



**BROWNFIELD
SOLUTIONS LTD**

GEO-ENVIRONMENTAL ENGINEERING EXCELLENCE

St. Chad's RC Primary

Balmfield Street, Manchester

Phase I Geo-Environmental Assessment Report

JAD/C43943/10683

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PROJECT QUALITY CONTROL DATA SHEET

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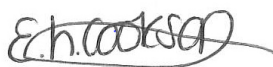
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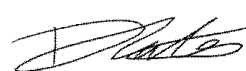
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DRAWINGS

Drawing Number	Rev	Title
PL02	-	As Proposed Site Plan
PL04	-	As Proposed Floor Plan
C4943/01	-	Site Location Plan
C4943/02	-	Site Features Plan

APPENDICES	
Appendix	Title
Photographs	Site Walkover Photographs
Appendix A	BSL Methodology and Guidance
Appendix B	Historical Maps
Appendix C	Geo-Environmental Data Report
Appendix D	BGS Boreholes
Appendix E	Mining Search Report
Appendix F	UXO Screening Map

1.0 INTRODUCTION

1.1 Context

This report describes a desk-based Phase I Geo-Environmental Assessment Report carried out by Brownfield Solutions Limited (BSL) for St. Chad's RC Primary as instructed by Bradbury Consulting on a site off Balmfield St, Manchester and has been completed in general accordance with the following guidance:

- Environment Agency guidance - Land Contamination: Risk Management (LCRM).
- BS 10175:2011+A2:2017 Investigation of Potentially Contaminated Sites.
- BS5930: 2015+A1:2020 Code of Practice for Ground Investigations.
- BS EN 1997-1:2004+A1:2013 Eurocode 7. Geotechnical design. General rules plus UK National Annex.
- BS EN 1997-2:2007 Eurocode 7 Geotechnical design. Ground investigation and testing plus UK National Annex.

Definitions of terms and acronyms used within this report is presented in Section 8.0.

1.2 Proposed Development

The proposed development is for an extension to the existing building as shown on the proposed development plans, drawing Nos. PL02 and PL04 provided to BSL by Bradbury Consulting.

1.3 Objectives and Scope

The objectives of this assessment were to determine the environmental setting and ground conditions of the site, highlighting potential areas of concern that may govern the redevelopment.

The scope of works comprises a Phase I Assessment and site walk-over, with a review of the site, surroundings, historical uses and environmental setting in order to develop a preliminary Conceptual Site Model (CSM).

This report is intended to meet the requirements of a Preliminary Investigation as defined in BS10175:2011+A2:2017 and has been produced in general accordance with the recommendations for a Tier 1 Preliminary Risk Assessment as described in LCRM guidance.

1.4 Limitations

This Phase 1 Geo-Environmental Assessment Report has been prepared in accordance with the relevant legislative framework, guidance and risk assessment methodology as outlined in Appendix A.

The findings and opinions conveyed via this assessment are based on information obtained from a number of sources as detailed within this report, BSL have assumed this information is correct and reliable. Nevertheless, BSL cannot and does not guarantee the authenticity or reliability of the information it has relied upon.

BSL have used reasonable skill, care and diligence in the production of this report. There may be other conditions prevailing on the site which are outside the scope of work and have not been highlighted by this assessment and therefore have not been taken into account by this report. Responsibility cannot be accepted for such site conditions not revealed by the assessment.

This report has been prepared for the sole use and reliance of the Client, St. Chad's RC Primary. No other third parties may rely upon or reproduce the contents of this report without the written permission of

Brownfield Solutions Ltd (BSL). If any unauthorised third party comes into possession of this report, then they rely on it at their own risk and BSL do not owe them any Duty of Care.

Any recommendations made in this report should be confirmed with the Regulatory Authorities prior to implementation to ensure compliance.

This assessment has been based on the proposed planning layouts provided. Any subsequent change to the planning layout may have an impact on the validity of recommendations made within this report. Furthermore, new information, changed practices or new legislation may necessitate revised interpretation of the report after the date of its submission.

The site plans enclosed in this report should not be scaled off. Any site boundary line depicted on plans does not imply legal ownership of land.

Notwithstanding site observations concerning the presence or otherwise of archaeological issues, asbestos-containing materials (ACM) or invasive weeds (e.g. Japanese knotweed), this report does not constitute a formal survey of these potential issues.

2.0 THE SITE

2.1 Location

The site is located off Balmfield St, Cheetham Hill, Manchester, M8 0SP. It is situated approximately 2 Km north of Manchester City Centre, centred on National Grid Reference 384360 400422 as shown on the Site Location Plan, Drawing No. C4943/01.

2.2 Site Description

A site reconnaissance survey was carried out at the site on 21st December 2021. The main site features and potential issues identified during this survey are detailed below and are shown on the Site Features Plan, Drawing No. C4943/02. A selection of photographs from the site walkover are presented to the rear of this report.

Feature	Description
Site Area	Approximately 50m ² .
Site Access	Access to the site is gained off Balmfield Street to the north into the school grounds.
Current Land Use and Site Features	The wider site comprises a school with associated car park, playgrounds, and green spaces. The area of the proposed extension comprises a walkway of paving slabs adjacent to the existing school building with grass bordering the path. Several services are present within the walkway as evidenced by service covers.
Potential Sources of Gross Contamination	No potential sources of gross contamination were identified during the site walkover.
Vegetation	There are sporadic mature/semi-mature trees around the school site perimeter and a newly planted hedge along the south fence. The development area comprises majority grass.
Topography	The site is generally flat.
Site Boundaries	Steel palisade fencing encloses the school site on all sides. The development area is bordered to the north and west by the existing school buildings and to the east and south is a grassed play field.
Surrounding Area	The school site is set within a mixed commercial and residential area and is bordered by residential properties to the north, east and west. To the south of the site across the A6010 Queen's Road is Manchester Fort Shopping Park.

3.0 GEO-ENVIRONMENTAL SETTING

3.1 Historical Setting

A review of the available historical Ordnance Survey Maps and satellite imagery has been conducted, with the pertinent issues that may have affected the site, or its environs, summarised below. The Historical Maps are presented in Appendix B. A review of the historical industrial data within the geo-environmental data report has also been undertaken below, the report is presented in Appendix C.

It should be noted that whilst the proposed development forms part of a wider school site, the features and distances discussed below are relative to the area of development only.

Notable features within 100m of the site boundary have been presented. Any features that have potentially been infilled will be considered up to 250m from the site boundary.

Feature	Distance	Years Present	Description
Field	On Site	1848 to 1891	The site is located within an undeveloped field.
Residential Housing	On Site	1891 to 1975	The site is occupied by two small outbuildings which form part of a residential garden. The outbuildings are no longer shown on 1908 mapping. A road and pavement also encroach across the eastern site boundary.
St. Chad's RC Primary School	On Site	1975 to present	The school was constructed between 1965 and 1975 and has had a consistent footprint to the present day. The site is located within the school premises as land adjacent to the school building. The residential housing surrounding the school was also demolished at this time.
Queen's Road clay pits and brick works	From 82m SE	1890 to 1965	An area to the south-east of the site is mapped as a brickwork with associated clay pits from 1890. The nearest pits are 82m from the site. The brickworks are listed as disused by the 1956 mapping. The site has since been re-developed with the Manchester Fort Shopping Park (circa 2005).
Depot, Works and Garage	94m SE	1949 to 2003	A series of buildings to the south-east are labelled as a depot, garage and works between 1963 and 2003. These buildings were subsequently demolished and now form part of the Manchester Fort Shopping Park.
Refuse Heap	150m SE	1949 to 1963	Part of the brickworks site was used as a refuse heap in 1949. It is no longer shown as a refuse heap on 1963 mapping.
Brickworks and Refuse Heaps	250m SW	1893 to 1963	Brickworks with multiple clay pits are present to the south-west, with refuse heaps also shown to be present. Mapping shows that the brickworks is no longer present (presumed infilled) from 1963. The area is now occupied by commercial premises.

In summary, the map evidence indicates that the site was developed as a housing estate from open fields circa 1891, with subsequent demolition of buildings for the current school to be constructed circa 1975.

The wider school site is surrounded by residential developments to the north and historically residential development which has subsequently been utilised for commercial development to the south. The most significant sources of offsite contamination include infilled clay pits and refuse heaps, a depot, a garage and a former works building.

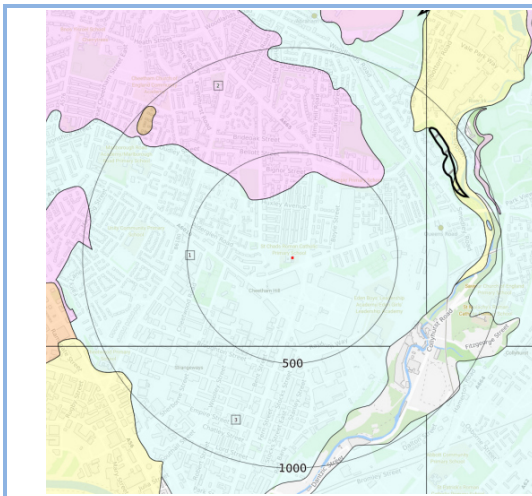
3.2 Published Geology

The following publications of the British Geological Survey (BGS) were examined in respect of the geology underlying the site:

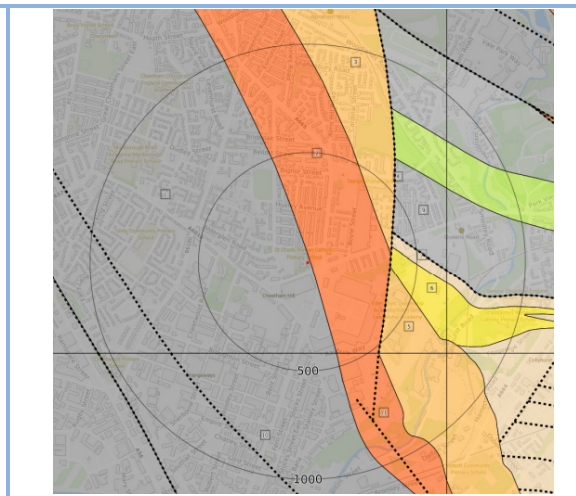
- British Geological Survey (BGS) 1:50,000 Scale Geological Map Sheet 85 Macclesfield. Solid and Drift Edition.
- BGS Geology of Britain Map Viewer.
- BGS GeoIndex Onshore.
- Coal Authority Interactive Map.
- Coal Mining Abandonment Plans.
- Geo-Environmental Data Report.

Extracts of the 1:10,000 geological mapping from the Geo-Environmental Data Report are presented below for reference:

BGS 1:10 000 Superficial Geology



BGS 1:10 000 Solid Geology



Made Ground

BGS mapping does not display any made ground deposits on site from 30m, however significant made ground deposits are present in close proximity to the site.

Superficial Deposits

The site is indicated to be underlain by Diamicton Till which typically comprises an over consolidated heterogenous mixture of clay, sand, gravel, and boulders.

Solid Geology

The deeper solid geology is indicated to be part of the Chester Pebble Beds Formation which typically comprises sandstone. Regional geology indicates these strata to dip south between 5°-15°.

3.3 BGS Boreholes

There are three BGS borehole records within a 100m of the site, one of which is located 8m east of the proposed development, which generally show similar ground conditions.

Made ground was encountered from ground level to between 0.68m and 1.52m, overlying clay to depths of between 4.88 to 8.08m. The BGS Borehole Logs are presented in Appendix D.

3.4 Natural Geological Hazards

The BGS GeoSure Data presented within the Geo-Environmental Data Report is summarised in the table below:

Hazard	BGS Hazard Rating	Comments
Shrink Swell Clays	Very Low	Ground conditions predominantly low plasticity.
Running Sands	Very Low	Running sand conditions are unlikely. No identified constraints on land use due to running conditions unless water table rises rapidly.
Compressible Ground	Negligible	Compressible strata are not thought to occur.
Collapsible Deposits	Very Low	Deposits with potential to collapse when loaded and saturated are unlikely to be present.
Landslides	Very Low	Slope instability problems are not likely to occur but consideration to potential problems of adjacent areas impacting on the site should always be considered.
Soluble Rocks	Negligible	Soluble rocks are either not thought to be present within the ground, or not prone to dissolution. Dissolution features are unlikely to be present.

3.5 Natural Soil Chemistry

Information contained within the Geo-Environmental Data Report gives indicative natural concentration values (estimated) for the natural soils at the site.

The values presented in the table below indicate the expected natural background concentration levels, and thereby provide a baseline guideline estimate that can be used to assess the significance of any chemical test data acquired from any future intrusive investigations at the site.

Element	Arsenic	Bioaccessible Arsenic	Lead	Bioaccessible Lead	Cadmium	Chromium	Nickel
Concentration (mg/kg)	35 - 45	No Data	200 - 300	120 - 240	1.8	60 - 90	15 - 30

3.6 Mining and Mineral Extraction

Coal Mining

The online Coal Authority Interactive Map layers have been reviewed and the details are summarised in the table below:

Relevant Interactive Map Data	Issue at Subject Site?
Coal Authority Reporting Area	Yes
High Risk Development Area	No
Past Shallow Coal Mine Workings	No
Probable Shallow Coal Mine Workings	No
Mine Entries within 20m	No

As the site lies within the Coal Authority Reporting Area, a mining search has been undertaken as the site could be affected by past or current coal mining.

The mining searches are presented in Appendix E, the main findings of which are presented below.

Highlighted Evidence	Issue	Details
Past Underground Mining	Yes	The property lies within the potential zone of influence of recorded workings in 1 seam of coal. The most recent underground working in the area was in 1966. These workings lie approximately 490m below surface. Any ground movement due to this coal mining activity should have stopped.
Present Underground Mining	No	
Future Underground Mining	No	The property is not in an area where the Coal Authority has plans to grant a licence, or a licence has been granted to remove coal using underground methods.

Highlighted Evidence	Issue	Details
		The property is not in an area likely to be affected from any planned future underground coal mining. No notices have been given, under section 46 of the Coal Mining Subsidence Act 1991, stating that the land is at risk of subsidence.
Mine Entries	No	There are no known coal mine entries within, or within 20 metres of, the boundary of the property. There may however be mine entries/additional mine entries in the local area which the Coal Authority has no knowledge of.
Past, present and future opencast coal mining	No	
Coal mining subsidence	No	
Mine gas	No	
Withdrawal of support	No	
Information from the Cheshire Brine Subsidence Compensation Board	No	

Given the anticipated depth of historic underground mine workings, it is considered that risks from coal mining are low and future mining investigation works are not required.

3.7 Hydrogeology

Based on the inferred geology, a summary of the Environment Agency aquifer designations is presented in the table below:

Stratum	Coverage	Aquifer Designation	Groundwater Vulnerability
Diamicton Till	Full Site	Secondary Aquifer (Undifferentiated). The classification is assigned where it is not possible to attribute either category A or B to the aquifer.	Low Vulnerability.
Chester Pebble Beds Formation - Sandstone	Full Site	Secondary (B) Aquifer. Predominantly lower permeability layers which may store/yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers	Low Vulnerability.

The site is not indicated to lie within 500m of a Source Protection Zone.

The nearest active groundwater abstraction licence is 713m to the south east for general cooling purposes.

There are no potable water abstraction licences listed within 2000m.

The nearest Water Framework Directive (WFD) Groundwater Body is the Manchester and East Cheshire Permo-Triassic Sandstone Aquifer, with an overall poor chemical rating (2019).

3.8 Hydrology

The nearest watercourse and surface water feature to the site is the River Irwell which lies at a distance of 1424m southwest of the site.

There are no surface water abstraction licences within 2000m.

There are no active licenced discharge consents listed within 500m.

Information obtained from the Environment Agency (EA) Risk of Flooding from Rivers and the Sea (RoFRaS) database indicates that the risk of flooding across the site is low (greater than 1 in 1000 but less than 1 in 100 chance of flooding in any given year).

The site is not indicated to lie within an EA designated Zone 2 or Zone 3 flood plain.

The British Geological Survey indicate there is a potential for groundwater flooding at the subject site, with a low risk rating. Groundwater flooding is defined as the emergence of groundwater at the ground surface or the rising of groundwater into man-made ground under conditions where the normal range of groundwater levels is exceeded.

No further consideration of flood risk is undertaken in this report. Specialist flood risk advice should be sought with regards to drainage and flooding.

3.9 Geo-Environmental Searches

A summary of the relevant environmental aspects, both on site and within 500m of the site contained in the Geo-Environmental Data Report, are presented in the table below:

Entry	On-site	0 – 249m	250 – 500m	Details
Environmental Permits, Incidents and Registers	0	0	0	
Pollution Incidents	0	10	0	The closest record is a collection of 5 wastes (vehicles and vehicle parts, tyres, commercial waste and household waste) in 2001 and was 201m to the south east. All records from this incident are listed as either Category 3 (Minor impact) or Category 4 (No impact).
Landfill Sites	0	1	1	There is one historical landfill site within 250m of the site, this was 97m to the south east and is the Queen's Road Tip, which is presumably associated with the former brickworks in this location. Waste types listed include inert, industrial, commercial, household, special and liquid sludge and waste is recorded as being deposited between 1955 and 1970. A second historical landfill site was located 251m to the south west on Elizabeth Street, however there are limited records pertaining to this site.
Waste Treatment	0	0	0	
Waste Exemptions	0	0	2	457m South, Cheetham Hill Road, M8 8LW – Storage of Non-Agricultural Waste. 470m East at an unspecified location – Use of waste in construction.
Control of Major Accident Hazard (COMAH) Sites	0	0	0	
Consents issued under planning (Hazardous Substances) Act 1990	0	0	0	
Radioactive Substances	0	0	0	
Fuel Station Entries	0	0	1	Obsolete: 396m south, Cheetham Hill Road, M8 LW
Other Current industrial land uses	0	3	0	There are three electricity substations in proximity to the site, the nearest is 154m to the south west.
National Grid Services	0	0	0	

3.10 Radon

Information from the environmental database report indicates the property is in an area where less than 1% of properties are affected by radon and therefore no radon protective measures are necessary in accordance with BRE Report 211 'Radon – Guidance on protective measures for new dwellings' 2015 Edition.

3.11 UXO Risk

In accordance with CIRIA Report C681, BSL have reviewed non-specialist UXO data for the site using the online Zetica Bomb Risk Mapping data. The map indicates the site to be in an area where the bomb risk is moderate. A copy of the map is presented in Appendix F.

It should be noted that there is no indication of former military use from the Phase I Assessment and the available historical mapping does not indicate any significant bomb damage in the area of the site around the time of WWII. In addition, the construction of the school in 1975 would likely have encountered and dealt with any UXO risks.

Since the site is considered to be at moderate bomb risk, a PDSA (Pre Desk Study Assessment) has been requested from Zetica in order to determine if and what further action may be required to mitigate the risk, depending on the result of the PDSA the next stage could be to follow the recommended process set out in CIRIA Report C681 and carry out a preliminary risk assessment or undertake a full detailed risk assessment. Intrusive works on site may also require supervision by a UXO specialist.

4.0 PHASE 1 SUMMARY AND RISK ASSESSMENT

4.1 Introduction

The risk posed by any contaminants in soil or groundwater will depend on the nature and level of the source, the probability of exposure occurring, the potential pollution pathway and the likely effects on the receptors.

A contaminant is defined as a substance that has the potential to cause harm, a risk is considered to exist if such a substance is present at sufficient concentrations to cause harm and if a pathway is present through which a receptor could be exposed to the contaminant.

The following sections discuss the identified potential on-site and off-site sources, and any pollution that could impact receptors via the pathways associated with the proposed development. Pollution linkages are assessed which may represent a risk to human health and/or controlled water receptors from the information gained from the Phase I Assessment searches. The assessment has been carried out on a qualitative basis and aims to produce a complete and comprehensive Preliminary Conceptual Site Model.

Three potential impacts exist for any given site and all three need to be considered in the qualitative risk assessment, these are:

- On-site impacts.
- The site impacting its surroundings.
- Off-site sources impacting the subject site.

4.2 Potential Contaminative Sources

On-Site

From the information obtained, the following sources have been identified which may affect the redevelopment of the site for its ongoing use as a school:

- Made ground associated with the former residential outbuildings and garden use.

Off-Site

The following off-site sources have been identified which may affect the redevelopment of the site:

- Brickworks (82m SE).
- Waste Heaps / landfilling (from 82m SE).
- Ground gas from former clay pits / landfilling (from 82m SE).

Associated Contaminants

The contaminants commonly associated with the potential sources of contamination identified are tabulated below:

Contaminative Sources	Department of the Environment Industry Profile or Other Source	Commonly Associated Contaminants
On Site		
Made Ground	-	Heavy metals, polycyclic aromatic hydrocarbons (PAHs), asbestos, ground gases (carbon dioxide and methane).
Off Site		

Contaminative Sources	Department of the Environment Industry Profile or Other Source	Commonly Associated Contaminants
Backfilled Clay Pits / Refuse Heaps / Landfilling	-	Heavy metals, polycyclic aromatic hydrocarbons (PAHs), asbestos, ground gases (carbon dioxide and methane).

4.3 Pathways

A pathway is defined as a medium by which a contaminant comes into contact with, or otherwise impacts a receptor.

At this stage the potential contaminants identified above are considered to present potential risks to site end users and controlled waters through the following pathways:

Potential Pathways	
Pathways in respect to Human Health	• Ingestion of contaminated soils. • Dermal contact with contamination. • Inhalation of dusts. • Inhalation of gases or vapours.
Pathways in respect to Controlled Waters – Surface water	• Surface run-off /over land flow. • Drainage discharge. • Base flow from groundwater.
Pathways in respect to Controlled Waters – Groundwater	• Leaching of mobile contamination into groundwater via the unsaturated zone. • Migration of perched groundwater in any permeable soils or along existing or proposed service runs. • Migration into the saturated zone and flow through the Diamicton Till and the Chester Pebble Bed Formation underlying the site.
Pathways in respect to Property/structures/water pipes	• Direct contact with substances deleterious to building materials and potable water supply pipelines. • Migration of ground gases (methane) into confined spaces (explosion and damage to property).

4.4 Receptors

The identified receptors are listed below:

- Staff and pupils of St Chad's RC Primary School (human health).
- Potable water supply pipes.
- Nearest watercourse. River Irwell watercourse (Controlled waters).
- Superficial Aquifer. Diamicton Till – Secondary Unproductive (Controlled waters).
- Bedrock Aquifer. Chester Pebble Beds Formation – Secondary B (Controlled waters).
- Construction workers.

4.5 Preliminary Conceptual Site Model

The information obtained in the previous sections has been used to compile a Preliminary CSM. The identified potential contaminants and receptors have been assessed in the table below as to whether a plausible source-pathway-receptor pollutant linkage for the proposed end use of the site exists. The risk classification has been estimated in accordance with information in the BSL Guidance and Methodology in Appendix A.

The Preliminary CSM's are presented in the tables overleaf, any assessed risk above moderate will possibly require further action:

Human Health						
Potential Source	Potential Pathway	Potential Receptor	Likelihood	Severity	Level of Risk	Justification
On site Made ground Metals, organic contamination, asbestos	Ingestion, direct contact, inhalation of dusts	End-users	Unlikely	Medium	Low	The proposed development is for an extension of the existing school which will comprise converting existing grass / paved areas to a new building and therefore the pathway for future site users is limited. Made ground is not indicated on mapping however may be present as part of the school construction. Given the site's current use it is unlikely that it will contain significant contamination.
On site Made Ground Metals and organic contamination	Migration into/Chemical attack of water supply pipelines	Water Pipelines / End users	Unlikely	Medium	Low	Contaminants within the soil/groundwater could potentially attack clean potable water supply pipes if installed as part of the proposed development. If new underground potable water supply pipes will be installed, then contaminants should be assessed to determine the correct pipe material and level of precautions required.
Off site Infilled Clay Pits / Refuse Heaps / Landfill Ground Gas (carbon dioxide and methane)	Migration into confined spaces	End-users/ Buildings	Unlikely	Severe	Low / Moderate	The area of infilled clay pits / landfilling is within 100m of the site and given the age of infilling (between 1955 and 1970) and the variation in fill materials, it is likely to have a high gas generation potential which could drive gas migration. Whilst the construction of the Manchester Fort Shopping Park may have dealt with much of the putrescible materials, this has not been confirmed. The preferential pathway for ground gas would be the open playground / grass areas next to the proposed extension and the cohesive nature of the superficial soils in the area would help to limit migration potential, which means it is unlikely that ground gas would affect future site users, however the overall risk is considered low / moderate.

Controlled Waters						
Potential Source	Potential Pathway	Potential Receptor	Likelihood	Severity	Level of Risk	Justification
Made Ground PAH's, Metals	Overland flow, / migration through saturated zone	River Irwell 1424m away (Surface waters)	Unlikely	Medium	Low	No significant deposits of made ground are anticipated on site. If present, made ground is likely to be inert associated with the construction of the school. The watercourse is a significant distance from the site, providing a considerable distance for attenuation, with the surrounding geology comprising low permeability clays which would inhibit contaminant migration, limiting any baseflow supply to surface waters, in effect breaking any pollutant pathway linkage. The risk is therefore considered to be low.
	Leaching through unsaturated zone / Migration through saturated zone	Undifferentiated Secondary Aquifer (Ground-water)	Unlikely	Medium	Low	As above no significant sources have been identified, aside from potential unmapped made ground, and it is not envisaged there would be any significant contamination that could potentially leach and to pose a risk to controlled waters. In addition, there are no sensitive groundwater abstraction licences or Source Protection Zones near the site. Therefore, the risk is considered to be low.
	Migration through saturated zone	Chester Pebble Beds Formation Secondary B Aquifer (Ground-water)	Unlikely	Medium	Low	

Human Health Risk – Summary

Based on the preliminary CSM and the current use of the site, the overall risk from land contamination at the site is considered to be **low** for a redeveloped site. This would need to be confirmed by appropriate intrusive investigation, testing and assessment.

A potential ground gas source has been identified in the former brickworks / clay pits which were subsequently used for refuse heaps and landfilling to the south east of the site. Based on Figure 6 in BS8576:2013, the ground gas generation potential of this source is considered to be high. However; due to the likely presence of cohesive soils which would limit migration to the site, and the likely preferential migration route of venting to atmosphere during migration due to the presence of the school playing field between the proposed extension and the historic landfill, the overall risk to future site users has been assessed as being low / moderate, requiring future assessment and / or mitigation measures.

In accordance with CIRIA C665 and as set out in Appendix A of this report, the gas generation potential combined with the moderate / high sensitivity of the development (based on the site's end use as a primary school) would indicate that a recommendation of ground gas monitoring comprising 12 visits over a 6 month period should be undertaken.

However; given the small size of the extension and the points discussed above regarding migration pathways of potential ground gas, it is considered that an alternative approach, including installation of a gas resistant membrane in accordance with CS2 gas regime conditions would be suffice to mitigate potential risks to end users without the need for extensive ground gas monitoring. This approach should be agreed with the Local Authority to ensure that they are in agreement with these mitigation measures.

Controlled Waters Risk - Summary

Based on the preliminary CSM, BSL believes the overall risk to controlled waters at the site is **low** for the following reasons:

-
- No significant contamination is anticipated on site.
 - The site is underlain by low permeability clays which will inhibit lateral and vertical contaminant migration.
 - The site does not lie within 500m of an SPZ.
 - There are no groundwater abstractions within 2000m.
 - There are no potable (sensitive) water abstractions within 2000m.
-

The above assessed level of risk will need to be confirmed by intrusive investigation and quantitative risk assessment.

5.0 PRELIMINARY GEOTECHNICAL ASSESSMENT

5.1 Hazard Identification

Potential geotechnical hazards based on the expected ground conditions are listed below:

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- Attack of buried concrete by aggressive ground conditions; the site may contain unknown made ground and potentially sulphate bearing soils.
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5.2 Foundation Design

The proposed development will comprise an extension to the existing school building. The type of foundation solution should be informed by an onsite intrusive investigation to expose the existing foundations, confirm ground conditions and obtain geotechnical parameters for preliminary design.

5.3 Sustainable Drainage Systems (SUDS)

Given the site is underlain by low permeability clays, it is unlikely that drainage to SUDS such as traditional soakaways will be suitable.

6.0 OTHER DEVELOPMENT CONSTRAINTS

6.1 Constraint Identification

A formal survey of asbestos within structures is not covered in this report. It should be noted that an asbestos refurbishment / demolition survey will be required prior to any demolition of structures. If asbestos is present in soils, these will need to be dealt with in accordance with the Control of Asbestos Regulations (CAR) 2012.

The preliminary risk assessment undertaken within this Phase I Assessment may identify potential risks to site construction workers. However, full consideration of occupational health and safety issues is beyond the scope of this report.

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 Geo-Environmental

The site has a limited development history, with no significantly contaminative uses identified. Off site sources of contamination are also considered to be limited. Given the proposed development (small extension of the existing school building), the overall risk to human health is considered to be low.

There is considered to be a risk from ground gas due to the presence of historic infilled land / landfilling off site and therefore intrusive investigation with ground gas monitoring may be required, although it is proposed that ground gas monitoring may be forfeited in favour of installation of ground gas protection measures (gas protective membrane) if the Local Authority are in agreement.

The risk to controlled waters is considered to be low due to the nature of the proposed development, the limited contamination anticipated to be present and the sensitivity of the underlying and nearby controlled waters.

7.2 Geotechnical

The proposed development will comprise extension to an existing school building. Intrusive investigations will be required to confirm the most suitable foundation solution and to obtain parameters for concrete classification, floor slab and highways design.

Given the site is underlain by low permeability clays, it is unlikely that drainage to SUDS such as traditional soakaways will be suitable.

7.3 Further Work

To confirm the risks to the identified receptors and confirm the ground conditions in respect to the identified geotechnical and geo-environmental risks, an appropriate intrusive investigation will need to be undertaken.

Therefore, to allow future development of the site the following further works are recommended, although this list is not exhaustive and should be read in conjunction with any planning conditions that are applicable to the site.

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- Update report with findings of UXO PDSA (Unexploded Ordnance Pre Desk Study Assessment).
 - Topographical survey / service trace.
 - Intrusive site investigations comprising:
 - Exposure of existing foundations (where possible) and confirmation of ground conditions
 - Geotechnical testing of soils
 - Contamination analyses of soil
 - Discussions with the LA to confirm acceptance of ground gas mitigation strategy (installation of ground gas protective measures), or agreement to undertake ground gas monitoring at the site.
 - Assessment and recommendations based on the above, including requirements for further work, if necessary.
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8.0 ABBREVIATIONS AND DEFINITIONS

GLOSSARY	
Term / Abbreviation	Definition
AST	Above Ground Storage Tank.
B(a)P	Benzo (a) Pyrene.
BGS	British Geological Survey.
BRE	Building Research Establishment.
BS	British Standard.
BSL	Brownfield Solutions Ltd.
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes.
CBR	California Bearing Ratio (used in pavement/highways design).
CAR 2012	Control of Asbestos Regulations (2012).
CBCB	Cheshire Brine Compensation Board.
CBCD	Cheshire Brine Compensation District.
CBR	California Bearing Ratio.
CIEH	Chartered Institute of Environmental Health.
CIRIA	Construction Industry Research Association.
CL:AIRE	Contaminated Land: Applications in Real Environments.
CLEA	Contaminated Land Exposure Assessment.
CLO	Contaminated Land Officer.
COMAH	Control of Major Accident Hazards.
Contamination	Presence of a substance which is in, on or under land, and which has the potential to cause significant harm or to cause significant pollution of controlled water. There is no assumption in this definition that harm results from the presence of the contamination. Naturally enhanced concentrations of harmful substances can fall within this definition of contamination. Contamination may relate to soils, surface water, groundwater or ground gas.
Controlled Waters	Inland freshwater (any lake, pond or watercourse above the freshwater limit), water contained in underground strata and any coastal water between the limit of highest tide or the freshwater line to the three-mile limit of territorial waters.
CPT	Cone Penetration Test.
CSM	Conceptual Site Model. A schematic hypothesis of the nature and sources of contamination, potential migration pathways (including description of the ground and groundwater) and potential receptors, developed on the basis of the information from the preliminary investigation and refined during subsequent phases of investigation and which is an essential part of the risk assessment process. The conceptual site model is initially derived from the information obtained by the preliminary investigation (i.e. the Phase I Phase I Assessment). This conceptual model is used to focus subsequent investigations, where these are considered to be necessary, in order to meet the objectives of the investigations and the risk assessment. The results of intrusive investigations can provide additional data that can be used to further refine the conceptual site model.
DCP	Dynamic Cone Penetrometer.
DNAPL	Dense Non-Aqueous Phase Liquid.
DoWCoP	Definition of Waste Code of Practice.
DWS	Drinking Water Standard.
EA	Environment Agency.
EHO	Environmental health Officer.
EQS	Environmental Quality Standard.
GAC	Generic Assessment Criteria.

GLOSSARY	
Term / Abbreviation	Definition
GDR	Geotechnical Design Report.
GFR	Geotechnical Feedback Report.
GIR	Ground Investigation Report.
GSV	Gas Screening Value.
Harm	Adverse effect on the health of living organisms, or other interference with ecological systems of which they form part, and, in the case of human health, including property/structures and water supply pipelines.
Hazard	Inherently dangerous quality of a substance, procedure or event.
HDPE	High Density Polyethylene.
HSV	Hand Shear Vane.
K	Modulus of Subgrade Reaction.
LCRM	Land Contamination: Risk Management (EA guidance).
LNAPL	Light Non-Aqueous Phase Liquid (petrol, diesel, kerosene).
LOD	Limit of Detection (for particular method adopted).
MMP	Materials Management Plan.
Mv	Modulus of Volume of Compressibility.
ND	Not Detected.
NHBC	National House Building Council.
NR	Not Recorded.
OS	Ordnance Survey.
PAH	Polycyclic Aromatic Hydrocarbon.
Pathway	Mechanism or route by which a contaminant comes into contact with, or otherwise affects, a receptor.
PCB	Poly-Chlorinated Biphenyl.
PCSM	Preliminary Conceptual Site Model.
pH	Scale used to specify how acidic or basic a water-based solution is.
PHC	Petroleum Hydrocarbons.
PID	Photo Ionisation Detector.
PNEC	Predicted No-Effect Concentration.
Precision	Level of agreement within a series of measurements of a parameter.
PSD	Particle Size Distribution.
PVC	Polyvinyl Chloride.
Receptor	Human health, living organisms, ecological systems, controlled waters (surface waters and groundwater within aquifers), atmosphere, structures and utilities that could potentially be adversely affected by contaminant(s).
Risk	Probability of the occurrence, magnitude and consequences of an unwanted adverse effect on a receptor.
Risk Assessment	Process of establishing, to the extent possible, the existence, nature and significance of risk.
Sampling	Methods and techniques used to obtain a representative sample of the material under investigation.
SOM	Soil Organic Matter.
Source	Location from which contamination is, or was, derived. This could possibly be the location of the highest soil, groundwater or gas concentration of the contaminant(s).
SPT	Standard Penetration Test.
SVOCs	Semi Volatile Organic Compounds.
TOC	Total Organic Carbon.
TPH CWG	Total Petroleum Hydrocarbon (Criteria Working Group).

GLOSSARY	
Term / Abbreviation	Definition
TVOCs	Total volatile organic compounds.
UCS	Unconfined Compressive Strength.
Uncertainty	Parameter, associated with the result of a measurement that characterises the dispersion of the values that could reasonably be attributed to the measurement.
UST	Underground Storage Tank.
UXO	Unexploded Ordnance.
VCCs	Vibro Concrete Columns.
VSCs	Vibro Stone Columns
VOCs	Volatile Organic Compounds.
WAC	Waste Assessment Criteria.
WFD (in waste context)	Waste Framework Directive.
WFD (in water context)	Water Framework Directive.
Units	Definition
°	Degrees
Φ	Phi angle (in degrees)
g/l	Grams per Litre
Km	Kilometres
kPa	Kilo Pascal (Equivalent to kN/m ²)
KN/m ² /mm	Kilo Newton per metered squared per millimeter
kN/m ²	Kilo Newtons per metre squared
kPa	Kilo Pascal (Equivalent to kN/m ²)
l/hr	Litres per hour
MJ/kg	Mega joule per kilogram
MN	Mega Newton
M ² /MN	Mega Newton per metre squared
M	Metres
m bgl	Metres Below Ground Level
m OD	Metres Ordnance Datum (sea level)
µg/l	Micrograms per Litre (parts per billion)
µm	Micrometre
mb	Millibars (atmospheric pressure)
mg/kg	Milligrams per kilogram (parts per million)
mg/m ³	Milligram per metre cubed
mm	Millimetre
ppb	Parts Per Billion
Ppm	Parts Per Million

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