

AINSWORTH NURSING HOME, RADCLIFFE

PHASE 1: PRELIMINARY RISK ASSESSMENT

Job Number: LKC 20 1567

Date: July 2020

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LK Consult Document Verification			
Site Address	Ainsworth Nursing Home, Knowsley Road, Radcliffe, BL2 5PT		
Report Title	Phase 1 Preliminary Risk Assessment		
Job Number	LKC 20 1567	Document Ref.	CL-602-LKC 20 1567-01
Date Issued	30 th July 2020	Report Version	R1
Prepared By	Beth Ryder	Signature	
Reviewed By	Emma Khadun	Signature	

Revision Record			
Revision No.	Date	Nature of Revision	Approved By
R1	30/07/2020	Introduction, client and disclaimer amended to reflect all 7no. plots on site to be redeveloped at a future date.	Emma Khadun

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Appendix B: Envirocheck Report
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Appendix D: Site Reconnaissance
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1 Introduction

1.1 Background

LK Consult Ltd (LKC) has been commissioned on behalf of the plot buyers of Ainsworth Nursing Home to carry out a Phase 1 Preliminary Risk Assessment (PRA) for Ainsworth Nursing Home, Bury. The report was undertaken to redevelop the wider Ainsworth Nursing Home site (see Drawing No. R-0517-03: Existing Site Plan) for residential use and is intended for use by all those named within the report disclaimer. Two redevelopment plans for planning application (Reference Number: 65626; for Plot 3 'The Wash House' and Reference Number: 65626 for Plot 2 'The Bungalow') have been made available to LKC; redevelopment plans for the remaining plots on the site have not been made available.

According to guidance set out in CLR11¹ and the National Planning Policy Framework (NPPF)², a PRA with a site reconnaissance is required as a minimum to ascertain if there is a potential contamination risk.

In accordance with current guidance, the PRA will include a site reconnaissance, site history, geology, hydrogeology, hydrology, mineral search and a landfill search. Information gathered from the desk study and site reconnaissance will be used to develop a contamination conceptual model for the site, which will support the identification and assessment of any pollutant linkages. In addition, the information gathered will be used to identify potential geotechnical constraints associated with the redevelopment of the site.

Based on the findings of this report, an appropriate site investigation can be derived, if required.

Please note: while the historical maps contained in Appendix A show the site boundary for Plot 3, this boundary is erroneous; this report from Section 1.2 onwards has been compiled for the wider Ainsworth Nursing Home site, as shown on Figure 1.

1.2 Site Details

A summary of the site details is presented in Table 1-1. Figure 1 indicates the site location and boundary. Drawing No. R-0517-03 indicates the individual 7no. plots/buildings and plot/building names at the time of sale. Figure 2 and Drawing No. A.01.2.1 indicates the proposed development plan for Plot No.3 'The Wash House' and Plot No. 2 'The Bungalow'. Proposed development plans for the remaining plots have not been made available to LKC.

Location	Site is the former Ainsworth Nursing Home and surrounding grounds. Centred at approximate National Grid Reference 376430E 410940N.
Approximate Area	1300m ² .
Topography	168 metres Above Ordnance Datum (AOD). Site has a slight slope from north to south, with some flat areas.

Table 1-1: Summary of the site details.

¹ EA (2004). "Model Procedures for the Management of Land Contamination". R&D Publication CLR 11.

² "National Planning Policy Framework." The Ministry of Housing, Communities and Local Government. February 2019.

Current Land Use	<u>Site</u> The site comprises of multiple vacant buildings used previously as a nursing home and hospital. The site slopes southwards with levelled parts across the site. A fuel tank, septic tank and chimney are present on site. Mature trees are present along the site boundary, with a wooded area in the eastern areas. There are several areas of overgrown vegetation on site. <u>Surrounding Area</u> North: pastoral farmland. East: remaining buildings from the former nursing home. South: remaining buildings from the former nursing home. West: pastoral farmland.
Proposed Development	Entire Site: It is understood that the 7no. plots / buildings on site will be redeveloped for residential housing. Plot No. 3 'The Wash House': Conversion of property to 1 no. residential building; proposed two storey extension at rear/ porch to front elevation and increase of ridge height; change of use of open land to residential garden.

Table 1-1 (continued): Summary of the site details.

2 Site History

In compiling the site history, LKC consulted historical mapping provided by the Landmark Information Group Ltd. Copies of relevant historical plans are provided in Appendix A; please note the error in the site boundary, which should be for the entire Ainsworth Nursing Home site (see Figure 1). On site features for the wider Ainsworth Nursing Home site are summarised in Table 2-1. Notable potentially contaminated features within 100m of the site boundary have been presented in Table 2-2 (distances will be approximate). The exception to this will be potentially significant features within a 250m buffer that could be infilled historically.

Site Features	Location	Map Dates Present	Comments
Ainsworth Hospital/ Nursing Home	Whole Site	1850-present	- 3no. large unnamed buildings and several smaller buildings present on site from earliest mapping in 1850. Site labelled as 'Broom Field'. - Glass house noted in the south of site on 1893 mapping only. - Change of layout by 1910 mapping with a total of 6no. buildings across the site. New building present in the northwest corner of site noted to have changed layout also. - Site labelled 'Ainsworth Hospital (infectious diseases)' by 1910 mapping and 'Ainsworth Smallpox Hospital' by 1930 mapping. Small building present on 1930 mapping only; no longer present by 1931 mapping. - Glass house extension to southeast building noted by 1939 mapping. - 2no. smaller out buildings present to the northwest by 1955 mapping, no longer present by 1956 mapping. Re-annotated only on 1992 and 2020 mapping. Assumed to be still present. - Grassed areas with trees annotated across by 1955 mapping with hardstood paths throughout. - Building change of use from 'Ainsworth Hospital' to 'Ainsworth Nursing Home' by 1992 mapping. - 2no. additional buildings present in the north and southwest of site by 1992 mapping. - Thick vegetation and trees noted by 2000 aerial photo in north and west of site.
Embankment	NW	1930 only	- No longer present by 1931 mapping.
Excavation	NE	1930 only	- No longer present by 1931 mapping. Potentially infilled.
Private road/Track	E	1931-present	- Change of layout by 1955 mapping. - Change of layout by 1974 mapping.

Table 2-1: Summary of the on site historical features.

Surrounding Features	Area	Distance / Location	Map Dates Present	Comments
2no. Wells		26m S, 172m W	1850-1893	- No longer present by 1894 mapping, potentially infilled.
Pond/Marsh		57m W	1893-present	- Annotated as Marsh by 1930 mapping. - Not annotated on early 2020 mapping, however area of land noted to be heavily vegetated on 2020 aerial photograph. - Potentially historically infilled or marsh still present.
Drain		53m SE	1850-present	- Collects and Marsh present by 1955 mapping.
Tank and pump		147m W	1910-1956	- Likely to be above ground tank associated with surrounding farmland / wind pump. - Noted to be isolated from any nearby industry. - No longer present by 1969 mapping.
Pond		165m SW	1850-1982	- No longer present by 1992 mapping. Potentially infilled.
Well		165m SE	1850-1911	- No longer present by 1929 mapping. Potentially infilled.
Filter Beds		180m SE	1910-1992	- Tank present on 1992 mapping. - No longer marked by 2003 mapping. Potentially infilled.
2no. Embankments / Excavations		185m NE, 207m NE	1930-1956	- No longer present by 1969 mapping. Potentially infilled.
Well		195m SE	1850-1956	- No longer marked by 1965 mapping; presumed infilled.
Marsh		197m SE	1937-present	- Additional pond present by 1974 mapping.
Embankment / Excavation		247m SE	1889-present	

Table 2-2: Summary of the offsite historical features.

3 Environmental Setting

In compiling this Section, LKC consulted environmental information provided by the Envirocheck Report (Appendix B), British Geological Survey (BGS), the Coal Authority, Zetica UXO (Appendix C), Natural England and the Environment Agency. A summary is presented in Table 3-1.

Categories ^(data sources)		Details
Geology	Artificial ¹	- None recorded on the database.
	Superficial ¹	- None recorded on site. - Glacial Till recorded approximately 50m south of the site.
	Bedrock ^{1,2}	- Pennine Lower Coal Measures (Sandstone).
	BGS Logs ³	- No relevant data available.
Hydro-geology ¹	Aquifer Designation	- Superficial - None recorded.
		- Bedrock - Secondary A Aquifer.
	Source Protection Zone (SPZ)	- Site is not within an SPZ.
	Groundwater Abstractions	- None within 250m. - Nearest 630m W, borehole at Arthur Lane Nurseries Ainsworth, general agriculture use – spray irrigation, permit start date 01/05/1995.
Hydrology ¹	Nearest Surface Water	- Collects and drain 53m SE. - Un-named pond 111m west.
	Water Quality Data	- No data available.
	Flooding	- No risk from rivers or sea. - Limited potential for groundwater flooding to occur 23m S of the site.
	Surface Water Abstractions	- None within 250m: - Nearest 795m NW, Harwood Golf Club– spray irrigation from unnamed trib. Of Blackshaw Brk., permit date 25/04/1980.
	Discharge Consents	- None within 250m: - Nearest 324m SE, Ainsworth Nursing Home Ltd, discharge type – sewage and trade combined –trib. to Lower Croft Reservoir, dated 02/03/2007.
	Pollution Incidents	- 1no. within 250m. - 134m SE, Private Sewage (Non-PLC); Crude Sewage to Tributary Lowercroft Bk, caused by blocked sewer, category 3 – minor incident, 07/10/1995.
Minerals & Mining	Coal Report ⁴	- Site is within a coal reporting area. - Not within DHRA.
	Surface Extractions ¹	- 394m SW, New Brown Hill, Opencast Sandstone (quarry), ceased operation.
	Cheshire Brine Compensation District ^{1,5}	- N/A.
	Mining Instability / Non-Coal Mining Area ¹	- Not within area of recorded non-coal mining.

Table 3-1: Summary of the environmental setting.

Data Sources: 1 – Envirocheck Report (Appendix A & B); 2 – BGS Sheet 85 1:50,000; 3 – BGS GeoIndex <http://mapapps2.bgs.ac.uk/geoindex/home.html>; 4 – The Coal Authority Web Mapping Services (WMS) and Interactive Map Viewer <http://coal.decc.gov.uk/en/coal/cms/publications/data/map/map.aspx> 5 – Cheshire Brine Subsidence Compensation Board Compensation District & Consultation Areas <http://www.cheshirebrine.com/wp-content/uploads/2016/11/NL08134-001-002.pdf>

Categories ^(data sources)		Details
Ground Stability (onsite) ¹	Collapsible Ground	- Very Low hazard.
	Compressible Ground	- No hazard.
	Ground Dissolution	- No hazard.
	Landslide	- Very Low hazard.
	Running Sand	- No hazard.
	Shrinking / Swelling Clay	- No hazard.
Landfill Sites ¹	Known / Registered	- None within 250m: - Nearest 528m SW, T J Murphy, Delph Lane Quarry, deposited waste included household waste, dates of operation not supplied.
	Potential	- 1no. onsite; 12no. within 250m.
Radon ¹		- Probability of <1% of homes above Action Level. No further action required.
Designated Sites ¹		- Adopted Green Belt on site (SE), Bury Metropolitan Borough Council.
Contemporary Trade Directory ¹		- None within 100m.
Fuel Station Entries ¹		- None within 100m.
Unexploded Bomb Risk (UXO) ⁶		- Low.

Table 3-1 (continued): Summary of the environmental setting.

Data Sources: 1 – Envirocheck Report (Appendix A & B); 6 – Zetica UXO Unexploded Bomb Risk Map (Appendix C).

4 Site Reconnaissance

A site reconnaissance was carried out on 9th July 2020. Hand dug trial holes were undertaken in accessible areas to confirm the shallow ground conditions.

Building / plot names are given on Drawing No. R-0517-03, the Existing Site Plan. An annotated plan with photographs, and trial hole descriptions and pertinent features is provided in Appendix D.

General site layout

- » The site comprises of multiple vacant buildings used previously as a nursing home and hospital.
- » The site slopes southwards with levelled parts across the site.
- » A fuel tank is present in the central area omitting a hydrocarbon odour (see P5, Appendix D).
- » A possible septic tank is located next to the border in the southeast area with a control board in north of it (see P7, Appendix D).
- » A c.5 metre chimney is present off the building in the east of the site (see P9, Appendix D).
- » Mature trees are present along the borders and densely in the eastern areas.
- » Along the northern border is a raised area supported by bricks roughly 1 metre tall, cleared of vegetation at time of reconnaissance (see P3, Appendix D).
- » No access restrictions however specific areas are restricted due to space and overgrown vegetation.
- » The surrounding area comprises pastoral farmland.

Western area

- » Comprises of 3no. buildings: 'The Gatehouse', 'The Bungalow' and 'The Wash House'.
- » In the north west area the 'Wash House' surrounded by disturbed ground which contained brick.
- » The Wash house is noted to have had a below ground burner for coal (anecdotal information from the owner; see P8, Appendix D).
- » A trial hole (TH1) refused in the northwest of the site at 0.10m on possible brick gravel.
- » In the south west area is a building titled as a 'Gate House' this is surrounded by vegetated land (likely greenbelt, see P11, Appendix D).
- » 'The Bungalow' is currently occupied.

Central area

- » Comprises of 4no. buildings: 'The Stables', 'The Haven', 'Knowsley House' and 'Knowsley Manor' (see P1, P4 and P6, Appendix D).
- » Buildings are surrounded by asphalt and flagged ground. Hardstood asphalt ground is noted to be in variable condition. Drive leading into the site is surfaced in asphalt in good condition. Asphalt closer to buildings is in poor condition.
- » Area of burning noted.
- » A trial hole (TH2) was carried out showing topsoil to 0.10m, and a refusal at 0.15m on possibly made ground sandy gravel.

5 Preliminary Conceptual Model

5.1 Introduction

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

The Sections below are therefore divided into potential contaminant, potential pathway and potential receptor as described in CLR11³, on the premise that, if there is no pollutant linkage, then there will be no risk to the receptor. The final Section provides an assessment of the potential pollutant linkages that may still be present on the site if redevelopment were to occur.

5.2 Potential Contaminants

Potential contamination sources are detailed in Table 5-1.

Source	Contaminants
Onsite former buildings	- Asbestos Containing Material (ACM).
Former onsite hospital	- Ash waste associated with boiler house: Heavy metals (arsenic and lead), sulphates and PAHs. - Fuels (dependant of power type): Hydrocarbons / oils. - Demolished buildings: ACM. - Other general contaminants. - Radiation is not considered to be a viable contamination source, given the scale and use of the hospital.
Onsite made ground, area of burning (centre), coal burner (NW), potential septic tank (SE), fuel tank (east), embankment (north), 1no. infilled excavation (NE)	- Ash and clinker (e.g. from hearths and boilers, often historically used for site raising / levelling, noted in the site walkover): Heavy metals, sulphates and PAHs ⁴ . - Fuel tank: hydrocarbons / oils. - If significant depth of organic / putrescible material: Hazardous gas (principally carbon dioxide and methane).
Offsite potentially infilled ground (12no. features)	- Hazardous gas (principally carbon dioxide and methane). - Given the unknown nature of superficial deposits underlying the site, given the number of features these are considered to be a potential source.
Surrounding area Tank 147m SW	- Tank likely associated with nearby 'windpump' and unlikely to be a source of significant contamination. - No significant contamination sources within influencing distance of the site.
Underlying Pennine Lower Coal Measures	- Ground Gas (principally carbon dioxide and methane).

Table 5-1: Potential contamination sources.

³ Defra (2004). "Model Procedures for the Management of Land Contamination". R&D Publication CLR 11.

⁴ Defra (2002). "Potential Contaminants for the Assessment of Land". R&D Publication CLR 8.

5.3 Potential Receptors

Potential receptors are detailed in Table 5-2.

Receptors	
Human Health	- Future site users (including residents, visitors and site workers). - Offsite land users.
Controlled Waters	- Collects and drain 53m SE. - Un-named pond 111m west. - Secondary A Aquifer (bedrock).
Buildings and structures.	
Potable water pipes.	
Flora within future gardens and landscaping.	

Table 5-2: Potential receptors.

5.4 Potential Pathways

Potential pathways are detailed in Table 5-3.

Pathways		
Soil	Human Health ⁵ (residential land use: houses with private gardens)	- Ingestion of soil. - Ingestion of soil-derived indoor dust. - Ingestion of contaminated vegetables. - Ingestion of soil attached to vegetables - Dermal contact with soil. - Dermal contact with soil-derived indoor dust. - Inhalation of soil-derived outdoor dust. - Inhalation of soil-derived indoor dust. - Inhalation of vapours outside. - Inhalation of vapours inside.
		- Windblown dust and fibres to adjacent receptors.
		- Direct contact with receptors (building foundations, services).
		- Root uptake.
Water		- Surface run-off over impermeable surface. - Slight slope from north to south, with some flat areas; surface run-off will be limited over grassed and vegetated areas.
		- Infiltration into the ground in grassed areas, through potentially contaminated material (contamination possibly going into solution). - Infiltration is likely to be limited in asphalt hardstood areas.
		- Migration through potentially permeable strata and preferential pathways. - Unknown permeability of superficial deposits (none recorded) - Bedrock (sandstone) likely to be relatively permeable. - Preferential pathways: services.
Gas		- Migration through potentially permeable strata and preferential pathways. - Unknown permeability of superficial deposits (none recorded). - Bedrock (sandstone) likely to be relatively permeable. - Preferential pathways: services.
		- Migration into buildings (e.g. via services) and accumulation of gases in confined spaces (potentially causing explosion if methane is present).

Table 5-3: Potential pathways.

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

5.5 Preliminary Contamination Conceptual Model

The Preliminary Contamination Conceptual Model is illustrated in Table 5-4 and has identified seven generic potential pollutant linkages across the wider Ainsworth Nursing Home site.

Each linkage is described along with an assessment of the risk based upon guidance on probabilities and consequences outlined in CIRIA C552⁶.

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

Where LKC identified a low to very low risk, limited intrusive investigation work, a watching brief (during construction work) or no investigation work will be recommended. This will be dependent on the nature of the site and the proposed development.

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

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

It should be noted that there may be risk from short term exposure from contaminated soil to site workers. The Preliminary 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 guidance⁷) should be adopted by all workers involved with site enabling and construction works. Therefore, this receptor is not considered in the contamination conceptual model.

⁶ CIRIA (2001). "Contaminated Land Risk Assessment: A Guide to Good Practice". C552.

⁷ HSE (1991). "Protection of Workers and the General Public During Development of Contaminated Land". London HMSO.

Pollutant Linkage	Pathway	Receptor	Contaminant (source)	Probability	Consequence	Risk	Assessment & Recommendations
PL1	- Dermal contact. - Inhalation of soil, fibres and dust. - Ingestion of soils, dust, vegetables, soil attached to vegetables. - Windblown dust.	- Future site users. - Offsite receptors.	- ACM (former buildings, potentially in made ground). - Heavy metals, PAHs (made ground, coal burner, chimney).	Likely	Medium	Moderate	- Likely probability given history of site, areas of burning including coal burner and chimney, identified made ground on site and potential pathway to receptors in gardens / landscaping. - Recommendation: Intrusive investigation required to include soil sampling.
			- Heavy end hydrocarbons (oil / fuel from tank).	Low likelihood	Medium	Moderate / Low	- Low likelihood of hydrocarbons as minimal spills / leakages expected from tank. However potential pathway exists to receptors in gardens / soft landscaping. - Low risk assumed as significant source not expected. - Recommendation: Intrusive investigation required (TPHCWG testing) if evidence of hydrocarbons identified in the ground.
PL2	- Inhalation of vapours. - Migration through permeable strata and preferential pathways.	- Future site users. - Offsite receptors.	- Volatile contaminants such as hydrocarbons (made ground, tank).	Low likelihood	Medium	Moderate / Low	- Low likelihood as limited source identified (fuel tank). - Low risk assumed as significant source not expected. - Recommendation: SVOC/ VOC testing dependent on PID readings and if odours noted within made ground.
PL3	- Inhalation of gas. - Migration through permeable strata and preferential pathways. - Explosion in confined spaces.	- Future site users. - Buildings. - Offsite land users.	- Ground gas: Methane, carbon dioxide (coal measures) - Hazardous Gas: Methane, carbon dioxide (1no. onsite feature and 12no. potentially infilled features offsite 250m of the site).	Low likelihood	Severe	Moderate	- Low likelihood due to only one viable source of gas identified on site. Moderate risk due to sensitive nature of development (residential). - Ground investigation required to identify superficial deposits and depth of made ground. - Recommendation: If significant source and pathway identified, gas monitoring or precautionary measures required.
			- Radon	Unlikely	Severe	Moderate / Low	- Low risk as <1% properties affected by radon; no protection measures required.

Table 5-4: Preliminary Contamination Conceptual Model.

Pollutant Linkage	Pathway	Receptor	Contaminant (source)	Probability	Consequence	Risk	Assessment & Recommendations
PL4	- Surface run-off. - Migration through permeable strata and preferential pathways. - Perched waters migration.	- Groundwater (Secondary A Aquifer). - Surface water (Collects and drain, pond).	- Mobile contaminants such as metals, PAHs, hydrocarbons, volatile compounds (made ground, tank, chimney, coal burner).	Low likelihood	Medium	Moderate / Low	- Low likelihood as significant contamination not anticipated. - Moderate risk due to unknown superficial deposits and potential pathway to underlying Secondary A Aquifer and offsite surface water features. - Recommendation: Intrusive investigation required to confirm ground conditions. No testing required unless evidence of significant potentially mobile contamination and pathway is identified.
PL5	- Sulphate attack on concrete.	- Building structure.	- Sulphate (ashy made ground anticipated).	Likely	Mild	Moderate / Low	- Likely probability as multiple sources of ash identified on site (coal burner, chimney, area of burning). - Moderate risk assumed at this stage. - Recommendation: Intrusive investigation required as part of PL1.
PL6	- Ingestion of tainted water supply.	- Future site users. - Water pipes.	- Organic contaminants such as hydrocarbons, solvents (made ground, tank).	Low likelihood	Medium	Moderate / Low	- Low likelihood as significant contamination not anticipated at pipeline depth (0.75-1.35m). - Risk is considered moderate at this stage due to unknown depth of made ground. - Recommendation: Sampling required if made ground present at pipeline installation depths. Water pipe risk assessment required.
PL7	- Direct contact (plant uptake).	- Flora.	- Phytotoxic contaminants (made ground).	Likely	Minor	Low	- Likely probability as contamination considered possible, which may be taken up by flora in soft landscaping / gardens. - Recommendation: Investigation work as part of PL1.

Table 5-4: Preliminary Contamination Conceptual Model.

6 Summary Conclusions and Recommendations

6.1 Summary Conclusions

It is understood the site has been divided into Plots and will be redeveloped for residential housing with gardens.

The site was historically used as a former hospital (infectious diseases and smallpox) from 1910-1967 and was renamed as 'Ainsworth Nursing Homes' from the 1992 mapping.

Except for several infilled features (excavations, ponds, wells, filter beds, marshes), no significant contamination sources were noted in the surrounding landscape.

The site currently comprises several vacant buildings surfaced in overgrown vegetation / former gardens and asphalt hardstanding of variable condition; made ground was observed during the site reconnaissance.

Potential contamination sources affecting the site were identified as heavy metals, PAHs, sulphate, asbestos, hydrocarbons and gas (carbon dioxide and methane).

These contaminants may pose a risk to site users (via ingestion, dermal contact, inhalation pathways and explosion), controlled waters (via migration through permeable strata and preferential pathways), buildings and structures (direct contact and explosion), water pipes (direct contact) and flora (root uptake).

A contamination conceptual model has been produced by LKC. This has identified the following risks summarised in Table 7-1. Where a moderate / low risk was identified, the assumed risk at this stage has been shown.

Pollutant Linkage		Risk	Recommendations
1	Contaminants posing a risk to future site users via dermal contact, ingestion and inhalation (of soil, dust, fibres and vegetables).	Moderate (ACM, PAHs, metals)	Investigation work required to include soil sampling.
		Moderate / Low (hydrocarbons)	
2	Volatile contaminants posing a risk to future site users via the inhalation of vapours.	Moderate / Low	Investigation work and sampling not required unless evidence of hydrocarbons / volatile contamination identified.
3	Gas posing a risk to buildings and future site users via the migration of gas into building causing explosion and asphyxiation.	Moderate (hazardous ground gas)	If significant source and pathway identified, gas monitoring or precautionary measures required.
		Moderate / Low (radon)	
4	Mobile contamination posing a risk to controlled waters via the migration through permeable strata.	Moderate / Low	Intrusive investigation required to confirm ground conditions. No testing required unless evidence of significant potentially mobile contamination and pathway is identified.

Table 7-1: Summary risk table.

Pollutant Linkage		Risk	Recommendations
5	Sulphate posing a risk to building via direct contact (sulphate attack).	Moderate / Low	Investigation work required.
6	Organic contaminants posing a risk to water pipes.	Moderate / Low	Sampling required if made ground present at pipeline installation depths. Water pipe risk assessment required.
7	Phytotoxic metals posing a risk to flora via root uptake.	Low	Limited investigation work recommended as part of PL1.

Table 7-1 (continued): Summary risk table.

Further work is recommended, which is detailed in the following Section.

6.2 Recommendations

6.2.1 General

It is recommended that to support the planning application for this development, a Phase 2 intrusive survey should be carried out across the site to investigate the identified potential pollutant linkages further.

LKC recommend that any remedial works or further assessment works undertaken at the site are suitably validated and supporting information documented in a Site Completion Report. This report will aid the Local Authority in the discharge of the appropriate planning conditions.

6.2.2 Phase 2 Site Investigation

In order to address the potential pollutant linkages, a site investigation is recommended. The site investigation should be carried in accordance with relevant guidance documents (including BS10175⁸ and BS5930⁹).

The investigation should include trial pits and / or boreholes at a sampling density of 1 sample per 25-50m square centres for an 'exploratory investigation' and 1 sample per 10-25m square centres for a 'detailed investigation'. In addition, targeted sampling locations should be undertaken in areas of concern (e.g. embankment, infilled excavation, below ground coal burner,

Soil samples should be collected from the trial pits / boreholes and tested for contaminants of concern based on the preliminary conceptual model and field observations (PID tests and visual / olfactory evidence).

If a source of gas is identified and a potential pathway during intrusive investigation work gas monitoring is recommended to address Pollutant Linkage 3. Boreholes drilled on site should be installed with monitoring wells. Monitoring should be undertaken in accordance with CIRIA C665¹⁰. As a minimum gas monitoring would likely be over a three month period with at least six gas monitoring visits under worst case temporal conditions. This would equate to a very low gassing risk under CIRIA C665. If high fluctuations occur during gas monitoring then further gas monitoring maybe required.

If significant soil contamination is identified, groundwater / surface water sampling will be carried out to address Pollutant Linkage 4. Groundwater samples should be collected from boreholes (monitoring wells) and surface water samples collected from

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

⁹ British Standard (2015). "Code of Practice for Ground Investigations". BS5930:2015.

¹⁰ CIRIA (2007). "Assessing Risks Posed by Hazardous Ground Gases to Buildings". CIRIA C665.

the nearby drain and pond. If no groundwater is present, soils can be subjected to leaching tests. Samples should be tested for contaminants of concern based on the Preliminary Risk Assessment, field observations and results of the soil analysis.

It should be noted that boreholes and / or trial pits may also be utilised to provide appropriate geotechnical information on sub-surface conditions.

This investigation, in conjunction with appropriate geotechnical testing, will identify and characterise any contaminants encountered. Information from this investigation can then be used to provide a more detailed assessment of the identified pollutant linkages, provide appropriate foundation solutions and, if necessary, identify appropriate remedial measures to ensure that the site is made suitable for its proposed end use.

6.3 Further Considerations

6.3.1 Asbestos

Although no asbestos was identified externally on the existing buildings, there may be areas inside that have Asbestos Containing Materials (ACMs) given the age of the properties. Therefore we would advise that a Pre-Demolition and Major Refurbishment Asbestos Survey is undertaken prior to demolition by a professional contractor.

The LK Group have a designated Asbestos Department would be happy to advise you on the appropriate steps to take in order to have the building suitably surveyed.

Figures

Appendix A

Historical Maps

Appendix B

Envirocheck Report

Appendix C

Zetica UXO Unexploded Bomb Risk Map

Appendix D

Site Reconnaissance

Appendix E

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 552¹¹. It involves the classification of the:

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

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

Table A: Classification of consequence.

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

Table B: Classification of probability.

¹¹ CIRIA (2001). "Contaminated Land Risk Assessment: A Guide to Good Practice". C552.

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

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

Table C: Comparison of consequence against probability.

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

Risk	Action Required
Very High Risk	- There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening. - This risk, if realised, is likely to result in a substantial liability. - Urgent investigation (if not already undertaken) and remediation are likely to be required.
High Risk	- Harm is likely to arise to a designated receptor from an identified hazard. - Realisation of the risk is likely to present a substantial liability. - Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short term and are likely over the longer term.
Moderate Risk	- It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. - Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer term.
Low Risk	- It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very Low Risk	- There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.

Table D: Description of the classification and likely action required.

Where LKC identified a low to very low risk either limited intrusive investigation work, a watching brief (during construction work) or no investigation work will be recommended. This will be dependent on the nature of the site and the proposed development.

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

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