GEO-ENVIRONMENTAL DESK STUDY / PRELIMINARY RISK ASSESSMENT REPORT

FOR

141-143 DOLLIS ROAD
LONDON
NW7 1JX

JONAS

Specialists in the investigation & reclamation of brownfield sites

Report Title: **Geo-environmental Desk Study / Preliminary Risk Assessment for 141-143 Dollis Road, London, NW7 1JX**

Report Status: **Final v1.1**

Job No: **P9604J892**

Date: **27 July 2016**

Quality Control: Previous Release

Version	*Date*	*Issued By*
Final V1.0	15 July 2016	RS

Prepared by: JOMAS ASSOCIATES LTD For ENTRAN

Prepared by Tom Elbourne BSc (Hons), FGS
Geo-environmental Engineer

Checked by Marc Williams BSc (Hons) AIEMA
Principal Geotechnical Engineer

Approved by Roni Savage BEng (Hons), MSc, SiLC, CGeol, MCIWM, FGS
Technical Director

Should you have any queries relating to this report, please contact

Jomas Associates Ltd

www.jomasassociates.com

☎ 0843 289 2187

✉ info@jomasassociates.com

CONTENTS

Page

EXECUTIVE SUMMARY

Entran ('The client') commissioned Jomas Associates Ltd ('JAL') to undertake a geo-environmental desk study at 141-143 Dollis Road, London. The principal objectives of the study were as follows:

- To determine the nature and where possible the extent of contaminants potentially present at the site;
- To establish the presence of significant contaminant linkages, in accordance with the procedures set out within the Environment Agency (EA) report R&D CLR11 and relevant guidance within the National Planning Policy Framework (NPPF);
- To assess whether the site is safe and suitable for the purpose for which it is intended, or can be made so by remedial action.
- To identify and assess any geotechnical issues that may affect the site.

It should be noted that the table below is an executive summary of the findings of this report and is for briefing purposes only. Reference should be made to the main report for detailed information and analysis.

Desk Study	
Site History	A review of historical maps indicates that the earliest recorded site use was as agricultural land. This remained the case until the 1961/1962 map which shows the site partially developed (as today) with commercial buildings and labelled as a builder's yard, followed by a Depot. There are no further significant changes shown up to the present day. Surrounding land use is largely residential, with a garage shown immediately adjacent to the south/south-west. Further from site, a gas works is shown approximately 300m north-west of site.
Current Site Use	The site is currently part in use and part disused. There is a pottery business to the front of the site, with garages and buildings to the rear, some of which are apparently disused. There is also an undeveloped area of site, currently only holding a large skip.
Proposed Site Use	Demolition of existing buildings and construction of new residential units.
Site Setting	Information provided by the British Geological Survey indicates that the site is directly underlain by solid deposits of the London Clay Formation. Artificial and superficial deposits are not reported within the site. There were no publicly available borehole records available for the surrounding area at the time of writing. The solid deposits underlying the site are classified as "Unproductive Strata". Superficial deposits off site are classified as a Secondary A aquifer. A review of the EnviroInsight Report indicates that there are no source protection zones within 500m of the site. There are no groundwater, surface water or potable water abstractions reported within 500m of the site. The nearest detailed river entry is reported 190m south-east of the site, identified as a the Dollis Brook – a Primary River.. There are Zone 2 flood zones located 116m SE and 232m east of site, Zone 3 flood zones located 173m SE, 175m SE and 232m east.
Potential	• Potential for contaminated ground associated with previous site use – on site (S1)

Desk Study	
Sources	• Potential for Made Ground associated with existing and previous development operations – on site (S2) • Potential buried tanks associated with former use as a Garage – off site (S3) • Potential hydrocarbon impacted ground from previous industrial use – on and off site (S4) • Current and previous industrial use – on and off site (S5) • Potential asbestos containing materials within existing buildings – on site (S6) • Infilled ponds – off site (S7)
Potential Receptors	• Construction workers (R1) • Maintenance workers (R2) • Neighbouring site users (R3) • Future site users (R4) • Building foundations and on site buried services (water mains, electricity and sewer) (R5) • Controlled waters – Aquifer, Surface Waters – off site (R6)
Preliminary Risk Assessment	The risk estimation matrix indicates a moderate risk. A high risk has been designated due to possible asbestos. It is understood that the proposed development comprises the demolition of the existing commercial buildings to be replaced by residential properties. A currently undeveloped area of site will also be developed with residential properties. It is understood that some of these properties will include private gardens. Due to the potential presence of asbestos containing materials, an asbestos survey should be undertaken, with any asbestos containing materials found, removed under suitably controlled conditions. There should be no risk to end users from asbestos if the potential asbestos containing materials are removed by suitably qualified and experienced specialists under controlled conditions. Due to the commercial history of the site and proximity to a historical garage site, a ground investigation is required to understand the risks posed to sensitive receptors. The investigation should assess the thickness of any made ground, and allow samples of made ground and natural soils to be taken for laboratory analysis. Due to the small size, age of likely infill material (ponds predominantly no longer shown by the start of the 20th century), and underlying geology (clay), soil gas from the infilled ponds is not considered to pose a significant risk to the proposed development. Should a significant thickness of Made Ground or hydrocarbon impacted ground be encountered during the investigation a programme of soil gas monitoring may be required
Potential Geological Hazards	The Groundsure data identifies a moderate risk relating to shrink-swell clays– for full details see Section 4

1 INTRODUCTION

1.1 Terms of Reference

1.1.1 Entran ("The Client") has commissioned Jomas Associates Ltd ('JAL'), to assess the risk of contamination posed by the ground conditions at a site referred to as 141-143 Dollis Road, London prior to redevelopment for residential use, and to provide indicative recommendations for foundation design prior to the redevelopment of the site.

1.1.2 To this end a desk based review and intrusive investigation has been undertaken in accordance with JAL's email proposal dated 12 July 2016.

1.2 Proposed Development

1.2.1 The proposed development is to comprise the demolition of the existing buildings and the construction of new residential properties, including on a currently undeveloped area of the site. Plans show that some properties are likely to come with private outside space; however it is unclear whether this will be soft landscaped.

1.2.2 For the purposes of the contamination risk assessment, the proposed development is classified as 'Residential with plant uptake'.

1.2.3 For the purpose of geotechnical assessment, it is considered that the project could be classified as a Geotechnical Category (GC) 1 site in accordance with BS EN 1997. GC 1 projects are defined as involving:

- Small and simple structures.
- Requiring qualitative investigation and analysis.
- With negligible risk.
- Straightforward ground conditions.
- Routine design and construction methods.
- No excavation below the water table (unless comparable local experience indicates it will be straightforward).

1.2.4 This will be reviewed at each stage of the project.

1.3 Objectives

1.3.1 The objectives of JAL's investigation were as follows:

- To present a description of the present site status, based upon the published geology, hydrogeology and hydrology of the site and surrounding area;
- To review readily available historical information (i.e., Ordnance Survey maps and database search information) for the site and surrounding areas, with respect to potentially contaminative land uses;
- To provide an assessment of the environmental sensitivity at the site and the surrounding area, in relation to any suspected or known contamination which may significantly affect the site and the proposed development;

- To conduct an intrusive investigation, to determine the nature and extent of contaminants potentially present at the site;
- To assess the potential presence of significant pollutant linkages, in accordance with the procedures set out within Part IIA of the Environmental Protection Act 1990, associated statutory guidance and current best practice including the EA report R&D CLR 11;
- To identify and assess geotechnical issues that may affect the site.

1.4 Scope of Works

1.4.1 The following tasks were undertaken to achieve the objectives listed above:

- A walkover survey of the site;
- A desk study, which included the review of third party reports (attached in Appendix 2 and Appendix 3);
- Intrusive ground investigation to determine shallow ground conditions, and potential for contamination at the site;
- Undertaking of laboratory chemical and geotechnical testing upon samples obtained;
- The compilation of this report, which collects and discusses the above data, and presents an assessment of the site conditions, conclusions and recommendations.

1.5 Limitations

1.5.1 Jomas Associates Ltd ('JAL') has prepared this report for the sole use of Entran in accordance with the generally accepted consulting practices and for the intended purposes as stated in the agreement under which this work was completed. This report may not be relied upon by any other party without the explicit written agreement of JAL. No other third party warranty, expressed or implied, is made as to the professional advice included in this report. This report must be used in its entirety.

1.5.2 The records search was limited to information available from public sources; this information is changing continually and frequently incomplete. Unless JAL has actual knowledge to the contrary, information obtained from public sources or provided to JAL by site personnel and other information sources, have been assumed to be correct. JAL does not assume any liability for the misinterpretation of information or for items not visible, accessible or present on the subject property at the time of this study.

1.5.3 Whilst effort has been made to ensure the accuracy of the data supplied, and analysis derived from it, there may be conditions at the site that have not been disclosed by the investigation, and could not therefore be taken into account. As with any site, there may be differences in soil conditions between exploratory hole positions. Furthermore, it should be noted that groundwater conditions may vary due to seasonal and other effects and may at times be significantly different from those measured by the investigation. No liability can be accepted for any such variations in these conditions.

1.5.4 Any reports provided to JAL have been reviewed in good faith. JAL cannot be held liable for any errors or omissions in these reports, or for any incorrect interpretation contained within them.

1.5.5 This investigation and report has been carried out in accordance with the relevant standards and guidance in place at the time of the works. Future changes to these may require a re-assessment of the recommendations made within this report.

1.5.6 ***This report is not an engineering design and the figures and calculations contained in the report should be used by the Structural Engineer, taking note that variations may apply, depending on variations in design loading, in techniques used, and in site conditions. Our recommendations should therefore not supersede the Engineer's design.***

2 SITE SETTING

2.1 Site Information

2.1.1 The site location plan is appended to this report as Figure 1.

Table 2.1: Site Information

Name of Site	-
Address of Site	141-143 Dollis Road, London, NW7 1JX
Approx. National Grid Ref.	524269, 191143
Site Area (Approx)	0.29ha
Site Ownership	Unknown
Site Occupation	Mixed business and medical
Local Authority	London Borough of Barnet
Proposed Site Use	Demolition of existing and construction of new residential units, potentially with private gardens

2.2 Walkover Survey

2.2.1 A site walkover survey was undertaken by Jomas Associates on 13th July 2016.

Table 2.2: Site Description

Area	Item	Details
On-site:	**Current Uses:**	Site is currently part in use, part disused. There is a pottery business to the front with residential flats above, with garages and out buildings to the rear. There is a disused area that appears to have never been developed, currently holding a large skip.
	Evidence of historic uses:	There was no evidence of historic uses of the site.
	Surfaces:	Much of the site is hard cover; either the building footprints or by asphalt. The undeveloped area is soft cover, comprised of wood chippings and general plant growth.
	Vegetation:	The undeveloped area is largely overgrown with weeds, with large trees along the southern edge, and an oak tree noted in the north of this area.
	Topography/Slope Stability:	Site is generally flat and even. There is a slight slope upward into the undeveloped area.
	Drainage:	Site appears to be connected to the usual drainage services.

Area	Item	Details
	Services:	Active water supply noted on site. The site is assumed to be connected to usual services
	Controlled waters:	No controlled waters were noted on site.
	Tanks:	A 950l diesel tank was noted on site.
Neighbouring land:	**North:**	Residential.
	East:	Residential.
	South:	Residential/commercial.
	West:	Residential/commercial.

2.2.2 Photos taken during the site walkover are provided in Appendix 1.

2.3 Historical Mapping Information

2.3.1 The historical development of the site and its surrounding areas was evaluated following the review of a number of Ordnance Survey historic maps, procured from GroundSure, and provided in Appendix 3 of this report.

2.3.2 A summary produced from the review of the historical map is given in Table 2.3 below. Distances are taken from the site boundary.

Table 2.3: Historical Development

Dates and Scale of Map	Relevant Historical Information	
	On Site	**Off Site**
1865 – 1:2,500	Site is shown as undeveloped agricultural land.	Site is surrounded by agricultural land. A stream is shown within 250m to the SE of site, running broadly NE-SW. Farm buildings shown approximately 50m SW and 200m SSW. Several ponds are shown in the surrounding area, with the nearest shown approximately 70m south of the site.
1868 – 1:10,560	No significant changes noted to the site.	**Railway line** shown approximately 100m north of site. Finchley Station shown approximately 100m SE of site along with a town of residential and farm buildings. The stream is labelled as Dollis Brook.
1896/1897 – 1:2,500/10,560	No significant changes noted to the site.	Mostly residential development has occurred to the east (>500m), west is still undeveloped. Several of the ponds are no longer shown. A gas company works is shown approximately 300m north west of the site.

Dates and Scale of Map	Relevant Historical Information	
	On Site	**Off Site**
1913/1914 – 1:10,560/2,500	No significant changes noted to the site.	A row of terraced residential properties has been built in close proximity to the north-westernmost extreme of the site. Nursery buildings have been built 250m to the west of site. A row of residential properties are shown to the SE of the site, on the edge of the mapped area approximately 300m from site. Only areas greater than approximately450m north of site are mapped on small scale map. Hospital, Mill Hill Barracks, **optical works** and nursery are all shown >750m from site to the north. The gas works has expanded.
1920 – 1:10,560	No significant changes noted to the site.	Significant residential development to the east and SE, from approximately 400m from site beyond the mapped area.
1936/1938 – 1:2,500/10,560	No significant changes noted to the site area.	Neighbouring plots to the north and south have been developed with residential properties. Immediately surrounding areas have been largely developed with residential properties. 250m NE of site the gas works has expanded and is showing new **tanks** and a circular structure – possibly a new **gas tank**. Areas to the NE, east, SE, south and SW are completely developed with mostly residential properties. Some residential development up to 750m west of site, with undeveloped land beyond, some labelled golf course, some appears to be agricultural land. An additional railway siding is now shown approximately 200m north of the site.
1951 – 1:10.560	No significant changes noted to the site.	No significant changes noted.
1961/1962 – 1:2,500	Site has been partially developed with commercial buildings and is labelled as **builder's yard.**	Surrounding area has been further developed with residential properties. Neighbouring building to the south/SW is labelled as a **garage.** The sidings to the north have expanded and are identified as a **Goods Yard.**
1968 – 1:10,560	No significant changes noted to the site.	Further residential development has occurred to the NW.
1976 – 1:10,000	No significant changes noted to the site.	Stadium has been constructed >1km to the west. No other significant changes.
1986 – 1:1,250	Several structures within the site have expanded and the site is now identified as a Depot..	Neighbouring garage is no longer shown and has been replaced by a new unlabelled building.
1991 – 1:1,250	No significant changes noted to the site.	No significant changes noted.
2002 – 1:10,000	No significant changes noted to the site.	Gas works appears to have reduced in size slightly, now labelled as **gas holder station.**

Dates and Scale of Map	Relevant Historical Information	
	On Site	Off Site
2010 – 1:10,000	No significant changes noted to the site.	Gas works appears to have been demolished and replaced by residential properties.
No significant changes.	No significant changes noted to the site.	No significant changes.

Potentially polluting/contaminating uses/activities shown in **bold**

2.4 Historical Industrial Sites

2.4.1 Groundsure have provided some information on historical industrial sites on and in the vicinity of the site. Table 2.4 below, summarises the information provided, which is presented in further detail in the Enviroinsight in Appendix 2. Where the identified features have appeared on more than one map they have been counted multiple times and therefore the reported numbers are higher than the actual count.

Table 2.4: Industrial and Statutory Consents

Type of Consent/Authorisation	On site	Off-site (within 500m of site, unless stated otherwise)	Potential to Impact Site*
Potentially Contaminative Uses identified from 1:10,000 scale mapping	None reported – Builder's yard on site.	81No reported; nearest 62m NW: unspecified commercial/industrial.	✓
Additional Information - Historical Tank Database	None	49No reported; nearest 134m NW related to the gas holder station.	✓
Historical Energy Features Database	None	23No reported; nearest 62m NW for electricity substation	X
Historical Petrol & Fuel Site Database	None	None	X
Historical Garage & Motor Vehicle Repair Database	2No reported on site, believed to be immediately adjacent off site. Identified as Garage	6 No reported within 500m of the site. Nearest reported 78m south of the site, identified as a Garage	✓
Potentially infilled land	None	27No reported, nearest 72m SW for a cemetery	✓

2.5 Previous Site Investigations

2.5.1 Jomas associates are not aware of any previous site investigations undertaken at this site.

2.6 Local Authority Information

2.6.1 No information was provided at the time of writing this report.

3 ENVIRONMENTAL SETTING

3.1.1 The following section summarises the principal environmental resources (geological, hydrogeological and hydrological) of the site and its surroundings. The data discussed herein is generally based on the information given within the EnviroInsight Report and published information provided by the Environment Agency and British Geological Survey.

3.2 Solid and Drift Geology

3.2.1 Information provided by the British Geological Survey indicates that the site is directly underlain by solid deposits of the London Clay Formation.

3.2.2 Artificial and superficial deposits are not reported within the site.

3.3 British Geological Survey (BGS) Borehole Data

3.3.1 As part of the assessment, publicly available BGS borehole records were obtained and reviewed from the surrounding area. No borehole data was available from the surrounding area.

3.4 Hydrogeology & Hydrology

3.4.1 General information about the hydrogeology of the site was obtained from the EnviroInsight and/or Environment Agency website.

Groundwater Vulnerability

3.4.2 The EA operates a classification system to categorise the importance of groundwater resources (aquifers) and their sensitivity to contamination. Aquifers were formerly classified as major, minor and non-aquifers, based on the amenity value of the resource. A major aquifer is a significant resource capable of producing large quantities of water suitable for potable supply. Minor aquifers produce water in varying quantities or qualities, and if utilised are of local importance. Non aquifers are low permeability strata, which contain no significant exploitable groundwater and have very limited capacity to transmit contaminants.

3.4.3 Since 1 April 2010, the EA's Groundwater Protection Policy uses aquifer designations that are consistent with the Water Framework Directive. This comprises;

- **Secondary A** - permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers;

- **Secondary B** - predominantly lower permeability layers which may store and 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.

- **Secondary Undifferentiated** - has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.

- **Principal Aquifer** – this is a formation with a high primary permeability, supplying large quantities of water for public supply abstraction.

- **Unproductive Strata** - These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

Source Protection Zones (SPZ)

3.4.4 In terms of aquifer protection, the EA generally adopts a three-fold classification of SPZs for public water supply abstraction wells.

- Zone I - or 'Inner Protection Zone' is located immediately adjacent to the groundwater source and is based on a 50-day travel time. It is designed to protect against the effects of human activity and biological/chemical contaminants that may have an immediate effect on the source.
- Zone II - or 'Outer Protection Zone' is defined by a 400-day travel time to the source. The travel time is designed to provide delay and attenuation of slowly degrading pollutants.
- Zone III - or 'Total Catchment' is the total area needed to support removal of water from the borehole, and to support any discharge from the borehole.

Hydrology

3.4.5 The hydrology of the site and the area covers water abstractions, rivers, streams, other water bodies and flooding.

3.4.6 The Environment Agency defines a floodplain as the area that would naturally be affected by flooding if a river rises above its banks, or high tides and stormy seas cause flooding in coastal areas.

3.4.7 There are two different kinds of area shown on the Flood Map for Planning. They can be described as follows:

Areas that could be affected by flooding, either from rivers or the sea, if there were no flood defences. This area could be flooded:

- from the sea by a flood that has a 0.5 per cent (1 in 200) or greater chance of happening each year;

- or from a river by a flood that has a 1 per cent (1 in 100) or greater chance of happening each year.

(For planning and development purposes, this is the same as Flood Zone 3, in England only.)

- The additional extent of an extreme flood from rivers or the sea. These outlying areas are likely to be affected by a major flood, with up to a 0.1 per cent (1 in 1000) chance of occurring each year.

(For planning and development purposes, this is the same as Flood Zone 2, in England only.)

3.4.8 These two areas show the extent of the natural floodplain if there were no flood defences or certain other manmade structures and channel improvements.

3.4.9 Outside of these areas flooding from rivers and the sea is very unlikely. There is less

than a 0.1 per cent (1 in 1000) chance of flooding occurring each year. The majority of England and Wales falls within this area. (For planning and development purposes, this is the same as Flood Zone 1, in England only.)

3.4.10 Some areas benefit from flood defences and these are detailed on Environment Agency mapping.

3.4.11 Flood defences do not completely remove the chance of flooding, however, and can be overtopped or fail in extreme weather conditions.

Table 3.1: Summary of Hydrogeological & Hydrology

Feature		On Site	Off Site	Potential Receptor?
Aquifer	**Superficial:**	-	Secondary A	**X**
	Solid:	Unproductive	Unproductive	**X**
Source Protection Zone		None	None reported within 500m of the site.	**X**
Abstractions		None	No groundwater, surface water or potable water abstractions reported within 500m of the site.	**X**
Surface waters		None	Nearest detailed river entry reported 190m south east of the site, identified as a primary river. Nearest surface water feature reported 187m south east	**X**
Flood Risk		RoFRaS – Very Low	Zone 2 – 116m SE/232m E Zone 3 – 173m SE, 175m SE/232m E	**X**

3.5 Sensitive Land Uses

3.5.1 The London Area Greenbelt is located 115m SW and 148m NE of site.

3.6 Industrial and Statutory Consents

3.6.1 The Groundsure EnviroInsight Report also provides information on various statutory and industrial consents on and in the vicinity of the site. The following section summarises the information collected from the available sources.

Table 3.2: Industrial and Statutory Consents

Type of Consent/Authorisation	On site	Off-site (within 500m of site, unless stated otherwise)	Potential to Impact Site*
Industrial Sites holding licences and/or authorisations.	None	4 No. reported within 500m of the site. Nearest reported 27m south east of the site, for the unloading of petrol.	X
Discharge Consents.	None	1No 241m SE for miscellaneous discharges.	X
Water Industry Act Referrals	None	1No 55m west - effective.	✓
Red List Discharges	None	None reported within 500m of the site	X
List 1 and List 2 Dangerous Substances	None	None reported within 500m of the site	✓
Control of Major Accident Hazards (COMAH) and Notification of Installations Handling Hazardous Substances (NIHHS) Sites.	None	2 No. reported 230m west of the site, both registered to British Gas	✓
Planning Hazardous Substance Consents	None	1 No. reported 366m north west of the site, no details provided	X
Category 3 or 4 Radioactive substances Authorisations	None	1 No. reported 193m south west of the site, for the disposal of radioactive waste	X
Pollution Incidents (List 2).	None	6 No. reported within 500m of the site. Nearest reported 275m east of the site, for sewerage materials. Minor impact reported to water, no impacts reported to land or air.	X
Pollution Incidents (List 1)	None	1 No. reported 228m east of the site. Pollutant not identified, significant impact to water.	X
Contaminated Land Register Entries and Notices.	None	None reported within 500m of the site	X
Registered Landfill Sites.	None	None reported within 500m of the site	X
Waste Treatment and/or Transfer Sites.	None	None reported within 500m of the site	X
Fuel Station Entries	None	1 No. reported 30m south east of the site, identified as Open	✓
Current Industrial Site Data.	1No vehicle repair, testing and servicing.	13 No. reported within 250m of the site. Nearest reported 41m south of the site, for petrol and fuel stations. Other uses include waste storage and electrical features	✓

***** *From a land contamination perspective*

3.7 Radon

3.7.1 As reported, the site is not within a Radon affected area, as less than 1% of properties are above the action level.

3.7.2 Consequently, no radon protective measures are necessary in the construction of new dwellings or extensions as described in publication BR211 (BRE, 2007).

4 POSSIBLE GEOLOGICAL HAZARDS

4.1 Database Information Review

4.1.1 The following are brief findings extracted from the GroundSure GeoInsight Report, that relate to factors that may have a potential impact upon the engineering of the proposed development.

Table 4.1: Geological Hazards

Potential Hazard	Site check Hazard Rating	Details	Further Action Required?
Shrink swell	Moderate	Ground conditions predominantly high plasticity. Do not plant or remove trees or shrubs near to buildings without expert advice on their effect and management. For new build, consideration should be given to advice published by the National House Building Council (NHBC) and the Building Research Establishment (BRE). There is a probable increase in construction cost to reduce potential shrink-swell problems.	YES
Landslides	Very low	Slope instability problems are unlikely to be present.	No
Ground dissolution soluble rocks	Negligible	Soluble rocks are present, but unlikely to cause problems except under exceptional conditions. No special actions required to avoid problems due to soluble rocks. No special ground investigation required and increased financial risks are unlikely due to potential problems with soluble rocks.	No
Compressible deposits	Negligible	No indicators for compressible deposits identified. No special actions required to avoid problems due to compressible deposits. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with compressible deposits.	No
Collapsible Rock	Very low	Deposits with the potential to collapse when loaded and saturated are unlikely to be present.	No
Running sand	Negligible	No indicators for running sand identified. No special actions required, to avoid problems due to running sand. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with running sand.	No
Coal mining	No	The study site is not located within the specified search distance of an identified mining area.	No
Non-coal mining	No	The study site is not located within the specified search distance of an identified mining area.	No

Potential Hazard	Site check Hazard Rating	Details	Further Action Required?
Brine affected areas	No	-	No

4.1.2 In addition, the GeoInsight report notes the following:

- 7No. historical surface ground working features are reported within 250m of the site. Nearest reported 72m south-west of the site for a cemetery.
- No historical underground working features are reported within 1km of the site.
- No current ground workings are reported within 1000m of site.

4.1.3 The clearance of the site, including removal of foundations and services is likely to increase the depth of Made Ground on the site. Foundations should not be formed within Made Ground or Topsoil due to the unacceptable risk of total and differential settlement.

4.1.4 The resultant thickness of Made Ground and the potential for clays beneath the proposed footprint would likely mean that a suspended floor slab would be required.

4.1.5 A geotechnical investigation is recommended to inform foundation design.

5 QUALITATIVE RISK ASSESSMENT

5.1 Legislative Framework

5.1.1 A qualitative risk assessment has been prepared for the site, based on the information collated. This highlights the potential sources, pathways and receptors. Intrusive investigations will be required to confirm the actual site conditions and risks.

5.1.2 Under Part IIA of the Environmental Protection Act 1990, the statutory definition of contaminated land is:

"*land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that:*

(a) significant harm is being caused or there is a significant possibility of such harm being caused; or
(b) significant pollution of controlled waters is being caused, or there is significant possibility of such pollution being caused."

5.1.3 The Statutory Guidance provided in the DEFRA Circular 04/2012 lists the following categories of significant harm to **human health**:

- death; life threatening diseases (e.g. cancers); other diseases likely to have serious impacts on health; serious injury; birth defects; and impairment of reproductive functions.

5.1.4 Other health effects may also be considered by the local authority to constitute significant harm with a wide range of conditions that may or may not constitute significant harm (alone or in combination) including: physical injury; gastrointestinal disturbances; respiratory tract effects; cardio-vascular effects; central nervous system effects; skin ailments; effects on organs such as the liver or kidneys; or a wide range of other health impacts.

5.1.5 In deciding whether or not land is contaminated land on grounds of significant possibility of significant harm to human health there are four categories to be considered. Categories 1 and 2 would encompass land which is capable of being determined as contaminated land on grounds of significant possibility of significant harm to human health. Categories 3 and 4 would encompass land which is not capable of being determined on such grounds.

5.1.6 For non-human receptors the following types of harm should be considered to be significant harm:

Ecological System Effects

- Harm which results in an irreversible adverse change, or in some other substantial adverse change, in the functioning of the ecological system within any substantial part of that location; or
- Harm which significantly affects any species of special interest within that location and which endangers the long-term maintenance of the population of that species at that location.
- In the case of European sites, harm should also be considered to be significant harm if it endangers the favourable conservation status of natural habitats at such locations or species typically found there. In deciding what constitutes such harm, the local authority should have regard to the advice of Natural England and to the requirements of the Conservation of Habitats and Species Regulations 2010.

-

Property Effects

- Crops: A substantial diminution in yield or other substantial loss in their value resulting from death, disease or other physical damage. For domestic pets, death, serious disease or serious physical damage. For other property in this category, a substantial loss in its value resulting from death, disease or other serious physical damage.
- Buildings: Structural failure, substantial damage or substantial interference with any right of occupation. The local authority should regard substantial damage or substantial interference as occurring when any part of the building ceases to be capable of being used for the purpose for which it is or was intended. In the case of a scheduled Ancient Monument, substantial damage should also be regarded as occurring when the damage significantly impairs the historic, architectural, traditional, artistic or archaeological interest by reason of which the monument was scheduled.

5.1.7 Contaminated land will only be identified when a 'pollutant linkage' has been established.

5.1.8 A 'pollutant linkage' is defined in Part IIA as:

"A linkage between a contaminant Source and a Receptor by means of a Pathway".

5.1.9 Therefore, this report presents an assessment of the potential pollutant linkages that may be associated with the site, in order to determine whether additional investigations are required to assess their significance.

5.1.10 In accordance with the National Planning Policy Framework, where development is proposed, the developer is responsible for ensuring that the development is safe and suitable for use for the purpose for which it is intended, or can be made so by remedial action. In particular, the developer should carry out an adequate investigation to inform a risk assessment to determine:

- whether the land in question is already affected by contamination through source – pathway – receptor pollutant linkages and how those linkages are represented in a conceptual model;
- whether the development proposed will create new linkages, e.g. new pathways by which existing contaminants might reach existing or proposed receptors and whether it will introduce new vulnerable receptors; and
- what action is needed to break those linkages and avoid new ones, deal with any unacceptable risks and enable development and future occupancy of the site and neighbouring land.

5.1.11 A potential developer will need to satisfy the Local Authority that unacceptable risk from contamination will be successfully addressed through remediation without undue environmental impact during and following the development.

5.2 Conceptual Site Model

5.2.1 On the basis of the information summarised above, a conceptual site model (CSM) has been developed for the site. The CSM is used to guide the investigation activities at the site and identifies potential contamination sources, receptors (both on and off-site) and exposure pathways that may be present. The identification of such potential "pollutant linkages" is a key aspect of the evaluation of potentially contaminated land.

5.2.2 The site investigation is then undertaken in order to prove or disprove the presence of these potential source-pathway-receptor linkages. Under current legislation an

-

environmental risk is only deemed to exist if there are proven linkages between all three elements (source, pathway and receptor).

5.2.3 This part of the report lists the potential sources, pathways and receptors at the site, and assesses based on current and future land use, whether pollution linkages are possible.

5.2.4 Potential pollutant linkages identified at the site are detailed below:

Table 5.1: Potential Sources, Pathways and Receptors

Source(s)	Pathway(s)	Receptor(s)
• Potential for contaminated ground associated with previous site use – on site (S1) • Potential for Made Ground associated with existing and previous development operations – on site (S2) • Potential buried tanks associated with former use as a Garage – off site (S3) • Potential hydrocarbon impacted ground from previous industrial use – on and off site (S4) • Current and previous industrial use – on and off site (S5) • Potential asbestos containing materials within existing buildings – on site (S6) • Infilled ponds – off site (S7)	• Ingestion and dermal contact with contaminated soil (P1) • Inhalation or contact with potentially contaminated dust and vapours (P2) • Leaching through permeable soils, migration within the vadose zone (i.e., unsaturated soil above the water table) and/or lateral migration within surface water, as a result of cracked hardstanding or via service pipe/corridors and surface water runoff. (P3) • Horizontal and vertical migration of contaminants within groundwater (P4) • Accumulation and Migration of Soil Gases (P5) • Permeation of water pipes and attack on concrete foundations by aggressive soil conditions (P6)	• Construction workers (R1) • Maintenance workers (R2) • Neighbouring site users (R3) • Future site users (R4) • Building foundations and on site buried services (water mains, electricity and sewer) (R5) • Controlled waters – Aquifer, Surface Waters– off site (R6)

5.3 Qualitative Risk Estimation

5.3.1 Based on information previously presented in this report, a qualitative risk estimation was undertaken.

5.3.2 For each potential pollutant linkage identified in the conceptual model, the potential risk can be evaluated, based on the following principle:

Overall contamination risk = Probability of event occurring x Consequence of event occurring

5.3.3 In accordance with CIRIA C552, the consequence of a risk occurring has been classified into the following categories:

- Severe
- Medium
- Mild

-

- Minor

5.3.4 The probability of a risk occurring has been classified into the following categories:

- High Likelihood
- Likely
- Low Likelihood
- Unlikely

5.3.5 This relationship can be represented graphically as a matrix (Table 5.2).

Table 5.2: Overall Contamination Risk Matrix

		Consequence			
		Severe	**Medium**	**Mild**	**Minor**
Probability	**High Likelihood**	Very high risk	High risk	Moderate risk	Low risk
	Likely	High risk	Moderate risk	Moderate risk	Low risk
	Low Likelihood	Moderate risk	Moderate risk	Low risk	Very low risk
	Unlikely	Low risk	Low risk	Very low risk	Very low risk

5.3.6 The risk assessment process is based on guidance provided in CIRIA C552 (2001) *Contaminated Land Risk Assessment – A Guide to Good Practice*. Further information including definitions of descriptive terms used in the risk assessment process is included in Appendix 4.

5.3.7 The degree of risk is based on a combination of the potential sources and the sensitivity of the environment. The risk classifications can be cross checked with reference to Table A4.4 in Appendix 4.

5.3.8 Hazard assessment was also carried out, the outcome of which could be:

- Urgent Action (UA) required to break existing source-pathway-receptor link.
- Ground Investigation (GI) required to gather more information
- No action required (NA)

5.3.9 The preliminary risk assessment for the site is presented in Table 5.3 below.

Table 5.3: Preliminary Risk Assessment for the Site

Sources	Pathways (P)	Receptors	Consequence	Probability of pollutant linkage	Risk Estimation	Hazard Assessment
• Potential for contaminated ground associated with previous site use – on site (S1) • Potential for Made Ground associated with existing and previous development operations – on site (S2) • Potential buried tanks associated with former use as a Garage – off site (S3) • Potential hydrocarbon impacted ground from previous industrial use – on and off site (S4) • Current and previous industrial use – on and off site (S5) • Potential asbestos containing materials within existing buildings – on site (S6) • Infilled former Ponds – off site (S7)	• Ingestion and dermal contact with contaminated soil (P1) • Inhalation or contact with potentially contaminated dust and vapours (P2) • Permeation of water pipes and attack on concrete foundations by aggressive soil conditions (P6)	• Construction workers (R1) • Maintenance workers (R2) • Neighbouring site users (R3) • Future site users (R4) • Building foundations and on site buried services (water mains, electricity and sewer) (R5)	Medium Severe for Asbestos	Likely	Moderate High for Asbestos	GI – Ground Investigation Due to the commercial history of the site and proximity to a historical garage site, a ground investigation is required to understand the risks posed to sensitive receptors.
	• Accumulation and migration of soil gases (P5)		Mild	Likely	Moderate	
	• Leaching through permeable soils, migration within the vadose zone (i.e., unsaturated soil above the water table) and/or lateral migration within surface water, as a result of cracked hardstanding or via service pipe/corridors and surface water runoff. (P3) • Horizontal and vertical migration of contaminants within groundwater (P4)	• Neighbouring site users (R3) • Controlled Waters – off site (Aquifer, Dollis Brook) (R6) • Building foundations and on site buried services (water mains, electricity and sewer) (R5)	Mild	Low	Low	

5.3.10 It should be noted that the identification of potential pollutant linkages does not necessarily signify that the site is unsuitable for its current or proposed land use. It does however act as a way of focussing data collection at the site in accordance with regulatory guidance in CLR 11.

5.4 Outcome of Risk Assessment

5.4.1 The risk estimation matrix indicates a moderate risk as defined above. A high risk has been designated due to possible asbestos.

5.4.2 It is understood that the proposed development comprises the demolition of the existing commercial buildings to be replaced by residential properties. A currently undeveloped area of site will also be developed with residential properties. It is understood that some of these properties will include private outside space, although whether these will be soft landscaped is unknown.

5.4.3 Due to the potential presence of asbestos containing materials, an asbestos survey should be undertaken, with any asbestos containing materials found removed under suitably controlled conditions.

5.4.4 A review of historical maps indicates that the earliest recorded site use was as agricultural land. This remained the case until the 1961/1962 map which shows the site partially developed (as today) with commercial buildings and labelled as a builder's yard, followed by a Depot. There are no further significant changes shown up to the present day. Surrounding land use is largely residential, with a garage shown immediately adjacent to the south/south-west. Further from site, a gas works is shown approximately 300m north-west of site.

5.4.5 Due to the commercial history of the site and proximity to a historical garage site, a ground investigation is required to understand the risks posed to sensitive receptors. The investigation should assess the thickness of any made ground, and allow samples of made ground and natural soils to be taken for laboratory analysis. A preliminary investigation may comprise a series of window sampler holes or trial pits.

5.4.6 Due to the small size, age of likely infill material (ponds predominantly no longer shown by the start of the 20th century), and underlying geology (clay), soil gas from the infilled ponds is not considered to pose a significant risk to the proposed development. Should a significant thickness of Made Ground or hydrocarbon impacted ground be encountered during the investigation a programme of soil gas monitoring may be required.

5.5 List of Key Contaminants

5.5.1 The possible contamination implications for both on-site and off-site sources have been assessed based on the information presented in the report. This has been achieved using guidance publications by the Environment Agency, together with other sources.

5.5.2 Based on recommendations within the guidance publications, an initial soil and water chemical testing suite would need to consider a range of contaminants as follows:

- *Metals*: cadmium, chromium, copper, lead, mercury, nickel, zinc;
- *Semi-metals and non-metals*: arsenic, boron, sulphur;
- *Inorganic chemicals*: cyanide, nitrate, sulphate and sulphide;

- *Organic chemicals*: aromatic hydrocarbons, aliphatic hydrocarbons, petroleum hydrocarbons, phenol, polyaromatic hydrocarbon;
- *Others*: pH, Asbestos

6 REFERENCES

Groundsure EnviroInsight Report Ref HMD-377-3169801

Groundsure GeoInsight Report Ref HMD-377-3169802

BRE Report BR211 ;Radon: Protective measures for new dwellings, 2007

Environment Agency (2004) *Model procedures for the management of land contamination*. CLR11. Bristol: Environment Agency

National Planning Policy Framework. Department for Communities and Local Government, March 2012

Code of Practice for Site Investigations BS5930: 2015

Investigation of Potentially Contaminated Sites – Code of Practice BS10175: 2011

APPENDICES

APPENDIX 1 – FIGURES

APPENDIX 2 – GROUNDSURE REPORTS

APPENDIX 3 – OS HISTORICAL MAPS

APPENDIX 4 – QUALITATIVE RISK ASSESSMENT METHODOLOGY

APPENDIX 5 – BGS BOREHOLE RECORDS