



Great Brighams Mead, Reading

Ground Conditions Assessment

On behalf of **McKay Securities Ltd**



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1 Introduction

1.1 Preamble

- 1.1.1 Stantec UK Limited (Stantec) has been commissioned by McKay Securities PLC (the Client) to provide consultancy services in relation to ground conditions for Great Brighams Mead (the Site) located in Reading.

1.2 Objective

- 1.2.1 The Clients objective is to redevelop the Site potentially using permitted development rights with the future as residential. The services commissioned relate to securing planning permission for the redevelopment.
- 1.2.2 The principal planning objective is to ensure that any unacceptable risks to human health, buildings and other property and the natural environment from the contaminated condition of the land are identified so that appropriate action can be considered and taken to address those risks.
- 1.2.3 Further information on the requirements of the National Planning Policy Framework (NPPF) (MHCLG, 2019) in respect of ground conditions is presented in our guide entitled Methodology for Land Contamination Assessment, a copy of which is presented in **Appendix A**.

1.3 Report Contents

- 1.3.1 This report presents a Ground Conditions Assessment (GCA) which comprises the following:
- A Preliminary Investigation in general accordance with BS18400:202 (comprising a desk-based study of published and readily available public information (see below for sources of information accessed) and a site reconnaissance (walkover)).
 - A Tier 1 Preliminary Risk Assessment (PRA) which is a qualitative assessment of data to develop an outline conceptual model (CM).
- 1.3.2 Information on the methodology adopted by Stantec is presented below and guidance on the use of this report is provided in **Section 8**.

1.4 Methodology

Ground Conditions - Land Instability

- 1.4.1 As required by the NPPF, this report presents information on the potential for land instability hazards to be present. The preliminary land instability assessment methodology adopted by Stantec follows the guidance given in the Planning Practice Guidance for Land Stability (MHCLG, 2019). The guidance states that "Preparation of a slope stability risk assessment report will vary according to location but is likely to involve at least a comprehensive desk study examination and a site visit." We have also assessed the risk of ground instability from hazards such as mining and natural solution features.
- 1.4.2 The work undertaken and presented herein also utilises the guidance given in NHBC Standards Chapter 4.1 Land Quality – Managing Ground Conditions (NHBC, 2020). A preliminary assessment of potential ground instability issues has therefore been undertaken by Stantec based on walkover information and readily available published geological information together with data acquired from public databases which equate to the NHBC Initial Assessment (desk study).

Ground Conditions - Contamination

- 1.4.3 As required by the NPPF this work has been carried out in accordance with “established procedures”. The methodology follows guidance called “Land contamination: risk management (LC:RM)” (which can be downloaded from <https://www.gov.uk/guidance/land-contamination-how-to-manage-the-risks>) which is based on and will replace Contaminated Land Research (CLR) Report 11: Model Procedures for the Management of Contamination CLR 11 (EA, 2004).
- 1.4.4 The risk assessment stage is an iterative process noting that all assessments must start with a PRA. Progression to the next tier is not always required if the assessment provides adequate confidence that the level of risk is acceptable.
- 1.4.5 Further information on the approach adopted by Stantec is set out in our guide entitled Methodology for Land Contamination Assessment, a copy of which is presented in **Appendix A**.

1.5 Sources of Information

- 1.5.1 The sources of information used in the preparation of this report are as listed below:
- A walkover reconnaissance by a Stantec Engineer to observe existing ground conditions and land use activities both on the Site and in the surrounding area. The walkover was undertaken on 8th February 2021. Photograph are presented in **Appendix B**.
 - Landmark Information Group (LIG) was commissioned to provide historical Ordnance Survey (OS) maps and data searches including geological and environmental setting. The mapping and Envirocheck report (LIG, 2021) are present in **Appendix C**.
 - A review of the borehole records held by the British Geological Society (BGS) accessed via their website, <http://www.bgs.ac.uk/data/boreholescans/home.html>. Relevant extracts are presented in **Appendix D**.
 - A review of geological mapping via <http://mapapps.bgs.ac.uk/geologyofbritain/home.html>.
 - A search of the Stantec project database to identify any ground condition reports in the vicinity of the Site. This includes the PBA Geoenvironmental Report for Great Brigham Mead (Ref, 9985, November 1998).
 - A review of MAGIC (Multi-Agency Geographic Information for the Countryside) website, <http://www.magic.gov.uk> (Accessed March 2021). The MAGIC website provides authoritative geographic information about the natural environment from across government. It is presented in an interactive map which can be explored using various mapping tools. The website was considered only in the context of the objectives of this report.

2 Site Setting

2.1 Site Location

- 2.1.1 The Site is centred at National Grid Reference (NGR) 471365, 174219 and the nearest Post Code is RG1 8DP.
- 2.1.2 A location plan for the Site is presented as **Figure 1**.

2.2 General Description

- 2.2.1 The Site is broadly rectangular in shape and occupies approximately 0.84 hectares (ha).
- 2.2.1 The Site is occupied by an H-shape building, with the remaining areas occupied by limited landscaping and an at grade car park.
- 2.2.2 A layout plan is presented as **Figure 2**.
- 2.2.3 Vehicular access to Great Brighams Mead is gained via an access road off Vastern Road.

2.3 Boundary and Immediate Surrounds

- 2.3.1 The Site is located in an urban setting, approximately 320m north west of Reading main train station.
- 2.3.2 The Site extends between the following features:
- North – Residential properties and associated car park.
 - East – Residential properties and associated car park.
 - South – Vastern Road.
 - West – Residential properties and associated car park.

2.4 Topography

- 2.4.1 Surrounding ground levels were noted to be flat.

2.5 Proposed Development

- 2.5.1 The proposed scheme is to convert the current commercial properties into 110 residential units.
- 2.5.2 The planning application will be for the conversion of the existing building.
- 2.5.3 Changes to the proposed development may necessitate a reassessment of the ground conditions and associated risks.

3 Environmental Setting

3.1 Introduction

- 3.1.1 The information from readily available information sources is summarised below and is used to provide context for the Instability Appraisal in **Chapter 4** and identify potential sources, pathways and receptors in the Preliminary Land Contamination Risk Assessment presented in **Chapter 5**.

3.2 Geological Setting

- 3.2.1 The following sources have been reviewed to provide information on the geological setting.

Review of Published Geology

- 3.2.2 The 1:50,000 scale geology map (BGS, 2000) indicates the following as being on-site or in the immediate surrounds:
- Superficial Deposits – Langley Silt - This deposit is described as comprising clay, silt, sand and gravel, massively bedded.
 - Solid Geology - Seaford and Newhaven Chalk Formations (undifferentiated) underlies the superficial geology. This stratum typically comprises off-white chalk with flint bands.
- 3.2.3 It is expected that Made Ground is present across the Site associated with the historical developments of the Site.

Borehole Records

- 3.2.4 The British Geological Survey (BGS) borehole record viewer (direct, online access to the National Geoscience Data Centre collection of onshore scanned boreholes, shafts and well records) was accessed via www.bgs.ac.uk/data/boreholescans/home.html on the 1 February 2021. The borehole scans are delivered under the Open Government Licence, subject to the following acknowledgement accompanying any reproduced BGS materials: "Contains British Geological Survey materials © UKRI [2020]".
- 3.2.5 No boreholes are shown on Site.

Stantec Report Database

- 3.2.6 A search of the Stantec database returned two ground investigations carried out at the Site by Terrasearch in 1974 and PBA in 1998. The key information to geology is summarised below:
- Terrasearch 1974. the investigation comprises of three boreholes drilled between 9 and 18m bgl. All recorded Made Ground between 1.0 and 1.7m bgl which overlays Langley Silt in two out of three boreholes at 2.4m bgl. River Valley Gravel is present on all three boreholes and on BH1 it is overlaid directly by Made Ground.
 - PBA 1998. The investigation comprises two boreholes drilled down to 20.0m bgl and ten window samplers sunk down between 1.3 and 3.0m bgl. All recorded Made Ground between 0.8 and 1.7m bgl which overlies Langley Silt between 2.0 to approximately 3.0m bgl. River Valley Gravel was identified in both boreholes down to a depth between 7.3 and 7.7m bgl and overlying the Upper Chalk. Groundwater level has been recorded between 1.5 and 2.3m bgl.

3.2.7 During the Ground Investigation in 1998 soil and water samples have been tested for contaminants.

3.2.8 The Soil contaminants results are summarized below:

- Water soluble extract Sulphate concentrations were recorded between 0.04 g/l and 1.06 g/l in the soil samples, and between less than 0.001 g/l and 0.7 g/l in the water samples.
- Arsenic: frequent exceedances the domestic gardens threshold as defined by the Interdepartmental Committee on the Redevelopment of Contaminated Land (ICRCL). Additionally, the ICRCL assessment criteria for parks, playing fields and open space was exceeded in one sample from 2.9m bgl from WS1. This indicates that the value of arsenic recorded fell in the range of 10mg/kg to 40mg/kg for the majority of samples with the sample from WS1 being greater than 40mg/kg based on the ICRCL threshold concentrations.
- Mercury: four exceedances of the ICRCL domestic garden assessment criteria, with a maximum concentration of 1.6 mg/kg. This indicates the other three results were between 1.0mg/kg and 1.6mg/kg.
- Nickel: slightly elevated concentrations recorded in five samples i.e. above 70mg/kg.
- Boron: slightly elevated concentrations recorded in one sample i.e. above 3mg/kg.
- Zinc: slightly elevated concentrations recorded in one sample i.e. above 300mg/kg.
- PAH: Concentrations below the 50mg/kg threshold in the ICRCL guidelines. The highest concentration of 44mg/kg was recorded at 0.5m bgl in WS5.

3.2.9 The water contaminants testing results are summarized below:

- Nitrate and Ammonia: elevated levels across most samples.
- Iron and Manganese: elevated concentrations for the gravel water samples.
- TPH: Concentrations less than 65 ug/l.
- PAH: Concentrations less than 2.3 ug/l.

3.3 Geodiversity Including Geomorphological Setting

3.3.1 Geodiversity can be defined as “The natural range (diversity) of geological (rocks, minerals, fossils), geomorphological (landforms, topography, physical processes), soil and hydrological features. It includes their assemblages, structures, systems and contributions to landscapes” (Gray, 2013).

3.3.2 These protected sites include geological Sites of Special Scientific Interest (SSSIs), National Nature Reserves (NNRs) and Local Geology Sites (formerly known as RIGS - Regionally Important Geological and Geomorphological Sites).

3.3.3 Features have not been identified on-site or within 100m, which is considered the likely extent of influence.

3.4 Soil Setting

3.4.1 A preliminary appraisal of readily available sources of information has been undertaken to determine whether soils as a resource require consideration within a ground condition assessment. This does not purport to be an agricultural land quality assessment and a specialist assessment of this aspect may require a separate commission.

3.4.2 A search of the interactive website <https://magic.defra.gov.uk/> accessed on the 7 January 2020 returned the following records for the Site:

- Post 1988 Agricultural Land Classification (England) – no features identified.

- National Historic Landscape Characterisation - "Settlement"

3.5 Mineral Resource Setting

- 3.5.1 Based upon information obtained from the British Geological Survey (BGS) website (<http://mapapps2.bgs.ac.uk/geoindex/home.html?layer=BGSMinMAAwith> accessed on the 1st February 2021). The Site is not located in an area with a current mineral assessment record.
- 3.5.2 The Replacement Minerals Local Plan map for Berkshire (Babtie, 2001) considers the Site within the areas with strongest presumption against allowing sharp sand and gravel extraction (Policy 11).
- 3.5.3 It is considered unlikely that development would be precluded on the grounds of mineral protection and mineral resources do not require further assessment.

3.6 Geochemical Setting

Ground Gases - Radon

- 3.6.1 The Envirocheck Report indicates the Site is in an area where the property is in a low probability radon area, as less than 1% of homes are above the action level. Radon protection measures are not required for the construction of new dwellings or extensions.
- 3.6.2 Radon is not identified as a potential human health hazard.

BGS Estimated Soil Chemistry

- 3.6.3 The Envirocheck Report indicates the estimated soil chemistry on the Site (based on rural soil and sediment samples) to be:
- Arsenic 15 to 25 mg/kg
 - Cadmium <1.8 mg/kg
 - Chromium 60 to 90 mg/kg
 - Lead <100 mg/kg
 - Nickel 15 to 30 mg/kg
- 3.6.4 None of the above exceed the published evaluation criteria for the most sensitive use in the proposed development (residential without the consumption of home grown produce) and naturally occurring soil chemistry is not identified as a potential human health hazard.
- 3.6.5 Whilst the above may be relevant to the natural soils on-site, given the urban location and likely presence of Made Ground associated with the historical and current developments of the Site the data is unlikely to be representative of the near surface soils.

3.7 Hydrogeological Setting

- 3.7.1 The following table summarises information regarding hydrogeology and groundwater vulnerability.

Table 3.1 Summary of Hydrogeology and Groundwater Vulnerability Related Information

Item and Provenance	Details
Aquifer Classification Envirocheck report	Superficial – Langley Silt – Unproductive Strata (low permeability strata) which is shown as at the surface across the majority of site. Solid Geology – Chalk – Principal Aquifer
Depth to Groundwater BGS 1978 / Judgement	Likely to be shallow and associated with the Langley Silt. The one historical record indicates that water was struck at 2.0m bgl.
Groundwater Flow Direction BGS 1978 / Judgement	Considering the topography and the location of the River Thames, it is assumed that the groundwater flow direction in the Superficial deposits has an eastward trend.
Source Protection Zone (SPZ) and Groundwater Abstraction Envirocheck report	Source Protection Zone (SPZ) located 240 east to the site.
Groundwater Vulnerability Envirocheck report	Solid Geology – High Vulnerability
Groundwater Flood Risk Envirocheck report	The Site has potential for Groundwater Flooding to occur at surface.
* The scope of this report does not include a flood risk assessment.	

- 3.7.2 Groundwater is identified as a Controlled Water receptor. Given the likely extremely localised nature of the superficial deposits and any associated aquifer the risk assessment will not consider this as a separate receptor. The risk assessment will consider the bedrock groundwater and given the characteristics presented above is likely to estimate greater risk levels than would be generated for the superficial aquifer.

3.8 Hydrological Setting

- 3.8.1 The following table summarises the information regarding hydrology.

Table 3.2 Summary of Surface Water Related Information

Item and Provenance	Description
Feature Envirocheck report	The report identifies the nearest feature as being approximately 44m north.
Catchment https://environment.data.gov.uk/catchment-planning/	River Thames to Cookham and River Kennet recorded as heavily modified rivers with an overall classification in 2019 of “Moderate”
Abstractions Envirocheck report	None of the abstraction records relate to surface water.
* The scope of this report does not include a flood risk assessment.	

- 3.8.2 Given the distance to the nearest surface water feature the risk assessment will not consider this as a separate receptor. The risk assessment will consider groundwater and given the characteristics presented above is likely to estimate greater risk levels than would be generated for the surface water feature.

3.9 Ecological Setting and Property – Animal or Crop Effect

- 3.9.1 The statutory guidance requires consideration of both ecology and a receptor termed Property – Animal or Crop Effect which is defined as including timber; produce grown domestically, or on allotments, for consumption; livestock; other owned or domesticated animals; wild animals which are the subject of shooting or fishing rights.
- 3.9.2 A preliminary appraisal of readily available sources of information has been undertaken to determine whether ecology as a resource requires consideration within a ground condition assessment. It should be noted the statement regarding ecological systems does not purport to be an ecological risk assessment which might require a separate commission.
- 3.9.1 Information on the ecological setting and areas of environmental sensitivity has been obtained from the Envirocheck report and the MAGIC website which was accessed on the 1 February 2021.
- 3.9.2 Based on the above information ecology is not identified as a receptor and is eliminated from further consideration in this assessment.
- 3.9.3 In terms of the receptor termed Property – Animal or Crop Effect the immediately surrounding land use includes residential properties with landscaping and consideration is therefore given in the risk assessment to adverse impacts on domestic animals and plants. The current and future development includes landscaping and therefore the receptor termed Property – Animal or Crop Effect is considered in the risk assessment.

4 Land Use Information (Hazard Identification)

4.1 Introduction

- 4.1.1 This section presents a review of various sources of information and identifies historical and current land uses on and immediately adjacent to the Site. Land use is used to inform the hazard identification element of the Tier 1 preliminary risk assessment (contamination).

4.2 Walkover Inspection

- 4.2.1 A walkover inspection was undertaken by a Stantec representative on 8th January 2020 to identify current land-uses on and off site.
- 4.2.2 The walkover was also attended by the Buildings Manager for the Site, Mr Maskell who provided additional information with regards to the Site and the land uses.
- 4.2.3 Photographs taken during the walkover are presented in **Appendix B**. The locations where the photographs were taken are shown on the Layout Plan (**Figure 2**).

On-site

- 4.2.4 The main building is H-shaped consisting of two rectangular main building joined in the middle.
- 4.2.5 Small buildings are located along the east and west and north west corner of the Site. To the east and west two small buildings for the collection of general waste. To the north west, a rectangular building for the electricity. On the South west corner another building for services is present.
- 4.2.6 The pavement is even, and no sign of cracks or surface deformations have been identified.
- 4.2.7 Area of soft landscaping are concentrated at the four corner of the site and along the pavement of the car parking areas. They consist of shrubs, small trees and grass and occasional gravel surfaces.

Off-Site

- 4.2.8 Between the Site and the River Thames, a block of residential houses is located. Residential properties are also present along the east boundary of the site.
- 4.2.9 To the west the site boundary with Brigham Road separating the site from residential properties.
- 4.2.10 To the south the main entrance is connected with Vastern Road.

4.3 Review of Historical Mapping

- 4.3.1 The historical land use of the Site and surrounding area has been obtained from reviewing historical Ordnance Survey (OS) maps supplied by Landmark Information Group (LIG, 2020) which is presented in **Appendix C**.
- 4.3.2 It should be recognized that historical maps only represent a 'snapshot' of land usage at the time of usage.
- 4.3.3 The historical Ordnance Survey maps provided have been reviewed and the pertinent information summarized below:

- 4.3.4 1879 – first map available (scale 1:2500), the site is divided roughly north to south by a row of trees. The two sections belong to two adjacent plots of rural lands. The layout of the Site is confirmed to be the same on the OS map dated 1881 (scale 1:2500) and OS map dated 1882 (scale 1:10560).
- 4.3.5 1899 – The OS map (scale 1:2500) shows the presence of a Sawmill and a smithy along with few residential and commercial properties within the Site boundaries. Residential properties are located to the east, south and west of the Site. A coal depot with rail tracks is located within 100 m south of the Site boundaries. To the north, along the River Thames, two buildings are present and interpreted as warehouses.
- 4.3.6 1912-1913 – The OS map (scale 1:2500) shows that the site layout is not altered. North of the site, along the River Thames, a boat house and a Timber yard are now visible. The Coal depot within 100 m from the site boundaries is still in use. The buildings are still present on the OS map dated 1957, engineering works are added on the north west within the 100 m buffer area of the Site boundary. In the OS map dated 1913-1914 (scale 1:10560) a commercial building is located west of the Sawmill.
- 4.3.7 1962-1975 – The OS map (scale 1:2500) shows some alterations. The Sawmill and the smithy are demolished. Part of a Club area is not within the Site boundaries. On the OS map dated between 1969 and 1986 (scale 1:1250) show the Club now converted into Offices, a rectangular warehouse has been built where the Sawmill was previously located. A Depot is also present to the west of the Site which replace the previous commercial building now demolished.
- 4.3.8 1979-1990 – The OS map (scale 1:1250) shows the engineering works replaced by residential properties. The coal depot within the 100m buffer zone south of the Site has been dismantled. The layout remained the same on the OS map dated 1993.
- 4.3.9 1990-1991 – The OS map (scale 1:10000) warehouse which extend to the bank of the River Thames.
- 4.3.10 1999 – The warehouse and depot are demolished, and construction of the Great Brigham Mead started. North of the Site boundary demolition of the previous building has been carried out. Commercial buildings are now built on the former Coal depot.

4.4 Review of Historical Imagery on Google Earth

- 4.4.1 A review of historical aerial imagery hosted by Google Earth provides no additional information relating to on-site land use.

4.5 Review of Database Searches

- 4.5.1 The results of the database searches provided in the Envirocheck report relating to land-use are summarised in the following table and discussed in the following sections.

Table 4.1 Summary of Environmental Database Searches

Data Type	Number on Site ⁽¹⁾	Number within 250 m of Site ⁽¹⁾
Waste Regulation		
Landfill Sites	0 (0)	0 (0)
Licensed Waste Management Facilities	0 (0)	0 (0)
Statutory Permits/Authorisations		

Data Type	Number on Site (1)	Number within 250 m of Site (1)
Pollution Prevention and Control ⁽²⁾	0 (0)	0 (0)
Radioactive Substance Authorisations	0 (0)	0 (0)
Planning Hazardous Substances	0 (0)	0 (0)
COMAH Sites ⁽³⁾	0	0
NIHHS Sites ⁽⁴⁾	0	0
Recorded Pollution / Potential Pollution		
Substantiated Pollution Incidents	0	3
Contaminated Land ⁽⁵⁾	0	0
Potential Contaminative Uses		
Fuel Stations	0	0
Trade Directory	0 (0)	0 (14)
Note: 1) Numbers in brackets denotes number of authorisations, licenses or permits that are lapsed, revoked, cancelled, superseded, defunct, surrendered, not applicable, inactive, withdrawn or not yet started. 2) Includes Integrated Pollution Controls, Integrated Pollution Prevention and Control, Local Authority Integrated Pollution Prevention and Control and Local Authority Pollution Prevention and Control permits. 3) COMAH denotes Control of Major Accident Hazards 4) NIHHS denotes Notification of Installations Handling Hazardous Substances 5) Sites determined as Contaminated Land under Part 2A of the Environmental Protection Act		

Landfill Sites

- 4.5.2 There are no records for landfill sites within 250m in the Envirocheck report.
- 4.5.3 The Envirocheck report identifies an Historical Landfill Site 376 m north west to the Site.

Pollution Incidents

- 4.5.4 The Envirocheck report indicates that there have been 13 pollution incidents recorded within 250m of the Site.
- 4.5.5 Given the distance, age and nature of the recorded pollution incidents, none of the incidents identified above are expected to have adversely impacted the Site.

Trade Directory Entries

- 4.5.6 The Envirocheck report shows no active trade directory records for on-site activities.

4.6 Review of Unexploded Bomb Risk Map

- 4.6.1 A preliminary unexploded ordnance (UXO) identification has been undertaken through review of the Unexploded Bomb (UXB) risk map (from <https://zeticauxo.com/downloads-and->

resources/risk-maps). The map indicates the potential for Unexploded Bombs (UXB) to be present as a result of World War Two (WWII) aerial bombing.

4.6.2 The map shows the Site to be in an area designated as 'Low' where Low is defined as "Areas indicated as having a bombing density of less than 15 bombs per 1000 acre".

4.6.3 Based on the above UXO has not been taken forward as a potential hazard.

4.7 Consultation with Regulators

4.7.1 A freedom of information request has been submitted to Environmental Agency (EA) relating to the Site. The EA has replied back with an email presented in **Appendix H** confirming the following:

- (a) No landfills are present within 250m from the Site, the nearest is 370m away;
- (b) There are no current environmental permits within the specified area from L&W point of view (discharge consents);
- (c) No past prosecutions within the specified area from a L&W point of view;
- (d) There are no current environmental licenses within the specified area from L&W point of view (abstraction licenses).

4.7.2 The Site is not registered in the records of RBC as a Part IIa site under the Environmental Protection Act 1990.

4.8 Search of the Planning Portal

4.8.1 The RCC planning portal holds one record of a recent planning applications for Great Brigham Mead for a renewal of temporary consent for car hire deposit submitted in 1997 by Europcar UK Ltd.

4.9 Internet Searches Using Site Address and Post Code

4.9.1 Internet searches using the site address did not reveal additional significant information relating to ground conditions or land use.

5 Ground Instability Appraisal

5.1 Introduction

- 5.1.1 The NPPF requires that 'a site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability'. Accordingly, consideration is given below to the potential risk of subsidence arising from Artificial Cavities; Natural Cavities; and Potential Adverse Foundation Conditions arising from existing ground conditions across the Site.
- 5.1.2 A preliminary assessment of potential ground instability issues has been undertaken based on walkover information and readily available published geological information together with data acquired from public databases which equate to the NHBC Initial Assessment (desk study).
- 5.1.3 An assessment of potential geological hazards that may give rise to instability or adverse foundation or construction conditions as supplied by the British Geological Survey (BGS) from their National Geoscience Information Service (NGIS) is presented in the Envirocheck Report reproduced in **Appendix C**. The generic assessment is generated automatically based on digital geological maps and the scope and the accuracy is limited by the methods used to create the dataset and is therefore only indicative for the search area. The information contained in the Envirocheck Report has been reviewed and, where considered necessary, reassessed considering the specific information available for the Site.

5.2 Mining (past, present and proposed)

- 5.2.1 The online viewer (<http://mapapps2.bgs.ac.uk/coalauthority/home.html>) shows the Site and area not to be in a Coal Mining Reporting Area. Stantec agrees with this assessment.
- 5.2.2 There is no evidence that the Site has been used for prior mineral extraction.
- 5.2.3 A search of the Stantec Non-coal Mining Database indicated that there are no mining cavities within 1 km of the Site, as shown in the table below.
- 5.2.4 The Envirocheck report records a hazard rating of "Low" for the presence of mining cavities and Stantec concurs with this assessment.

5.3 Potential for Compressible Ground Stability Hazards

Natural Ground

- 5.3.1 The Envirocheck report records the on-site compressible ground stability hazard potential to be "Very Low". Stantec concurs with this assessment.

Infill / Made Ground

- 5.3.2 Made Ground might be present from with the demolition of previous phases of development and degradable matter, obstructions and voids may be present. Stantec has assigned a hazard potential of "Low to Moderate" for compressible ground.

5.4 Potential for Running Sand Stability Hazards

- 5.4.1 The Envirocheck report records the on-site potential for running sands stability hazards to be "No Hazard". On the assumption that these hazard potentials relate to the Chalk and Superficial Deposits respectively Stantec agrees with the hazard relating to chalk but considers the potential for running sands to be encountered in excavations within the superficial deposits to be Moderate.

5.5 Potential Shrinking or Swelling Clay Stability Hazards

5.5.1 The Envirocheck report records the on-site Shrinking or Swelling Clay Stability hazard potential to be “Very Low”. Stantec concurs with this assessment.

5.5.2 Potential for Ground Dissolution Stability Hazards

5.5.3 The Envirocheck report records the on-site Ground Dissolution Stability hazard potential as “Low”.

5.5.4 A search of the Stantec Natural Cavities Database and Envirocheck Report indicated that there are 7 recorded natural cavity locations within 1.0km of the Site centre. They are summarized in the Table below.

Table 5.1 Summary table of the Natural Cavities

Approximate National Grid Reference	Approximate distance from site centre (m) and (direction)	Recorded Location	Geology	Mining Cavity Details	Source
SU 715 734	761 (S)	Broad Street, Reading, Berkshire	Superficial: Taplow Gravel Solid: Chalk Group	Solution Pipe x3	Stantec UK Limited
SU 715 734	771 (S)	Broad Street, Reading, Berkshire	Superficial: Taplow Gravel Solid: Chalk Group	Solution Pipe x5	Stantec UK Limited
SU 711 734	799 (S)	Oxford Road, Reading, Berkshire	Superficial: Taplow Gravel Solid: Chalk Group	Solution Pipe x3	Stantec UK Limited
SU 715 750	800 (N)	Berrylands Road, Caversham, Berkshire	Superficial: Lynch Hill Gravel Solid: Chalk Group	Solution Pipe x1	Stantec UK Limited
SU 715 750	829 (N)	Berrylands Road, Caversham, Berkshire	Superficial: Lynch Hill Gravel Solid: Chalk Group	Solution Pipe x1 Sinkhole x1	Stantec UK Limited
SU 715 733	859 (S)	Gun Street, Reading, Berkshire	Superficial: Taplow Gravel Solid: Chalk Group	Solution Pipe	Stantec UK Limited
SU 714 732	951 (S)	Castle Street, Reading, Berkshire	Superficial: Taplow Gravel Solid: Chalk Group	Solution Pipe x2	Stantec UK Limited

5.5.5 Based on the expected ground conditions and mapped geology, the groundwater level, and the geomorphology, Stantec concurs with the Envirocheck statement of Very Low Hazard Potential. The chalk surface has been eroded by fluvial activity which has removed the deepened karstic

zone formed as a result of past water table changes linked to the wider effects of glaciation outside the area. The eroded chalk surface is now overlain by Alluvium and Langley Silt. These erosional activities will have removed dissolution features like solution pipes and swallow holes formerly associated with the cover deposits of Palaeogene and fluvial Terrace. However, since the chalk is within the valley floor of the Thames where there is high transmissivity of ground water through the underlying chalk there is a “Moderate” potential for minor solution cavities to exist within the chalk at depth where dissolution has taken place along bedding planes, flint bands and marl bands.

5.6 Potential for Landslide Ground Stability Hazards

- 5.6.1 The Envirocheck report records the on-site Landslide Ground Stability hazard potential as “Very Low”. Stantec concurs with this assessment.

6 Geoenvironmental Results

6.1 Recent Ground Investigation

- 6.1.1 A ground investigation has been carried out on 4th March 2021. The scope of the work aims to confirm the current ground gassing conditions at the Site required to identify/confirm potential risks with respect to ground gases and the proposed change of use.
- 6.1.2 The current ground investigation consisted of:
- The sinking of four boreholes to a depth of 4m bgl using window sample technique and recovery of soil samples.
 - The construction of groundwater and ground gas monitoring wells in each borehole.
- 6.1.3 The installation of the wells has been followed by groundwater and gas monitoring with a periodicity of five days between reading events.
- 6.1.4 Gas monitoring has been also carried out inside the building by a Stantec Engineer using a Flammable Ionization Detector (Gas-Tec MK5) the same day as the external gas and water monitoring. The flame ionisation detector can record methane and other volatile combustible gases in the very low part per million (ppm) range e.g. <0.001% methane by volume. The detector was used to sense for gas along the floor slab and wall junction and around service entry point where gas migration from the underlying ground if present could enter the building.

6.2 Ground

- 6.2.1 The Logs of the intrusive ground investigation has been included in **Appendix D** along with the Historical records.
- 6.2.2 Made Ground is present in all window sampler and has a depth between 1.2 to 1.65m bgl. The base of Langley Silt is between 2.4 and 2.75 m bgl overlying in all the boreholes the River Gravel which is deeper than 4.0m bgl. The groundwater has been measured in all boreholes and it strikes between 1.56 and 2.55m bgl.

6.3 Ground Gases

- 6.3.1 Gas monitoring started on 5th March and it has been repeated every five days. Falling atmospheric pressure is associated with gas migration potential as it causes gas to expand and come out of the ground. However, it is likely to occur where there are open pathways in the ground and not for soils with low permeability (Card et al. 2019). Monitoring has been undertaken on the following occasions:
- 5th March 2021 – 1032 millibar (mb). Wider trend of steady atmospheric pressure.
 - 10th March 2021 – 1002 mb. Wider trend of falling atmospheric pressure.
 - 15th March 2021 – 1013 mb. Wider trend of raising atmospheric pressure.
 - 19th March 2021 – 1020 mb. Wider trend of falling atmospheric pressure.
 - 24th March 2021 – 1014 mb. Wider trend of falling atmospheric pressure.
 - 29th March 2021 – 1021 mb. Wider trend of raising atmospheric pressure.

- 6.3.2 Current guidance on ground gas monitoring suggests that it should be carried out over a sufficient period to allow prediction of worst-case conditions (BS8576: 2013). BS8576 states also that gas monitoring does not necessarily need to be carried out at worse-case conditions or at low or falling barometric pressure, but measurements should be continued until it is unlikely that any additional data change the outcome of the risk assessment or mitigation design.
- 6.3.3 Based on the atmospheric conditions and the anticipated low permeability of the Made Ground (predominantly clay or clayey) and high water table, it is considered that the gas monitoring carried out is sufficient to enable a suitable assessment of the ground gas regime at the site and the requirements for mitigation measures for a future change of use.
- 6.3.4 The steady-state concentrations of ground gases measured in the gas monitoring wells installed in the boreholes sunk as part of the recent ground investigation are summarised in the following **Table 5-2**.

Table 6.1 Summary of Gas Monitoring at GBM

Gas	05/03/2021	10/03/2021	15/03/2021	20/03/2021	24/03/2021	29/03/2021
CH ₄ (% v/v)	0	0	0	0	0	0
CO ₂ (% v/v)	0.5-2.5	0.3-2.7	0.3-2.8	0.2-3.2	0.9-3.4	0.6-2.8
O ₂ (% v/v)	16.3 - 19.1	16.8-19.4	17.3-19.4	16.9-20.0	16.2-18.4	17.7-19.7
H ₂ S (ppm)	0	0	0	0	0	0
Hexane (ppm)	0.051-0.054	0.052-0.056	0.047-0.053	0.043-0.049	0.047-0.051	0.050-0.055
CH ₄ ⁽¹⁾ (ppm)	0	0	0	0	0	0

Note: (1) CH₄ monitored indoor using FID.

- 6.3.5 The measured concentration of ground gases indicates predominantly near atmospheric conditions present across the Site. Locally, slight elevated levels of carbon dioxide with corresponding reduced levels of oxygen have been measured which could be related to the organic matter present in the Langley Silt Formation underlying the Made Ground Deposit.

7 Land Contamination Risk Assessment

7.1 Approach and Conceptual Model

- 7.1.1 The land contamination risk assessment presented in this chapter is a Tier 1 Preliminary Risk Assessment (PRA) which uses published information. A summary of the guidance for the assessment of land contamination and the approach developed and adopted by Stantec is presented in **Appendix A**.
- 7.1.2 A conceptual model (CM) identifies the types and locations of potential contamination sources, the identification of potential receptors and the identification of potential transport/migration pathways.
- 7.1.3 Guidance requires a risk assessment to include the following steps:
- Identify the hazard - establish contaminant sources.
 - Assess the hazard - use a source-pathway-receptor (S-P-R) pollutant linkage approach to find out if there is the potential for unacceptable risk.
 - Estimate the risk - predict what degree of harm or pollution might result and how likely it is to occur.
 - Evaluate the risk - decide whether a risk is unacceptable.
- 7.1.4 The findings for each step are summarised in the following subsections.

Conceptual Site Model

7.2 Hazard Identification (Sources of Contamination)

Naturally Occurring Geochemical Hazards

- 7.2.1 Radon has not been identified as a naturally occurring ground gas requiring gas protection measures.
- 7.2.2 The estimated natural soil chemistry information does not indicate the presence of elevated concentrations of metals. Chalk as a carbonaceous rock can generate carbon dioxide, however, it is not identified as a potential hazard as it is unlikely to pose a risk (CL:AIRE, 2012).

Anthropogenic Geochemical Hazards

- 7.2.3 The sources of potential contamination (SPCs) identified and associated contaminants of concern (COC) are presented in **Table 6.1** below and take into consideration the soil and water contaminant testing carried out after the 1998 GI (PBA 1998) which has been summarized in the paragraph 3.2.8 and 3.2.9 of this report.

Table 6.1 Sources of Potential Contamination (SPC)

Location of Source	Reference	Description & (Hazard Score)*	Contaminants of Concern (COC)
Site wide	1	Made Ground from previous phases of development (3)	Petroleum Hydrocarbons including fuels, solvents (degreasers) and oils. Metals

Location of Source	Reference	Description & (Hazard Score)*	Contaminants of Concern (COC)
Off-site North	2	Made Ground from previous phases of development (3)	Petroleum Hydrocarbons including fuels, solvents (degreasers) and oils. Metals
* hazard score from methodology			

7.2.4 The historical data recorded some elevated contaminants generally below or around the current C4SL or SU4L assessment criteria for residential use without home grown produce. The current hard surface and soft landscaping represent a barrier breaking the pathway to contaminants. As they will not be affected by the proposed redevelopment, there is no hazard for current and future users.

7.2.5 The recent gas monitoring does not identify a significant source of soil gas. Monitoring internal to the building has not identified any methane or volatile gases at trace levels. Therefore, soil gas is not considered a hazard to the current or future redevelopment in terms of change of use from commercial to residential.

7.3 Hazard Assessment

7.3.1 To determine whether the identified hazards pose a risk it is necessary to identify the presence of potential receptors and pathways by which these receptors can be exposed to the hazard.

Identification of Potential Pathways

7.3.2 Potential hazards require a pathway connecting the source (if present) to potential receptors to impact upon the receptors. These pathways are capable of conveying the potential contaminants identified. Pathways may be anthropogenic (artificial) or natural.

7.3.3 Anthropogenic pathways are artificial routes capable of conveying contaminants and include such routes as surface water drains, high permeability backfill materials, poorly consolidated Made Ground, foundations, and persons disturbing contamination sources in such a way as to liberate contaminants.

7.3.4 Natural pathways include solution features which might be present in Chalk.

7.3.5 Table 3 of the methodology presented in **Appendix A** describes the possible pathways for each receptor type.

Receptor Identification

7.3.6 Potential receptors identified by this assessment and determination of the sensitivity/value are presented in **Table 6.2** below.

Table 6.2 Potential Receptors

Receptor	Comment	Receptor/Sensitivity
Human Health – On Site	Current (baseline) – Car park users and Office personnel Construction phase – workers	4

Receptor	Comment	Receptor/Sensitivity
	Operational – future residents	
Human Health – Off Site	All phases residential	4
Controlled Water (Surface Water)	River Thames	Eliminated
Controlled Waters (Groundwater - Superficial)	Superficial	Eliminated
Controlled Waters (Groundwater – Solid Geology)	Solid Geology - Principal	Eliminated
Property – Buildings on-site	Structure and associated services	1
Property – Buildings off-site	Low rise residential buildings	Eliminated

7.4 Risk Estimation

7.4.1 Risk estimation tables presenting the consequence (degree of harm based on the assigned hazard classification) and the probability of the harm occurring for each plausible pollutant linkage have been prepared for each of the three Phase areas and are presented in **Appendix F**. The estimated risks for each receptor in the three scenarios (current/ baseline, construction and operational) are summarised in the following table.

Table 7.3 Summary of Estimated Risk for the Development Phase

Receptor	Baseline	Construction	Operational
Human Health – On-site	Very Low	Moderate if ground is disturbed. Very low associated with internal building alteration.	Very Low
Human Health – Off-site	Very Low	Very Low	Very Low
Controlled Water (Surface Water)	N/A	N/A	N/A
Controlled Waters (Groundwater - Superficial)	N/A	N/A	N/A
Controlled Waters (Groundwater – Solid Geology)	N/A	N/A	N/A
Property – Buildings on-site	Low	Low	Low
Property – Buildings off-site	Very Low	Very Low	Very Low

7.5 Risk Evaluation

- 7.5.1 Possible pollutant linkages are determined using professional judgement. If a linkage is considered plausible with some associated risk, even if estimated to be Low, it is considered to require further consideration. Risk reduction can be achieved through implementation of remediation or mitigation measures or through further tiers of assessment following collection of site-specific data.
- 7.5.2 From our experience of developing similar sites, it is considered that there are readily available mitigation measures that will reduce the likelihood of harm occurring and therefore the risk to an acceptably low level. Whilst an intrusive investigation is required to robustly define the mitigation measures to be adopted it is considered that there is sufficient information on the likely ground conditions to conclude that the risks can be satisfactorily reduced to an acceptable level. The possible measures for each receptor are described below. These measures are typically deployed on the majority of Brownfield developments and not considered onerous.

Controlled Waters

- 7.5.3 Developments on Brownfield sites typically have a Construction Environmental Management Plan (CEMP) which defines measures to be adopted to minimise release of contamination from soils or generation of new pollution.

Human Health - Construction Phase

- 7.5.4 As the Contractor will prepare documents (risk assessment and method statements (RAMS) and implement measures to address the requirements of health and safety legislation, including but not limited to, the Control of Asbestos Regulations (CAR 2012) and the Construction (Design and Management) Regulations (CDM 2015) it is considered that the pollutant linkages can be simply managed. The following good practice and hygiene measures are typically implemented on Brownfield sites and assumed to be the minimum:
- Designated eating and drinking area(s) and these are kept clean (free of dirt / dust).
 - Provision of hand washing facilities.
 - Toolbox box talks, induction awareness and regular refresher talks.
 - All site personnel should be made aware of the risk of instability hazards. Any loss of ground or instability during the site works should be reported and fully investigated.

Off-Site Receptors (Human Health and both Property Effects)

- 7.5.5 The primary exposure pathway to these receptors is via wind-blown dust and vapours. The CEMP typically includes measures minimise dust generation and distribution. Uncertainties and Data Gaps
- 7.5.6 Whilst the data used in this assessment is considered robust and suitable for purpose, the available ground condition data is preliminary in nature, based largely on desk-based studies, supplemented by a walkover inspection.
- 7.5.7 The nature and extent of contamination used in the risk estimation is based on worst case assumptions regarding the historical land uses. Given that the site was redeveloped relatively recently it is considered that gross contamination, if present, would have been addressed at that time. Whilst site specific data from the intrusive investigation is required to confirm the actual ground conditions and fully define the risk reduction measures it is considered that there are readily available risk reductions measure available and that there are routinely adopted on Brownfield developments.

8 Conclusions and Recommendations

8.1 Conclusions

- 8.1.1 The preliminary ground instability assessment identified that all the ground stability hazards were rated as very low or low potential. This risk has been dealt with through the adoption of piled foundations. The change of use for the building will not have a negative effect on the current foundation.
- 8.1.2 The council has confirmed that the site has not been identified as statutory “contaminated land” under Part IIa of the Environmental Protection Act, 1990. The current and historical ground investigation is sufficient to assess the risk for redevelopment and further ground investigation is not considered necessary.
- 8.1.3 Based on experience with similar developments, it is considered that no significant risks are presented by the site for the redevelopment and change of use from commercial to residential. Given this, there is no contamination reason why prior approval cannot be granted for this application.

9 References

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