

DESK STUDY / PRELIMINARY RISK ASSESSMENT REPORT

FOR

WOKING FOOTBALL CLUB
LAITHWAITE COMMUNITY STADIUM
KINGFIELD ROAD
KINGFIELD
WOKING
GU22 9AA



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EXECUTIVE SUMMARY

Woking Football Club ('The client') commissioned Jomas Associates Ltd to undertake a desk study and preliminary risk assessment at Woking Football Club, Laithwaite Community Stadium, Kingfield Road, Kingfield, Woking, GU22 9AA. 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.

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	
Current Site Use	Commercial football ground with other leisure facilities.
Proposed Site Use	Mixed use residential and commercial development comprising residential flats surrounding a new football ground.
Site History	<p>A review of earliest available (1871) historical maps indicates that the site comprised undeveloped and/or agricultural land. From the 1934 plan development is noted on site as consisting of a sports ground, including a tennis ground towards the south and pavillions areas of worked ground are noted on this plan. Residential building development is noted within the northern part of the site in 1966. Large building developments are noted on the plan 1992 comprising a tennis centre, gymnasium and snooker hall.</p> <p>The site vicinity on the earliest available plan comprised predominately undeveloped and/or agricultural land. A large pond is located directly east of site, an inland river is also located towards the north of site. The site vicinity shows consistent building development noted as detached residential buildings. No significant changes to the site vicinity are noted from 1966 to the most recent historical map 2014.</p> <p>A historic landfill site is recorded 41m west of the site.</p>
Site Setting	<p>The British Geological Survey indicates that the site is mainly underlain by superficial sand and gravel deposits of both the Kempton Park Gravel Formation Alluvium along the northern boundary.</p> <p>The superficial deposits are underlain by solid sand deposits of the Bagshot Formation, deposits of the London Clay Formation are reported to encroach onto site along the south eastern boundary.</p> <p>The superficial deposits underlying the site are identified as a secondary (A) aquifer with the underlying solid deposits also identified as a secondary (A) aquifer. The underlying London Clay Deposits are identified as unproductive strata.</p> <p>A review of the Envirolnsight Report indicates that there are no source protection zones within 500m of the site.</p> <p>There are no groundwater, surface water or potable water abstractions reported within 1km of the site.</p> <p>The nearest detailed river entry is reported 39m north of the site, identified as How Stream. The nearest surface water entry is located 9m east, identified as a pond.</p>

Desk Study	
	The nearest reported Environment Agency Zone 2 floodplains is reported 16m north of site. The nearest Zone 3 floodplain is located 26m north of site.
<ul style="list-style-type: none"> • Potential Sources 	<ul style="list-style-type: none"> • Potential for Made Ground associated with previous development operations – on site (S1) • Potential hydrocarbon impacted ground from unspecified historic tanks – on site (S2) • Potential asbestos containing materials within existing buildings – on site (S3) • Potential ground gas generation from unspecified pit and alluvium– on site (S4)
Potential Receptors	<ul style="list-style-type: none"> • 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 - secondary (A) aquifer (R6) Surface water – pond located east of site (R7)
Preliminary Risk Assessment	<p>The risk estimation matrix indicates a moderate to low risk.</p> <p>It is recommended that an intrusive investigation is undertaken to clarify potential risks to the identified 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.</p> <p>Soil gas monitoring should be undertaken in accordance with CIRIA C665.</p>
Potential Geological Hazards	<p>The Groundsure data identifies moderate to negligible risks – for full details see Section 4</p> <p>The Geolnsight report notes historical ground working features identified as an unspecified pit on site in 1955. Ground working features are also noted directly east of site, associated with a historic pond development. No other significant ground working features are noted within the vicinity.</p> <p>A geotechnical investigation is recommended to assess the significant potential for compressibility associated with the potential Alluvium.</p> <p>An intrusive investigation will also address the potential issue with ground plasticity and inform foundation design.</p>

1 INTRODUCTION

1.1 Terms of Reference

- 1.1.1 Woking Football Club (“The Client”) has commissioned Jomas Associates Ltd, to assess the risk of contamination posed by the ground conditions at a site referred to as the Woking Football Club, Laithwaite Community Stadium, Kingfield Road, Kingfield, Woking, GU22 9AA, prior to redevelopment of the site.
- 1.1.2 To this end a desk-based assessment has been undertaken in accordance with Jomas Associates Limited’s email proposal dated 02 February 2018.

1.2 Proposed Development

- 1.2.1 The proposed development comprises the following:
- ‘Redevelopment of the site, following the demolition of all existing buildings and structures, to provide a replacement stadium with ancillary facilities, including flexible retail, hospitality and community spaces, independent retail floorspace (Classes A1/A2/A3), a medical centre (Class D1) and vehicle parking, plus residential accommodation comprising of 1,048 dwellings (Class C3) within 5 buildings of varying heights of between 3 and 10 storeys (and undercroft and part basement levels) on the south and west sides of the site, together with provision of new accesses from Westfield Avenue to car parking, associated landscaping and the provision of a detached residential concierge building.’
- 1.2.2 For the purposes of the contamination risk assessment, the proposed development is classified as ‘Residential without 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) 2 site in accordance with BS EN 1997 Part 1. GC 2 projects are defined as involving:
- Conventional structures.
 - Quantitative investigation and analysis.
 - Normal risk.
 - No difficult soil and site conditions.
 - No difficult loading conditions.
 - Routine design and construction methods.
- 1.2.4 This will be reviewed at each stage of the project

1.3 Objectives

- 1.3.1 The objectives of Jomas Associates Limited’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 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 environmental database reports (attached in Appendix 2 and Appendix 3);
- 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 Supplied Documentation

1.5.1 Jomas Associates were not supplied with any previously produced reports at the time of writing this report.

1.6 Limitations

1.6.1 Jomas Associates Ltd has prepared this report for the sole use of Woking Football Club 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 Jomas Associates Limited. 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.

1.6.2 The records search was limited to information available from public sources; this information is changing continually and frequently incomplete. Unless Jomas Associates Limited has actual knowledge to the contrary, information obtained from public sources or provided to Jomas Associates Limited by site personnel and other information sources, have been assumed to be correct. Jomas Associates Limited 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.

1.6.3 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.

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

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- 1.6.5 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.
- 1.6.6 ***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 in Appendix 1.

Table 2.1: Site Information

Name of Site	Woking Football Club
Address of Site	Laithwaite Community Stadium Kingfield Road Kingfield Woking GU22 9AA
Approx. National Grid Ref.	500569 157301
Site Area (Approx)	5ha
Site Occupation	Mixed commercial and residential
Local Authority	Woking Borough Council

2.2 Walkover Survey

2.2.1 A site walkover survey was undertaken by Jomas Associates on 13 August 2018.

Table 2.2: Site Description

Area	Item	Details
On-site:	Current Uses:	Site consists of numerous developments surrounding a large football ground. The football ground has numerous stands surrounding its perimeter. Building uses on site include a large gymnasium, sports hall, gymnastics club and snooker centre. Small units on site are also utilised as a bar and club house associated with the football ground. An area of residential development is located within the northern part of site. Parking areas are located across site within hardstanding areas.
	Evidence of historic uses:	No evidence of historic uses noted.
	Surfaces:	Site is predominately covered by hardstanding asphalt and concrete cover. The football ground is grass covered with some minor areas of soft landscaping located across site.
	Vegetation:	Vegetation located within soft landscaping areas consists of shrubs, weeds and trees. Within the football ground the pitch is covered in well maintained turf. None of the vegetation observed showed signs of distress or dieback.

Area	Item	Details
	Topography / Slope Stability:	Site is generally flat with a minor slope noted within the car park located towards the south of site.
	Drainage:	Normal drainage facilities are installed with no issues noted.
	Services:	Site is connected to electrical and water services. The site is also assumed to be connected to communication services.
	Controlled waters:	None observed.
	Tanks:	None observed.
Neighbouring land:	North:	Residential
	East:	Residential
	South:	Sports ground
	West:	Residential

2.2.2 Key features noted during the walkover are shown on a site walkover plan, together with site photos, 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
1871 – 1:10,560	Site consists of undeveloped and/or agricultural land.	The site vicinity within 500m consists predominately of undeveloped and/or agricultural land.
1897 – 1:10,560	No significant changes.	A large pond is located directly east of site in the area of Kingfield green, another water body is located 100m north east of site identified as a river. This feature is orientated north east to south west. Minor building development noted to the north within 500m of site.
1913 – 1:10,560	No significant changes.	Continued minor building development within 500m of site, no other significant changes.

Dates and Scale of Map	Relevant Historical Information	
	On Site	Off Site
1934/35 – 1:2,500 1:10,560	Site consists of a sports ground with some pavilions/stands including a tennis ground towards the south. A small area of worked ground is located close to the pavilions in the northern part of site. Additional building development noted as semi-detached buildings within the north western corner of site.	Significant building development noted within the immediate site vicinity. This comprises detached residential properties with private gardens. Areas of allotments and other sports ground are also located towards the south between the residential developments.
1955 – 1:10,560	No significant changes.	Continued building development noted within 500m of site, no other significant changes.
1966 – 1:2,500	The pavilions/stands have been extended, additional ground working features are noted as part of this development. Additional building development noted within the northern part of site.	Continued residential building development within 100m of site, no other significant changes.
1977/82 – 1:10,000	No significant changes.	No significant changes.
1992/94 – 1:10,000 1:1,250	Numerous large buildings developed within the southern half of site, these buildings include a tennis centre, gymnasium and snooker hall.	No significant changes.
2002/10/14 – 1:10,000	No significant changes.	No significant changes. The pond feature identified directly east of site is still present on this plan. The site vicinity consists predominately of terraced residential buildings within 500m of site.

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

2.3.3 An aerial photograph supplied as part of the GroundSure EnviroInsight report and taken in April 2013 generally shows that the site comprises a football ground with large buildings and car parking facilities. The site vicinity consists predominately of residential buildings with large sports ground located to the south of site. This information coincides with the historical map review and the walkover.

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	1No report of an unspecified pit,	13No reported; nearest entry, nursery located 116m east.	✓

Type of Consent/Authorisation	On site	Off-site (within 500m of site, unless stated otherwise)	Potential to Impact Site*
mapping	dated 1955.		
Historical Tank Database	2No reports of unspecified tanks, dated 1993 and 1988.	None	✓
Historical Energy Features Database	None	29No reported; all entries identified as electricity substations, nearest located 38m north east.	X
Historical Petrol & Fuel Site Database	None	None	X
Historical Garage & Motor Vehicle Repair Database	None	3No reported; all entries identified as garages, nearest located 368m east.	X
Potentially infilled land	1No reported of an unspecified pit, dated 1955. With reference to historical mapping this is likely to comprise raised earthworks associated with former football stands.	19No reported; nearest entry, pond located 4m east. Other entries include pond located 9m north east and 15m east.	X
Tunnels	None	None located within 250m of site.	X

2.5 Industrial and Statutory Consents

2.5.1 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 2.5: Industrial and Statutory Consents

Type of Consent/Authorisation	On site	Off-site (within 500m of site, unless stated otherwise)	Potential to Impact Site*
Discharge Consents.	None	3No reported; nearest entry, Hoe Stream located 23m north west, revocation date July 2012.	✓
Water Industry Act Referrals	None	None	X
Red List Discharges	None	None	X
List 1 and List 2 Dangerous Substances	None	None	X
Control of Major Accident Hazards (COMAH) and Notification of Installations Handling Hazardous Substances (NIHHS) Sites.	None	None	X

Type of Consent/Authorisation	On site	Off-site (within 500m of site, unless stated otherwise)	Potential to Impact Site*
Planning Hazardous Substance Consents	None	None	X
Category 3 or 4 Radioactive substances Authorisations	None	None	X
Pollution Incidents (List 2).	None	1No reported; identified as inorganic chemical or product pollutant, located 349m north east. Water and land impact category 4 (no impact), air impact category 3 (minor).	X
Pollution Incidents (List 1)	None	None	X
Contaminated Land Register Entries and Notices.	None	None	X
Registered Landfill Sites.	None	1No reported; identified as historical Westfield Tip, located 41m west. Waste type noted as commercial and household. Date last recorded as December 1979.	✓
Waste Treatment and/or Transfer Sites.	None	None	X
Fuel Station Entries	None	None	X
Current Industrial Site Data.	None	7No reported; nearest entries, electrical features located 16m west and 41m north east.	X

* From a land contamination perspective

2.6 Previous Site Investigations

2.6.1 Jomas Associates are not aware of any previous site investigation undertaken at this site prior to this desk study.

2.7 Local Authority Information

2.7.1 Jomas have made a request to Woking Borough Council for information relating to contamination on the site and surrounding areas. A copy of the correspondence is included in Appendix 5.

2.7.2 A response is pending.

2.8 Planning Information

2.8.1 A review of the local authority's planning portal was undertaken on 16 August 2018 at '<https://caps.woking.gov.uk/online-applications/>'.

2.8.2 Although several applications were identified in the vicinity of the site, no documents containing useful information regarding ground conditions or potential contamination were identified.

2.9 Unexploded Ordnance

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- 2.9.1 The initial data indicates that there is a low risk.
- 2.9.2 Low-risk regions are those that show a bomb density of up to 10 bombs per 1000 acres.
- 2.9.3 This does not comprise a full UXO risk assessment.

3 GEOLOGICAL & ENVIRONMENTAL SETTING

3.1.1 The following section summarises the principal environmental resources (geological, hydrogeological and hydrological) of the site and its surroundings.

3.1.2 The data discussed herein is generally based on the information given within the Envirolnsight Report and published information provided by the Environment Agency and British Geological Survey.

3.2 Solid and Drift Geology

3.2.1 The British Geological Survey indicates that the site is mainly underlain by superficial sand and gravel deposits of Kempton Park Gravel Formation. Superficial sand and gravel deposits of alluvium are reported to encroach onto site along the northern boundary.

3.2.2 The BGS describes the Kempton Park Gravel Formation to have an average thickness of 6m, but much thicker where infilled deep hollows. The description of this formation is as follows

“Sand and gravel, locally with lenses of silt, clay or peat.”

3.2.3 The alluvium deposits encroaching onto site from the north are described as

“Normally soft to firm consolidated, compressible silty clay, but can contain layers of silt, sand, peat and basal gravel.”

3.2.4 The superficial deposits are underlain by solid sand deposits of the Bagshot Formation, deposits of the London Clay Formation are reported to encroach onto site along the south eastern boundary.

3.2.5 The BGS describes the Bagshot Formation as consisting of

“pale yellow-brown to pale grey or white, locally orange or crimson, fine- to coarse-grained sand that is frequently micaceous and locally clayey, with sparse glauconite and sparse seams of gravel. The sands are commonly cross-bedded but some are laminated.”

3.2.6 The BGS describes the London Clay Formation as consisting of

“bioturbated or poorly laminated, blue-grey or grey-brown, slightly calcareous, silty to very silty clay, clayey silt and sometimes silt, with some layers of sandy clay. It commonly contains thin courses of carbonate concretions (‘cementstone nodules’) and disseminated pyrite. It also includes a few thin beds of shells and fine sand partings or pockets of sand, which commonly increase towards the base and towards the top of the formation. At the base, and at some other levels, thin beds of black rounded flint gravel occurs in places. Glauconite is present in some of the sands and in some clay beds, and white mica occurs at some levels.”

3.2.7 The Bagshot Formation is younger than the London Clay Formation. Consequently where the Bagshot Formation is initially encountered the London Clay may be encountered at depth.

3.2.8 Although artificial deposits are not reported within the site they are noted 8m to the east and as such may encroach onto the site. These artificial deposits are in the area identified as a pond during the historical map review. In addition, given the identified site history a thickness of Made Ground should be expected.

3.3 British Geological Survey (BGS) Borehole Data

3.3.1 As part of the assessment, the publicly available BGS borehole records from the surrounding area were reviewed.

3.3.2 No borehole records providing information on the underlying ground conditions were identified within 250m of the site boundary.

3.4 Hydrogeology & Hydrology

3.4.1 General information about the hydrogeology of the site was obtained from the EnviroInsight and / or the DEFRA "MAGIC" 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 Hydrogeology & Hydrology

Feature	On Site	Off Site	Potential Receptor?
Aquifer	Superficial: Secondary (A)	Secondary (A) within 200m of site.	✓
	Solid: Predominately Secondary (A) (Bagshot Formation), Unproductive strata within south eastern corner of site (London Clay Formation).	Secondary (A) within 250m of site, Unproductive strata towards the south east of site.	✓
Source Protection Zone	None	None	X
Abstractions	Ground water	None	2No reported within 2km; nearest active entry located 1275m south.
	Surface water	None	10No reported within 2km; nearest active entry located 1158m south east.
	Potable	None	None within 2km;
Surface Waters	None	Nearest entry located 9m east, identified as a pond. Other entries include inland river reported 39m north, identified as Hoe Stream.	✓
Flood Risk	EA Flood Zone 2	None	Nearest entry located 16m north west, other entries located 20m north.
	EA Flood Zone 3	None	Nearest entry located 26m north west, other entries located 28m west.
	RoFRaS	Very low	Nearest entry located 17m north west reported as low risk. Nearest high risk entry located 18m north west.
	Flood Defences	There are 6No reports of flood defences located within 250m of the site. Nearest entry is located 54m north.	

Feature	On Site	Off Site	Potential Receptor?
	BGS	BGS has a "moderate" confidence that there is the potential for surface "clearwater" flooding.	-

3.5 Sensitive Land Uses

3.5.1 3No reports of Local Nature Reserves (LNR) are located within 1km of the site. Nearest entry located 807m north east, identified as White Rose Lane.

3.5.2 2No reports of Green Belt land are located within 1km of the site. Nearest entry located 125m south west, identified as London Area Greenbelt.

3.5.3 No other sensitive land use was identified within 1km of the site.

3.6 Radon

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

3.6.2 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 GeolInsight 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	Low	Ground conditions predominantly medium plasticity. Do not plant trees with high soil moisture demands near to buildings. For new build, consideration should be given to advice published by the National House Building Council (NHBC) and the Building Research Establishment (BRE).	No
Landslides	Very low	Slope instability problems are unlikely to be present. No special actions required to avoid problems due to landslides.	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
Compressible deposits	Moderate	Significant potential for compressibility problems. Avoid large differential loadings of ground. Do not drain or de-water ground near the property without technical advice. For new build consider possibility of compressible ground in ground investigation, construction and building design. Consider effects of groundwater changes.	Yes
Collapsible Rock	Very low	Deposits with the potential to collapse when loaded and saturated are unlikely to be present	No
Running sand	Low	Possibility of running sand problems after major changes in ground conditions. Normal maintenance to avoid leakage of water-bearing services or water bodies (ponds, swimming pools) should reduce likelihood of problems due to running sand. For new build consider possibility of running sand into trenches or excavations if water table is high or sandy strata are exposed to water. Avoid concentrated water inputs to site.	No
Coal mining	None	There are no coal mining areas located within 1km of the site.	No
Shallow mine workings	None	There are no shallow mine workings located within 1km of the site.	No
Brine affected areas	None	There are no brine affected areas located within 1km of the site.	No

4.1.2 In addition, the GeolInsight report notes the following:

- 1No historical surface ground working feature is reported within the site boundary. This entry is identified as an unspecified pit dated 1955. With reference to historical mapping this is likely to comprise raised earthworks associated with former football stands.
 - 7No historical surface ground working features are reported within 250m of the site, all entries within the site vicinity identified as ponds, nearest located 4m east.
 - No historical underground working features are reported within 1km of the site.
 - 2No BGS Current Ground Working Features are reported within 1km of the site. The nearest entry is reported 925m north identified as Downside Goods Yard producing crushed rock and slag.
- 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.
- 4.1.4 Foundations should not be formed within Made Ground or organic rich material (e.g. Topsoil) due to the unacceptable risk of total and differential settlement.
- 4.1.5 The presence of Made Ground derived from demolition material may be a source of elevated sulphate, associated with plaster from the previous structures. If such levels are noted then sulphate resistant concrete may be required.
- 4.1.6 The BGS notes disseminated pyrite within the London Clay Formation and as such may be a source of elevated sulphate results. If such levels are noted then sulphate resistant concrete may be required.
- 4.1.7 The resultant thickness of Made Ground and the potential for clays beneath the proposed footprint may mean that a suspended floor slab would be required.
- 4.1.8 Although the site is not indicated to lie within a flood zone 2 or 3, such zones are in close proximity, and therefore it is recommended that a site specific flood risk assessment is undertaken.
- 4.1.9 For developments within an EA Flood Zone the EA usually requires finished floor levels to be a suitable height (plus an allowance for climate change) above the highest predicted 1:100 flood event w
- 4.1.10 A geotechnical investigation is recommended to assess the significant potential for compressibility issues regarding the proposed development. An intrusive investigation will also address the potential issue with ground plasticity as outlined in Table 4.1.
- 4.1.11 A geotechnical investigation is also recommended to inform foundation design for the proposed developments.

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)
<ul style="list-style-type: none"> • Potential for Made Ground associated with previous development operations – on site (S1) • Potential asbestos containing materials within existing buildings – on site (S2) • Potential ground gas generation from nearby landfill site (S3) 	<ul style="list-style-type: none"> • 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) 	<ul style="list-style-type: none"> • 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 - secondary (A) aquifer (R6) • Surface water – pond located east of site, Hoe Stream 39m north (R7)

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
- Watching Brief there is no evidence of potential contamination but the possibility of it exists and so the site should be monitored for local and olfactory evidence of contamination.
- No action required (NA)

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

**SECTION 5
QUALITATIVE RISK ASSESSMENT**



Table 5.3: Preliminary Risk Assessment for the Site

Sources	Pathways (P)	Receptors	Consequence of Impact	Probability of Impact	Risk Estimation	Hazard Assessment	
<ul style="list-style-type: none"> Potential for Made Ground associated with previous development operations – on site (S1) Potential asbestos containing materials within existing buildings – on site (S2) Potential ground gas generation from nearby landfill site (S3) 	<ul style="list-style-type: none"> 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) 	<ul style="list-style-type: none"> 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	Low	Moderate	GI – Ground Investigation	
				Severe for Asbestos	Low		Moderate
				Severe	Low		Moderate
	<ul style="list-style-type: none"> Accumulation and migration of soil gases (P5) 						
	<ul style="list-style-type: none"> 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) 	<ul style="list-style-type: none"> Neighbouring site users (R3) Building foundations and on site buried services (water mains, electricity and sewer) (R5) Controlled waters - secondary (A) aquifer (R6) Surface water – pond located east of site, Hoe Stream 39m north (R7) 	Medium	Unlikely	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.

5.4.2 The proposed development comprises the following:

‘Redevelopment of the site, following the demolition of all existing buildings and structures, to provide a replacement stadium with ancillary facilities, including flexible retail, hospitality and community spaces, independent retail floorspace (Classes A1/A2/A3), a medical centre (Class D1) and vehicle parking, plus residential accommodation comprising of 1,048 dwellings (Class C3) within 5 buildings of varying heights of between 3 and 10 storeys (and undercroft and part basement levels) on the south and west sides of the site, together with provision of new accesses from Westfield Avenue to car parking, associated landscaping and the provision of a detached residential concierge building.’

5.4.3 A review of earliest available (1871) historical maps indicates that the site comprised undeveloped and/or agricultural land. No significant changes are noted until the plan dated 1934; development is noted on site as consisting of a sports ground, including a tennis ground towards the south, areas of worked ground are noted on this plan. Residential building development is noted within the northern part of the site in 1966. Large building developments are noted on the plan 1992 comprising a tennis centre, gymnasium and snooker hall.

5.4.4 The site vicinity on the earliest available plan comprised predominately undeveloped and/or agricultural land. A large pond is located directly east of site, an inland river is also located towards the north of site. The site vicinity shows consistent building development noted as detached residential buildings. No significant changes to the site vicinity are noted from 1966 to the most recent historical map 2014.

5.4.5 A historic landfill site is recorded 41m west of the site.

5.4.6 It is recommended that an intrusive investigation is undertaken to clarify potential risks to the identified 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.

5.4.7 It is recommended that in accordance with BS 5930 (2015) the preliminary investigation is combined with the geotechnical investigation. It is likely that such a combined investigation may comprise a series of window sampler holes and cable percussive boreholes.

5.4.8 Soil gas monitoring should be undertaken should be undertaken in accordance with CIRIA C665.

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 In the case of the site uses identified as part of the desk study research, reference to DoE industry profiles would not indicate a specific use reference, although reference has been made to the miscellaneous industries profile
- 5.5.3 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-377-5286261 August 2018

Groundsure GeoInsight Report Ref HMD-377-5286262 August 2018

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 – LOCAL AUTHORITY CORRESPONDENCE