydrocarbon contamination was identified in the north east of the site during the coal mining site investigation undertaken by LKC.

Given the bands of ash and clinker encountered during the additional site investigation, and visual/olfactory evidence of hydrocarbon contamination recorded during the coal mining site investigation, LKC consider that further contamination may be present across the site.

The probability of vapours posing a risk to site users is considered to be low. With a medium consequence, the risk is expected to be moderate/low. Using a suitably cautious approach and in the absence of more detailed laboratory testing as part of the site investigation report, precautionary remediation is recommended. This is to include installing a vapour resistant membrane in proposed buildings.

In addition, a watching brief for the presence of any significant hydrocarbon contamination should also be maintained during earthworks. Further assessment may be required.

5.2 Gas Risk Assessment

Six gas monitoring visits have been undertaken at the site. Gas monitoring results in full are presented in Appendix C. It should be noted that the gas monitoring results are reported together with the Varley Street site adjacent to the east. Data from WS107, WS108, WS109 and WS110 apply to this report.

Following guidance set out in CIRIA C665[14] and BS8485[15] 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 5-1.

[14] CIRIA (2007). "Assessing Risks Posed by Hazardous Ground Gases to Buildings." CIRIA C665.
[15] BSI (2019). "Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings." BS8485:2015+A1 2019.

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)
WS107	1	<0.1	**8.8**	4.4	<1	28	<0.1	2.57	1015 (s)
	2	<0.1	**10.9**	3.1	<1	13	<0.1	2.23	1009 (r)
	3	<0.1	**11.9**	6.4	<1	6	<0.1	2.23	1005 (s)
	4	<0.1	**15.6**	6.7	<1	3	<0.1	2.20	1007 (s)
	5	<0.1	**11.2**	5.2	<1	4	<0.1	4.86	1010 (f)
	6	<0.1	**11.5**	4.7	<1	4	<0.1	2.23	1006 (fs)
WS108	1	<0.1	**7.4**	11.9	<1	7	<0.1	4.13	1015 (s)
	2	<0.1	**9.4**	6.4	<1	17	<0.1	3.26	1009 (r)
	3	<0.1	**11.0**	6.4	<1	9	<0.1	2.60	1005 (s)
	4	<0.1	**11.2**	7.2	<1	5	<0.1	2.16	1007 (s)
	5	<0.1	**9.8**	14.2	<1	5	<0.1	1.42	1010 (f)
	6	<0.1	**9.5**	8.8	<1	4	<0.1	1.55	1007 (fs)
WS109	1	<0.1	**6.2**	15.5	<1	29	<0.1	4.19	1015 (s)
	2	<0.1	**8.1**	10.4	<1	14	<0.1	2.18	1009 (r)
	3	<0.1	**8.0**	13.1	<1	5	<0.1	1.97	1005 (s)
	4	<0.1	**8.4**	13.2	<1	4	<0.1	1.78	1007 (s)
	5	<0.1	**8.9**	4.2	<1	6	<0.1	1.18	1010 (f)
	6	<0.1	**7.8**	13.5	<1	4	<0.1	1.26	1007 (fs)
WS110	1	<0.1	3.9	17.4	<1	9	<0.1	4.40	1015 (s)
	2	<0.1	**6.0**	3.7	<1	2	<0.1	2.18	1009 (r)
	3	<0.1	**9.0**	3.2	<1	2	<0.1	2.31	1005 (s)
	4	<0.1	**8.6**	6.9	<1	1	<0.1	2.35	1007 (s)
	5	<0.1	**8.9**	4.2	<1	5	<0.1	2.38	1010 (f)
	6	<0.1	**9.1**	6.2	<1	4	<0.1	2.34	1007 (fs)

Table 5-1: 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, s=steady, f=falling, fs=falling then steady.

Six monitoring visits have been undertaken at the site to date during high atmospheric pressure conditions (1005mB-1015mB). Carbon dioxide concentrations were recorded at 3.9-15.6%v/v. Methane concentrations were recorded at <0.1%v/v. Flow rates were all recorded as less than limits of detection.

Reduced oxygen concentrations were recorded in all of the wells with the lowest concentration recorded at 3.1%v/v (WS107 visit 2). Depleted oxygen levels may be potentially associated with localised biological respiration and quickly equilibrate with ambient air concentrations near the surface. We do not consider the low oxygen levels to be a significant risk to the site and no further action is considered necessary.

Carbon monoxide was >1ppm in all boreholes. The maximum concentration was recorded as 29ppm (WS109) however this was recorded as a peak, and the concentration decreased to a steady concentration of 1ppm.

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

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

Gas Screening Value

In accordance with CIRIA C665[16], 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 5-2 shows the maximum GSV for each borehole and the appropriate characteristic situation (based on GSV only). An overall site assessment (WS107-WS110) has also been included (worst case values across the site).

Boreholes	Max GSV (l/hr)	CS
WS107	0.0156	CS1
WS108	0.0112	CS1
WS109	0.0089	CS1
WS110	0.0091	CS1
WS107-WS110	0.0001 (CH_4) 0.0156 (CO_2)	CS1

Table 5-2: Summary of worst-case Gas Screening Values (GSV).
Notes:
CS – Characteristic Situation.

In addition, in accordance with CIRIA C665[17], if carbon dioxide and methane are recorded above 5%v/v and 1%v/v respectively, you should consider upgrading the characteristic situation from CS1 to CS2.

The assessment for ground / hazardous gas also needs to take into account the release of CL:AIRE guidance on Coal Mine Gas[18].

CLAIRE guidance states that the gas screening value is not considered appropriate in isolation for assessing mine gas risk on sites where there are complex conceptual site models.

As part of the shallow coal mining site investigation a shaft (ref. 386399-001) was identified in the north eastern part of the site. In addition, a shaft is shown to be located approximately 5m from the south eastern site boundary. The shaft was not located during the site investigation and is therefore assumed to lie beyond the site boundary.

Depth to rockhead was recorded as between 27.50-28.00mbgl and the depth to intact coal was recorded as between 34.00-34.90mbgl. The thickness of the coal ranged between 0.50-0.70mbgl.

Viable sources of mine gas have been identified on site associated with shallow worked coal seams.

[16] CIRIA (2007). "Assessing Risks Posed by Hazardous Ground Gases to Buildings." CIRIA C665.
[17] CIRIA (2007). "Assessing Risks Posed by Hazardous Ground Gases to Buildings." CIRIA C665.
[18] CL:AIRE. "Good Practice for Risk Assessment for Coal Mine Gas Emissions". October 2021.

Despite thick low permeability superficial deposits having been recorded across the site (depth to rockhead between 27.50-28.00mbgl) potential preferential pathways are present associated with the mineshaft located in the north east of the site, the shaft mapped 5m south east of the site and rotary investigation boreholes.

No significant flow has been identified during gas monitoring, indicating that mine gas is not impacting the surface of the site. However, should hazardous ground gases be encountered as part of routine monitoring undertaken as part of coal mining remediation (including the shaft and shallow coal mining), then further gas monitoring and/ or upgrading of gas protection rating may be required.

Taking the risks associated with coal mine gas, and the elevated carbon dioxide concentrations recorded, it is recommended that the site is upgraded from CS1 to CS2.

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 a low likelihood. Assuming a severe consequence, there is a moderate risk associated with Pollutant Linkage 3 and remediation is required in line with CS2 in proposed buildings.

Should hazardous ground gases be encountered as part of routine monitoring undertaken as part of coal mining remediation (including the shaft and shallow coal mining), then further gas monitoring and/ or upgrading of gas protection rating may be required.

5.3 Controlled Water Assessment

A Secondary Undifferentiated Aquifer is present in the superficial strata below the site. A Secondary A Aquifer is present in the bedrock below the site. No groundwater abstractions have been identified within 400m of the site and the site is not within a Source Protection Zone.

Rochdale Canal is located 110m south of the site. Given the low permeability clay deposits beneath the site, assumed clay lining of the canal and likely head of water above groundwater on site it is not considered to be a feasible receptor.

During the monitoring undertaken by EnviroSolution, the groundwater level in one well was recorded as between 1.54-1.70mbgl. No groundwater was recorded in the remaining two wells installed. Groundwater levels have been recorded between 1.18-4.40mbgl during the six monitoring visits undertaken by LKC. Given that cohesive superficial deposits were recorded during the site investigations (gravelly sandy clay with occasional sand lenses), it is considered that the water strikes recorded are representative of perched water. LKC therefore consider that the main controlled waters receptor is the Secondary A bedrock aquifer.

Visual / olfactory evidence of hydrocarbons were identified during the trial trenching undertaken as part of the shallow coal mining investigation.

One groundwater sample was collected as part of the EnviroSolution site investigation report and compared to UK Drinking Water Standards. Exceedances of arsenic and lead were detected. All other contaminants tested (TPH, PAHs, VOCs, SVOCs, BTEX) were recorded as less than limits of detection.

LKC consider use of UK DWS as overly conservative given the environmental setting of the site. Moreover, most likely 'elevated' concentrations noted in the EnviroSolution report are associated with colloidal components within the sample associated with perched and sporadic made ground and results are not considered representative of groundwater quality beneath the site.

LKC therefore considers the probability of onsite contamination affecting the Secondary A Aquifer is a unlikely likelihood. With a medium consequence the risk is anticipated to be low and no remediation is required.

Notwithstanding the above, a watching brief should be maintained during earthworks. If any unusual ground conditions / unexpected contamination encountered (particularly hydrocarbon contamination), further assessment may be required.

5.4 Additional Risk Assessments

5.4.1 Potable Water Supply (Pollutant Linkage 5)

A United Utilities water pipeline risk assessment is recommended and will be required for a new connection. Numerous elevated contaminants have been identified on site. With a likely probability and medium consequence, the risk is considered moderate and it is likely that barrier pipe will be required. Once details of the pipeline location and depths are known a UU Risk Assessment should be undertaken.

5.5 Contamination Conceptual Model

A preliminary contamination conceptual model has been produced following the risk assessments undertaken in Sections 5.1-5.4 and is presented in Table 5-3. The risk matrix is provided in Appendix A.

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

Where a moderate or higher risk is identified, remediation or further investigation work is recommended.
Further details of the remedial proposals and a remedial option appraisal are given in Section 6.

Pollutant Linkage	Pathway	Receptor	Contaminant	Probability	Consequence	Risk	Assessment
PL1	- Dermal contact. - Inhalation of soil, fibres and dust. - Ingestion of soils, dust. - Windblown dust.	- Future site users. - Offsite receptors.	Heavy metals: - Arsenic, lead. PAHs: - B(a)P. Petroleum hydrocarbons: -Aro C16-21, C21-35.	Likely	Medium	**Moderate**	- Likely probability as elevated contaminants identified in the made ground which could come into contact with site users in soft landscaping areas. - **Recommendation:** Remediation required, to include an environmental cover system in soft landscaping areas. A watching brief should also be maintained during earthworks.
			ACM -None identified.	Unlikely	Medium	**Low**	- Unlikely probability as no asbestos identified on site. - **Recommendation**[*1]**:** No remediation required. However a watching brief should be maintained during earthworks.
PL2	- Inhalation of vapours. - Migration through permeable strata and preferential pathways.	- Future site users. - Offsite receptors.	Volatile Contaminants: - Aro C10-12. -Naphthalene. SVOCs: - Dibenzofuran, carbazole.	Low Likelihood	Medium	**Moderate / Low**	- Elevated VOC and SVOCs contaminants identified and further contamination may be present. - **Recommendation**: Precautionary remediation required, to include installing a vapour resistant membrane in proposed buildings. A watching brief should also be maintained during earthworks.
PL3	- Inhalation of gas. - Migration through permeable strata and preferential pathways. - Explosion in confined spaces (methane only).	- Future site users. - Buildings. - Offsite land users.	- Carbon dioxide, methane.	Low Likelihood	Severe	**Moderate**	- Elevated carbon dioxide identified in all monitoring wells and mine shaft located on site. - **Recommendation:** Gas protection measures in line with CS2 recommended. Should hazardous ground gases be encountered as part of routine monitoring undertaken as part of coal mining remediation, then further gas monitoring and/ or upgrading of gas protection rating may be required
PL4	- Surface Run-off. - Migration through permeable strata and preferential pathways - Perched waters migration.	- Groundwater (Secondary A Aquifer).	Mobile contaminants: - Metals.	Unlikely	Medium	**Low**	- Although elevated metals identified in one groundwater sample tested, given the environmental settings and ground conditions encountered not considered to pose a significant risk to groundwater. - **Recommendation**: No remediation required. However a watching brief should be maintained during earthworks, particularly for petroleum hydrocarbons.
PL5	- Ingestion of tainted water supply.	- Future site users (via potable water).	Organic Contaminants: - VOCs. - SVOCs - Petroleum hydrocarbons.	Likely	Medium	**Moderate**	- Likely probability as elevated organic contaminants identified which could permeate water pipes and contaminate water supply. - **Recommendation:** UU risk assessment undertaken. Barrier piping likely to be required.

Table 5-4: Revised Contamination Conceptual Model. **Notes**[*1] Although no ACM identified, contractors should be vigilant during earthworks of any potential ACM. This is discussed further in Section 6.2.

6 Remediation Strategy

6.1 Introduction

Remediation works may be spilt in to the 'pre-construction' (or enabling works) phase and the 'build phase' (i.e. during the residential development works) phase. The recommended remedial works and validation works are outlined in the following Sections.

6.2 Summary of Recommended Remediation & Validation Works

The remediation works may be split into 'pre-construction' (or enabling works) phase and the 'build phase' (i.e. during the redevelopment works) phase. The following earthworks, remediation and validation required for this site are summarised in Table 6-1. More detail of proposed works will be provided in the following Sections.

No specific remediation is required for Pollutant Linkage 4 (Controlled Waters).

Due to the minor consequence associated with the phytotoxic effect to flora (i.e. loss of plants in a landscaping scheme), the overall risk for the majority of sites will be very low to low. Where soils contain significant concentrations of heavy metals, in general there will other pollutant linkages (i.e. the risk to human health) that will trigger the requirement for remediation (e.g. a clean environmental cover system). As such the risk to flora associated with phytotoxic contaminants will not be considered further.

The risk to buildings associated with elevated sulphate should be considered by a structural engineer as part of the geotechnical assessment and will not be included in the contamination risk assessment.

It should be noted that there may be risk from short term exposure from contaminated soil to site workers. The Contamination Conceptual Model deals with long term exposure to key receptors. 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[19]) should be adopted by all workers involved with site enabling and construction works. Therefore, this receptor is not considered in the contamination conceptual model.

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

Phase	Remediation Requirements	Validation Requirements
Pre-Construction (enabling)	Excavation, processing and stockpiling This will include the grubbing out and processing of hardstanding and unsuitable material. Any oversize material, if encountered will be processed and re-used as appropriate. Appropriate site won material will be stockpiled for potential reuse. Additionally, suspect material will be quarantined for characterisation prior to possible offsite disposal.	Log of work undertaken including photographs. Re-use of material will be under suitable exemption or MMP. Testing of site won/ imported soil as per Table 6-2.
	Earthworks Site Inspections & Unexpected Contamination A watching brief should be maintained by a suitably qualified and experienced person during enabling works to identify any unusual ground conditions. If any visual or olfactory evidence of contamination be encountered at the site, further assessment of the material may be required. Particular attention should be paid to hydrocarbons, as visual and olfactory evidence of contamination identified in the north east of the site during previous investigation. Should hazardous ground gases be encountered as part of routine monitoring undertaken as part of coal mining remediation, then further gas monitoring and/ or upgrading of gas protection rating may be required	Log of work undertaken including photographs. Details of any sampling undertaken and validation of any potential additional remedial work. Further assessment of gas risk if hazardous ground gas encountered.
	Segregation and removal of unsuitable materials As part of the watching brief during earthworks, areas of unexpected contamination (including hazardous waste) and geotechnically unsuitable material will be delineated, excavated and removed following suitable testing and verification.	Log of work undertaken including photographs. Consignment notes confirming removal of unsuitable material.
Build Phase	Vapour Membrane Elevated petroleum hydrocarbon (aromatic C10-12) and naphthalene were identified on site. Given the ground conditions encountered, further contamination may be present across the site. It is therefore recommended that buildings are to include a vapour resistant membrane.	Plan including foundation design. Photographic evidence showing installation of membrane.

Table 6-1: Summary of Remediation Requirements

Phase	Remediation Requirements	Validation Requirements
Build Phase	Gas Protection Measures In line with CS2 as per UK guidance[20,21]. This is likely to / should include: • 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. Depending on the type of building and foundation design the protection measures can vary. The gas protection measures will be detailed and approved with the Local Authority once the foundation design has been confirmed.	Supply and review of foundation designs. Photographic evidence of sub-floor void, ventilation and suitably sealed gas membrane. Validation of gas protection measures should be in line with CIRIA 735[22]
	Environmental Cover System Shared Landscaping: 450mm thick environmental cover system comprising: geotextile membrane and at least 450mm comprising clean inert fill and sufficient topsoil for a growing medium.	Measured thickness of environmental cover system via hand dug pits and staff and/or as-built survey at each layer. Photographic evidence throughout each stage, showing geotextile membrane, subsoil and topsoil installation process and completion. Chemical validation of imported/ site-won soils.: See Table 6-2.
	United Utilities (UU) Risk Assessment UU Potable Water Risk Assessment to be undertaken once the location and depth of potable water pipes are known and following completion of the earthworks. Barrier pipe likely to be required.	To be completed following completion of the remediation earthworks.

Table 6-1 (continued): Summary of Remediation Requirements.

[20] CIRIA (2007). "Assessing Risks Posed by Hazardous Ground Gases to Buildings." CIRIA C665
[21] BSI (2015). "Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for new buildings." BS8485:2015.
[22] CIRIA (2014). "Good Practice on the Testing and Verification of Protection Systems for Building Against Hazardous Ground Gas". CIRIA C735.

6.3 General Remediation & Enabling Works Requirements

6.3.1 Construction Management Plan and Health and Safety

A Construction Management Plan and Method Statement should be produced which details appropriate Health and Safety measures to be employed during the site works.

Risks to site workers and adjacent receptors from contamination present in the site soils can be easily mitigated by good environmental management of the site during site works. Standard health and safety precautions (as per HSE guidance) should be adopted by all workers involved with site enabling and construction works.

6.3.2 Segregation & Removal of Unsuitable Material

There is potential for some unidentified geotechnically or chemically unsuitable material to be encountered during enabling works.

Such materials will undergo appropriate investigation and testing to ascertain their suitability for re-use, if feasible. Should material be considered either chemically or geotechnically unsuitable then this material will be removed from site (including hazardous waste) under the protocols described in the following sections.

6.3.3 Materials Management

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 [23]):

- -5,000 tonnes (*c.* 2,500m^3) treatment of crushed concrete / stone.
- -1,000 tonnes (*c.* 500^3) use of non-hazardous soil
- -5,000 tonnes (*c.* 2,500m^3) use of clays, sand, gravel, brick, concrete, stone etc.
- -50,000 tonnes (*c.* 25,000m^3) use of bituminous material to be used in roadways.

A Materials Management Plan (MMP) with recourse to the CL:AIRE Code of Practice may be required if volumes exceed exemption limits. This must be registered **before** material movement starts onsite.

If an MMP is required, this needs to be registered by a Qualified Person (QP) and there must be ‘certainty of use’ for any material re-used onsite or exported to site to ensure there is no ‘sham recovery’.

For all the above material will need to be tested at the rate and analytical suites presented in Table 6-2.

6.3.4 Removal of Below Ground Obstructions & Crushing

It is envisaged that grubbing out of in-ground structures is undertaken as part of enabling works.

[23] https://www.gov.uk/guidance/waste-exemptions-using-waste

Site turn over to remove relict structures including relict drainage, brick walls, concrete / stone slabs, etc should be included. Note that it may not be possible to include full turnover in areas of deep made ground due to limits of plant and constraints from adjacent properties.

Suitable materials derived from grubbing-up should be stored in a location on site, to be agreed with the Engineer, prior to crushing. Any unsuitable materials should be removed to a suitably licensed landfill site.

There is potential that some of the grubbed-up concrete and brick arisings may be coated with, and possibly impregnated by, hydrocarbon contaminants. Consideration could be given to steam-cleaning of these arisings in order to generate material suitable for crushing and re-use.

6.3.5 Control of Water

It is considered that significant de-watering is unlikely to be required across the majority of the site. Limited perched groundwater was encountered during the site investigation, therefore some localised ingress of small volumes of perched groundwater should be anticipated.

Arrangements should be made to prevent ponding in shallow excavations; the Contractor should ensure that ground levels are of sufficient gradient to enable the collection of surface water run-off in sumps or grips. Pumping from over-excavated sumps may be required to maintain satisfactory working conditions.

Contingency arrangements to remove groundwater (including contamination groundwater if encountered) from excavations/ relict structures should be allowed. Small volumes of pumped fluids / groundwater should be stored in appropriate, sealed tanks / containers and analysed for a range of determinants prior to disposal to suitable facility. Alternatively, a temporary discharge licence, including their requirements for treatment / testing, should be agreed with local utility providers prior to start on site.

6.3.6 Disposal

Material required to be removed from site should be undertaken under an appropriate duty of care and the results of chemical analysis should be provided to a licensed landfill for confirmation of waste classification.

Waste records such as disposal tickets and waste carrier licences should be provided in the Site Completion Report. Photographic evidence of removal and waste removal tickets should be retained and included in the validation report.

6.4 Pre-Construction (Enabling Works)

6.4.1 Watching Brief for Unexpected Contamination

A watching brief will be maintained for evidence of previously unidentified contamination (including asbestos containing material and areas of hydrocarbon contamination) during the remediation earthworks and development works.

If evidence of contamination is identified, then works in the area will stop pending further sampling and assessment, and the Local Authority will be informed.

Delineation works will be undertaken, and this may include collection of appropriate samples for laboratory analysis to further characterise the material and allow a risk assessment to be undertaken or removal of the impacted material to quarantine.

Soil samples will be taken and analysed for a suite of contaminants, including *inter alia* heavy metals, Soil Organic Matter, VOCs, SVOCs, BTEX, TPHCWG and asbestos (depending on ground conditions). Soil samples should represent the impacted material. In order to determine that significantly impacted soils have been removed, verification samples will be collected from the base and sides of the excavation.

Quarantined material may be removed offsite to a licensed treatment facility or an assessment made of its potential for treatment and / or retention on site.

6.5 Build Phase Remediation Works

The scope of the build phase remediation works will comprise the following:

- Gas protection measures installed in line with CS2.
- Vapour membrane installed in proposed buildings.
- Environmental cover system in areas of soft landscaping.
- Risk assessment for potable water pipes and installation of barrier pipes, as required.

Further details are given in the following Sections. LKC recommend that the proposed works are prior approved by the regulators prior to the commencement of construction works.

6.5.1 Environmental Cover System

In soft landscaping areas, remediation will be required and comprise and environmental cover system which should be constructed as follows:

- **450mm thick environmental cover system comprising:** geotextile membrane and at least 450mm comprising clean inert fill and sufficient topsoil for a growing medium.

A diagram of a typical environmental cover system is shown in Plate 6-1 below.

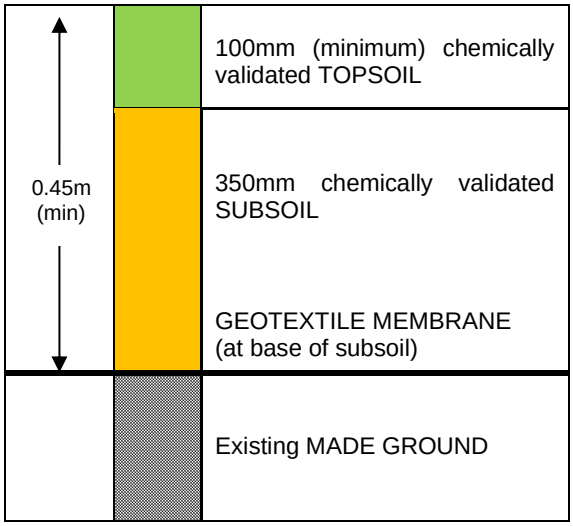


Plate 6-1: Typical Environmental Cover System Construction.
Notes: Subsoil can be replaced with additional topsoil.
Hardstood areas– No Remediation Required.

Validation of the provision of environmental cover soils should be provided in the completion report and should include evidence of thickness of clean cover soils construction, including geotextile membrane, subsoil and topsoil.

Suitable evidence includes a measured thickness of environmental cover system via hand dug pits and staff and / or as-built surveys at each layer. Photographic evidence throughout each stage, showing geotextile membrane, subsoil and topsoil installation process and completion should also be provided.

6.5.2 Vapour Membrane

Elevated potentially volatile contaminants were identified on site. Given the ground conditions encountered, further contamination may be present across the site. It is therefore recommended that buildings are to include a vapour resistant membrane.

The vapour membrane will be detailed and approved with the Local Authority once the foundation design has been confirmed. Photographic evidence showing installation of membrane will be required as part of the site completion report.

6.5.3 Gas Protection Measures

Gas protection measures are required in proposed buildings in line with CS2 as per UK guidance[24,25]. This is likely to / should include:

- 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.

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

- All joints and penetrations to be sealed.

Depending on the type of building and foundation design the protection measures can vary.

The gas protection measures will be detailed and approved with the Local Authority once the foundation design has been confirmed. Photographic evidence of sub-floor void, ventilation and suitably sealed gas membranes will be required as part of the site completion report. Validation of gas protection measures should be in line with CIRIA 735[26].

6.5.4 Potable Water Pipelines

It is recommended that a Water Pipeline Assessment is undertaken once the location and depth of potable water pipes are known and once enabling works have been completed. Additional sampling may be required following reduced levels and confirmation of pipeline routes. Barrier pipe is likely to be required.

In the event that barrier pipe is required then the risk assessment should be approved by water supply company prior to any installation works. Pipework should be installed in trenches back filled with first generation materials (if installed within made ground).

For the purposes of the build phase validation report (if barrier pipe is required), a works notice, delivery notes indicating the source of the first generation backfill material and photographic evidence of this material in the trenches should be collated along with photographs illustrating the installation of barrier pipe.

6.5.5 Validation of Subsoil / Topsoil

Chemical validation of all imported soils to be used on site 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 6-2, based on MCC 'Guidelines to Developer' (2021)[27]. However, LKC consider no testing, but proof of provenance is sufficient for natural, virgin, quarried material. 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 / soft landscaping to ensure suitability for use.

[26] CIRIA (2014). "Good Practice on the Testing and Verification of Protection Systems for Building Against Hazardous Ground Gas". CIRIA C735.
[27] MCC (2021). "Planning & Contaminated Land Technical Guidance." February 2021.

Material Type	Source	Suite of Analysis	Sampling Rate (min. 3 per source) *		
			Garden	Landscape	Other **
Topsoil / subsoil / Fill material	Greenfield	Suite A	200m^3	200m^3	200m^3
	Remediated	Suite A / B dependent upon original SI	100m^3	150m^3	200m^3
	Brownfield / Unknown	Suite B	50m^3	150m^3	200m^3
Quarried Fill	First Generation i.e. quarried sand (subsoil) or stone (break layer)	No testing is required. Certification of material provenance is required.			

Table 6-2: Sampling requirements for imported and site won 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.

** Other assumed to be stone / 6F2 / mass fill etc.

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[28]). LKC advise this information is provided by the supplier before material is imported onto site.

Imported material to be used in gardens will be compared against residential without plant uptake criteria (as used in the contamination risk assessment (Section 5)). Appropriate remedial target criteria are presented in Appendix D.

6.6 Site Completion Report

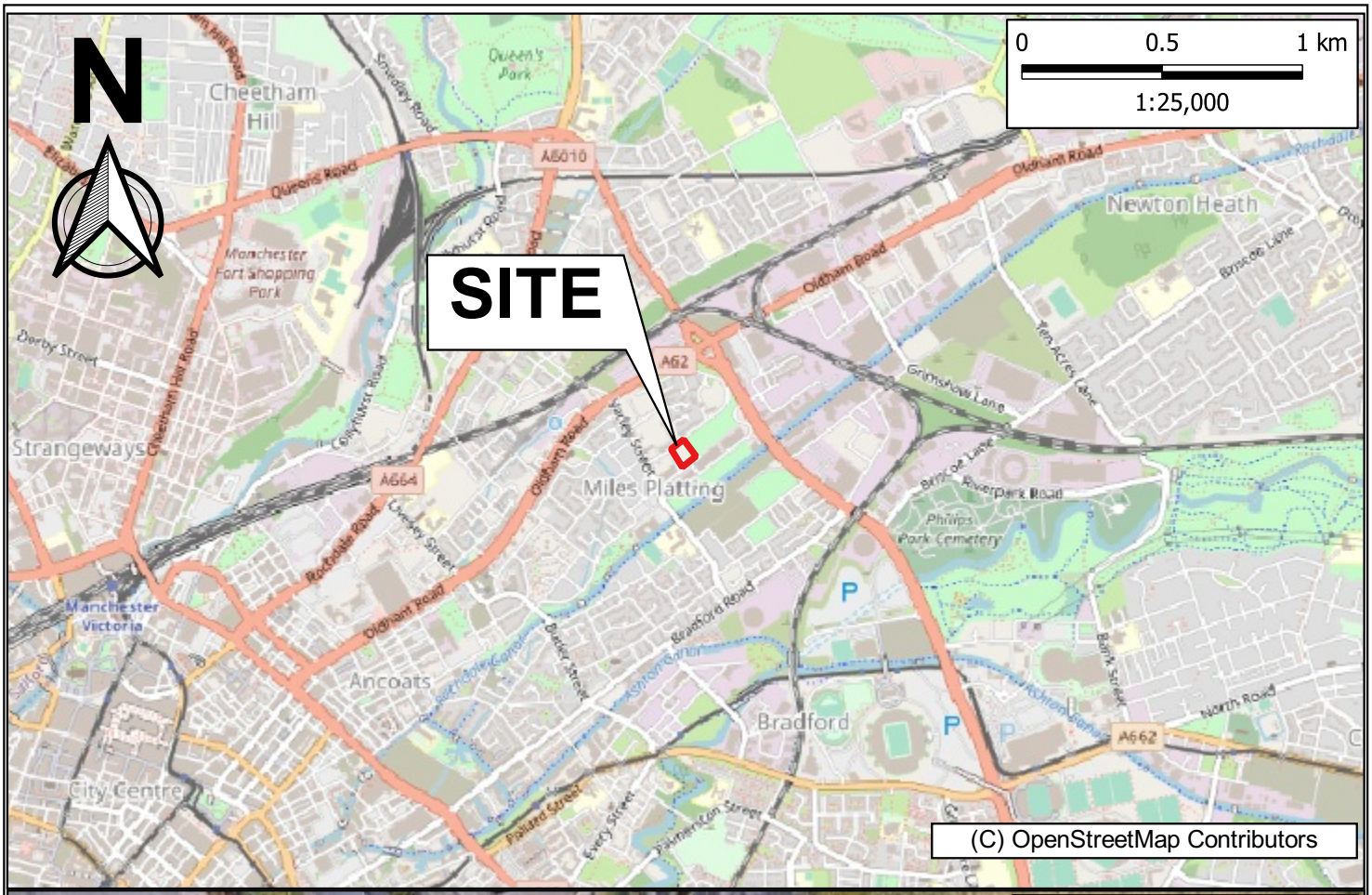
It is recommended that any remediation carried out on the site is validated by a third party and suitable documentary evidence provided in a Site Completion Report, such as photographs, consignment documents and analytical results. This should include as a minimum:

- Validation of gas protection measures installed.
- Validation of vapour membrane installed.
- Provision of waste transfer documents.
- Validation of environmental cover system.
- Verification testing of all imported soil for soft landscaping areas.
- Information on the installation of protective pipes and / or sterile trenches.
- Details of any unexpected contamination identified onsite, suitably risk assessed and / or validated.

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

[28] BS (2015). "Specifications for Topsoil and Requirements for use." BS3882:2015.

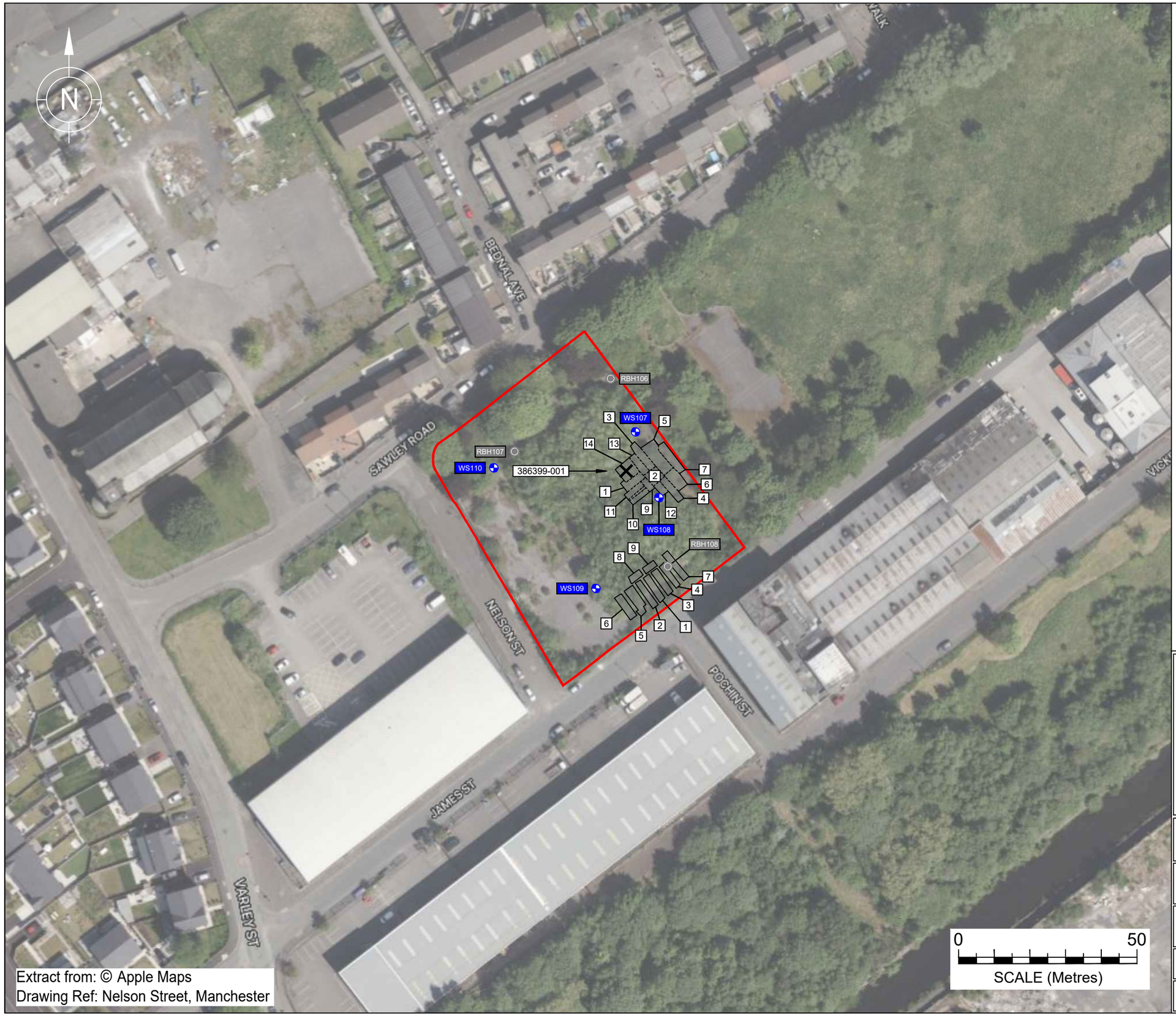
Figures





Client: ISG Ltd				Title: Site Location & Boundary Plan	
Site: Nelson Street, Manchester				Scale (see scale bar): 1:25,000 & 1:1000 @ A4	Figure: 1
Job No.: LKC 22 1670A	Drawn By: EM	Checked By: PD	Drawn: July 2023		Revision:

LK CONSULT



KEY

- Site Boundary
- Window Sample Borehole (WS)

COAL MINING SITE INVESTIGATION:

- Mine Entry
- Rotary Borehole (RBH)
- Excavation
- Excavation Identification Number (9)

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:	ISG Ltd
Site:	Nelson Street, Manchester
Title:	Site Investigation Location Plan (West Land Parcel)
Job No.:	LKC 22 1670
Scale (See Scale Bar):	See Scale Bar
Figure:	2
Revision:	
Drawn By:	AC
Checked By:	EM
Drawn:	Jul 2023

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[29]. 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.

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

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.

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

LK CONSULT LTD

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

Site
Varley and Nelson Street, Manchester

Number
WS107

Excavation Method
Drive-in Windowless Sampler driven to 5.45mbgl.

Dimensions

Ground Level (mOD)
58.35

Client
ISG Ltd

Job Number
LKC 22 1670

Location (Handheld GPS)
386051.2 E 399544.5 N

Dates
25/05/2023

Engineer
LKC

Sheet
1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
				58.30	0.05	MADE GROUND: Tarmacadam. Poor condition.			
0.05-1.00	D PID=0.1ppm				(0.95)	MADE GROUND: Black slightly silty SAND and GRAVEL predominantly comprising ash with occasional brick fragments, clinker, coal, rootlets and bands of very sandy clay. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded.			
				57.35	1.00				
1.00-1.80	D PID=0.2ppm					MADE GROUND: Grey sandy clayey GRAVEL with occasional coal, brick fragments, ash and burnt shale. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded comprising laminated mudstone.			
1.20-1.65	SPT N=10		1,2/2,2,3,3		(0.80)				
				56.55	1.80				
					(0.20)	MADE GROUND: Dark orangish brown SAND and GRAVEL predominantly comprising ash and clinker. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded.			
				56.35	2.00				
2.00-2.45	SPT N=6		3,3/2,1,1,2		(0.30)				
2.00-2.30	D PID=0.3ppm			56.05	2.30	MADE GROUND: Black and dark grey sandy clayey GRAVEL with occasional ash and rare bands of orange sand. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded comprising mudstone.			
2.30-2.50	PP 55.2kPa				(0.20)				
2.50-2.90	PP 94kPa			55.85	2.50				
2.70-2.90	D					Soft becoming firm consistency medium strength grey slightly organic sandy silty CLAY with rare rootlets. Sand is fine to medium.			
3.00-3.45	SPT N=14		2,2/3,3,4,4						
3.00-4.00	PP 181.9kPa					Stiff becoming very stiff consistency high to very high strength brown with light grey mottling slightly gravelly slightly sandy silty CLAY with rare rootlets and bands of sand. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded comprising sandstone, mudstone and coal.			
					(2.00)	Very stiff consistency and very high strength from 2.90mbgl.			
4.00-4.45	SPT N=18		3,3/4,4,5,5			Band of grey fine to medium SAND at approximately 3.50-3.55mbgl. Strata is wet.			
4.00-5.00	PP 166.4kPa								
				53.85	4.50	Very stiff consistency very high strength gravelly slightly sandy CLAY. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded comprising sandstone, mudstone and coal.			
5.00-5.45	SPT N=27		3,4/5,6,7,9		(0.95)				
				52.90	5.45				
						Complete at 5.45m			

Remarks
Borehole stable.

Scale (approx)
1:40

Logged By
EM

Figure No.
LKC 22 1670.WS107

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LK CONSULT LTD

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

Site
Varley and Nelson Street, Manchester

Number
WS108

Excavation Method
Drive-in Windowless Sampler driven to 5.45mbgl.

Dimensions

Ground Level (mOD)
58.45

Client
ISG Ltd

Job Number
LKC 22 1670

Location (Handheld GPS)
386057.8 E 399526.1 N

Dates
25/05/2023

Engineer
LKC

Sheet
1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
				58.25	(0.20) 0.20	MADE GROUND: Brown slightly gravelly clayey SAND with occasional brick fragments and rootlets. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded comprising sandstone.			
0.20-0.70	D PID=0.4ppm				(0.50)				
				57.75	0.70	MADE GROUND: Black SAND and GRAVEL predominantly comprising ash with occasional clinker and brick fragments. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded.			
0.70-1.00	D PID=0.2ppm				(0.30)				
1.00-1.40	D PID=0.1ppm			57.45	1.00				
1.20-1.65	SPT N=4		1,1/1,1,1,1		(0.40)	MADE GROUND: Firm consistency sandy silty CLAY with occasional brick fragments, ash and coal. Sand is fine to coarse.			
1.40-1.90	D PID=0.3ppm			57.05	1.40				
					(0.50)	MADE GROUND: Black with occasional orange and dark green lenses SAND and GRAVEL predominantly comprising ash and clinker with occasional brick and glass fragments and clay inclusions. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded.			
2.00-2.45	SPT N=12		1,1/3,3,3,3	56.55	1.90				
2.00-2.45	D					MADE GROUND: Firm consistency grey slightly organic slightly sandy silty CLAY with occasional brick fragments and occasional rootlets. Sand is fine to medium.			
2.00-3.00	PP 174.7kPa								
3.00-3.45	SPT N=20		3,3/4,5,5,6			Stiff to very stiff consistency very high strength brown with occasional light grey mottling slightly gravelly slightly sandy CLAY with rare rootlets. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded comprising sandstone and mudstone. Increasing sand content with depth.			
3.00-4.00	PP 185.7kPa				(3.55)				
4.00-4.45	SPT N=21		3,3/4,5,6,6						
4.00-5.00	PP 176.3kPa								
5.00-5.45	SPT N=22		3,3/4,5,6,7			Occasional bands of brown fine to medium SAND between 5.00-5.45mbgl.			
				53.00	5.45				
						Complete at 5.45m			

Remarks
Borehole dry and stable.

Scale (approx)
1:40

Logged By
EM

Figure No.
LKC 22 1670.WS108

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LK GROUP	**LK CONSULT LTD** Eton Business Park, Eton Hill Road, Radcliffe, M26 2ZS Tel: 0161 763 7200 web: www.thelkgroup.com	**Site** Varley and Nelson Street, Manchester	**Number** **WS109**

Excavation Method	**Dimensions**	**Ground Level (mOD)**	**Client**	**Job Number**
Drive-in Windowless Sampler driven to 5.45mbgl.		58.19	ISG Ltd	LKC 22 1670
	Location (Handheld GPS) 386040.1 E 399500.7 N	**Dates** 25/05/2023	**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	D PID=0.3ppm				(0.90)	MADE GROUND: Dark brown gravelly very silty SAND with frequent ash, occasional brick fragments, coal, rootlets and rare concrete fragments. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded comprising sandstone.			
0.90-1.30	D PID=1.3ppm			57.29	0.90 (0.40)	MADE GROUND: Firm consistency brownish grey slightly organic sandy silty CLAY with occasional rootlets, brick fragments and rare coal. Sand is fine to medium.			
1.20-1.65 1.30-1.70	SPT N=8 PP 138kPa		1,1/2,2,2,2	56.89	1.30 (0.40)	Stiff consistency high strength light orangish brown and light grey mottled sandy silty CLAY with occasional rootlets. Sand is fine to medium.			
1.70-2.00 1.80-2.00	PP 198kPa D			56.49	1.70	Very stiff consistency very high strength brown with occasional light grey mottling slightly gravelly slightly sandy CLAY with occasional rootlets with rare laminations of sand. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded comprising sandstone, mudstone and quartzite. Rare rootlets from 2.00mbgl.			
2.00-2.45 2.00-2.45 2.00-3.00	SPT N=14 D PP 201.5kPa		2,2/3,3,4,4						
3.00-3.45 3.00-4.00	SPT N=19 PP 183.9kpa		3,3/3,5,5,6		(3.30)	Rare grey mottling from 3.00mbgl.			
4.00-4.45 4.00-5.00	SPT N=22 PP 184kPa		2,3/4,5,6,7						
5.00-5.45	SPT N=20		3,4/4,5,5,6	53.19	5.00 (0.45)	Stiff consistency brown very sandy silty CLAY with occasional bands of sand. Sand is fine to medium.			
				52.74	5.45	Complete at 5.45m			

Remarks
Borehole dry and stable.

Scale (approx)	**Logged By**
1:40	EM

Figure No.
LKC 22 1670.WS109

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LK GROUP	**LK CONSULT LTD** Eton Business Park, Eton Hill Road, Radcliffe, M26 2ZS Tel: 0161 763 7200 web: www.thelkgroup.com	**Site** Varley and Nelson Street, Manchester	**Number** **WS110**

Excavation Method	**Dimensions**	**Ground Level (mOD)**	**Client**	**Job Number**
Drive-in Windowless Sampler driven to 5.45mbgl.		57.83	ISG Ltd	LKC 22 1670
	Location (Handheld GPS) 386011.5 E 399534.5 N	**Dates** 25/05/2023	**Engineer** LKC	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.00-1.00	D PID=0.2ppm				(1.20)	MADE GROUND: Dark greyish brown slightly gravelly clayey SAND with occasional tarmacadam fragments, ash, brick fragments, whole bricks, rootlets and bands of sandy clay. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded comprising sandstone.			
1.00-2.30	D PID=0.2ppm								
1.20-1.65	SPT N=7		4,3/2,2,2,1	56.63	1.20				
					(1.10)	MADE GROUND: Greyish brown very clayey SAND with occasional ash, brick fragments, glass fragments and rare rootlets. Sand is fine to coarse. Limited recovery. Approximately 20% recovery between 1.20-2.00mbgl and approximately 30% recovery from 2.00mbgl SPT.			
2.00-2.45	SPT N=8		2,2/2,2,2,2						
2.30-2.50	PP 116.5kPa			55.53	2.30				
2.50-3.00	PP 168.6kPa					Stiff becoming very stiff consistency high to very high strength brown and light grey mottled slightly gravelly slightly sandy CLAY with rare rootlets. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded comprising sandstone and mudstone.			
2.70-2.90	D								
3.00-3.45	SPT N=17		2,3/4,4,4,5						
3.00-4.00	PP 150.6kPa								
					(2.70)	Very stiff consistency and very high strength from 2.50mbgl.			
4.00-4.45	SPT N=19		4,4/4,4,5,6						
4.00-5.00	PP 143.1kPa								
						Occasional laminations of brown fine to medium SAND between 4.50-5.00mbgl.			
5.00-5.45	SPT N=21		3,4/5,5,5,6	52.83	5.00				
					(0.45)	Very stiff consistency brown gravelly very sandy CLAY. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded comprising sandstone and mudstone.			
				52.38	5.45				
						Complete at 5.45m			

Remarks
Borehole dry and stable.
Limited recovery between 1.20-2.00mbgl and from 2.00mbgl SPT.

Scale (approx)	**Logged By**
1:40	EM

Figure No.
LKC 22 1670.WS110

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Appendix C

Gas Monitoring Results

LK CONSULT LTD

GAS MONITORING RECORD

Site	Varley and Nelson Street
Job Number	LKC 22 1670
Date	08/06/2023
Engineer	CD
Visit	1 of 6

Equipment[1]		
Instrument	**Serial Number**	**Comments**
Gas Analyser GA5000	G507783	Serviced, calibrated, gas checked.
HydroTechnik	HT-03	Operating normally.
Pho-Check Tiger	T-106802	Serviced, calibrated.

Atmospheric / Ground Conditions	
Atmospheric pressure trend onsite	Rising then steady
Atmospheric pressure (prev 24hrs)	Steady
Weather Conditions	Clear, Hot, No wind.
Ground Conditions	Dry

Borehole ID	**Date & Time**	**CH_4 (%v/v)**	**CO_2 (%v/v)**	**O_2 (%v/v)**	**Peak CH_4 (%v/v)**	**Peak CO_2 (%v/v)**	**Min O_2 (%v/v)**	**% LEL[2]**	**Peak CO (ppm)**	**Peak H_2S (ppm)**	**Balance (%)**	**Barometric Pressure (mb)**	**Internal Flow[3] (l/hr)**	**PID (ppm)**	**Standing water level (mbgl)**	**Installation base depth (mbgl)**	**Notes**
WS101	08/06/2023 11:57	0	15.7	4.4	0	15.7	4.4	0	26	0	79.9	1014	0	2.1	4.85	4.90	Steady CO=3ppm.
WS102	08/06/2023 14:03	0	1.8	18.9	0	1.8	18.9	0	5	0	79.3	1015	0	0.6	1.71	4.85	Steady CO=1ppm.
WS103	08/06/2023 12:22	0	13.2	0.4	0	13.2	0.4	0	12	0	86.4	1015	0	0.9	1.94	3.95	Steady CO=2ppm, Slightly Silty.
WS104A	08/06/2023 12:33	0	4.9	14.4	0	4.9	14.4	0	12	0	80.7	1015	0	0.8	4.57	4.89	Steady CO=1ppm.
WS105	08/06/2023 12:44	0	9.2	5.7	0	9.2	5.7	0	3	0	85.1	1015	0	1.1	3.88	3.95	Steady CO=2ppm.
WS106	08/06/2023 13:00	0	7.6	2.8	0	7.6	2.8	0	9	0	89.6	1015	0	0.8	2.01	4.83	Steady CO=4ppm.
WS107	08/06/2023 13:16	0	8.8	4.4	0	8.8	4.4	0	28	0	86.8	1015	0	1.3	2.57	4.86	Steady CO=2ppm.
WS108	08/06/2023 13:27	0	7.3	11.9	0	7.4	11.9	0	7	0	80.8	1015	0	0.7	4.13	4.85	Steady CO=1ppm.
WS109	08/06/2023 13:37	0	6.2	15.5	0	6.2	15.5	0	29	0	78.3	1015	0	1.4	4.19	4.44	Steady CO=1ppm, Peak PID=2.0
WS110	08/06/2023 13:47	0	3.9	17.4	0	3.9	17.2	0	9	0	78.7	1015	0	0.7	4.40	4.91	Steady CO=1ppm.

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

NOTES

All monitoring is carried out in line with LK Consult Ltd procedures, with reference to CIRIA C665.

[1]Equipment is serviced and checked as recommended by the manufacturer. Refer to calibration records and service certificates.

[2]CH4 is explosive between the range of 5-15%v/v. 100% lower explosive limit is equal to 5%v/v CH4.

[3]Flow readings are based on a 1 minute average value where flow is detected (equipment range of +/- 12 ltr/hr).

LK CONSULT LTD

GAS MONITORING RECORD

Site	Varley and Nelson Street, Manchester
Job Number	LKC 22 1670
Date	21/06/2023
Engineer	CD
Visit	2 of 6

Equipment[1]		
Instrument	**Serial Number**	**Comments**
Gas Analyser GA5000	G507783	Serviced, calibrated, gas checked.
HydroTechnik	HT-04	Operating normally.
Mini Rae Lite	PGM7300	Serviced, calibrated.

Atmospheric / Ground Conditions	
Atmospheric pressure trend onsite	Rising
Atmospheric pressure (prev 24hrs)	Rising
Weather Conditions	Slight Breeze, Warm, Sudden Showers
Ground Conditions	Initially Dry, Damp after Rain.

Borehole ID	Date & Time	CH_4 (%v/v)	CO_2 (%v/v)	O_2 (%v/v)	Peak CH_4 (%v/v)	Peak CO_2 (%v/v)	Min O_2 (%v/v)	% LEL[2]	Peak CO (ppm)	Peak H_2S (ppm)	Balance (%)	Barometric Pressure (mb)	Internal Flow[3] (l/hr)	PID (ppm)	Standing water level (mbgl)	Installation base depth (mbgl)	Notes
WS101	21/06/2023 10:58	0	17.1	0.1	0	17.2	0.1	0	30	1	0	1008	0	5	4.91	4.91	Steady CO=30ppm.
WS102	21/06/2023 11:14	0	4.3	6.1	0	4.3	6.1	0	4	0	0	1008	8.6	1.9	0.95	4.87	Steady CO=3ppm.
WS103	21/06/2023 11:29	0	15.4	0.1	0	15.4	0.1	0	6	0	0	1009	0	1.2	1.97	3.91	Steady CO=3ppm, Very Silty.
WS104A	21/06/2023 11:40	0	6.5	8.6	0	6.5	8.6	0	6	0	0	1009	0	1.1	3.77	4.87	Steady CO=1ppm.
WS105	21/06/2023 11:57	0	11.1	2.4	0	11.1	2.4	0	2	0	0	1009	0	1.6	3.44	3.95	Steady CO=2ppm.
WS106	21/06/2023 12:27	0	8.7	0.2	0	8.8	0.2	0	16	0	0	1008	0	1.4	1.79	4.87	Steady CO=16ppm.
WS107	21/06/2023 12:34	0	10.9	3.1	0	10.9	3.1	0	13	0	0	1009	0	1.1	2.23	4.72	Steady CO=2ppm.
WS108	21/06/2023 12:54	0	9.4	6.4	0	9.4	4.5	0	17	0	0	1009	0	0.6	3.26	4.85	Steady CO=0ppm.
WS109	21/06/2023 13:08	0	8.1	10.4	0	8.1	10.4	0	14	0	0	1009	0	0.9	2.18	4.46	Steady CO=0ppm.
WS110	21/06/2023 13:20	0	6	3.7	0	6	3.7	0	2	0	0	1009	0	1	2.18	4.90	Steady CO=2ppm.

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

NOTES

All monitoring is carried out in line with LK Consult Ltd procedures, with reference to CIRIA C665.

[1]Equipment is serviced and checked as recommended by the manufacturer. Refer to calibration records and service certificates.

[2]CH4 is explosive between the range of 5-15%v/v. 100% lower explosive limit is equal to 5%v/v CH4.

[3]Flow readings are based on a 1 minute average value where flow is detected (equipment range of +/- 12 ltr/hr).

LK CONSULT LTD

GAS MONITORING RECORD

Site	Varley and Nelson Street
Job Number	LKC 22 1670
Date	05/07/2023
Engineer	CD
Visit	3 of 6

Equipment[1]		
Instrument	**Serial Number**	**Comments**
Gas Analyser GA5000	G507783	Serviced, calibrated, gas checked.
HydroTechnik	HT-01	Operating normally.
Mini Rae Lite	PGM7300	Serviced, calibrated.

Atmospheric / Ground Conditions	
Atmospheric pressure trend onsite	Rising
Atmospheric pressure (prev 24hrs)	Steady
Weather Conditions	Partial Cloud Cover, Slight Wind, Dry
Ground Conditions	Dry

Borehole ID	**Date & Time**	**CH_4 (%v/v)**	**CO_2 (%v/v)**	**O_2 (%v/v)**	**Peak CH_4 (%v/v)**	**Peak CO_2 (%v/v)**	**Min O_2 (%v/v)**	**% LEL[2]**	**Peak CO (ppm)**	**Peak H_2S (ppm)**	**Balance (%)**	**Barometric Pressure (mb)**	**Internal Flow[3] (l/hr)**	**PID (ppm)**	**Standing water level (mbgl)**	**Installation base depth (mbgl)**	**Notes**
WS101	05/07/2023 10:38	0	16.8	0.1	0	16.8	0.1	0	9	5	83.1	1003	0	4.3	4.89	4.90	Steady CO=8ppm.
WS102	05/07/2023 12:25	0	0.6	20	0	1.4	19.7	0	0	0	79.4	1005	0	1.3	3.02	4.86	Steady CO=0ppm, Bung removed, measured 1hr 30 later.
WS103	05/07/2023 11:10	0	15.8	0.5	0	15.8	0.5	0	2	0	83.7	1004	0	1.3	2.01	3.90	Steady CO=1ppm.
WS104	05/07/2023 11:39	0	8.1	3.7	0	8.1	3.7	0	3	0	88.2	1004	-0.1	1.1	2.92	4.86	Steady CO=1ppm
WS105	05/07/2023 12:03	0	12.5	0.4	0	12.5	0.4	0	2	0	87.1	1004	0	1.2	3.07	3.91	Steady CO=1ppm
WS106	05/07/2023 12:14	0	11.4	0.1	0	11.4	0.1	0	2	0	88.5	1005	0	1.3	1.89	4.86	Steady CO=1ppm
WS107	05/07/2023 12:40	0	11.9	6.4	0	11.9	6.4	0	6	0	81.7	1005	0	1.5	2.23	4.83	Steady CO=1ppm
WS108	05/07/2023 12:51	0	11	6.4	0	11	6.4	0	9	0	82.6	1005	-0.1	1.5	2.60	4.85	Steady CO=1ppm
WS109	05/07/2023 13:03	0	8	13.1	0	8	13.1	0	5	0	78.9	1005	-0.1	0.4	1.97	4.45	Steady CO=0ppm
WS110	05/07/2023 13:12	0	9	3.2	0	9	3.2	0	2	0	87.8	1005	0	1	2.31	4.90	Steady CO=1ppm

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

NOTES

All monitoring is carried out in line with LK Consult Ltd procedures, with reference to CIRIA C665.

[1]Equipment is serviced and checked as recommended by the manufacturer. Refer to calibration records and service certificates.

[2]CH4 is explosive between the range of 5-15%v/v. 100% lower explosive limit is equal to 5%v/v CH4.

[3]Flow readings are based on a 1 minute average value where flow is detected (equipment range of +/- 12 ltr/hr).

LK CONSULT LTD

GAS MONITORING RECORD

Site	Varley and Nelson Street
Job Number	LKC 22 1760
Date	21/07/2023
Engineer	CD
Visit	4 of 6

Equipment[1]		
Instrument	**Serial Number**	**Comments**
Gas Analyser GA5000	G502417	Serviced, calibrated, gas checked.
HydroTechnik	HT-02	Operating normally.

Atmospheric / Ground Conditions	
Atmospheric pressure trend onsite	Rising then steady
Atmospheric pressure (prev 24hrs)	Steady
Weather Conditions	Heavy Showers and Sun
Ground Conditions	Damp

Borehole ID	Date & Time	CH_4 (%v/v)	CO_2 (%v/v)	O_2 (%v/v)	Peak CH_4 (%v/v)	Peak CO_2 (%v/v)	Min O_2 (%v/v)	% LEL[2]	Peak CO (ppm)	Peak H_2S (ppm)	Balance (%)	Barometric Pressure (mb)	Internal Flow[3] (l/hr)	PID (ppm)	Standing water level (mbgl)	Installation base depth (mbgl)	Notes
WS101	21/07/2023 10:10	0.1	16	0.1	0.1	16	0.1	2	3	7	83.8	1007	0	NR	4.86	4.91	Steady CO=2ppm.
WS102	21/07/2023 10:29	0	5.2	6.4	0	5.2	6.4	0	2	0	88.4	1007	14.2	NR	0.79	4.85	Steady CO=2ppm, Peak flow=14.21 l/hr. Decreased to 0 l/h over 3 minutes.
WS103	21/07/2023 10:47	0	15.9	0.5	0	16	0.5	0	4	0	83.6	1007	0	NR	1.96	3.92	Steady CO=0ppm, Silty.
WS104A	21/07/2023 11:00	0	9.1	1.3	0	11	1.3	0	1	0	89.6	1007	13.9	NR	0.66	4.88	Steady CO=1ppm, Peak flow=13.9 l/hr. Decreased to 0 l/h over 3 minutes.
WS105	21/07/2023 11:12	0	12.6	0.2	0	12.6	0.2	0	2	0	87.2	1007	0	NR	2.63	3.93	Steady CO=0ppm
WS106	21/07/2023 11:26	0	11.3	0.1	0	13.3	0.1	0	4	0	88.6	1007	0	NR	2.01	4.88	Steady CO=1ppm
WS107	21/07/2023 11:49	0	11.8	6.7	0	15.6	6.7	0	3	0	81.5	1007	0	NR	2.20	4.85	Steady CO=0ppm
WS108	21/07/2023 11:39	0	10.6	7.2	0	11.2	7.2	0	5	0	82.2	1007	0	NR	2.16	4.85	Steady CO=0ppm
WS109	21/07/2023 12:03	0	8.4	13.2	0	8.4	13.2	0	4	0	78.4	1007	0	NR	1.78	4.45	Steady CO=0ppm
WS110	21/07/2023 12:13	0	8.6	6.9	0	8.6	6.9	0	1	0	84.5	1007	0	NR	2.35	4.91	Steady CO=1ppm

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

NOTES

All monitoring is carried out in line with LK Consult Ltd procedures, with reference to CIRIA C665.

[1]Equipment is serviced and checked as recommended by the manufacturer. Refer to calibration records and service certificates.

[2]CH4 is explosive between the range of 5-15%v/v. 100% lower explosive limit is equal to 5%v/v CH4.

[3]Flow readings are based on a 1 minute average value where flow is detected (equipment range of +/- 12 ltr/hr).

LK CONSULT LTD

GAS MONITORING RECORD

Site	Varley and Nelson Street
Job Number	LKC 22 1670
Date	11/08/2023
Engineer	CD
Visit	5 of 6

Equipment[1]		
Instrument	**Serial Number**	**Comments**
Gas Analyser GA5000	G507783	Serviced, calibrated, gas checked.
HydroTechnik	HT-04	Operating normally.
Mini Rae Lite	PGM7300	Serviced, calibrated.

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

Borehole ID	**Date & Time**	**CH_4 (%v/v)**	**CO_2 (%v/v)**	**O_2 (%v/v)**	**Peak CH_4 (%v/v)**	**Peak CO_2 (%v/v)**	**Min O_2 (%v/v)**	**% LEL[2]**	**Peak CO (ppm)**	**Peak H_2S (ppm)**	**Balance (%)**	**Barometric Pressure (mb)**	**Internal Flow[3] (l/hr)**	**PID (ppm)**	**Standing water level (mbgl)**	**Installation base depth (mbgl)**	**Notes**
WS101	11/08/2023 10:13	0.7	14.8	0	0.7	14.8	0	14	4	6	84.5	1009	0	6.5	4.17	4.91	Steady CO=3ppm.
WS102	UR	UR	UR	UR	UR	UR	UR	UR	UR	UR	UR	UR	UR	UR	UR	UR	Unable to locate well.
WS103	11/08/2023 10:31	0	13.6	5.2	0.1	21.8	5.2	0	4	0	81.2	1010	0	1.4	1.55	3.90	Steady CO=1ppm, Silty.
WS104A	11/08/2023 10:46	0	9.3	2	0	9.3	1.5	0	7	8	88.7	1010	-0.1	5.1	0.68	4.89	Steady CO=2ppm. H2S= 0ppm for first 175 seconds, followed by sharp rise to 8ppm.
WS105	11/08/2023 11:10	0	11.3	0.2	0	11.3	0.2	0	2	0	88.5	1009	0	2.9	1.34	3.93	Steady CO=1ppm.
WS106	11/08/2023 11:28	0	11.3	0.1	0	11.3	0.1	0	4	0	88.6	1010	0	2.1	1.68	4.86	Steady CO=2ppm.
WS107	11/08/2023 11:39	0	11.2	5.2	0	15.7	5.2	0	4	0	83.6	1010	0	2.4	2.21	4.86	Steady CO=1ppm.
WS108	11/08/2023 11:50	0	9.8	8.1	0	11.3	8	0	5	0	82.1	1010	0	2	1.42	4.86	Steady CO=1ppm.
WS109	11/08/2023 12:01	0	8	14.2	0	9.5	14.2	0	6	0	77.8	1010	-0.1	1.6	1.18	4.46	Steady CO=1ppm.
WS110	11/08/2023 12:12	0	8.9	4.2	0	8.9	4.2	0	5	0	86.9	1010	-0.1	2.2	2.38	4.93	Steady CO=2ppm.

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

NOTES

All monitoring is carried out in line with LK Consult Ltd procedures, with reference to CIRIA C665.

[1]Equipment is serviced and checked as recommended by the manufacturer. Refer to calibration records and service certificates.

[2]CH4 is explosive between the range of 5-15%v/v. 100% lower explosive limit is equal to 5%v/v CH4.

[3]Flow readings are based on a 1 minute average value where flow is detected (equipment range of +/- 12 ltr/hr).

LK CONSULT LTD

GAS MONITORING RECORD

Site	Varley and Nelson Street
Job Number	LKC 22 1670
Date	01/09/2023
Engineer	CD
Visit	6 of 6

Equipment[1]		
Instrument	**Serial Number**	**Comments**
Gas Analyser GA5000	G507783	Serviced, calibrated, gas checked.
HydroTechnik	HT-03	Operating normally.
Mini Rae Lite	PGM7300	Serviced, calibrated.

Atmospheric / Ground Conditions	
Atmospheric pressure trend onsite	Rising
Atmospheric pressure (prev 24hrs)	Falling then steady
Weather Conditions	Sunny, clear to overcast. No wind.
Ground Conditions	Damp.

Borehole ID	**Date & Time**	**CH_4 (%v/v)**	**CO_2 (%v/v)**	**O_2 (%v/v)**	**Peak CH_4 (%v/v)**	**Peak CO_2 (%v/v)**	**Min O_2 (%v/v)**	**% LEL[2]**	**Peak CO (ppm)**	**Peak H_2S (ppm)**	**Balance (%)**	**Barometric Pressure (mb)**	**Internal Flow[3] (l/hr)**	**PID (ppm)**	**Standing water level (mbgl)**	**Installation base depth (mbgl)**	**Notes**
WS101	01/09/2023 10:02	1.2	15.3	0	1.2	15.3	0	0	4	6	83.5	1004	0	4.5	4.60	4.91	Steady CO=2ppm
WS102	01/09/2023 10:29	0	3.1	14.1	0	3.1	14.3	0	3	0	82.8	1005	6.2	2.1	0.72	4,86	Steady CO=3ppm. Peak flow=6.2l/h, decreased to 2.0l/h over 3 minutes. Water taken up tubing at 40 seconds.
WS103	01/09/2023 10:02	0	15.2	2.6	0	15.2	2.6	0	3	0	82.2	1005	-0.1	1.1	1.67	3.90	Steady CO=1ppm, Silty
WS104A	01/09/2023 10:58	0	2.6	17.2	0	2.6	17.2	0	8	2	80.2	1005	0.2	3	0.69	4.88	Steady CO=6ppm. Peak flow=1.8l/h, decreased to 0.2l/h over 3 minutes.
WS105	01/09/2023 11:29	0	12	0.1	0	12.1	0.1	0	2	0	87.9	1006	-0.1	1.5	1.49	3.93	Steady CO=1ppm
WS106	01/09/2023 11:57	0	12	0.1	0	12	0.1	0	4	0	87.9	1006	0	1.2	1.75	4.86	Steady CO=2ppm
WS107	01/09/2023 12:13	0	11.5	4.7	0	11.6	4.7	0	4	0	83.8	1006	-0.1	1.9	2.23	4.85	Steady CO=1ppm
WS108	01/09/2023 12:25	0	9.5	8.8	0	9.5	8.7	0	4	0	81.7	1007	0	1.1	1.55	4.86	Steady CO=1ppm
WS109	01/09/2023 12:39	0	7.8	13.5	0	7.8	13.5	0	4	0	78.7	1007	0	0.6	1.26	4.47	Steady CO=1ppm
WS110	01/09/2023 12:45	0	9.1	6.2	0	9.1	6.2	0	4	0	84.7	1007	0	0.7	2.34	4.91	Steady CO=1ppm

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

NOTES

All monitoring is carried out in line with LK Consult Ltd procedures, with reference to CIRIA C665.

[1]Equipment is serviced and checked as recommended by the manufacturer. Refer to calibration records and service certificates.

[2]CH4 is explosive between the range of 5-15%v/v. 100% lower explosive limit is equal to 5%v/v CH4.

[3]Flow readings are based on a 1 minute average value where flow is detected (equipment range of +/- 12 ltr/hr).

Appendix D

Generic Assessment Criteria Values

CATEGORY 4 SCREENING LEVELS

Substance	Residential (with home-grown produce)	Residential (without home-grown produce)	Allotments	Commercial	Public Open Space 1	Public Open Space 2
Arsenic	37 mg/kg	40 mg/kg	49 mg/kg	640 mg/kg	79 mg/kg	170 mg/kg
Benzene	0.87 mg/kg	3.3 mg/kg	0.18 mg/kg	98 mg/kg	140 mg/kg	230 mg/kg
Benzo(a)pyrene	5.0 mg/kg	5.3 mg/kg	5.7 mg/kg	77 mg/kg	10 mg/kg	21 mg/kg
Cadmium	22 mg/kg	150 mg/kg	3.9 mg/kg	410 mg/kg	220 mg/kg	880 mg/kg
Chromium VI	21 mg/kg	21 mg/kg	170 mg/kg	49 mg/kg	21 mg/kg	250 mg/kg
Lead	200 mg/kg	310 mg/kg	80 mg/kg	2300 mg/kg	630 mg/kg	1300 mg/kg
Tetrachlorethene (PCE) – 1% SOM	0.31 mg/kg	0.32 mg/kg	2.0 mg/kg	24 mg/kg	3,200 mg/kg	1,400 mg/kg
Tetrachlorethene (PCE) – 2.5% SOM	0.70 mg/kg	0.71 mg/kg	4.8 mg/kg	55 mg/kg	3,300 mg/kg	1,900 mg/kg
Tetrachlorethene (PCE) – 6% SOM	1.6 mg/kg	1.6 mg/kg	11 mg/kg	130 mg/kg	3,400 mg/kg	2,500 mg/kg
Trichlorethene (TCE) – 1% SOM	0.0093 mg/kg	0.0097 mg/kg	0.032 mg/kg	0.73 mg/kg	76 mg/kg	41 mg/kg
Trichlorethene (TCE) – 2.5% SOM	0.020 mg/kg	0.020 mg/kg	0.072 mg/kg	1.5 mg/kg	78 mg/kg	54 mg/kg
Trichlorethene (TCE) – 6% SOM	0.043 mg/kg	0.045 mg/kg	0.16 mg/kg	3.4 mg/kg	79 mg/kg	69 mg/kg
Vinyl Chloride (VC) – 1%SOM	0.0064 mg/kg	0.015 mg/kg	0.0017 mg/kg	1.1 mg/kg	7.8 mg/kg	18 mg/kg
Vinyl Chloride (VC) – 2.5%SOM	0.010 mg/kg	0.019 mg/kg	0.0031 mg/kg	1.4 mg/kg	7.8 mg/kg	19 mg/kg
Vinyl Chloride (VC) – 6%SOM	0.017 mg/kg	0.029 mg/kg	0.0058 mg/kg	2.2 mg/kg	7.8 mg/kg	19 mg/kg

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

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

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

NOTES

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

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

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

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

NOTES

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

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

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

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

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

NOTES

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

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

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

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

NOTES

Sol / vap = solubility / vapour limit (potentially use if free product identified, although highly conservative).

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

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

NOTES

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

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

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

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