



Dice
Environmental

Holland Park, Spalding
Phase I & II Ground Investigation
Report

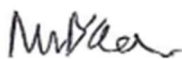
12/05/2026

102378

Ref: HOL-DEL-XX-XX-RP-GE-0001

Site	Holland Park, Spalding, Lincolnshire PE11 1GU
Client	Country Court Care Group
Date	12/05/2026
Project Reference	102378
Document Reference	HOL-DEL-XX-XX-RP-GE-0001
Revision	P01

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8th May 2026

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12th May 2026

Executive Summary	
Site Description	The site comprises a polygonal grassed open plot of land located adjacent south of Shakespeare Way and adjacent north / east off Orwell Drive, Spalding. The site is accessible via a set of locked Heras fencing panels adjacent off Shakespeare Way. There are no significant features located on the site. The site boundaries comprise wooden post and metal Heras fencing barriers along Shakespeare Way and Orwell Drive and wooden fence panels separating the site from the adjacent residential dwellings to the south of the site. Beyond the presence of minimal thin potential Made Ground, no significant visual or olfactory evidence of contamination was observed during the site walkover.
Proposed Development	The proposed development on site is to include the construction of a c70No. bed care home with associated infrastructure and soft landscaping.
Geology	The British Geological Survey (BGS) map sheet for the site area, published at 1:50,000 scale shows the Holland Park site to be covered by superficial Tidal Flat Deposits, comprising Clay and Silt. Tidal Flat Deposits generally consists of a mixture of clay, silt, sand and occasional gravel layers. Made Ground was identified within all of the exploratory hole locations across the site comprising a brown slightly clayey, silty, slightly gravelly, topsoil with gravels of brick, concrete and chalk. The Made Ground topsoil was identified to overlie a slightly sandy silt with occasional fragments of brick / concrete. Superficial geology was identified to at least 20.0mbgl comprising Tidal Flat Deposits over Glacial Till (gravelly sands over cohesive 'Boulder Clay' type soils).
Hydrogeology	The underlying superficial geology across the site (Tidal Flat Deposits) and underlying bedrock geology (Oxford Clay Formation) are both classified as an Unproductive Aquifers, identified as rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow. The site is not located within a groundwater extraction Source Protection Zone. There are no groundwater abstraction licenses recorded within 500m of the site.
Hydrology	No flowing water courses or bodies of open water are present on site. Pond present 120m south-west and an open drain is present approximately 211m west of the site.
Radon	The site is located within an area where the percentage of homes above the radon action level is below 1%. Therefore, it is considered that no radon protection measures are required for this development.
Ground Gas & Vapours	Potential underlying organic on-site soils, and potentially deep infilled ground associated with the historic railway 110m north of the site have been identified as potential sources of ground gas for the development. Ground gas monitoring has been carried out in general accordance with BS 8485:2015+A1:2019 over a 6-week monitoring period. The worst-case GSV has been identified as CS1 / Green. Therefore, it is recommended that the site be classified as CS1 / Green.

Geotechnical	Cohesive Tidal Flat Deposit soils identified across the site were found to have a low volume change potential and modest allowable bearing properties. Ancillary structures may be founded upon shallow mass concrete foundations, however, the care home structure is likely to require piled foundations with suspended floor slabs. Excavations are considered unlikely to remain dry with the groundwater table recorded as shallow as 0.91mbgl during groundwater monitoring visits. Any slight seepages and minor inflows into excavations should be dealt with by pumping from screened sumps to keep them dry, however, faster inflows of groundwater will need more significant groundwater controls, especially after sustained periods of inclement weather. Any excavated surfaces should be protected from deterioration since the soils revealed by the boreholes are prone to rapid deterioration in the presence of water. CBR values of <2.0% have been obtained for the likely formation materials to hardstanding and highways.
Risk to Controlled Waters	No significant levels of contaminants of concern were identified, with respect to controlled waters and previous site uses identified do not indicate the likely presence of gross contamination. Therefore, the risk posed to controlled waters is considered to be negligible.
Human Health Risk Assessment & Remedial Measures	Based on published LQM/CIEH S4UIs & DEFRA's C4SLs, no exceedances have been identified with respect to a residential public open space end use and the localised presence of amosite asbestos at <0.001% quantification has been identified as posing a low risk to human health. Therefore, no remediation is deemed necessary for the proposed residential care home proposed on the Holland Park site.

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Appendix C – Historical Maps (Groundsure)

Appendix D – Aerial Photograph Timeline

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Appendix F – Laboratory Results

Appendix G – GACs

Appendix H – Ground Gas Monitoring Results

Appendix I – Falling Head Results

1. Introduction

1.1. Client Brief

Dice Environmental Limited (DEL) was instructed by the Client, Country Court Care Group, to undertake a Phase I & II Ground Investigation Report for the site known as Holland Park, Spalding, Lincolnshire, PE11 1GU.

The proposed development on site is to include the construction of a c70No. bed care home with associated infrastructure and soft landscaping.

The site location plan is included within Appendix A to this combined Phase I and II Ground Investigation Report (GIR).

1.2. Report Objectives

This Phase I & II Ground Investigation includes:

- A record, including written and photographic evidence, of a site inspection walkover, subsequent site description, and appraisal of any observed land contamination, or potential contaminative sources.
- A review of historical maps, including aerial imagery, for the site and surrounding area, with respect to potential sources of contamination.
- A review of the general expected environmental setting, including geology, hydrogeology and hydrology, alongside BGS Borehole Archive records.
- The development of a preliminary conceptual site model based on the concept of 'contaminant linkage', which considers potential contamination sources, pathways and receptors.
- The provision and execution of a Phase II Contamination Assessment strategy, to investigate the potential sources of contamination identified.
- The sampling of soils with chemical and geotechnical analysis to make recommendations and conclusions on geotechnical and geoenvironmental matters associated with the proposed development of the site.
- The development of a Phase II Conceptual Model.
- Conclusions and recommendations to facilitate responsible development of the site, in relation to the intended end use.
- An Executive Summary.

1.3. References

Assessment guidance and site-specific information has been sought from the following locations:

- EA/DEFRA (2020) LCRM: Land contamination Risk Management (Supersedes (2004), CLR11: Model Procedures for the Assessment of Land Contamination).
- BS 5930:2015+A1:2020: Code of practice for ground investigations.
- BS 8004:2015: Code of practice for Foundations
- Nathanail, C.P., McCaffrey, C., Gillett, A.G., Ogden, R.C. and Nathanail, J.F. 2015. The LQM/CIEH S4UIs for Human Health Risk Assessment. Land Quality Press, Nottingham.
- DEFRA (2014). Category 4 Screening Levels (C4SL) – SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination.
- CIRIA. (2001). *Contaminated land risk assessment A guide to good practice*.
- DoE (1995), Industry profiles.
- Environment Agency. (2008). *R&D Publication 66. Guidance for the Safe Development of Housing on Land Affected by Contamination*.
- Environment Agency. (March 2017). *New Groundwater Vulnerability Mapping Methodology in England and Wales. Reference SC040016/R. Environment Agency*.
- BS 8485:2015+A1:2019 Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings.
- BRE (2004), BR465: Cover systems for land regeneration.
- CIRIA (2014), C733 Asbestos in soil and made ground: a guide to understanding and managing risks.
- Scivyer, C. (2015). *BRE 211. Radon: Guidance on protective measures for new buildings (including supplementary advice for extensions, conversions and refurbishment projects). Fifth Edition*.
- The Coal Authority. (2018). *Coal Authority Interactive Viewer. Retrieved from <http://mapapps2.bgs.ac.uk/coalauthority/home.html>*

1.4. Limitations

The recommendations and opinions expressed in this report are based on information obtained as part of the desk study or provided by others. Information provided from other sources is taken in good faith and Dice Environmental cannot guarantee its accuracy. By the very nature of a ground investigation, information gained through intrusive investigation is from specific point locations. ground conditions have the potential to vary significant across any site, and the ultimate decision with regards to foundation design or other technical specifications lies with the developer and/or structural engineer. Reliance upon the contents of this report is subject to receipt of payment for any outstanding balance owed to Dice Consulting Engineers Ltd. or Dice Environmental Ltd. dated prior to, and in associated with this report.

This report does not include specific investigation for the presence of either Potential Asbestos Containing Material (PACM) (unless identified within soils) or Japanese Knotweed at the subject site however, if obvious evidence of either is observed during the site walkover, details will be provided in this report. Specialist contractors should be commissioned to make detailed assessments and recommendations if these materials are suspected.

The information contained in this report is intended for the use of Country Court Care Group and Dice Environmental can take no responsibility for the use of this information by any third party or for uses other than that described in this report or detailed within the terms of our engagement.

2. Site Information

2.1. Site Location

The Holland Park site of the proposed care home is located on the southern side of Shakespeare Way along the south-western outskirts of Spalding in Lincolnshire, approximately 1.8km south-west of the town centre. The National Grid Reference (NGR) for the approximate centre of the site is TF 233 213 with the coordinates 523359, 321391.

A site plan is presented within Appendix A.

2.2. Site Description

On the 4th March 2026, a comprehensive site walkover took place undertaken by a suitably experienced DEL Geotechnical Engineer, with a photographic record available in Appendix A.

The site comprises a polygonal grassed open plot of land located adjacent south of Shakespeare Way and adjacent north / west of Orwell Drive in Spalding. The site is accessible via a set of locked Heras type temporary steel fencing panels adjacent to Shakespeare Way. There are no significant features located on the site, with it comprising widespread grass cover. The route of existing buried services is evident within the western part of the site with a series of inspection chamber and utilities covers present at near ground level.

The site boundaries comprise wooden post and metal Heras type temporary fencing barriers along Shakespeare Way, Orwell Drive and the public footpath to the west, between Shakespeare Way and Orwell Drive, and wooden fence panels separating the site from the adjacent residential properties to the south of the site.

Whilst the site did not contain any significant deep rooting vegetation, several trees were noted within parking areas to the north and east, adjacent to the site. These trees were tentatively identified as Cherry and ranged in height from approximately 4m to 6m.

Beyond the presence of minimal thin potential Made Ground, no significant visual or olfactory evidence of contamination was observed during the site walkover.

2.3. General Area Context

North: To the north of the site there are predominantly residential properties with associated gardens, parking facilities and POS.

East: To the east of the site there are predominantly residential properties with associated gardens, parking facilities and POS.

South: To the south of the site there are predominantly residential properties with associated gardens, parking facilities and POS, and undeveloped fields beyond.

West: To the west of the site there are residential properties with associated gardens, parking facilities and POS, and undeveloped fields to the south-west and south-east.

3. Geo-Environmental Setting

3.1. Geology

3.1.1 Mapping Data

The British Geological Survey (BGS) map sheet for the site area, published at 1:50,000 scale shows the Holland Park site to be covered by superficial Tidal Flat Deposits, comprising Clay and Silt. Tidal Flat Deposits generally consists of a mixture of clay, silt, sand and occasional gravel layers with the potential for peat.

The solid geology strata beneath the site is shown as the Oxford Clay Formation, comprising Mudstone, which weathers near surface to a fissured green/grey clay. The Oxford Clay within this part of the country has a significant thickness (>30m) and contains occasional concretionary limestone layers and nodules, known locally as 'Doggers'.

No significant geological structures or observations are presented within the BGS records for the site area.

The BGS Records do not indicate the known presence of worked or Made Ground on site or within close proximity of the site boundaries. Some Made Ground could be expected on site, close to the site boundaries given the adjacent residential developments and nearby highway infrastructure.

3.1.2 BGS Borehole Archive

The BGS hold historical exploratory hole records that were drilled/excavated in the past for various purposes, within an online database that is open for inspection and has the function to download relevant boreholes, probes, machine excavated trial pits and well records.

Upon inspection of the BGS database, there are 19 No. BGS boreholes recorded within 250m of the site.

The records closest to the site are present 11m west and 37m north-west, both associated with the recent residential development proximal to the site. The records comprising trial pits generally describe an initial layer of topsoil to 0.40mbgl, underlain by a layer of 'sandy silt' to a maximum of 0.90mbgl, 'sandy silt' to a maximum of 1.30mbgl and 'sandy silt/ silty sand' to 2.00mbgl.

The solid geology of the Oxford Clay was not met within 15m of ground level within any of the relatively nearby BGS boreholes.

Groundwater and 'running sand' conditions were met at around 1.8m to 20mbgl within the deeper BGS machine excavated trial pits

3.1.3. Soil Chemistry

The indicative background concentration values (estimated) for the natural topsoil on site are recorded within the Groundsure Reports (Appendix B) and reproduced in Table 1.

Element	Arsenic	Bioaccessible Arsenic	Lead	Bioaccessible Lead	Cadmium	Chromium	Nickel
Concentration (mg/kg)	15	N/A	100	60	1.8	60 – 90	15 – 30

Table 1: Background natural soil chemistry values

3.2. Hydrogeology

The underlying superficial geology across the site (Tidal Flat Deposits) and underlying bedrock geology (Oxford Clay Formation) are both classified as an Unproductive Aquifers, identified as rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

The site is not located within a groundwater extraction Source Protection Zone.

There are no groundwater abstraction licenses recorded within 500m of the site.

3.3. Hydrology

No flowing water courses or bodies of open water are present on site. An open attenuation pond constructed for the nearby residential developments is present approximately 120m south-west of the site.

An open watercourse comprising a typical fen ditch is present approximately 211m west of the site, which discharges into Hill's Drain to the southwest.

3.4. Ecology

There are no Sites of Special Scientific Interest (SSSIs), Conserved wetland sites (Ramsar Sites), Special Protection Areas (SPAs), Special Areas of Conservation (SACs), Local Nature Reserves (LNRs) or National Nature Reserves (NNRs) recorded within 500m of the site.

The site is located within the Vernatt's Drain surface water Nitrate Vulnerable Zone (NVZ), identified as an area at risk from agricultural nitrate pollution designated under the EC Nitrate Directive (91/676/EEC).

3.5. Radon

The Groundsure reports included within Appendix B shows that the site is located within an area where the percentage of homes above the radon action level is below 1%.

Therefore, it is considered that no radon protection measures are required for this development.

3.6 Heritage & Archaeological Sites

No Areas of Outstanding Natural Beauty, Listed Buildings, Conservation Areas, World Heritage Sites or Scheduled Ancient monuments are present within 500m of the site.

3.7. Historical Coal & Non-Coal Mining

The site is not located within a coal mining reporting as defined by the Coal Authority.

No non-coal mining has been recorded on or proximal to the site.

3.8. Landfills & Waste Sites

The Groundsure reports included within Appendix B show that:

- There are no active landfills recorded within 500m of the site.
- There are no historical landfills recorded within 500m of the site.

3.9. Industrial Land Use

3.9.1. Current Industrial Land Use

The Groundsure reports included within Appendix B show that:

- No waste treatment works are recorded within 250m of the site.
- No petrol stations are recorded within 250m of the site.

The site is currently occupied by an undeveloped field surrounded by residential land use.

The only industrial land use recorded within 250m of the site in the present day are electricity substation 15m north-east and 51m north-east, and a sewage pumping station 68m north-east.

3.9.2. Historic Industrial Land Use

The Groundsure reports included within Appendix B show that:

- No historic petrol stations are recorded within 250m of the site.

Historically, the site was occupied by nurseries between 1932 and 1992.

Historic proximal industrial land use included unspecified tanks from 126m north-west, windmills from 270m south-east and railway-associated land use from 290m south-east (railway buildings and sidings).

4. Site History

4.1. Historical Map Review

A review of all relevant mapping resources, including aerial images and Groundsure Mapping, has been undertaken below, identifying all the significant changes between 1887 and 2025. Groundsure mapping provides data between 1887 and 2025. Supplementary aerial images between 1999 and 2024 have been obtained from Google Earth Pro.

Map Date	Significant Changes on Site	Significant Changes in the Surrounding Area
1887-89	The site comprises an undeveloped field.	Marshland is present from approximately 100m north of the site. A railway is recorded approximately 110m north, and another 250m south-east. A corn windmill is present approximately 260m south.
1904	No significant change.	A nursery is recorded approximately 90m east.
1929-32	The site potentially comprises land occupied by the nurseries.	A Sewage Pumping Station is recorded 520m east.
1968	No significant change.	The railway 110m north has been dismantled. Nursery structures are present from 100m south and 120m north. The sewage pumping station is no longer recorded.
1977	No significant change.	A tank associated with the nurseries is present 120m north.
1992	The site is identified as Spalding Common.	No significant change.
2010	The site is an unspecified plot of land.	Residential development has occurred adjacent north-west of the site.
2016	Disturbed ground is present on the site, associated with the surrounding residential development.	Residential development is occurring in the land surrounding the site.
2025-26	No significant change.	Further residential development.

Table 2: Summary of site targeted historical map data.

A copy of the historical maps and aerial images used for this review are included within Appendix C and Appendix D.

Mapping data available demonstrates the site was occupied by undeveloped fields by 1887, and comprises land associated with nurseries by 1929. By 1992, the site was an undeveloped

field identified as Spalding Common. The site has remained empty since temporary disturbed ground was recorded on site in 2016.

Significant changes to the surrounding area include the development of a railway approximately 110m north and 250m south-east of the site by 1887, later dismantled by 1968. Nurseries were also identified surrounding the site by 1904; these were later replaced with growing residential development from 2010.

5. Conceptual Site Model

5.1. Potential Sources

Significant potential on-site sources of contamination which have been identified for the site include:

- Potential for Made Ground across the site associated with periphery development and associated on-site disturbed ground, and potential historic use of the site as nurseries. The potential contaminants of concern associated with this potential source include:
 - o Heavy Metals, Polyaromatic Hydrocarbon (PAHs), Pesticides & Herbicides, asbestos containing materials (ACMs) and fibres.
- Potential presence of underlying organic deposits (e.g., organic clay or peat) beneath the site. The potential contaminants of concern associated with this potential source include:
 - o Ground Gas (CH₄ & CO₂).

Significant potential off-site sources of contamination which have been identified for the site include:

- Migratory dusts and spillages associated with proximal historic land use including the previous railway 110m north of the site, historic nurseries surrounding the site and recent construction of residential developments surrounding the site, including an electricity substation 15m north of the site. The potential contaminants of concern associated with this potential source include:
 - o Heavy Metals, Polyaromatic Hydrocarbon (PAHs), Total Petroleum Hydrocarbons (TPHs), Pesticides & Herbicides, Polychlorinated Biphenyls (PCBs), asbestos containing materials (ACMs) and fibres.
- Potentially deep infilled ground associated with the historic railway 110m north of the site. The potential contaminants of concern associated with this potential source include:
 - o Ground Gas (CH₄ & CO₂).

5.2. Potential Pathways

Pathways to human receptors:

- Direct dermal contact or ingestion of soils, or inhalation of dust/fibres and/or vapours (i.e. human interaction with surface and subsurface materials).
- The migration and accumulation of ground gases through permeable sub-surface materials and/ or preferential pathways.

Pathways to environmental receptors:

- Lateral and vertical migration of groundwater through permeable sub-surface materials and/ or preferential pathways, alongside overland flow.
- Root uptake of plant life and subsequent ingestion by fauna.

- Direct dermal contact or ingestion of soils by fauna.

5.3. Potential Receptors

The potential receptors for the site include:

- Humans: site workers during the redevelopment of the site, intended end users of the site (residents & employees) and neighbours.
- Groundwater: The superficial and bedrock Unproductive Aquifers.
- Surface Water: The pond around 120m south-west and small open ditch water course approximately 211m west of the site.
- Ecology: flora and fauna associated with the end use of the site.

5.4. Classification of Consequence, Probability and Risk

Classification of Consequence of Risk

Category	Definition
Severe	Short-term (acute) risk to human health likely to result in 'significant harm' as defined within Part 2A of the Environment Protection Act (1990). Short-term risk of pollution of a sensitive water resource. Catastrophic damage to buildings or property. A short-term risk to a particular ecosystem, or organism forming part of such ecosystem.
Medium	Chronic damage to human health (significant harm). Pollution of sensitive water resources. A significant change in a particular ecosystem, or organism forming part of such ecosystem.
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures, services or the environment. Non-permanent health effects to human health.
Minor	Harm, although not necessarily significant harm, which may result in a financial loss, or expenditure to resolve. Easily repairable effects of damage to buildings, structures and services.

Table 3: Consequence of risk

Classification of Probability of Risk

Category	Definition
High Likelihood	There is a contaminant linkage and an event, which would either appear likely in the short term and almost inevitable over the long term, or, there is evidence at the receptor of harm or pollution.
Likely	There is a contaminant linkage, and all the elements are present and in the right place, which means that it is probable than an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low Likelihood	There is a contaminant linkage, and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place and is less likely in the shorter term.
Unlikely	There is a contaminant linkage, but circumstances are such that it is improbable that an event would occur even in the very long term.

Table 4: Probability of risk

Risk as a Function of Consequence and Probability

		Consequence			
		Severe	Medium	Mild	Minor
Risk	High	Very High Risk	High Risk	Moderate Risk	Low to Moderate Risk
	Likely	High Risk	Moderate Risk	Low to Moderate Risk	Low Risk
	Low	Moderate Risk	Low to Moderate Risk	Low Risk	Very Low Risk
	Unlikely	Low to Moderate Risk	Low Risk	Very Low Risk	Very Low Risk

Table 5: Risk as a function of consequence and probability

6. Phase I Conceptual Site Model

Sources	Potential Contaminants of Concern	Pathway	Receptor	Probability	Consequence	Overall Risk
On – Site Sources						
Potential for Made Ground across the site associated with periphery development and associated on-site disturbed ground, and potential historic use of the site as nurseries.	Heavy Metals, Polyaromatic Hydrocarbon (PAHs), Total Petroleum Hydrocarbons (TPHs), Pesticides & Herbicides, asbestos containing materials (ACMs) and fibres.	Direct dermal contact or ingestion of soils, or inhalation of dust/fibres and/or vapours (i.e. human interaction with surface and subsurface materials).	Site workers during the redevelopment of the site	Likely	Mild	Low to Moderate
			Intended end users of the site (care home residents & employees)	Likely	Mild	Low to Moderate
			Neighbours	Low	Mild	Low
		Lateral and vertical migration of groundwater, alongside overland flow.	The Unproductive Aquifer within the underlying superficial strata	Low	Mild	Low
			The Unproductive Aquifers within the underlying bedrock strata	Unlikely	Mild	Very Low
			The pond 120m south-west and open ditch approximately 211m west of the site	Unlikely	Medium	Low
		Root uptake of plant life and subsequent ingestion by fauna. Direct dermal contact or ingestion of soils.	Flora and fauna associated with the end use of the site	Unlikely	Mild	Very Low

Potential presence of underlying organic deposits (e.g., organic clay or peat) beneath the site.	Ground Gas (CO ₂ & CH ₄)	The migration and accumulation of ground gas through permeable sub-surface materials and/ or preferential pathways.	Site workers during the redevelopment of the site	Low	Medium	Low to Moderate
			Intended end users of the site (care home residents and employees)	Likely	Medium	Moderate
			Neighbours	Low	Medium	Low to Moderate
Off – Site Sources						
Migratory dusts and spillages associated with proximal historic land use including the previous railway 110m north of the site, historic nurseries surrounding the site and recent construction of residential developments surrounding the site, including an electricity substation 15m north of the site.	Heavy Metals, Polyaromatic Hydrocarbon (PAHs), Total Petroleum Hydrocarbons (TPHs), Pesticides & Herbicides, Polychlorinated Biphenyls (PCBs), asbestos containing materials (ACMs) and fibres.	Direct dermal contact or ingestion of soils, or inhalation of dust/fibres and/or vapours (i.e. human interaction with surface and subsurface materials).	Site workers during the redevelopment of the site.	Low	Medium	Low to Moderate
			Intended end users of the site (care home residents & employees).	Low	Medium	Low to Moderate
		Lateral and vertical migration of groundwater, alongside overland flow.	The Unproductive Aquifer within the underlying superficial strata.	Low	Mild	Low
			The Unproductive Aquifers within the underlying bedrock strata.	Unlikely	Mild	Very Low
		Root uptake of plant life and subsequent ingestion by fauna. Direct dermal contact or ingestion of soils.	Flora and fauna associated with the end use of the site.	Unlikely	Mild	Very Low
Potentially deep infilled ground associated with the historic railway 110m north of the site.	Ground Gas (CO ₂ & CH ₄)	The migration and accumulation of ground gas through permeable sub-surface materials and/ or preferential pathways.	Site workers during the redevelopment of the site.	Low	Medium	Low to Moderate
			Intended end users of the site (care home residents and employees).	Low	Medium	Low to Moderate

Table 6: Phase 1 CSM

7. Uncertainties and Limitations

A comprehensive evaluation of potential on-site contamination has been conducted through analysis of historical maps, environmental data, available council records, and a site walkover inspection.

The Phase 1 investigation has identified several issues necessitating further intrusive investigation and assessment (Phase II Investigation) to inform the proposed development's design:

1. On-site Made Ground: The risk to human health (groundworkers, end users) from potential on-site Made Ground and proximal potential sources of contamination has been determined as 'Low to Moderate'. The presence, extent, and depth of Made Ground should be determined, along with any potential contaminants resulting from identified potential sources. The status of natural underlying soils should also be investigated to assess the extent of potential contamination.
2. Ground Gas: The desk study has identified a 'Low to Moderate' risk to human health due to potential migration and accumulation of ground gas from potential on-site organic strata and potential off-site sources. Further investigation is required to confirm or rule out the presence and quantities of potentially hazardous ground gases.

8. Phase II Investigation

8.1. Overview of Works

The Phase II intrusive investigation was undertaken between the 4th and 6th March 2026 under the supervision of a suitably qualified Geotechnical/Geo-Environmental engineer and in general accordance with the Code of Practice for Site Investigations BS 5930:2015+A1:2020.

The Phase II investigation incorporated the following:

- The advancement of 2No. sonic rig boreholes to a maximum depth of 20mbgl, within both of which gas and groundwater monitoring wells were installed for subsequent monitoring.
- The advancement of 6No. machine excavated trial pits to a maximum depth of 2.60mbgl.

In all exploratory locations, holes were advanced through any Made Ground/ploughed topsoil into underlying natural soils, soils were logged, and any visual or olfactory evidence of contamination was noted.

- The analysis of 19No. soil samples at a MCERTS accredited laboratory for general and site-specific chemical determinands. This included:
 - 6No. soil samples being analysed for a standard 'CLEA' screening suite of heavy metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Se, V, Zn), PAHs (USEPA 16 & Total) and asbestos.
 - 13No. soil samples analysed for a BRE DS1 suite.
 - 2No. soil samples tested for TPH Ali/Aro split.
- The analysis of 2No. groundwater samples collected from installed monitoring wells for Soluble Sulphate and pH value.
- The analysis of 12No. soils samples at a UKAS accredited laboratory for Geotechnical properties. This included:
 - o 9No. samples analysed for plasticity index and moisture content.
 - o 3No. samples analysed for particle size distribution.
 - o 2No. samples undergoing recompacted California Bearing Ratio testing.
 - o 2No. samples underground quick undrained triaxial tests.

Soil logs are contained in Appendix E.

Boreholes and sample locations are contained within Appendix A.

9. Ground Conditions

9.1. Made Ground

Made Ground was identified within all of the exploratory hole locations across the site.

Made Ground was predominantly identified as a brown slightly clayey, silty, slightly gravelly topsoil with gravels of brick, concrete and chalk. The Made Ground topsoil was identified to overlie a Made Ground subsoil of brown slightly sandy silt with occasional fragments of brick and concrete.

9.2. Superficial Strata – Tidal Flat Deposits

The BGS reported superficial geology of Tidal Flat Deposits were identified to a maximum recorded depth of 12.5mbgl. These deposits were identified as a greyish brown / brownish grey sandy silt with occasional peaty organic seams to depth between 5.50mbgl (BH02) and 6.50mbgl (BH01). This was followed by a brownish grey silty fine to medium sand to depths of 10.0mbgl (BH02) and 12.5mbgl (BH01).

9.3. Superficial Strata – Glacial Till

A Glacial Till was met beneath the Tidal Flat Deposits at between 10.0m and 12.5m depth and extended down to at least the borehole completion depths of 20.0mbgl. The Glacial Till initially consisted of a greyish brown slightly silty very gravelly sand to between 14.8mbgl (BH02) and 14.9mbgl (BH01). The gravel fraction of these deposits comprised fine to medium, angular to sub-angular chalk and flint.

From around 14.8mbgl to at least 20.0mbgl, the Glacial Till became a 'Boulder Clay' comprising a very stiff, grey / dark grey slightly gravelly clay with low cobble content of sub-angular flint. The gravel fraction of these deposits comprised fine to coarse, angular to sub-angular chalk and flint.

9.3. Solid Strata – Oxford Clay Formation

The BGS reported solid geology of the Oxford Clay Formation was not encountered during this site investigation within 20m of ground level.

9.4. Groundwater

The groundwater strike was encountered at 3mbgl during the excavation of both boreholes. Slight groundwater ingress was observed within the bases of some trial pits between 2.40m and 2.60mbgl.

Follow up groundwater monitoring in installed boreholes WS01 and WS02 identified groundwater levels between 0.91mbgl and 2.37mbgl.

9.5. Field Observations

Beyond the presence of Made Ground (predominantly comprising reworked natural ground with anthropogenic brick and concrete fragments), no significant visual or olfactory evidence of contamination was noted within soils across the site.

10. Engineering Considerations

10.1. In-Situ Geotechnical Characteristic Testing

Beneath the Made Ground topsoil and reworked silts, the site was predominantly underlain by cohesive slightly sandy, silt deposits overlying silty sands, believed to be the Tidal Flat Deposits identified on geological mapping. These deposits were identified overlying superficial Glacial Till with the underlying solid geology of the Oxford Clay Formation unproven within 20m of ground surface.

Hand Shear Vane Testing (HSV) was undertaken within these shallow superficial silts; however, no solid recovery was achievable from the excavations to provide suitable surfaces to perform HSV testing.

Standard Penetration Testing (SPT) was undertaken within natural soils in accordance with BS 5930:2015+A1:2020 with SPT 'N' values determined and presented on the borehole records. SPT testing undertaken between 1.0mbgl and 6.5m / 5.5mbgl (between BH01 and BH02) within the silts determined SPT 'N' values between 1 and 5 (loose). SPT testing undertaken with the deeper granular silty gravelly sands (6.5m - 14.9mbgl) determined SPT 'N' values between 5 – 22, indicating primarily medium dense granular deposits. SPT 'N' values within the cohesive Glacial Till (Boulder Clay) >15mbgl were 37 – 46, indicating very stiff clays.

10.2. Geotechnical Laboratory Testing

Atterberg Limits testing was instructed within cohesive soils, and Particle Size Distribution (PSD) testing was instructed within the granular strata. Results are presented within Appendix F of this report.

Cohesive soils were identified across the site, with samples taken from between 0.55mbgl and 2.00mbgl within the on-site Made Ground and superficial clays / silts were found to have a modified Plasticity Index (mPI) range, determined in accordance with National House Building Council, Chapter 4.2 'building near trees' of between 4.3% and 17%. According to NHBC guidance, the Plasticity Index range for the natural soils across the site indicate a non-shrinkable to low volume change potential with variation in moisture content. Plasticity Index Testing undertaken within the cohesive Glacial Till in BH02 at 16.0m – 16.5mbgl, determined that that Modified Plasticity Index is 19.2% indicating a higher bound low volume change potential with variation in moisture content.

Soil samples from BH01 at 13.5 – 14.0mbgl, TP03 at 0.55mbgl, TP05 at 0.65mbgl and 1.3mbgl, were instructed for particle size distribution testing, with results outlined below:

Particle Size Distribution Testing				
Sample Reference	Sample Depth (m)	Fines (%)	Sands (%)	Gravels (%)
BH01 B22	13.5 - 14	13	53	34
TP03 B1	0.55	37	25	38
TP05 B1	0.65	64	28	8
TP05 D1	1.3	62	38	0

Table 7: PSD Testing

10.3. Proposals

The proposed development on site is to include the construction of a c70No. bed care home with associated infrastructure, parking and soft landscaping POS.

At the time of report preparation, no imposed structural loads have been provided by the Designer, however, given proposals low to moderate imposed loads are anticipated.

10.4. Shallow Mass Concrete Foundations and Structures

Considering the low SPT 'N' Values recorded within the on-site shallow superficial silts, it is considered most likely that any proposed foundations are to be constructed using concrete caps/beams on deep piles bearing into the underlying Glacial Till.

The natural Tidal Flat Deposits beneath the on-site Made Ground and reworked topsoil, recorded from 0.6m to 0.9mbgl, were found to generally comprise a brownish grey or orange/grey sandy silt with occasional regions of grey clayey silt with peaty bands.

BH01 and BH02 identified these sandy silt deposits to 6.5m / 5.5mbgl; overlying a brownish grey silty fine to medium sand to 12.50m / 10.0mbgl followed by a brownish grey gravelly sand (Glacial Till) found to be overlying the cohesive and competent Glacial Till at between 14.8m to 14.9mbgl. The 6No. trial pits were terminated within the superficial sandy silt deposits with the aforementioned clayey silt with peaty regions being mentioned in pits TP03 to TP06 (located in the central and eastern regions of the site typically at depths from 1.4m – 1.6mbgl, but between 1.6m and 2.0mbgl in TP04. These superficial sandy silts have been identified as having a low volume change potential.

For any proposed foundations to ancillary structures, when considering present the low volume change potential cohesive strata, NHBC guidance would recommend a minimum foundation depth of at least 0.75mbgl, in the absence of any deep rooting vegetation. Foundations should also be deepened in regions of thicker Made Ground so that foundations are bearing into the underlying natural superficial strata and also be taken through any peat/organic soils. This is in order to be below the zone of seasonal volume change in accordance the NHBC standards. Trees and shrubs can extend the depth affected by seasonal moisture variation, and advice on this is given in the NHBC document. The NHBC document provides guidance for the deepening of new foundations within the range of influence of existing and proposed (landscaping and POS) deep rooting vegetation, which should be taken into account during detailed design in areas of cohesive soils.

Where foundations require deepening due to variable ground conditions or the influence of trees, the design of increased foundations including steps and heave protection measures should be in accordance with NHBC recommendations.

Any proposed planting of trees, shrubs and screening hedgerows should also take into account the presence of existing dwellings adjacent to the site and not have a potential detrimental effect upon their foundations as the deep rooting vegetation matures and root network develops.

Based on the material observations and in-situ testing for the shallow cohesive strata present on site, the soils would possess an allowable bearing pressure in the order of 50kPa (or 50kN/m², whichever unit is preferred as they are mutually acceptable), based on a strip/trench-fill foundation of 0.60m width at a depth of 0.75m bgl or greater.

This maximum allowable bearing pressure is stated with a factor of safety of 3.0 applied against shear failure for cohesive soils. Where structural foundations span across varying soil types (from clay to sand and gravel or rock for example), then there is the potential for differential rates and amounts of total and consolidation settlement to occur beneath them. Where varying founding strata are present beneath structures, the foundations should be suitably reinforced and where necessary, the structure designed to incorporate the potential for differential settlement of foundations (for example movement joints).

It is unlikely that the modest allowable bearing capacity offered by shallow soils of 50kPa is adequate for the main car home foundations and that a deeper piled foundation solution will be required.

10.5. Piled Foundations

Where the depth of Made Ground or 'poor' / organic ground is too deep for traditional mass concrete strip/trench fill foundations to be used or the allowable bearing pressure available is inadequate, a piled foundation solution would be preferred for the construction of the proposed care home structure on site.

The ground conditions are considered suitable for driven pre-cast concrete piles, cased bored or Contiguous Flight Auger (CFA) cased piles, although a specialist should be consulted with regards to the presence of the adjacent structures, buried utilities and impact from shallow groundwater. Whilst no obstructions have been identified in the ground the presence of Made Ground implies that buried obstructions could be present and the competent cohesive Glacial Till 'Boulder Clay' at depth may also contain large flint boulder inclusions that could impact upon pile installation.

Precautions against future clay soil movement/volume change, such as sleeving and/or steel reinforcement may be required given the predominantly cohesive nature of the soils across the site with a with a low volume change potential. Again, the advice of a specialist piling contractor should be sought prior to design, particularly with respect to potential ground movement mitigation measures.

For the purposes of preliminary pile design, the pile bearing coefficients given in Table 8 are based on the following assumptions and may be used to assess working loads for a single bored pile. The pile bearing coefficients are based on the in-situ and laboratory determined tests, site observations and analyses for the ground profile information obtained from BH01.

- The upper 1.0m of ground is ignored as this will likely be replaced by the pile caps/beams and structure.
- The ultimate load on a pile would be the sum of the shaft adhesion/friction together with the end bearing load, ignoring any contribution from Made Ground accounting for potential negative skin friction/surcharging of the near surface materials.

- The shaft adhesion/friction would be a function of the overburden and groundwater level in the soils in which the pile is embedded (limited to 100kN/m²).
- The end bearing load would be a function of average shear strength at the level of the pile base.
- A Factor of Safety (FoS) of at least 2.5 would be used to assess the working load, which could be reduced to 2.0 with appropriate pile integrity and performance testing.
- Groundwater level taken as 1.5mbgl.
- General slenderness ratio for piles of 1:80 is passed assuming maximum 17m lengths, resulting in minimum 213mm dia. pile requirement. This doesn't take into account any reinforcing steel contribution.

Pile Element and Stratum	Ultimate Pile Bearing Value (kN/m ²)
Shaft adhesion/friction in Made Ground	Nil
Pile average shaft resistance in Tidal Flat Deposits – 1.0m-6.5mbgl	10
Pile average shaft resistance in Tidal Flat Deposits – 6.5m-9.0mbgl	15
Pile average shaft resistance in Tidal Flat Deposits – 9.0m-12.5mbgl	25
Pile average shaft resistance in granular Glacial Till – 12.5m-14.9mbgl	35
Pile average shaft resistance in cohesive Glacial Till – 14.9m-19.0mbgl	100
End bearing in granular Glacial Till – 13.0m-14.5m bgl	2000 (limited)
End bearing in cohesive Glacial Till – 15.5m-19.0m bgl	1800

Table 8: Pile Bearing Coefficients

It is likely that a specialist piling designer and installer will derive their own pile bearing coefficients based upon the information contained within this GIR and the previous GIRs by others, and prepare their own design calculations using their preferred systems. However, for preliminary assessment and costing purposes, the potential pile working loads for varying diameters and installation depths on site can be determined assuming a ground profile, in this case that given above for borehole BH01. The estimated pile working loads given in Table 9 are for individual bored piles under vertical loading with no pile grouping effect taken into account.

Estimated Pile Working Loads (kN)		Diameter (mm)		
		300	450	600
Length (m): at current ground level	13.0	130	240	370
	15.5	175	300	445
	17.0	230	385	560

Table 9: Estimated Pile Working Loads Matrix – Borehole BH01 – Bored Pile

Based on the above preliminary estimated pile working loads for individual bored piles in areas of the site near borehole BH01, the potential loads imposed by the care home structure could be carried by a piled foundation arrangement with multiple piles spaced along structural beams. Differing ground profiles could result in shorter or longer piles being required to carry imposed loads or piles with smaller/larger diameters may be required.

The final pile design and specification for any proposed piling works should be undertaken by a suitably experienced and qualified piling engineer and they may require specific borehole data for the location of proposed piling, should the layout change, or incorporate live analysis during installation to ensure long term performance of the piled foundations.

All calculations are based on single bored piles and these values may need to be revisited once the final layout of pile caps and piles is confirmed and the pile diameters are selected for each location, where piles are in close proximity to each other. Typically, where piles are installed within 3x diameter of each other, pile grouping effect occurs, where the sum of all piles beneath a single pile cap is less than the sum of the individual pile capacities. This is due to the zones of stress induced in the group by each pile overlapping and the ultimate load of the group becoming reduced. The plug of soil stressed by a pile group acts as a single unit and essentially becomes a large column and pad foundation formed at depth. The negative effect of pile grouping has a greater influence on friction piles than on end bearing piles, so the final selection of pile type, size and installation depth can be impacted by what base of the piles are installed within and what proportion of the pile working load is provided by the end bearing element.

Similar working loads are likely to be available for pre-cast concrete sections driven piles, where, cross sectional area and external contact distance with the ground is of a similar scale to those of the circular bored piles presented within Table 9.

10.6. Floor Slabs

The floor slab for the care home structure proposed on site should not be ground bearing where there is the use of deepened foundations (>1.5m bgl mass concrete [HNBC Standards Chapter 4.2] or piled foundations). This outcome is considered likely given the findings of this investigation and proposals. Where the foundations are deepened or piled, floor slabs should be well constructed with minimal penetrations, suspended upon the foundations and constructed with an appropriate ventilated sub-floor gap, taking into account a low-volume change potential soil, where the shallow clay soils are present. This is in order to avoid potentially damaging movement between the two.

Where traditional strip/trench-fill or pad and beam foundations are to be used within the new structure founded at shallow depths (<1.5m bgl) and in the absence of thickened Made Ground/disturbed ground, softened/organic ground and deep rooting vegetation/root influence, the use of ground bearing floor slabs could be considered. The proposed formation layer for any ground bearing floor slabs, should be rigorously inspected to ensure that it meets the above criteria and those assumptions made in structural design. Proof rolling of the formation is recommended and any soft/loose areas identified, over-excavated and replaced with a suitable well compacted coarse granular fill or lean mix concrete. Any rafted foundations would also create the floor slab and would be treated as ground bearing.

Ground gas protection measures due to landfill type gases (CO₂ and CH₄) are not considered necessary for the proposed care home on site (as detailed in Section 11.3 of this report) due to the low GSV/ (Characteristic Situation) CS determined from monitoring. In any case, the floor slab described above could satisfy those protection requirements needed for a CS-2 site (low risk from ground gas).

The site is located within a part of the UK where radon gas protection measures are not required within new structures, as detailed within Section 3.5 of this report.

10.7. Excavations and Groundwater

All trial pits with the exception of TP05 recorded a slight groundwater ingress at approximately 2.3m – 2.4mbgl and BH01 and BH02 identified a groundwater strike at 3.0mbgl. The boreholes and trial pits recorded no instability of the excavation sides during the short period of time that they were left open and unsupported. No buried foundations or other man-made obstructions was recorded in the walkover or exploratory holes.

Excavations are considered unlikely to remain dry with the groundwater table recorded as shallow as 0.91mbgl during groundwater monitoring visits. Any slight seepages and minor inflows into excavations should be dealt with by pumping from screened sumps to keep them dry, however, faster inflows of groundwater will need more significant groundwater controls, especially after sustained periods of inclement weather. Any excavated surfaces should be protected from deterioration since the soils revealed by the boreholes are prone to rapid deterioration in the presence of water.

Statutory safety precautions should not be neglected, especially where personnel are to enter excavations, when close side support will be required, since the superficial deposits could not be expected to stand unsupported for short or long periods of time.

10.8. Buried Concrete

The requirement for protecting concrete from aggressive ground is determined from BRE Special Digest 1 (SD-1): Concrete in Aggressive Ground. For the assessment of buried concrete mix requirements on site, the materials have been assessed in two soil group types rather than as a whole with no sub-division. Instead of a site wide characterisation based on the laboratory test results for the soil samples analysed, the assessment has been made for shallow soils (Made Ground, Tidal Flat Deposits and granular Glacial Till) and deeper soils comprising the cohesive Glacial Till.

Based on the historical review for the previous site usages and the stratum types exposed within the various exploratory holes conducted during the intrusive investigation, the site is classed as 'greenfield' for the benefit of the SD-1 assessment. The Made Ground across the site is suspected to have been derived from the surrounding residential developments, rather than from industrial processes with a more onerous provenance. The prevalent groundwater conditions are considered to be 'mobile' as classified within BRE SD-1 above the cohesive Glacial Till and static within the cohesive Glacial Till.

The results from the on-site superficial soils between 0.5m and 9.0mbgl indicate a design Sulphate Class of DS-3 and an Aggressive Chemical Environment for Concrete (ACEC) classification of AC-3 with acidity of soils recorded from 6.9pH units to 8.6pH units (near neutral to mildly alkaline).

The results taken from samples of the underlying cohesive Glacial Till, would require a Sulphate Class of DS-4 and an Aggressive Chemical Environment for Concrete (ACEC) classification of AC-3s with acidity of soils recorded from 7.8pH units to 8.5pH units (near neutral to mildly alkaline).

Shallow concrete mixes for floors (in contact with the ground) / ground beams / pads / pile caps etc should be designed in accordance with BRE SD-1 classification of DS-3, AC-3. Deeper concrete to be used within piled foundations installed within the cohesive Glacial Till should be designed for BRE SD-1 classification of DS-4, AC-3s. Where single mixes are used on bored/CFA piles then the worst case concrete mix criteria should be used.

10.9. California Bearing Ratio (CBR) Testing

California Bearing Ratio (CBR) testing was instructed on 2No. samples (TP03 at 0.55mbgl and TP05 at 0.65mbgl), Made Ground and natural sandy silt respectfully. Full test results are available within Appendix F.

The Holland Park, Spalding site is underlain by a variable thickness of Made Ground comprising topsoil overlying a reworked brown slightly, sandy, silt followed by a brown, slightly, sandy, silt. The formation materials for any new highway or hardstanding will generally be mixed cohesive and granular Tidal Flat Deposits. Any topsoil, ploughed sub-soil and sub-standard/unsuitable Made Ground/natural very soft/soft clay should be penetrated by any hardstanding and highway construction.

Whilst the proposals do not include for the placement of engineered fill, if any such materials are to be placed on site in the formation of the new highways, then the formation strata will be the engineered fill and will perform in accordance with the earthworks specification and placement requirements.

Based on published data, the observations of the ground investigation and the in-situ/laboratory analyses summarised, it would be prudent to adopt the following CBR value for preliminary design purposes across the whole of the site, subject to confirmation on site with in-situ testing at the time of construction:

- All shallow Made Ground and Tidal Flat Deposits – <2.0% CBR

The CBR values for the on-site soils, both recorded as <2% are considered to be unsuitable for direct pavement support, and a ground improvement solution should be sought. Potential strategies could comprise a thick granular capping layer and a geotextile mesh / geogrid to act as a working layer or a regime of lime stabilization is also considered to be feasible.

Once exposed, the proposed formation materials should be inspected, and proof rolled in addition to confirmatory in-situ CBR testing and if any soft/excessively loose spots are encountered these should either be removed and replaced with a well compacted suitable

coarse granular fill or if granular compacted in-situ. The variability of the potential formation materials, and poor performance, will result in the formation inspection, proof rolling and over-excavation exercise being paramount to successful construction and performance.

Engineering consideration and design should also be given to any areas of new highway that are to be tied into/constructed adjacent to existing highways (access road tied into Shakespeare Way), in order to avoid potentially damaging differential movement between the two.

The non-organic Made Ground and shallow Tidal Flat Deposits are considered to be potentially frost susceptible in accordance with Transport Research Laboratory (TRL), Road Note 29, Appendix 1. This is due to the presence of coarse granular materials on site having >10% passing the 75µm sieve, as proven by visual inspection and particle size distribution analyses. The clay soil elements are also considered potentially frost susceptible as unmodified Plasticity Indices of <15% have been achieved in tests. Where formation materials are proven to be frost susceptible then this should be taken into account during highway design and construction. In this instance, the minimum construction thickness for the highway, irrespective of design CBR value, should be 450mm, in order to avoid potentially damaging freeze/thaw weathering of the sub-base materials.

10.10. Infiltration Testing & Permeability

Falling head testing was undertaken on the 9th March 2026 in BH01 and BH02, with the results of the testing presented within Appendix I to this report. The tests were performed as per Condition D of BS5930:1999, Section 4, Figure 6 utilizing the Hvorslev 1951 – Basic Time Lag Approach.

Coefficient of Permeability (k) values of 9.6×10^{-9} m/sec and 2.8×10^{-8} m/sec were identified for BH01 and BH02, respectively. These soils would be as classed as being practically impervious in accordance with BS:8004 (now withdrawn) and hence poor soakaway infiltration potential.

Based on the material properties and in-situ testing results, the discharge of clean waters to the shallow deposits across the site is not recommended.

11. Geo-Environmental Considerations

The guidance detailed in Section 1.3 has been followed to ensure that the risk posed to identified receptors, is reported according to accepted compliance criteria.

A Tier 1 stage, the long term (chronic) human health toxicity of the soil has been assessed by comparing the on-site concentrations of organic and inorganic compounds with reference values published in LQM/CIEH S4UL ("Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3829. All rights reserved") and DEFRA's C4SLs within Appendix G.

11.1. Inorganics & Organics

Determinand	Greatest recorded value across all samples (mg/kg)	Residential Public Open Space end use (mg/kg)	Pass/Fail	Samples with exceedances
Arsenic (total)	17	79	Pass	N/A
Cadmium (total)	0.3	120	Pass	N/A
Chromium (total)	28	1500	Pass	N/A
Chromium (VI)	<1.8	7.7	Pass	N/A
Copper (total)	34	12000	Pass	N/A
Lead (total)	83	630	Pass	N/A
Mercury (total)	0.7	16	Pass	N/A
Nickel (total)	24	230	Pass	N/A
Selenium (total)	1.3	1100	Pass	N/A
Vanadium (total)	43	2000	Pass	N/A
Zinc (total)	88	81000	Pass	N/A
PAHs				
Naphthalene	0.08	4900	Pass	N/A
Acenaphthylene	0.13	15000	Pass	N/A
Acenaphthene	0.09	15000	Pass	N/A
Fluorene	0.06	9900	Pass	N/A
Phenanthrene	1.50	3100	Pass	N/A
Anthracene	0.51	74000	Pass	N/A
Fluoranthene	8.80	3100	Pass	N/A
Pyrene	8.40	7400	Pass	N/A
Benzo(a)anthracene	5.20	29	Pass	N/A
Chrysene	4.70	57	Pass	N/A
Benzo(b)fluoranthene	6.70	7.2	Pass	N/A
Benzo(k)fluoranthene	2.70	190	Pass	N/A
Benzo(a)pyrene	5.60	5.7	Pass	N/A
Indeno(123cd)pyrene	2.60	82	Pass	N/A
Dibenz(ah)anthracene	0.53	0.58	Pass	N/A
Benzo(ghi)perylene	2.90	640	Pass	N/A

TPH				
VPH Aromatic (>EC5-EC7)	<0.01	56000	Pass	N/A
VPH Aromatic (>EC7-EC8)	<0.01	56000	Pass	N/A
VPH Aromatic (>EC8-EC10)	<0.02	5000	Pass	N/A
EPH Aromatic (>EC10-EC12)	<1	5000	Pass	N/A
EPH Aromatic (>EC12-EC16)	<2	5000	Pass	N/A
EPH Aromatic (>EC16-EC21)	15	3800	Pass	N/A
EPH Aromatic (>EC21-EC35)	52	3800	Pass	N/A
EPH Aromatic (>EC35-EC44)	32	3800	Pass	N/A
VPH Aliphatic (>C5-C6)	<0.01	600000	Pass	N/A
VPH Aliphatic (>C6-C8)	<0.01	620000	Pass	N/A
VPH Aliphatic (>C8-C10)	<0.01	13000	Pass	N/A
EPH Aliphatic (>C10-C12)	<1	13000	Pass	N/A
EPH Aliphatic (>C12-C16)	<2	13000	Pass	N/A
EPH Aliphatic (>C16-C35)	<16	250000	Pass	N/A
EPH Aliphatic (>C35-C44)	<8.4	250000	Pass	N/A

Table 10: Contamination assessment

- Based on sandy loam soil as defined in SR3 (Environment Agency, 2009c) and 6% soil organic matter (SOM)
- Figures are rounded to two significant figures
- In applying the rules for non-soil background to the S4ULs, the background ADE is limited to being no larger than the contribution from the relevant soil ADE
- Based on comparison of inhalation exposure with inhalation ID
- Based on comparison of oral and dermal exposure with oral TDI

Based on published LQM/CIEH S4ULs & DEFRA's C4SLs, no exceedances have been identified with respect to a residential public open space end use.

11.2. Asbestos

A close watching brief was maintained during all excavation works on site by the DEL Geo-Environmental Engineer for the visible presence of possible Asbestos Containing Materials (pACM) within the soils exposed on site.

During the intrusive investigation works on site comprising 2No. boreholes and 6No. machine excavated trial pits spread across site to give coverage, Made Ground was found to be between 0.4m and 0.9m depth, overlying the apparent natural Tidal Flat Deposits. No fragments or evidence of pACM were identified visually on site within the Made Ground.

A total of six soil samples from across the site taken from the Made Ground were submitted to the laboratory as discussed in Section 11.1 of this report and as standard procedure an asbestos screening process is undertaken on each sample received. The soil samples are screened under microscopy in the laboratory for the presence/absence of asbestos. Of the six soil samples submitted, a single sample was found to have a recorded presence of asbestos fibres within it, the remaining 5No. samples were clear.

A Made Ground soil sample from 0.5m depth in trial pit TP04, located near centrally on site, was found to contain loose Amosite asbestos fibres.

Chrysotile or White Asbestos is the most commonly used type of asbestos in the UK and is considered to pose the lowest risk to human health out of the wider asbestos group, which includes the higher risk Brown and Blue Asbestos types (Amosite, Crocidolite, Tremolite, Actinolite and Anthophyllite). Amosite, as found in a single sample of site, is considered a higher risk to the human respiratory system as it is from the Amphibole family, which have needle shaped fibres that readily become lodged within the human respiratory system.

Following the presence of asbestos fibres being confirmed in a single sample of Made Ground, that sample was further analysed within the chemical laboratory for quantification assessment (% by hand picking/weighing). The further analyses revealed <0.001% of loose Amosite fibres in the sample from TP04. Unfortunately, no industry guidelines currently exist within the UK for acceptable levels, soil screening values or Generic Assessment Criteria (GAC) for asbestos. However, it is generally accepted that if asbestos fibres exist within soils at quantities less than the detection limit for laboratories using microscopy, hand picking of fibres and bulk weight measurement in comparison to the main sample (<0.001% asbestos fibres in soil) following HSG 264, then a minimal risk is perceived. The quantification process identified that <0.001% asbestos mass was present within the soil specimen from TP04 at 0.5m depth.

Based on supplementary testing and analysis, the TP04 Made Ground soils can be assessed as posing a low risk to human health from asbestos fibres.

Based on the above, it is considered that a low risk is posed to the groundworkers and future resident users of the site and neighbouring residents from the existing soils with respect to asbestos. No remedial measures are deemed necessary in respect to soil contaminants. However, any future excavations within the Made Ground across the site by Contractor's should be undertaken with the awareness for the potential for pACM fragments and loose fibres to be present and take appropriate precautions.

11.3. Ground Gas

The worst-case results from the 6-week monitoring period are displayed in the following table:

Test Location	Max recorded CH ₄ (% vol)	Max recorded CO ₂ (% vol)	Max. Flow Rate (l/hr)	Steady Flow Rate (l/hr)	Max GSV
BH01	0.0	3.5	3.2	0.1	0.1120
BH02	0.0	0.8	0.3	0.1	0.0024
ACROSS ALL (Worst case)	0.0	3.5	3.2	0.1	0.1120

Table 11: Gas monitoring worst-case results

Ground gas monitoring results and corresponding Gas Screening Values (GSVs) are contained within Appendix H.

The worst-case GSV has been identified as CS1 / Green. It should be noted that elevated peak flow rates were detected on a single occasion during the 6-week period in BH01 (3.2l/hr). This would classify the site as CS2 / Amber 1, however, in this case the flow rate shortly dropped to <0.1 l/hr within 2 minutes, indicating that the initial high recordings were a result

of pressure equalisation, rather than true flow. Therefore, steady flow has been adopted in the derivation of the GSV.

Therefore, no ground gas protection measures are considered required at this time.

Ground gas monitoring has been carried out in general accordance with BS 8485:2015+A1:2019 over a 6-week monitoring period including a minimum of a single visit during a low or falling atmospheric event (<1000mb).

11.4. Controlled Waters

No significant levels of contaminants of concern were identified, with respect to controlled waters and previous site uses identified do not indicate the likely presence of gross contamination. Therefore, the risk posed to controlled waters is considered to be negligible.

12. Phase II Conceptual Site Model

Source	Pathway	Receptor	Solution
Human Receptors			
Based on published LQM/CIEH S4UIs & DEFRA's C4SLs, no exceedances have been identified with respect to a residential public open space end use. Localised loose asbestos fibres have been identified within shallow Made Ground soils on-site, but determined as low risk (<0.001% quantification).	Direct dermal contact or ingestion of soils, or inhalation of dust/fibres (i.e. human interaction with surface and subsurface materials).	Site workers during the redevelopment of the site.	The principal contractor should determine suitable PPE for groundworkers.
		Intended end users of the site (care home residents and staff).	No ground gas measures are required.
		Neighbours	
Ground gas monitoring has been carried out to date over a 6-week monitoring period. Subsequently, the site has been identified as CS1 / Green,	The migration and accumulation of ground gases through permeable sub-surface materials and/ or preferential pathways.	Intended end users of the site (residents and staff).	No specific ground gas protection measures beyond radon protection measures are considered required at this time.
Environmental Receptors (Controlled Waters)			
No significant levels of contaminants of concern were identified, with respect to controlled waters.	Lateral and vertical migration of groundwater through permeable sub-surface materials and/ or preferential pathways.	The Unproductive Aquifer within the underlying superficial strata of the Tidal Flat Deposits.	No specific remediation is considered to be necessary for this receptor.
		The Unproductive Aquifer within the underlying bedrock geology (Oxford Clay Formation).	

Table 12: Phase II CSM

13. Risk Management & Remediation

Previous sections have quantified the risk posed to identified receptors. The following section details measures and recommendations for dealing with risks associated with soil, gas, and groundwater contamination in respect to the proposed development.

13.1. Remediation to Protect End Users

Based on published LQM/CIEH S4UIs & DEFRA's C4SLs, no exceedances have been identified with respect to a residential public open space end use and the localised presence of amosite asbestos at <0.001% quantification has been identified as posing a low risk to human health.

Therefore, no remediation is deemed necessary for the proposed residential care home proposed on the Holland Park site.

13.2. Ground Gas & vapours Protection Measures

Ground gas monitoring results and corresponding GSVs are contained within Appendix H.

The worst-case GSV has been identified as CS1 / Green. It should be noted that an elevated peak flow rates were detected on a single occasion during the 6-week period in BH01 (3.2l/hr). This would classify the site as CS2 / Amber 1, however, in this case the flow rate shortly dropped to <0.1 l/hr within 2 minutes, indicating that the initial high recordings was pressure equalisation, rather than true flow. Therefore, steady flow has been adopted as Q_{hg} (flow rate) in the derivation of the GSV.

Therefore, no ground gas protection measures are considered required at this time.

13.3. Remediation to Protect Controlled Waters

No significant levels of contaminants of concern have been identified with respect to controlled waters.

Therefore, no specific remediation is considered to be required.

13.4. Remediation to Protect Construction Workers

The principal contractor should carry out a risk assessment to determine suitable PPE for groundworkers.