

Redrow Homes (NW)

Desk Study Report

For

**Harthill Depot, Calderstones Park,
Liverpool**

December 2015

REPORT NO: 15RED096/DS

- *Desk Studies and Site Walkovers*
- *Intrusive Contaminated Land Investigations*
- *Geotechnical Appraisals and Ground Investigations*
- *Landfill Gas Assessments and Remedial Design*
- *Remediation Design and Implementation*
- *Remediation Project Management and Supervision*
- *Site Abnormal Assessments (Foundations and Contaminated Land)*
- *Ecological Surveys (Bats, Badgers, Newts, Japanese Knotweed etc)*

DOCUMENT ISSUE RECORD

Contract No: 15RED096/DS

Client: Redrow Homes (NW)

Contract: Harthill Depot, Calderstones Park, Liverpool

Document: Desk Study Report

Prepared by:



J Skues

Checked by:



B Lewis

Approved by:



M Fawcett

Date:

December 2015

REVISION RECORD

Revision	Date	Description	Prepared by
0	July 2015	Draft for issue and comments	JS
1	Dec 2015	Update with new site boundary	JS

CONTENTS

1	EXECUTIVE SUMMARY	3
2	SITE DESCRIPTION	6
2.1	Introduction	
2.2	Site Location	
2.3	Site Description	
3	SITE HISTORY	9
3.1	Site History from Ordnance Survey Maps	
3.2	Summary of Site History	
4	ENVIRONMENTAL DATA	12
4.1	Geology	
4.2	Mining, Extraction and Natural Cavities	
4.3	Environmental Permits, Incidents and Registers	
4.4	Landfills and Other Waste Management Sites	
4.5	Hydrogeology and Hydrology	
4.6	Flood Risk Assessment and Drainage Management Strategy	
4.7	Radon	
4.8	UXB Risk	
5	SUMMARY OF ENVIRONMENTAL SENSITIVITY	17
5.1	Sources	
5.2	Pathways and Receptors	
6	INITIAL CONTAMINATION CONCEPTUAL MODEL	18
6.1	Source-Pathway-Receptor-Linkages	
6.2	Summary	
6.3	Geotechnical Constraints	
7	SCOPE OF GROUND INVESTIGATION	21
7.1	Objectives of the Ground Investigation	
7.2	Proposed Ground Investigation Scope	
8	REFERENCES	22

APPENDIX A

- i) Site Location Plan
- ii) Site Photographs

APPENDIX B

- i) Historical Mapping

APPENDIX C

- i) Envirocheck Report

APPENDIX D

- i) Conceptual Model

APPENDIX E

- i) Notes on Limitations

1 EXECUTIVE SUMMARY

Site Location

The site is located south of Calderstones Road, east of Harthill Road and north east of Allerton Road, Liverpool, Merseyside, L18 3HR. The coordinates on National Grid are 340279, 387534. The proposed site area is approximately 8.37 hectares in total.

Proposed Development

The proposed construction of residential dwellings with associated infrastructure, gardens and public open space. At the time of writing this report, no proposed layout was available.

Site Description:

On Site

Site was visited by a Geo-Environmental Engineer on the 16th July 2015 and photos can be found in Appendix A.

The site is irregular in shape and can be accessed via three (3 No) unnamed roads found off Harthill Road to the west. The area is relatively flat though undulating across site (site levels varying from 57 – 61m AOD) and is currently used as both public open space and a green waste storage/processing area. A care home, stables and small hall building can also be found in the south western corner of the site. The proposed site makes up a small section of Calderstones Park (a 94 acre park comprising woodland, lake and fields with botanical and historical interest). A number of footpaths/small roads exist through the site allowing public/vehicular access. Evidence of existing/former services (in the form of a service box) can be seen adjacent to the entrance of the site.

A number of large trees and dense vegetation can be found along the majority of the site, particularly on the boundaries. An area to the very north of the site contains a stockpiling and processing area for leaves/vegetation/green waste with pre-fabricated walls separating the different material types. The processed waste (compost) is stored on site before use offsite. This storage and process area is located on top of a large area of concrete hardstanding.

Adjacent to the stockpiling area is an area of dense and overgrown vegetation. On the southern boundary of this densely vegetated area is a small stone wall with stone steps and fencing. This stone wall appears to be part of the remains of the former Harthill Glass Houses.

A small green house is located on the eastern edge of the site boundary. Research shows that this green house is all that is left of the once existing Botanic Gardens, and houses 'the Calderstones', stones that are said to be remnants of a burial chamber used for a local Neolithic community approximately 50,000 years ago. The 'Calderstones' were moved here from their original location (near Calderstones Manor) to protect them from vandalism.

The site boundaries are as follows;

- **North** – Large hedgerow followed by a footpath.
- **East** - Some large trees followed by a footpath.
- **South** - Large trees followed by a footpath.
- **South West** - Hedgerow and wall followed by Allerton Road.
- **West** - Trees and wall followed by Harthill Road.

Surrounding Area

Surrounding land uses for the site are as follows:

- **North** – Calderstones Park. 130m N is Calderstones Road followed by a large area of residential properties.
- **East** - Calderstones Park. 320m SE is a Boating Pond.
- **South East** - Calderstones Park.
- **South** – 0 – 500m is a large area of residential properties.
- **West** – Immediately W is Harthill Road. 40m W is Calderstones School and associated playing fields with residential housing beyond.
- **North West** – Immediately beyond is a large allotment area extending to 150m NW. Beyond allotments are residential properties.

Site History

On Site

The earliest map is the 1849 – 1850 1:10,560 map which shows the site to be mainly undeveloped apart from a small building named 'Beechley' in the south western corner of site. Areas of dense woodland are also shown to the north and south west of the

site. Between circa 1850 – 1893, a number of buildings appear on the northern half of the site however, their use was unknown (presumed to be the early Botanical Garden buildings). The building to the south west of site also appears to expand slightly. A fenced area can also be seen in the centre of the site but is no longer shown circa 1908.

No further changes occurred onsite until 1952 where a recreation ground with pavilion is shown to the south of the site. Circa 1964, Harthill glass houses were built on the northern half of the site. This development consisted of 16 x 100 foot long glass houses built of low grade spruce, all connected by a central corridor. The purpose of this development was to grow Liverpool's Botanical Collection. The existing buildings found to the very north of the site were also extended further westwards and the most southern building appears to have been demolished.

Circa 1970, the 'Beechley' building to the south west of the site is shown as a 'home for aged persons.' Circa 1983, the recreational ground to the south of the site is also no longer shown. A small 'hall' building is also shown to have been built on the south of the site.

Circa 1894, the glass houses was demolished due to the rotting spruce, and the area was left as open space.

Circa 2003, the existing buildings found to the very north of the site were also demolished and the site was left as it is found today, as public open space/park land with a care home, stables and small hall located in the south western corner of the site.

Surrounding Area

1849 – 1850. 50m W – Sandstone Quarry (no longer shown circa 1894). **100 - 200m E** – Calderstone Buildings (still present). **210m E** – Pond (no longer shown circa 1908 – 1909). **325m NE** – Sandstone Quarry (no longer shown circa 1894). **300 – 500m S** – Forty pits (shown as residential circa 2006).

1893 – 1894. 40m W – Small residential development (shown as high school circa 1928. Expands circa 2006. Still present).

50m WSW – All Hallows Church (no longer shown circa 1967). **150m SW** – Small residential development (no longer shown circa 1938).

1908 – 1909. 100m SE – Calderstones Park labelled (still present).

1927 – 1928. 120m NW – School (still present). **160m NE** – Bowling Green and tennis ground (Tennis ground no longer shown circa 1937. Bowling green still present). **250 – 500m NW** – Large residential development (still present).

1937 – 1938. 0m E – Road/Footpath (still present). **120m SW** – Small residential development (still present). **250m – 500m S/SW** – Large residential development (still present).

1952 – 1956. 250m N – 500m N – Large residential development (still present). **320m SE** – Boating Pond (still present). **400m SSE** – Pavilion and tennis courts (no longer shown circa 1974).

1967. No significant changes.

1974 – 1978. 0m – 130m NW – Allotment Gardens (still present). **70m W** – Substation (still present). **180m NE** – Substation (still present). **500m W** – TA centre (still present).

1982 – 1987. No significant changes.

1993. 110m SW – No significant changes.

2006 – No significant changes.

2015 – No significant changes.

Published Geology

The BGS map shows the geology (1:10,000 Maps SJ83NE, 2006) beneath the following:

- **Drift** – No Superficial Deposits Recorded.
- **Bedrock** – **Chester Pebble Beds Formation** – Sandstone.

Hydrogeology and Hydrology

- There are no recorded superficial deposits recorded on site.
- The bedrock deposits of the Chester Pebble Beds are classed as a Principal Aquifer (High Permeability).
- The site does not lie within a Groundwater Source Protection Zone as defined by the Environment Agency.
- The nearest water feature is a pond 163m E.
- There is one water abstraction within 1000m of site.

Radon Protection

The property is in a lower probability area, as less than 1% of homes are above the action level. Therefore no Radon protective measures are necessary in the construction of new dwellings or extensions.

Flood Risk Assessment and Drainage Management Strategy

The site lies within Flood Zone 1 as defined by the Environment Agency and due to the site being greater than one (1 No) hectare in size, a standalone Flood Risk Assessment and Drainage Strategy should be undertaken with consideration to surface water

drainage strategy.

Summary of Environmental Data

Possible Contamination Sources;

- **Current land use onsite – Unlikely.**
- **Historical land use onsite – Yes.**
- **Road/footpath 0m E – Possible.**
- **Neighbouring allotments 0m - 150m NW – Possible.**
- **Existing Substations 70m W and 180m NE – No.**

Qualitative Risk Assessment: In this qualitative risk assessment, a **Low/Moderate** risk implies that remedial action may be necessary at the site in particularly around the former glasshouses, the scope of which cannot be confirmed until the intrusive investigation has been completed.

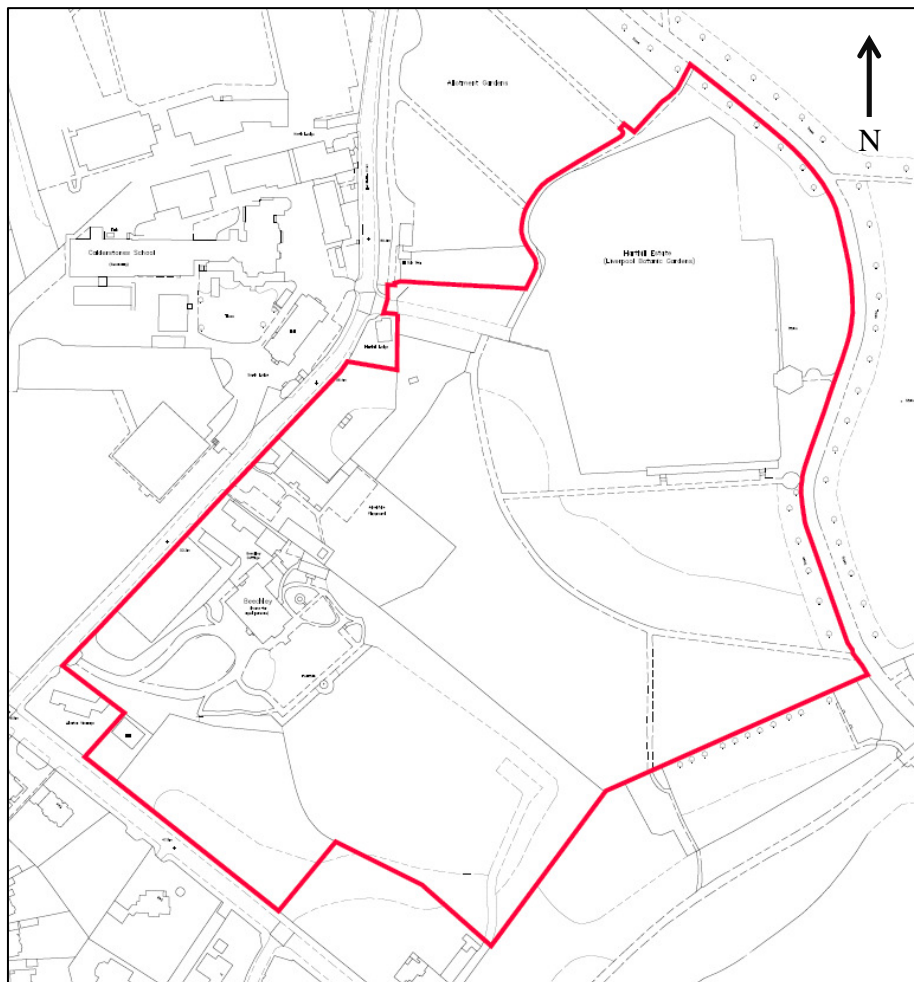
Geotechnical Constraints:

- Possible shallow sandstone bedrock, difficulty excavating.
- Dense vegetation on site limiting initial ground investigation.
- Potential Tree Heave should cohesive stratum be encountered.

2 SITE DESCRIPTION

2.1 Introduction

This investigation was carried out on the instruction of Redrow Homes (Lancashire). The purpose of the work was to carry out a Desk Study to provide geotechnical and contamination risk information for the proposed construction of residential dwellings with associated infrastructure, gardens and public open space. At the time of writing this report no proposed layout was available. A site boundary plan can be seen below;



Extract showing the site boundary (in red) for Harthill Depot, Calderstones Park, Liverpool.

2.2 Site Location

The site is located south of Calderstones Road, east of Harthill Road and north east of Allerton Road, Liverpool, Merseyside, L18 3HR. The coordinates on National Grid are 340279, 387534. The proposed site area is approximately 8.37 hectares in total. See Site Location Plan in Appendix A.

2.3 Site Description

2.3.1 On Site

Site was visited by a Geo-Environmental Engineer on the 16th July 2015 and photos can be found in Appendix A.

The site is irregular in shape and can be accessed via three (3 No) unnamed roads found off Harthill Road to the west. The area is relatively flat though undulating across site (site levels varying from 57 – 61m AOD) and is currently used as both public open space and a green waste storage/processing area. A care home, stables and small hall building can also be found in the south western corner of the site. The proposed site makes up a small section of Calderstones Park (a 94 acre park comprising woodland, lake and fields with botanical and historical interest). A number of footpaths/small roads exist through the site allowing public/vehicular access. Evidence of existing/former services (in the form of a service box) can be seen adjacent to the entrance of the site.

A number of large trees and dense vegetation can be found along the majority of the site, particularly on the boundaries. An area to the very north of the site contains a stockpiling and processing area for leaves/vegetation/green waste with pre-fabricated walls separating the different material types. The processed waste (compost) is stored on site before use offsite. This storage and process area is located on top of a large area of concrete hardstanding.

Adjacent to the stockpiling area is an area of dense and overgrown vegetation. On the southern boundary of this densely vegetated area is a small stone wall with stone steps and fencing. This stone wall appears to be part of the remains of the former Harthill Glass Houses.

A small green house is located on the eastern edge of the site boundary. Research shows that this green house is all that is left of the once existing Botanic Gardens, and houses 'the Calderstones', stones that are said to be remnants of a burial chamber used for a local Neolithic community approximately 50,000 years ago. The 'Calderstones' were moved here from their original location (near Calderstones Manor) to protect them from vandalism.

The site boundaries are as follows;

- **North** – Large hedgerow followed by a footpath.
- **East** – Some large trees followed by a footpath.
- **South** – Large trees followed by a footpath.
- **South West** – Hedgerow and wall followed by Allerton Road.
- **West** – Trees and wall followed by Harthill Road.

2.3.2 Surrounding Area

Surrounding land uses for the site are as follows:

- **North** – Calderstones Park. 130m N is Calderstones Road followed by a large area of residential properties.
- **East** – Calderstones Park. 320m SE is a Boating Pond.
- **South East** – Calderstones Park.
- **South** – 0 – 500m S is a large area of residential properties.

- **West** – Immediately W is Harthill Road. 40m W is Calderstones School and associated playing fields with residential housing beyond.
- **North West** – Immediately beyond is a large allotment area extending to 150m NW. Beyond allotments are residential properties.

3 SITE HISTORY

3.1 Site History from Ordnance Survey Maps

A search of available historic maps was undertaken to establish the land use history of the site. Extracts of the maps discussed below can be found in Appendix B of this report. All maps are Ordnance Survey unless otherwise stated. All distances quoted on OS maps are taken from the site boundary, which is marked on the map.

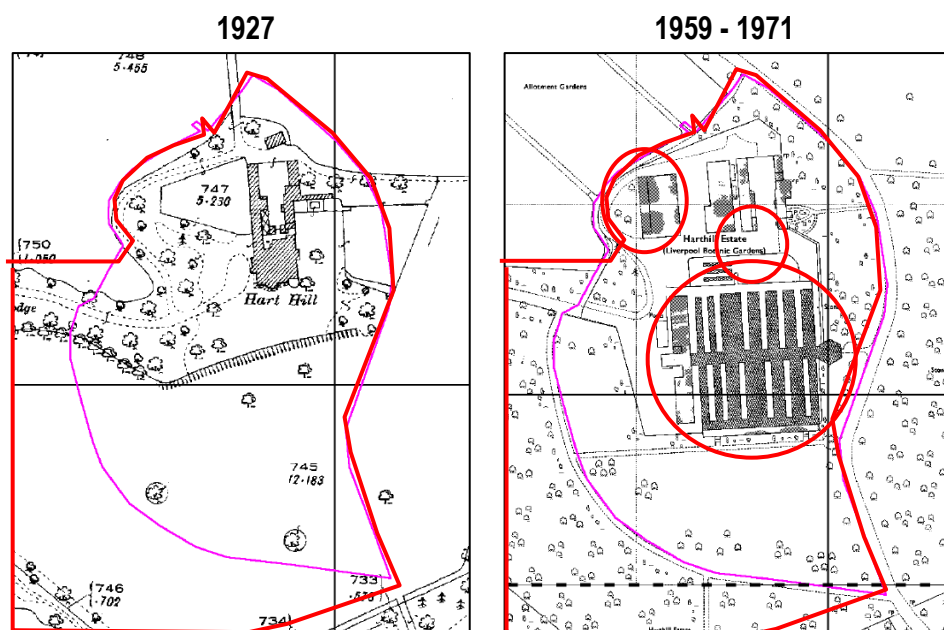
It is important to note that since the original dataset was ordered, the site boundary has been extended in a south westerly direction. Where necessary the relevant sections below have been updated to reflect this change.

3.2 Summary of Site History

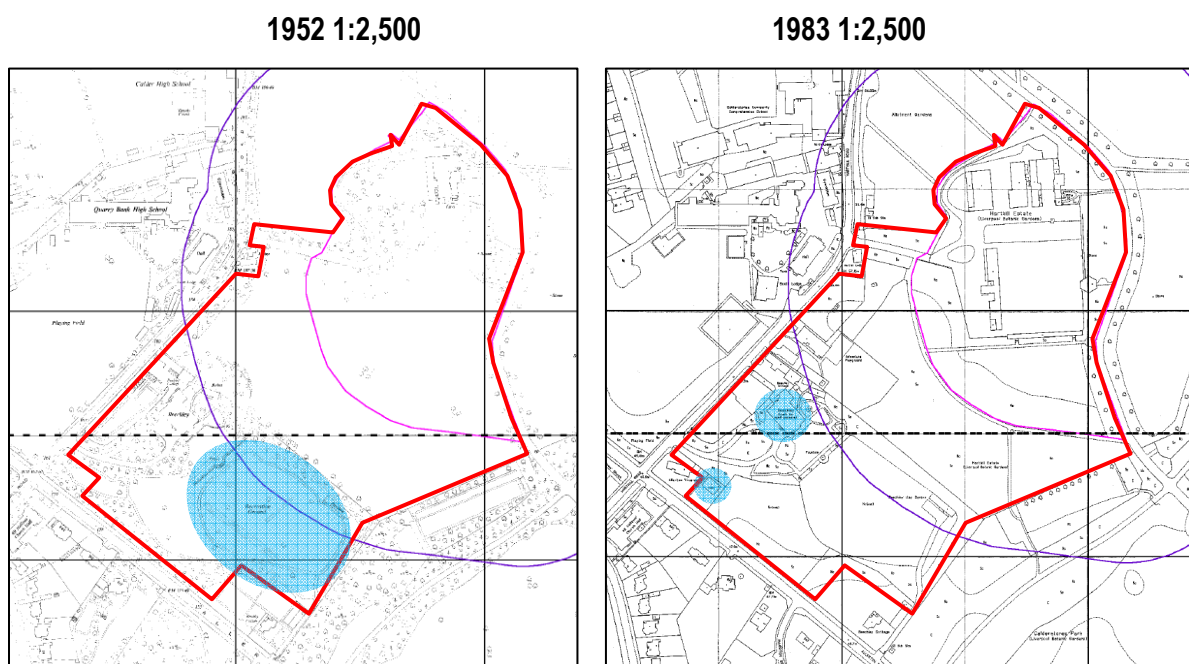
3.2.1 On Site

The earliest map is the 1849 – 1850 1:10,560 map which shows the site to be mainly undeveloped apart from a small building named 'Beechley' in the south western corner of site. Areas of dense woodland are also shown to the north and south west of the site. Between circa 1850 – 1893, a number of buildings appear on the northern half of the site however, their use was unknown (presumed to be the early Botanical Garden buildings). The building to the south west of site also appears to expand slightly. A fenced area can also be seen in the centre of the site but is no longer shown circa 1908.

No further changes occurred onsite until 1952 where a recreation ground with pavilion is shown to the south of the site. Circa 1964, Harthill glass houses were built on the northern half of the site. This development consisted of 16 x 100 foot long glass houses built of low grade spruce, all connected by a central corridor. The purpose of this development was to grow Liverpool's Botanical Collection. The existing buildings found to the very north of the site were also extended further westwards and the most southern building appears to have been demolished. An extract is shown below;



Circa 1970, the 'Beechley' building to the south west of the site is shown as a 'home for aged persons.' Circa 1983, the recreational ground to the south of the site is also no longer shown. A small 'hall' building is also shown to have been built on the south of the site. An extract of this is shown below;



Circa 1894, the glass houses were demolished due to the rotting spruce, and the area was left as open space.

Circa 2003, the existing buildings found to the very north of the site were also demolished and the site was left as it is found today, as public open space/park land with a care home, stables and small hall located in the south western corner of the site.

3.2.2 Surrounding Area

The following table below summarises the significant changes in historical use surrounding the site:

Date First Shown	Land Uses
1849 - 1850	50m W – Sandstone Quarry (no longer shown circa 1894). 100 - 200m E – Calderstone Buildings (still present). 210m E – Pond (no longer shown circa 1908 – 1909). 325m NE – Sandstone Quarry (no longer shown circa 1894). 300 – 500m S – Forty pits (shown as residential circa 2006).
1893 - 1894	40m W – Small residential development (shown as high school circa 1928. Expands circa 2006. Still present). 50m WSW – All Hallows Church (no longer shown circa 1967). 150m SW – Small residential development (no longer shown circa 1938).
1908 - 1909	100m SE – Calderstones Park labelled (still present).
1927 - 1928	120m NW – School (still present). 160m NE – Bowling Green and tennis ground (Tennis ground no longer shown circa 1937. Bowling green still present). 250 – 500m NW – Large residential development (still present).

1937 - 1938	0m E – Road/Footpath (still present). 120m SW – Small residential development (still present). 250m – 500m S/SW – Large residential development (still present).
1952 - 1956	250m N – 500m N – Large residential development (still present). 320m SE – Boating Pond (still present). 400m SSE – Pavilion and tennis courts (no longer shown circa 1974).
1967	No significant changes.
1974 - 1978	0m – 130m NW – Allotment Gardens (still present). 70m NW – Substation (still present). 180m NE – Substation (still present). 500m W – TA centre (still present).
1982 - 1987	No significant changes.
1993	No significant changes.
2006	No significant changes.
2015	No significant changes.

4 ENVIRONMENTAL DATA

The following section details both geological and environmental data available for the site and the surrounding area. Full details can be found in the Envirocheck Report by Landmark located in Appendix C.




4.1 Geology

The documented geology of the site is summarised on British Geological Survey map principally, with further site specific detailed below in maps:



Geology	Drift	Solid
1:10,000 SJ48NW 1946	No Superficial Deposits Recorded	Chester Pebble Beds Formation – Sandstone.

Geology 1:10,000 Maps Legends



Artificial Ground and Landslip

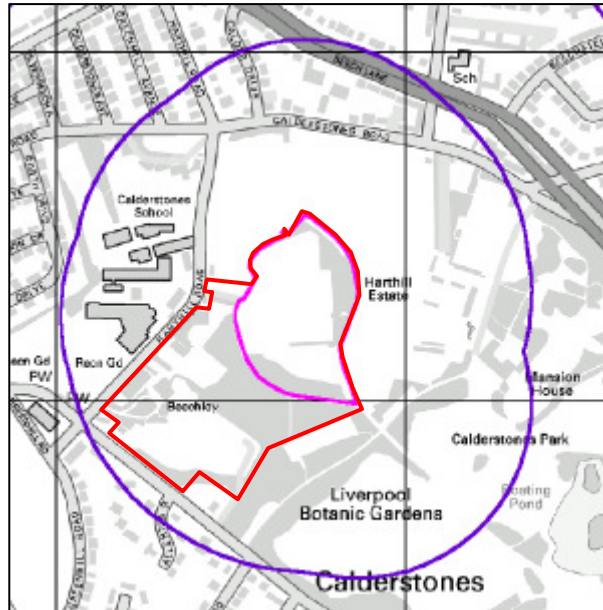
Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	MGR	Made Ground (Undivided)	Fill	Holocene - Holocene
	WMGR	Infilled Ground	Fill	Holocene - Holocene
	WGR	Worked Ground (Undivided)	Void	Holocene - Holocene

Superficial Geology

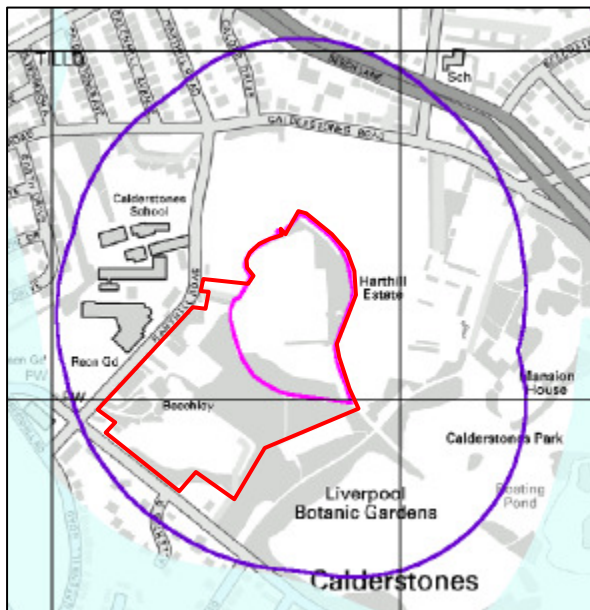
Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	TILLD	Till, Devensian	Diamicton	Devensian - Ipswichian
	TILLD	Till, Devensian	Clay, Sandy, Gravelly, Cobbly [Unlithified Deposits Coding Scheme]	Devensian - Ipswichian

Bedrock and Faults

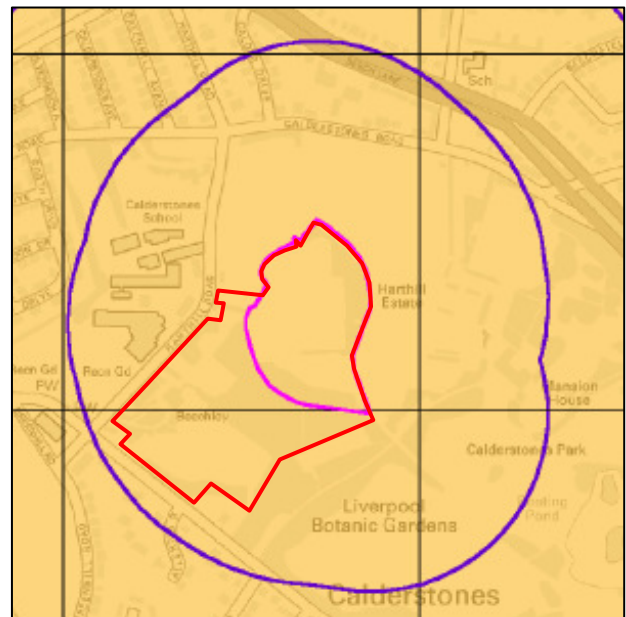
Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	CPB	Chester Pebble Beds Formation	Sandstone	Early Triassic - Early Triassic
	Fault			



Artificial Ground and Landslip



Superficial Geology



Bedrock Geology

4.1.1 Fault Lines

There are no fault lines within 500m of site.

4.2 Mining, Extraction and Natural Cavities

4.2.1 Coal Mining

The site does not lie within an area affected by historical, current or future coal mining.

4.2.2 Natural Cavities

There are no known recorded cavities within 500m of site.

4.2.3 Mineral Extraction

There is one (1 No) recorded mineral extractions site within 500m of site, however this extraction has now ceased. This site is detailed below;

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
8	BGS Recorded Mineral Sites Site Name: Calder Cottage Location: , Childwall, Liverpool Source: British Geological Survey, National Geoscience Information Service Reference: 91052 Type: Opencast Status: Ceased Operator: Unknown Operator Operator Location: Unknown Operator Periodic Type: Triassic Geology: Chester Pebble Beds Formation Commodity: Sandstone Positional Accuracy: Located by supplier to within 10m	A18SE (NE)	330	4	340575 388017

4.3 Environmental Permits, Incidents and Registers

4.3.1 Discharge Consents

There are no discharge consents recorded within 500m of site.

4.3.2 Local Authority Pollution Prevention and Controls

There are no Local Authority Pollution Prevention and Controls within 500m of site.

4.3.3 Pollution Incidents to Controlled Waters

There are no Pollution Incidents to Controlled Waters recorded within 500m of site.

4.3.4 Substantiated Pollution Incident Register

There are no Substantiated Pollution Incident Register recorded within 500m of site.

4.3.5 Contemporary Trade Directory Entries

There is one (1 No) Contemporary Trade Directory Entry within 500m of site, this is detailed below;

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
10	Contemporary Trade Directory Entries Name: Penny Lane Domestic Appliances Location: 58, Verdala Park, Liverpool, L18 3LD Classification: Washing Machines - Servicing & Repairs Status: Active Positional Accuracy: Automatically positioned to the address	A8NE (S)	500	-	340414 386996

4.3.6 Fuel Station Entries

There are no Fuel Station Entries within 500m of site.

4.4 Landfills and Other Waste Management Sites

There are no recorded Historical Landfill sites, registered landfill sites or other waste management sites within 500m of site.

4.5 Hydrogeology and Hydrology

- There are no recorded superficial deposits recorded on site.
- The bedrock deposits of the Chester Pebble Beds are classed as a Principal Aquifer (High Permeability).
- The site does not lie within a Groundwater Source Protection Zone as defined by the Environment Agency.
- The nearest water feature is a pond 163m E.
- There is one water abstractions within 1000m of site, this is detailed below;

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
5	Water Abstractions Operator: United Utilities Water Plc Licence Number: 2569030038 Permit Version: 100 Location: 1 Well & 2 B/Holes Each At Green La & Dudlow La, L'Pool \$212 Authority: Environment Agency, North West Region Abstraction: Public Water Supply: Potable Water Supply - Direct Abstraction Type: Water may be abstracted from a single point Source: Groundwater Daily Rate (m3): 0 Yearly Rate (m3): 0 Details: Green Lane Well & Dudlow Lane Well In Liverpool Authorised Start: 01 January Authorised End: 31 December Permit Start Date: 4th March 1966 Permit End Date: Not Supplied Positional Accuracy: Located by supplier to within 100m	A18NW (N)	847	2	340200 388600

4.6 Flood Risk Assessment and Drainage Management Strategy

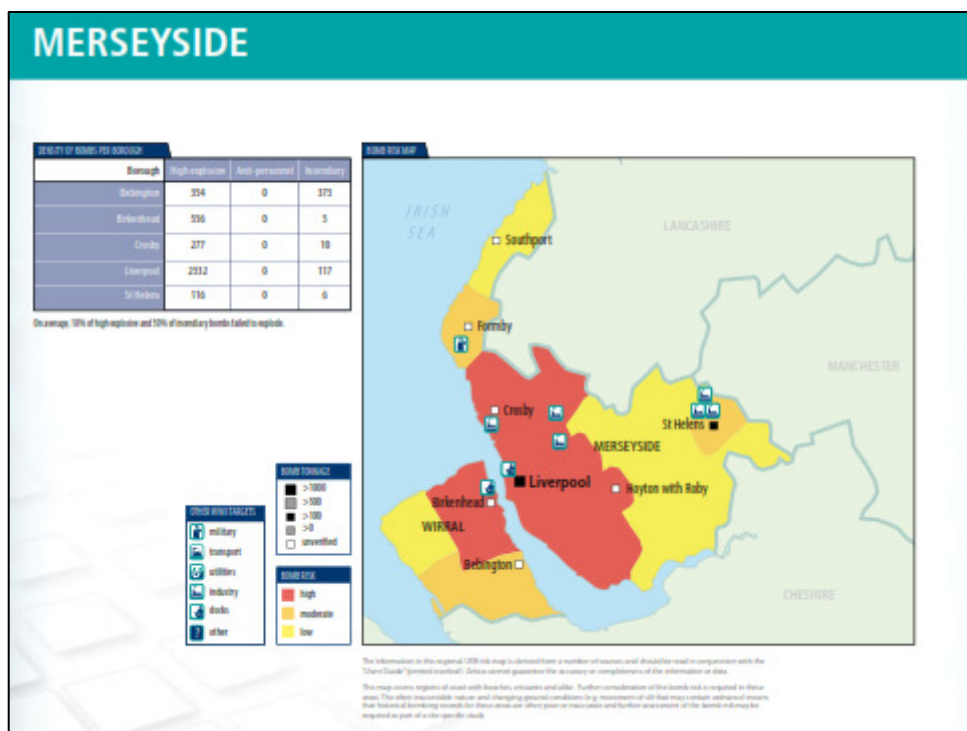
The site lies within Flood Zone 1 as defined by the Environment Agency and due to the site being greater than one (1 No) hectare in size, a standalone Flood Risk Assessment and Drainage Strategy should be undertaken with consideration to surface water drainage strategy.

4.7 Radon

The property is in a lower probability area, as less than 1% of homes are above the action level. Therefore no Radon protective measures are necessary in the construction of new dwellings or extensions.

4.8 UXB Risk

The site is potentially within a high Regional Unexploded Bomb Risk as outlined by Zetica. An internet search did not suggest any recorded bombs or damage to the Botanical Gardens which would have been on site at the time, however the risk can't be discounted completely. It would be prudent to have a specialist UXB company undertake a risk assessment for the site.



5 SUMMARY OF ENVIRONMENTAL SENSITIVITY

The following section is a review of the environmental sensitivity of the site as discussed in Sections 2-4. Significant potential risks are discussed in the following subsections and will then be evaluated as part of the Site Conceptual Model in Section 6.

Sources are defined as where pollution comes from, pathways are a route in which the pollution travels and receptors are anything affected by a pollutant. Further details on Source-Pathway-Receptor methodology can be found in Appendix D.

The table below focuses on significant site specific sources, pathways and receptors. More 'generic' pathways and receptors (such as site end uses) will be covered as part of the full Site Conceptual Model in Section 5.

5.1 Sources

Source	Distance/ Direction	Details	Significant Risk
Current Land Use	On Site	Site currently used as public open space with care home and stables found to the south west. A stockpiling area for leaves/vegetation/green space can be found to the north. Possible contamination contained within the stockpiles however the risk is likely to be localised and the concrete hardstandings below reduces the risk of migration. Sampling to confirm nature of material.	Unlikely
Historical Land Use	Onsite	Site used to contain a recreational ground and Liverpool Botanical Gardens and associated glasshouses. Risk from agro chemicals, weed killers, fertilizers and pesticides. Due to age of construction, asbestos (circa 1960's) also possible. Ground investigation to target area.	Yes
Road/Footpath	0m E	Road/footpath constructed on eastern edge of site boundary circa 1937/1938. Possible Made Ground.	Possible
Neighbouring Allotments	0m – 150m NW	Allotments present since 1974 – 1978. Potential heavy metals within soils. Ground investigation and sampling to confirm.	Possible
Existing Substations	70m W and 180m NE	Possible PCB, asbestos, heavy metal, PAH contamination within the vicinity. Due to distance from site, risk is deemed low.	No

5.2 Pathways and Receptors

Source	Distance/ Direction	Details	Significant Risk
Aquifers	Below Site	No superficial deposits recorded and Bedrock geology defined as a Principal Aquifer. Pathway from surface to receptor is moderate to high risk. No hard standing cover found onsite. Possible risk historical land use. The site does not lie within a groundwater source protection zone. No water abstractions within 1000m of site.	Possible

6 INITIAL CONTAMINATION CONCEPTUAL MODEL

For details on how the conceptual model is evaluated please refer to Appendix D

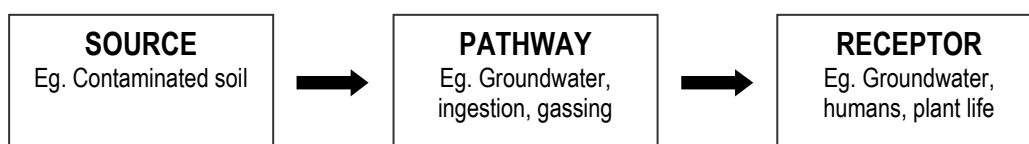
This section of the report aims to identify land which could potentially be affected by contamination, such that it could affect the value or re-use of the land, or such that mitigation would be required for certain proposed end uses of the land.

Potential contamination sources and environmentally sensitive receptors have been discussed in Section 5.1. Potentially significant risks are evaluated as part of the subsequent sub-sections.

6.1 Source-Pathway-Receptor-Linkages

The risk assessment uses a 'Source-Pathway-Receptor' methodology for assessing whether a source of contamination could potentially lead to harmful consequences. This means that there needs to be a pollutant linkage from source to receptor for harm to be caused, this linkage consisting of: a source of pollution; a pathway for the pollutant to move along; a receptor that is affected by the pollutant.

The current potential risks to site arising from various Source-Pathway-Receptor linkages are assessed below. A risk may be considered significant if all three of the stages are present and therefore providing a pollution linkage. The various sources, pathways and receptors are considered separately. The assessment is based on the future use, which is understood to be residential dwellings with gardens and associated infrastructure.



Type of Contamination	Potential Sources	Potential Pathway	Potential Receptors	Pollution Linkage	Comment	Estimated Level of Risk
Ground Gas	Possible Made Ground 0m E	Inhalation of Vapours	Construction/ Maintenance Workers	Potentially Active	Possible ground gas from localised Made Ground. Ground investigation and ground gas monitoring to confirm. PPE to minimise risk.	Low
		Vapours Penetrating Unprotected Buildings	Future Site Users	Potentially Active	Possible ground gas localised Made Ground. Ground investigation and ground gas monitoring to confirm.	Low/ Low - Moderate
Surface and Near Surface Contaminants Within Soils	Historical and Current Site Use Possible Made Ground 0m E Neighbouring Allotments 0 – 150m NW	Ingestion, Inhalation, Dermal Contact	Current Site Users	Potentially Active	Risk from current stockpiles and former glasshouses. Possible asbestos, TPH, PAHs and heavy metals. Current site use = public open space. Ground investigation to confirm and target.	Low/ Moderate
			Construction Workers	Potentially Active	Risk from current stockpiles and former glasshouses. Possible asbestos, TPH, PAHs and heavy metals. Ground investigation to confirm and target. PPE to minimise risk.	Low
			Future Site Users	Potentially Active	Risk from current stockpiles and former glasshouses. Possible asbestos, TPH, PAHs and heavy metals. Future site users = residential with gardens. Ground investigation to confirm and target.	Moderate
			Adjacent Land Users	Potentially Active	Allotments found to NW of site. Potential for contaminants to migrate due to no recorded superficial deposits and permeable bedrock.	Moderate
		Direct Contact	Structures	Potentially Active	Possible TPH and high sulphates within the localised Made Ground and area surrounding former glass houses.	Low/ Moderate
		Absorption in Root Zone	Plants	Potentially Active	Possible TPH, PAH, heavy metals and sulphates within the Made Ground and area surrounding former glass houses.	Low/ Moderate
Mobile Contaminants, Leachables e.g. from Pollution Sources Adjacent to Site/On Site	Historical and Current Site Use	Leaching into Groundwater	Groundwater	Potentially Active	No superficial deposits recorded. No hardstanding areas on site. Permeable bedrock anticipated.	Moderate
	Possible Made Ground 0m E	Off-site Migration in Groundwater	Abstractions	Potentially Active	No groundwater abstractions within 850m. Not in a Groundwater Source Protection Zone.	Low
	Neighbouring Allotments 0 – 150m NW		Controlled Waters	Potentially Active	Nearest controlled surface water feature is a pond 163m E.	Low
Organic and Inorganic Contaminants Within Soils / Groundwater	Historical and Current Site Use Possible Made Ground 0m E Neighbouring Allotments 0 – 150m NW	Potable Water Supply Pipes	Utilities Workers	Potentially Active	Possible TPH and PAH contamination onsite. Risk assess once water pipelines are known and final layout. Ground investigation to confirm, then liaise with local water authority supplier.	Low/ Moderate

6.2 Summary

In this qualitative risk assessment, a **Low/Moderate** risk implies that remedial action may be necessary at the site in particularly around the former glasshouses, the scope of which cannot be confirmed until the

intrusive investigation has been completed.

6.3 Geotechnical Constraints

- Possible shallow sandstone bedrock, difficulty excavating.
- Dense vegetation onsite limiting initial ground investigation.
- Potential Tree Heave should cohesive stratum be encountered.

7 SCOPE OF GROUND INVESTIGATION

7.1 Objectives of the Ground Investigation

The objectives of the intrusive ground investigation will be to:

- Clarify the 'Initial Contamination Conceptual Model'.
- Clarify the initial risk assessment.
- Benchmark the contamination status of the site.
- Provide data for the design of any remedial works that may be required.
- Provide a geotechnical appraisal for the site

7.2 Proposed Ground Investigation Scope

On assessing the previous potential risks on site, we have compiled the following recommendations for further investigation.

It is noted that clearance of existing overgrown vegetation on the depot part of the site will be required prior to SI being undertaken

- Two (2 No) days machine excavated trial holes 3.00 – 4.00mbgl using a JCB 3CX.
- Seven (7 No) small diameter boreholes to 3.00 – 5.00 mbgl to assess risk of ground gas migration at anticipated foundation depth.
- Install seven (7 No) gas monitoring wells – followed by 6 ground gas monitoring visits over a period of at least 3 months with varying barometric pressures.
- Thirty (30 No) soil samples (made ground and natural) taken for chemical analysis to benchmark contamination levels across the site targeted to garden areas which will be the key pathway. Proposed testing will include but not be limited to the following; heavy metals suite (comprising; As, Cd (low level), Cr Vi, Pb, Hg, Se, Ni, Cu, Zn), Organic Matter, Sulphate, pH, speciated polycyclic aromatic hydrocarbons and TPH CWG. Asbestos sampling within Topsoil and Made Ground. Soil samples to include some for current stockpiles found to north of site.
- Geotechnical analysis of samples if clay strata is encountered for tree heave protection and concrete design classification.
- Should elevated determinant levels be encountered, additional leachate testing within soil and/or groundwater testing may be required.

The scope of works should be agreed with the Local Authority prior to the intrusive ground investigation and as such may change.

Clearance of the dense/overgrown vegetation is also required on site prior to the SI to allow access.

8 REFERENCES

- 8.1** BS 5930:1999 +A2 Code of Practice for Site Investigation.
- 8.2** Investigation of Potentially contaminated sites BS10175:2011 +A1:2013.
- 8.3** BS8576:2013 Guidance on investigations for ground gas.
- 8.4** R & D Publication CLR 8 (March 2002) Assessment of Risks to Human Health from Land Contamination: An Overview of the Development of Soil Guideline Values and Related Research. Environment Agency.
- 8.5** R & D Publication CLR 10 (March 2002) The Contaminated Land Exposure Assessment Model (CLEA): Technical basis and algorithms. Environment Agency.
- 8.6** Contaminated Land Risk Assessment; a Guide to Good Practice; CIRIA C552: 2001.
- 8.7** BRE 211 Radon: guidance on protective measures for new buildings (including supplementary advice for extensions, conversions and refurbishment) (2007 edition)
- 8.8** British Geological Survey Maps Sheet 75
- 8.9** Assessment of risks to human health from land contamination: an overview of the development of guideline values and related research. EA, 2002
- 8.10** Contaminated Land Risk Assessment; A Guide to Good Practice; CIRIA C552: 2001.
- 8.11** Health and Safety in Construction, HSG150, HSE, 1996.
- 8.12** Baker W (1987), Investigation Strategy - lecture at City of Birmingham Development Department Symposium on Methane Generating Sites, 9 December 1987, Industrial Research Laboratories, Birmingham
- 8.13** NHBC Standards, Chapter 4.2, 2003 Building Near Trees
- 8.14** 'Guidance on Evaluation of Development Proposals on Sites Where Methane and Carbon Dioxide are Present', Report Edition No.04 March 2007 NHBC – designed for use with low rise residential properties
- 8.15** CIRIA C665 'Assessing risks posed by hazardous ground gases for buildings' 2007 - for high rise residential / flats
- 8.16** BS8485:2007 'Code of practice for the characterization and remediation from ground gas in affected developments'
- 8.17** BRE 414 'Protective measures for housing on gas-contaminated land' Roger Johnson, Parkman Environment 2001
- 8.18** BS 8500- 1:2006 'Concrete – Complementary British Standard to BS EN 206-1 – Part 1: Method of specifying and guidance for the specifier' November 2006
- 8.19** CLR11 'Model Procedures for the Management of Land Contamination' DEFRA 2004