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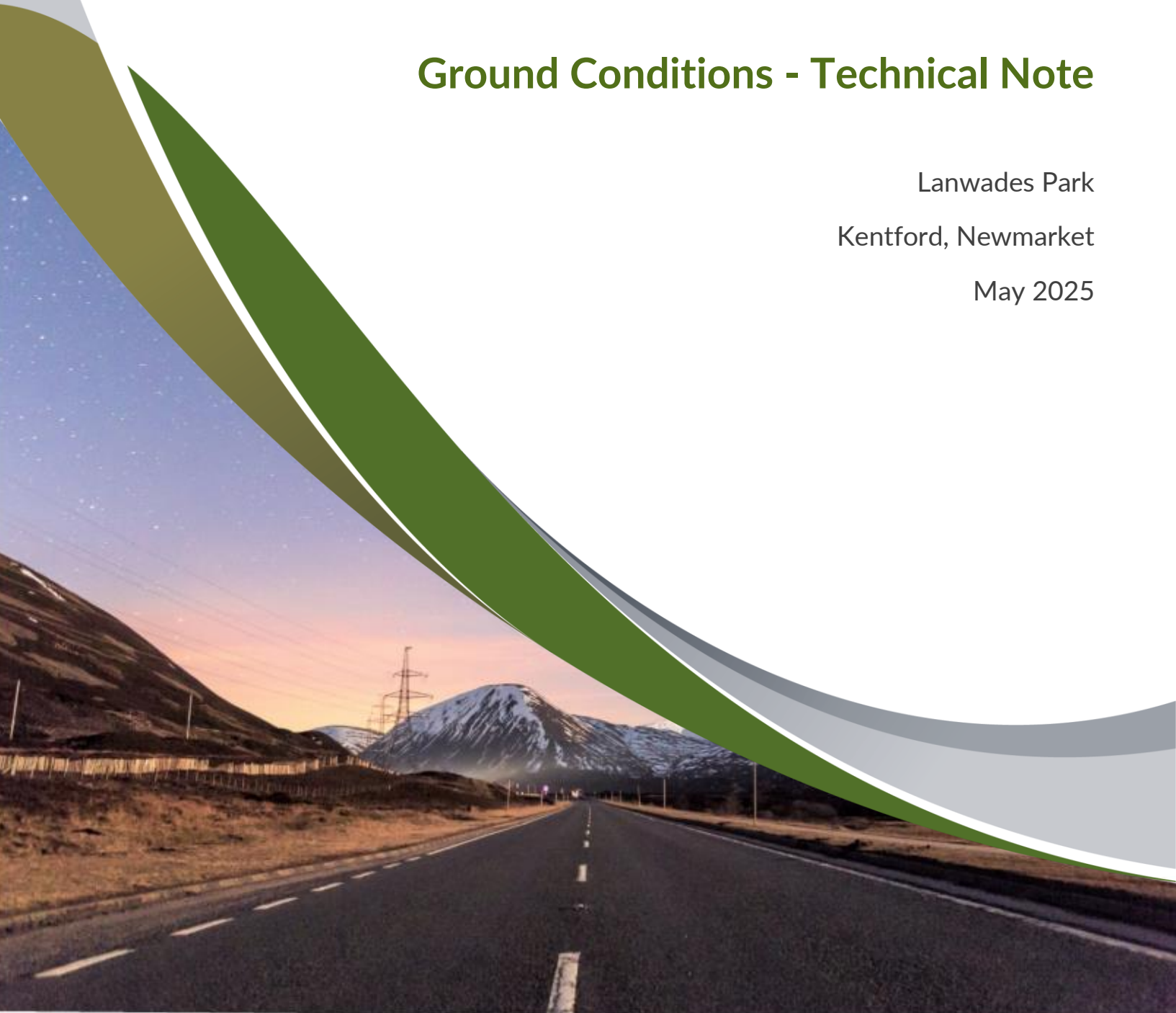
Ground Conditions - Technical Note

Lanwades Park

Kentford, Newmarket

May 2025



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Project Details

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Document Title:	Ground Conditions - Technical Note
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Appendix A Ground Investigation Report

Limitations

Soiltechnics disclaims any responsibility to our Client and others in respect of any matters outside the scope of this report. This report has been prepared with reasonable skill, care and diligence in accordance with the terms of our contract, taking account of the resources, investigations and testing devoted to it by agreement with our Client. This report is confidential to our Client and Soiltechnics accepts no responsibility of whatsoever nature to third parties to whom this report or any part thereof is made known. Any such party relies upon the report at their own risk.

1 Introduction

1.1 Brief

1.1.1 This Technical Note has been prepared in support of two planning Applications, one being made in Detail and one being made in Hybrid. The Hybrid Application includes a comprehensive application that includes the detailed application and has a larger site area to which this Note covers.

1.1.2 This report considers if either application has the potential to give rise to significant effects in relation to Ground Conditions, or if this can be 'Scoped Out' from further assessment within the EIA for the site.

1.2 Planning Status

1.2.1 Two Applications will be submitted for the site, as detailed below.

Detailed Application

Demolition of existing buildings on site, and phased redevelopment to provide residential units alongside a retail/ commercial/ employment building (Use Class E), conversion of the existing listed stable block to community/ commercial/ employment use (Use Class F2/ E), provision of open space, play space, woodland walks and associated infrastructure and car parking.

Hybrid Application

Hybrid application for the demolition of the existing buildings on site and the phases development of the entire site for residential, care home, retail and commercial/ employment, community and education uses along with provision of open space and woodland walks, play space, and associated infrastructure and car parking, comprising:

Full application - Demolition of existing buildings on site, and phased redevelopment to provide residential units alongside a retail/ commercial building (Use Class E), conversion of the existing listed stable block to community/ commercial use (Use Class F2/ E), provision of open space, play space, and associated infrastructure and car parking.

Outline application – Phased redevelopment of site to provide residential units alongside commercial (Class E) floorspace, one form entry primary school, 90 bed care home provision of open space, play space, and associated infrastructure and car parking.

1.3 Previous Reports

1.3.1 A Ground Investigation Report (including a combined Tier 1 and Tier 2 contamination assessment) was produced for the Hybrid Application Site by Soiltechnics in February 2023 (report ref: STU5875-R01-Rev_B) and is presented in Appendix A.

1.3.2 The objectives of the report were to:

i) Review and summarise desk study information.
ii) Undertake a land contamination Tier 1 preliminary risk assessment.
iii) Summarise the intrusive investigation works undertaken and associated laboratory testing.
iv) Present a ground model summarising the ground and groundwater conditions at the site including relevant geotechnical parameters.

v) Provide a geotechnical appraisal for the project and highlight key geotechnical issues that may impact upon the proposed scheme.

vi) Undertake a land contamination Tier 2 generic quantitative risk assessment.

vii) Provide recommendations to inform further works, an Options Appraisal and/or Remediation Strategy, should they be required.

viii) Provide a waste characterisation assessment of soils at the site for potential disposal to landfill.

1.3.3 It should be noted that following the completion of the desk study review and Tier 1 preliminary risk assessment, all identified potential contamination linkages (PCLs) were restricted to the east of the site (i.e. the Detailed Application Site). On this basis, items iv) to viii) above, were only undertaken on this area of the site.

1.4 Legislation, Policy and Guidance

1.4.1 UK legislation on contaminated land is principally contained in Part 2A of the Environmental Protection Act 1990. The principal feature of this legislation is that the hazards associated with contaminated land should be evaluated in the context of a site-specific risk -based framework.

1.4.2 Therefore, the assessment needs to identify if land contamination could pose an unacceptable risk to human health or the environment, within the context of the proposed development site. In the context of the existing site use, as a minimum, land should not be capable of being determined as 'contaminated land' under Part IIA of the Environmental Protection Act 1990.

1.4.3 The Regulations and Statutory Guidance that accompany the Environmental Protection Act 1990, include the Contaminated Land Statutory Guidance for England 2012 and the Contaminated Land (England) Regulations 2006, which have been revised with the issue of The Contaminated Land (England) (Amendment) Regulations 2012 (SI 2012/263).

1.4.4 The National Planning Policy Framework sets out the government's planning policies for England and how these should be applied. It provides a framework within which locally prepared plans for housing and other development can be produced. Chapter 11 (Making effective use of land) paragraph 125.c and Chapter 15 (Conserving and enhancing the natural environment) paragraphs 187.f and 196 to 201relate to ground conditions and pollution.

1.4.5 The risk assessment undertaken in the ground investigation report is underpinned by the following guidance and best practice:

- BS5930:2015 – 'Code of practice for ground investigations'.
- BSEN1997-2:2007 - Eurocode 7 — 'Geotechnical design Part 2'.
- BS10175:2011+A2:2017 – 'Investigation of potentially contaminated sites'.
- Online resource from GOV.UK, published by the Environment Agency, updated July 2023 – 'Land contamination risk management'.
- CIRIA C552 - 'Contaminated land risk assessment- a guide to good practice', 2001.
- BS EN ISO 21365:2020 - 'Soil quality – Conceptual site models for potentially contaminated sites'.
- BS 8576:2013 'Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds (VOC)'.

2 Baseline Data

2.1 Site Setting

2.1.1 The Application Sites are located in Kentford, Newmarket and the post code for the site is CB8 7UA. The site is accessed from the B1506 which lies adjacent to the site's northern boundary.

2.1.2 A map showing the approximate Hybrid Application Site boundary is presented below, marked in pink. Lanwades Hall and surrounding land is not part of the site (outlined in red). The site is a former veterinary research and development campus (Animal Health Trust). The eastern half of the site comprises a mixture of buildings (laboratories, office accommodation and incinerator), access roads, hardstanding areas and grassed fields. The western half of the site comprises fields.

2.1.3 The site is currently disused and unoccupied.

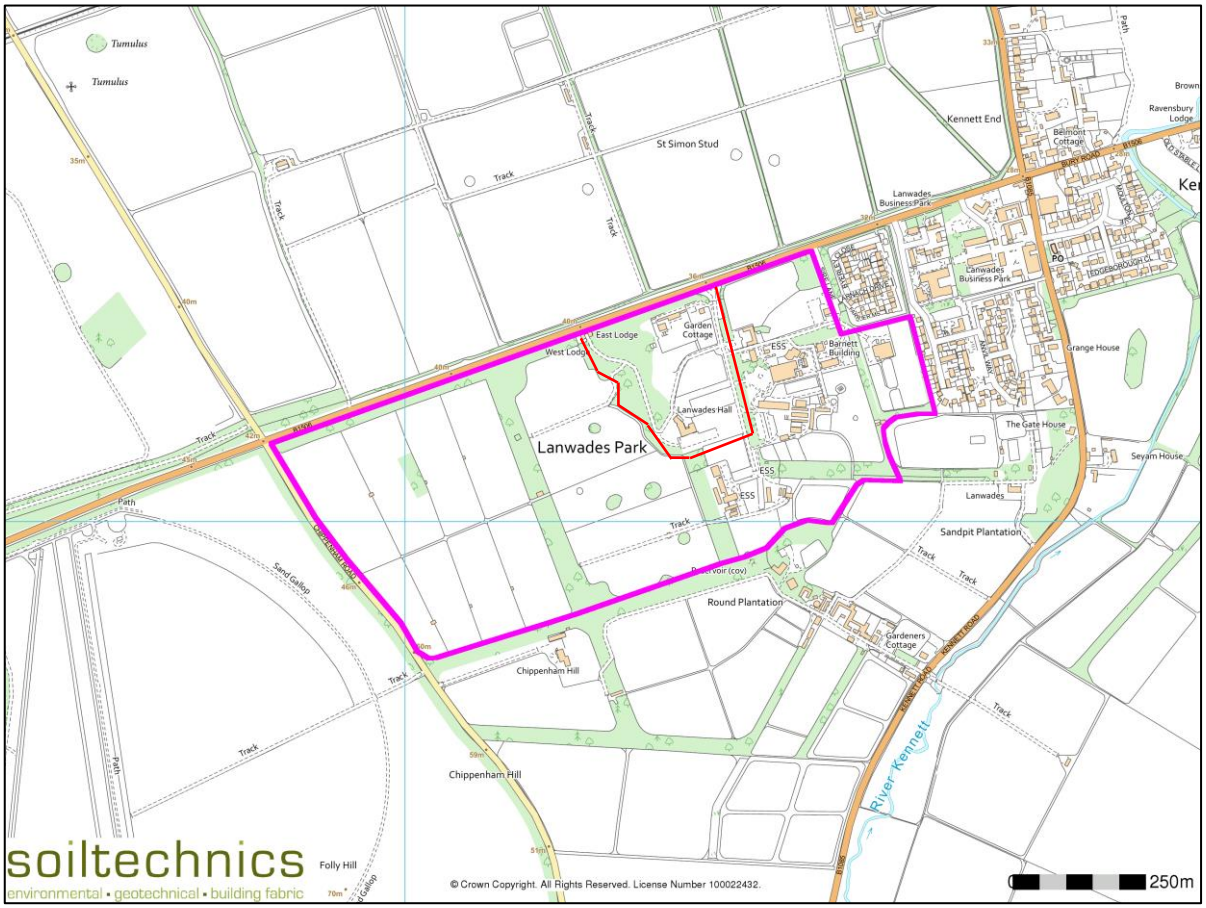

Figure 2-A: Hybrid Application Site boundary

2.2 Site History

2.2.1 Inspection of historical maps indicates the western half of the site has remained undeveloped open fields until present day, with sporadic small buildings (likely stables). The eastern part of the site has been gradually developed to the current configuration of Lanwades Park. A sewage filter bed and nursery were recorded in the north-eastern corner of the site and a small quarry was recorded in the southeast from the 1920s to the 1970s.

2.3 Site Walkover

2.3.1 The following potential sources of contamination were identified during the site reconnaissance within the east of the site. No potential sources of contamination were identified within the fields to the west.

- A number of above ground fuel tanks and electricity sub-stations were observed on site.
- It is also understood that the building to the far east of the site comprised an incinerator.
- A number of laboratories were present.
- A hydrocarbon odour was noted in the corner of a stable block adjacent to the north-western buildings. Possible oil leaks were also noted in two locations towards the centre of the site associated with tanks/pipework.
- Bunds/soil mounds are also present around the wooded area to the north-east of the site; the nature of the material used in their creation is unknown.
- General rubbish, disused machinery and barrels associated with the former site use were discarded on site, predominantly within storage buildings and gas canister holders.
- Given the former site use, there is a potential radiological risk on site. However, it is understood that all radiological materials have been removed from the site by specialists and therefore this risk is not considered further in this report.
- There is a potential risk of biological contaminants/pathogens specific to the former site use, which are likely to be predominantly present in drainage (as sludges etc.)

2.4 Geology and Ground Conditions

2.4.1 Based on geological mapping, the site is recorded to be underlain by the Holywell Nodular Chalk Formation and New Pit Chalk Formation (undifferentiated) to depths of around 60-70m

2.4.2 Although no superficial deposits are recorded on site, the Lowestoft Formation (clay/silt/sand/gravel) is recorded immediately to the south of the site. Head deposits and River Terrace deposits are also recorded in the local area.

2.4.3 Intrusive investigations in the eastern half of the site generally encountered consistent ground conditions, which were broadly in line with those anticipated from the desk study.

2.4.4 The following table presents a generalised interpretation of geological conditions encountered within the eastern half of the site and is considered likely to be comparable to those in the west.

Stratum	Brief description	Top depth range (m bgl)	Adopted model top depth (m bgl)	Adopted model thickness (m)
Topsoil	Dark brown gravelly sandy clay, gravel is flint.	G.L.	G.L.	0.4
Made Ground	Light brown and grey sandy gravelly clay with gravel of chalk, flint and brick.	G.L. – 0.3	G.L.	Generally absent but extending in excess of 1.2m in one location.
Quaternary Deposits	Brown and light brown clayey gravelly sand and soft gravelly very sandy clay. Gravel is flint and chalk.	0.10 –0.60	0.51	1.5

Stratum	Brief description	Top depth range (m bgl)	Adopted model top depth (m bgl)	Adopted model thickness (m)
Holywell Nodular Chalk Formation and New Pit Chalk Formation	Structureless chalk composed of sandy gravelly clay.	0.3 – 2.90	1.80	>3m

Table 2-A: Ground Model

2.4.5 Shallow groundwater was not encountered with the exception of a seepage of perched water within the Quarternary Deposits within a single exploratory position. Groundwater is anticipated to be present within the Chalk deposits at a depth of approximately 30m.

2.5 Radon

2.5.1 The desk study identified that the site is in a Lower probability radon area (less than 1% of homes are estimated to be at or above the Action Level). Therefore, no radon protective measures are necessary in the construction of new dwellings.

2.6 UXO

2.6.1 A preliminary risk review was undertaken by a UXO specialist concluded that there was a credible risk of encountering UXO during the ground investigation and recommended that a detailed UXO desk study be commissioned to support the construction phase.

2.7 Hydrology

2.7.1 The desk study identified that the River Kennett is located approximately 300m south-east of the site, and that there are no other surface water features located within 1km of the site.

2.7.2 There are no active surface water abstraction licenses within 1km of the site.

2.8 Hydrogeology

2.8.1 The desk study identified that available borehole records from the area around the site suggest that groundwater is present at depth (20m+ below ground level) within the chalk.

2.8.2 The site is located within a Source Protection Zone II (Outer Zone) with the far south-eastern corner within a Source Protection Zone I (Inner Zone) associated with an abstraction point located within the south-eastern corner of the site. The well is recorded as abstracting from the Principal Aquifer within the Chalk Formation for commercial use/general farming/spray irrigation.

2.8.3 There are no other active groundwater abstractions within 1km of the site.

2.9 Geoenvironmental Conditions – Soils

2.9.1 Based on the desk study and Initial Conceptual Site Model (iCSM), no PCLs were identified within the western part of the site (existing fields), therefore this part of the site is considered suitable for development without any further investigation works or remedial action taking place.

2.9.2 However, the desk study and iCSM did identify PCLs within the eastern half of the site. In particular, the historical site uses, particularly use as an animal health facility, were considered capable of giving rise to a wide range of contaminants.

2.9.3 Given the number of tanks on site and the potential for localised fuel contamination, there was considered a potential risk from vapour intrusion. There is also considered a potential risk from landfill gases associated with the backfilled quarry on site.

2.9.4 All relevant receptors (human health, controlled waters, buildings and services and environmental) have been considered in the Soiltechnics Ground Investigation Report (Appendix A) depending on the applicable sources and contaminants outlined above, the pathways identified and the presence of an appropriate receptor.

2.9.5 The Tier 2 assessment reported all concentrations of contaminants are below the relevant generic assessment criteria for human health receptors with the exception of a single arsenic concentration. All other concentrations of arsenic from elsewhere on site were well below the guideline value and thus is it likely this is relatively localised.

2.9.6 Analysis indicates that contaminant levels do not pose an acute risk to construction workers or site users, both during construction and following completion of the development.

2.9.7 Investigative works have not encountered any suspected area of contamination, and no significant groundwater has been encountered. On this basis, the overall risk to controlled waters is considered to be low.

2.9.8 Overall, based on the laboratory data and field observations to date, no significant areas of suspected contamination have been detected. However, localised areas of contamination cannot be discounted based on the past history of the site.

2.9.9 Fieldwork observations within the vicinity of the incinerator building detected some hydrocarbon odours/staining and exploratory work within this location was limited, and it is therefore possible that higher levels of hydrocarbon contamination may be present in unexplored areas in this location.

2.9.10 On this basis, further investigations, which would typically be secured via a standard planning condition, might be required in this area and in other targeted locations. For example, there are a number of tanks/pipework/substations on site and although we have undertaken excavations and some testing to target some of these areas, again, there is a possibility that unidentified contamination is present local to these sources. In addition, appropriate due diligence and a watching brief should be carried out during the demolition and enabling works, to identify any unexpected or previously unencountered contamination (again, typically secured via a standard planning condition).

2.9.11 It was also noted that if any areas of possible waste/equipment dumping be identified on site during construction works that could be a source of specific contamination associated with the former site use, specialist decontamination/remediation may be required prior to removal of such wastes.

2.10 Existing drainage

2.10.1 Based on the site reconnaissance, it was considered likely that any biohazard waste would likely be predominantly present in drainage at the site. On this basis, during fieldwork, manhole covers down gradient of the main site were lifted to assess the presence of any obvious silts or sludge material that could potentially indicate waste products within the drainage.

2.10.2 Some drainage runs appeared to be clear although others included some soils/silts. No sampling or testing was undertaken due to possible risk to personnel. Further assessment of the materials within the drainage system may be required as part of any future investigations, which will typically be secured via planning conditions.

2.11 Ground Gas Risk Assessment

2.11.1 Based upon the CSM and on the monitoring results obtained, there are no significant concerns regarding elevated carbon dioxide or depleted oxygen levels. No elevated gas flow rates were detected.

2.11.2 Due to the absence of a significant actively generating ground gas source and open migration pathway, it is considered very unlikely that ground gases could migrate into the proposed structures on site at sufficient speed and volume to pose any viable risk. A CS-1 classification applies.

2.11.3 However, it is acknowledged that deeper Made Ground is potentially present associated with a former quarry, and this has not yet been investigated. Depending on the depth and composition of Made Ground in this area, gas monitoring may be required in and around this area to refine the risk assessment locally.

2.12 Conceptual Site Model

2.12.1 A detailed conceptual site model has been undertaken within the Ground Investigation Report (Appendix A) and this identifies the key sources, pathways and receptors relevant to the site and identifies any significant pollutant linkages. The identified pollutant linkages and their overall risk classification are as follows:

- There is a **Low/Moderate risk** to future site users from potential localised contamination within soils associated with the former site use. Further, targeted investigations have been recommended.
- There is a **Moderate risk** to future site users associated with a former quarry (backfilled), within the east of the site, which has not yet been investigated.
- There is a **Moderate risk** to construction operatives from ground conditions within the area of the former quarry.
- There is a **Low/Moderate risk** to construction operatives associated with site drainage.
- There is currently a **Moderate risk** to construction operatives associated with UXO. However, further risk assessment undertaken by a specialist prior to the beginning of construction works, and appropriate mitigation measures if considered necessary, would reduce the risk.
- The overall risk to adjacent site users is is **Very Low.**
- There is a **Very Low risk** to proposed planting.
- There is a **Low risk** to controlled waters from ground conditions encountered at the site.
- The overall risk of potential contamination within soils and groundwater from on-site and off-site sources via direct contact is **low/moderate** for potable water pipes;
- The overall risk of potential contamination within soils and groundwater from on-site and off-site sources is **Moderate** for the superficial and bedrock aquifers as piling and foundation works could open up conduit pathways within the permeable aquifers and cause contamination from general construction related activities;
- The overall contamination risk from the existing buildings is considered to be **Moderate** for demolition and construction workers due to the potential presence of asbestos;

- The overall risk from existing ground gas accumulation and risk of explosion to construction/demolition workers and future site users is **Low** (increasing to **Low/Moderate** within he vicinity of the former quarry; and

3 Development Context

3.1.1 As recommended within the Ground Investigation Report, good demolition and construction practices should be used to reduce the risk posed to construction workers and adjacent site users from contamination during the construction phase. This will include ensuring demolition/construction workers wear appropriate personal protective equipment (PPE) and that any necessary licences would be obtained for the storage, treatment and disposal of waste.

3.1.2 As outlined in the Ground Investigation Report, it is recommended that further supplementary investigations are undertaken for each of the outstanding potential contamination sources to fully characterise the site with regard to contaminated land risk.

3.1.3 Depending on the findings of further investigations, there may be a requirement for a Remediation Strategy to be produced to outline the remediation measures necessary at the site if unacceptable levels of contamination are identified. Any Remediation Strategy produced for the site would then have to be implemented and verified with a Verification Report to monitor and ensure compliance with the Remediation Strategy.

3.1.4 The above would normally be secured by condition and the findings of the investigations will be reported to the Council and a remediation and/or mitigation strategy and verification report will be prepared and agreed.

4 Conclusion

4.1.1 Based on the Ground Investigation and with the implementation of appropriate mitigation/management measures it is considered that the development at each Application Site is unlikely to give rise to significant residual ground condition effects.

4.1.2 As part of the planning application, the Ground Investigation report will be submitted to accompany the planning application.

4.1.3 The risks from land contamination will be controlled through the planning process through a series of pre-commencement conditions, with all risk assessments, remedial strategies and verification reports requiring submission and approval to the regulator at key stages of development.

4.1.4 As such, it is recommended that the development is unlikely to give rise to significant effects that would require assessment under EIA requirements.

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Appendix A Ground Investigation Report

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Ground Investigation Report

Proposed Redevelopment

Lanwades Park, Kentford, Newmarket

February 2023

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Project Details

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Drawing Register

Title	Produced by	Date	Reference
Site location plan	Soiltechnics	January 2023	D-STU5875-01
Exploratory hole location plan	Soiltechnics	November 2022	D-STU5875-02
Contamination source plan	Soiltechnics	January 2023	D-STU5875-03

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Non-technical Summary

Topic	Commentary
Site description	The proposed development site comprises Lanwades Park, Kentford, Newmarket.The site is a former veterinary research and development campus (Animal Health Trust), comprising a mixture of buildings (laboratories, office accommodation and incinerator), access roads, hardstanding areas and grassed fields. The site is currently disused and unoccupied with the exception of a security presence.
Development proposals	It is understood that proposals are for a residential development at the site although at the time of writing, the client has yet to purchase the site and therefore there are no specific plans.
Ground conditions	Generally, ground conditions comprised Topsoil to approximately 0.3m overlying Quaternary Deposits and Chalk. The Quaternary deposits generally comprised light brown clayey sands and gravels while the underlying Chalk comprised structureless Grade Dc Chalk. Some limited Made Ground has been identified on site, generally to the north of the former incinerator building and associated with a bund in the north-eastern part of the site. In both cases, it exceeded 1.2m depth and the base was not encountered. Groundwater was generally not present although a seepage was observed within the Quaternary Deposits in one location. Although not investigated at this stage, a backfilled quarry is historically recorded on the site and therefore deep Made Ground may be present in this area.
Foundation and slab solution	The Quaternary deposits and Chalk will adequately support proposed buildings on concrete strip/trench fill foundations. Both deposits are either non-shrinkable or of low volume change potential when classified in accordance with NHBC Standards, Chapter 4.2 and therefore a minimum foundation depth of 0.75m is required. Ground bearing floor slabs can be adopted where they are remote from trees and where Made Ground and Topsoil deposits are fully removed within the footprint of the building. During construction, competent chalk could rapidly lose structure/competency if exposed to water (i.e. heavy rain) especially where disturbance is also ongoing, such as tracking with machinery so careful consideration to construction methods is also required. It is recommended that a contractor familiar with similar ground conditions is used for construction works.
Drainage potential	Soakaways were performed on site within the Chalk with infiltration rates ranging between $2.42x10^{-4}$ and 1.4×10^{-5} m/s. However, the test failed in one trial pit indicating some variation in permeability. The Chalk was generally encountered as low and medium density and therefore for the purpose of soakaway design it is recommended that they are sited a minimum of 10m from foundations.
Chemical contamination and remedial requirements	Given the nature of the site and its history, a relatively large number of potential contamination sources have been identified. This investigation is preliminary (pre-purchase) and has been undertaken to target the main contamination sources identified and give good site coverage. Overall, the investigation has not identified any significant contamination on site. One elevated concentration of arsenic was identified, which is considered to be relatively localised. Made Ground was encountered, which included odours and staining but laboratory testing did not identify any elevated contaminants within these soils. At this stage therefore, no contamination has been identified and there are no remedial requirements for the site. However, it is acknowledged that some sources have not been investigated and given the nature of the site, localised areas of contamination cannot be discounted. It should also be noted that investigations around tanks and sub-stations has generally been limited to one shallow excavation. On this basis, there is a risk that localised contamination is present around tanks/pipework that has not been identified although significant contamination is considered low-likelihood.
Radon, gas risk and protection measures	The property is in a Lower probability radon area (less than 1% of homes are estimated to be at or above the Action Level). Therefore, no radon protective measures are necessary in the construction of new dwellings.

Topic	Commentary
	With the exception of the small, backfilled quarry, no sources of landfill gas have been identified and a gas monitoring visit did not identify any elevated concentrations of landfill gas. Investigations in the area of the quarry are recommended to determine the nature and extent of the backfill material and further gas monitoring may be required to refine the risk assessment local to the quarry.
Waste characterisation	General Made Ground has been classified as inert. Clean, uncontaminated natural soils are considered non-hazardous and inert without any testing required. Topsoil should be reused where possible as an alternative to landfill. Should any TPH impacted soils be encountered, further testing will be required and treatment may be needed prior to disposal. As the waste classifications provided are preliminary only and based on limited sampling of soils in-situ, it is recommended to undertake additional sampling and testing during the construction works to fully characterise the waste soils intended for disposal. Additional testing may also be recommended during any supplementary phases of investigation.
Recommendation for further works	A detailed UXO desk study to support the whole construction phase. Further ground investigation targeting possible contamination sources not yet investigated and refine the contamination assessment in other areas. Further investigations recommended in the area of the former quarry and incinerator building to confirm depth of Made Ground and refine the geotechnical appraisal. The Principal Contractor should have a discovery strategy in place in the event of exposing unexpected or previously unencountered contamination. A Materials Management Plan may be required to facilitate the reuse of soils on site.

1 Introduction

1.1 Scheme Outline

1.1.1 It is understood that proposals are for a residential development at the site although at the time of writing, the client has yet to purchase the site and therefore there are no specific plans.

1.1.2 The report is based on the outline project proposals and information set out above. Should the scheme change and/or following completion of specific development proposal design, then it will be necessary to review the conclusions and recommendations presented in this report.

1.2 Brief

1.2.1 This report has been prepared following instructions received from our Client, Lochailort Investments Limited. The overall brief of works is to:

i) Undertake a ground investigation at the site to establish the prevailing ground conditions and identify potential abnormal development constraints.
ii) Support any future planning application by assessing the potential risks from contamination at the site.
iii) Determine geotechnical parameters and provide a general geotechnical appraisal for the scheme.

1.2.2 The objectives of this report are outlined below:

i) Review and summarise desk study information.
ii) Undertake a land contamination Tier 1 preliminary risk assessment.
iii) Summarise the intrusive investigation works undertaken and associated laboratory testing.
iv) Present a ground model summarising the ground and groundwater conditions at the site including relevant geotechnical parameters.
v) Provide a geotechnical appraisal for the project and highlight key geotechnical issues that may impact upon the proposed scheme.
vi) Undertake a land contamination Tier 2 generic quantitative risk assessment.
vii) Provide recommendations to inform further works, an Options Appraisal and/or Remediation Strategy, should they be required.
viii) Provide a waste characterisation assessment of soils at the site for potential disposal to landfill.

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1.3 Definition of Scope

1.3.1 The phasing and scope of the ground investigation works is broadly defined by the following documents.

Title	Document Reference	Publisher	Investigation Scope
Code of practice for ground investigations	BS 5930: 2015	British Standards Institution	Phase 1: Desk study Phase 2: Preliminary investigation
Eurocode 7 — Geotechnical design Part 2	BS EN 1997-2: 2007	British Standards Institution	Preliminary Investigation
Investigation of potentially contaminated sites	BS 10175: 2011+A2:2017	British Standards Institution	Preliminary Investigation (desk study) Exploratory Investigation
Land contamination risk management	Online resource, updated April 2021	Environment Agency	Stage 1 Risk Assessment: Tier 1: Preliminary risk assessment Tier 2: Generic quantitative risk assessment

Table 1-1: Definition of Investigation Scope

1.4 Limitations

1.4.1 This report has been prepared with reasonable skill, care and diligence in accordance with the terms of our appointment, taking account of the manpower, resources, investigations and testing devoted to it by agreement with our Client**, Lochailort Investments Limited (Company number 05605197**). (the **'Client'**) It may relied upon by them and such associated companies of Lochailort Investments as are from time to time notified to us in writing.

1.4.2 This report may also be relied upon by:

Animal Health Trust (in Liquidation) (Royal Charter Company Number: RC000011 and Registered Charity Number: 209642) a[illegible]by[illegible]e Re[illegible]e[illegible]er[illegible]

a[illegible]d[illegible]

Andrew Burton Hughes a[illegible]d **Julian Paul Smith** [illegible]der[illegible]a[illegible]y[illegible]u[illegible]ber[illegible] a[illegible]e[illegible]r[illegible]apacity as joint receivers of the premises (the "**Receivers**").

[illegible]e[illegible]er[illegible]e **'Additional Parties'**[illegible]

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2 Desk Study

2.1 Sources of information

2.1.1 Reference has been made to the following sources of information:

- An Envirocheck Report and historical map records, presented as Appendix K.
- British Geological Survey (BGS) GeoIndex – Onshore database.
- BGS Sheet 189 (Scale 1:50 000) – Thetford (2010).
- Ordnance Survey OpenData
- Coal Authority Development and Specific Risk databases.
- Environment Agency open-source databases
- Google mapping services
- Interrogation of search engines for anecdotal information on the site history and other readily available online resources.

2.2 Site Description

2.2.1 The proposed development comprises Lanwades Park, Kentford, Newmarket and the post code for the site is CB8 7UA. The site is accessed from the B1506 which lies adjacent to the site's northern boundary.

2.2.2 A map showing the approximate site boundary is presented below, marked in pink. Lanwades Hall and surrounding land is not part of the site (outlined in red). A table summarising the key site features is presented below. A site plan is provided within Appendix A.

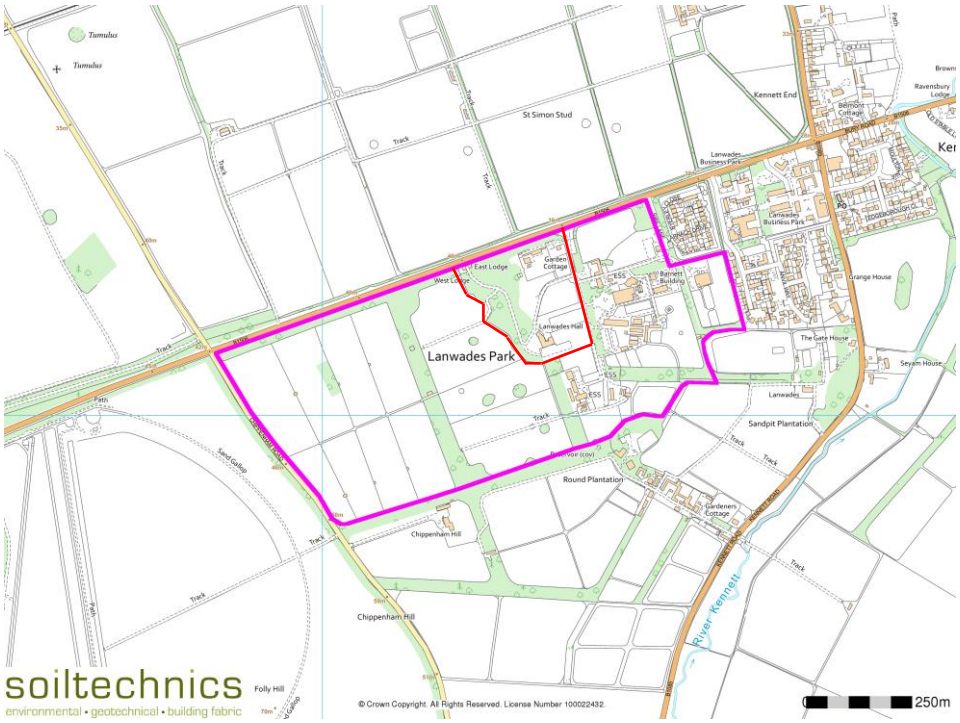


Figure 2-1: Site boundary

Theme	Feature
Current site use	The site is a former veterinary research and development campus (Animal Health Trust), comprising a mixture of buildings (laboratories, office accommodation and incinerator), access roads, hardstanding areas and grassed fields. The site is currently disused and unoccupied with the exception of a security presence. Buildings are present in the eastern half of the site and western half comprises fields.
Local area land use	Surrounding land to the north, west and south is predominantly open fields (paddocks, agricultural, horse training). Residential housing borders the site to the east. The site surrounds Lanwades Hall (wedding and events venue) and the B1506 is immediately adjacent to the northern boundary of the site.
Topography	The topography of the surrounding area generally falls gently to the north. A raised area is present to the north-east of the site, indicating some infilling may have occurred in this area.
Buildings, surfacing and other permanent features	Multiple buildings are present within the western half of the site associated with the former veterinary R&D campus, together with a number of storage sheds and gas canister storage holders. Hardstanding is present around some the buildings which appeared to have been formally used for parking, access roads and yards. Surfacing comprised a mixture of asphalt, paving slabs and gravel. A number of above ground tanks and electricity sub-stations were present on site.
Boundary features	The site boundaries are defined by hedgerows and timber post and rail fencing.
On-site / adjacent surface water features	None observed. The River Kennet lies 300m to the south-east of the site at its closest point.
Environmental Designations	The site is not reported to be within or in close proximity to any areas of designated sensitive land use, such as a Ramsar Site, Site of Special Scientific Interest (SSSI), or Special Area of Conservation.
Injurious and invasive weeds	None observed.
Asbestos containing material (ACM) in buildings	The scope of this report excludes identifying asbestos within buildings on site, and an asbestos survey was not made available at the time of writing. However, suspected corrugated ACM sheet roofing was observed on buildings throughout the site.
ACMs on site	No suspected ACMs were observed in any surface debris.
Potential sources of contamination	A number of above ground fuel tanks and electricity sub-stations were observed on site. It is also understood that the building to the far east of the site comprised an incinerator. A number of laboratories were present. Our client has also been informed of a possible “chemical dump” within the north-eastern corner of the site. A hydrocarbon odour was noted in the corner of a stable block adjacent to the north-western buildings. Possible oil leaks were also noted in two locations towards the centre of the site associated with tanks/pipework. Bunds/soil mounds are also present around the wooded area to the north-east of the site; the nature of the material used in their creation is unknown. General rubbish, disused machinery and barrels associated with the former site use were discarded on site, predominantly within storage buildings and gas canister holders. Given the former site use, there is a potential radiological risk on site. However, it is understood that all radiological materials have been removed from the site by specialists and therefore this risk is not considered further in this report. There is a potential risk of biological contaminants/pathogens specific to the former site use, which are likely to be predominantly present in drainage (as sludges etc.) The location of these contamination sources, and further sources identified within the desk study are presented on Drawing 03 in Appendix A.

Table 2-1: Site Description

2.2.3 The observations provided above are made by a Geoenvironmental Engineer, who is not a specialist in asbestos surveying or invasive weed identification. Any associated comments are intended for use by this report only, and not for any other purpose.

2.3 Planning Records

2.3.1 A search of online planning records held for the site by West Suffolk Council shows a number of planning applications associated with the eastern half of the site, associated initially with a centre for small animal studies and subsequently for clinical and research facilities for animal health. The applications include for yards, stables and barns as well as a pathology lab, extension of a generator building, relocation of a clinical waste bunker, construction of a hydrotherapy pool building and various other ancillary buildings/uses.

2.3.2 There are limited applications for the west of the site, all of which are for the erection of field shelters for horses and ponies.

2.3.3 A planning application for land to the immediate west was made for the redevelopment of a former pet care R&D site to commercial and subsequently residential housing. A ground investigation report for the site showed ground conditions to comprise Made Ground over sand and gravel (superficial deposits) with Chalk below. No significant contamination was identified.

2.4 Site History

2.4.1 Inspection of historical maps indicates the western half of the site has remained undeveloped open fields until present day, with sporadic small buildings (likely stables). The eastern part of the site has been gradually developed to the current configuration of Lanwades Park. A sewage filter bed and nursery were recorded in the north-eastern corner of the site and a small quarry was recorded in the southeast from the 1920s to the 1970s.

2.4.2 A chronological summary of the site's history is provided below.

Date	On-site	Off-site
Late-1800s	Site is recorded as open fields.	Surrounding land is predominantly rural with sporadic buildings. Small historical chalk and gravel pits are recorded 240m west and 250m southeast.
1920s	The north-eastern corner of the site is predominantly recorded as a sewage filter bed. A building and nursery are also recorded in this area. Remainder of site remains as fields, with the exception of some small buildings on the south-eastern boundary labelled as "electricity works". A small pit or localised earthworks is recorded within the south-eastern quadrant of the site.	Lanwades Hall and grounds is recorded adjacent to the site.
1930s to 1950s	Site recorded as Landwades Park although there is no obvious change in layout.	No significant change.
1970s to 1990s	A small animal centre is recorded to the south of Lanwades Hall. The sewage bed and nursery in the northeast are no longer recorded. Two tanks are recorded on the eastern half of the site.	A development is recorded to the immediate east of the site (possibly commercial).
Early-2000s	Additional buildings and access roads are present within the eastern half of the site. The layout is similar to that of present day.	No significant change.

Date	On-site	Off-site
2006 to present day	A building (former incinerator) is recorded in the far eastern part of the site.	Land to the immediate east is redeveloped for residential housing around 2010.

Table 2-2: Summary of site history

2.5 Regulatory Enquiries

2.5.1 Soiltechnics have requested the Local Authority Environmental Health to conduct a search of their records for any pertinent information they may hold for the site and surrounding area. They report three areas of the site, which are on the council's Part 2A inspection list and comprise a former sewage works, an above ground tank and a potentially backfilled pit on site.

2.5.2 A copy of their correspondence, including a plan of the above locations, is presented in Appendix L.

2.6 Anticipated Geology

2.6.1 Based on a review of available records, the site is anticipated to be underlain by the Holywell Nodular Chalk Formation and New Pit Chalk Formation (undifferentiated).

2.6.2 A summary of the anticipated geology underlying the site is summarised as follows:

Stratum	Bedrock / superficial	Anticipated thickness (m)	Typical description
Holywell Nodular Chalk Formation and New Pit Chalk Formation	Bedrock	60-70	White Chalk

Table 2-3: Summary of anticipated geology at the site

2.6.3 Although no superficial deposits are recorded on site, Lowestoft Formation (clay/silt/sand/gravel) is recorded to the immediate south of the site. Head deposits and River Terrace deposits are also recorded in the local area.

2.7 Hydrogeology and Groundwater Sensitivity

2.7.1 There are limited borehole records in the surrounding area but these suggest that groundwater is present at depth (20m+) within the Chalk Formation.

2.7.2 The site is located within a Source Protection Zone II (Outer Zone) with the far south-eastern corner within a Source Protection Zone I (Inner Zone) associated with an abstraction point located within the south-eastern corner of the site. The well is recorded as abstracting from the principal aquifer within the Chalk Formation for commercial use/general farming/spray irrigation.

2.7.3 There are no other active water abstractions within 1km of the site.

2.8 Hydrology and Surface Water Sensitivity

2.8.1 The River Kennett is located approximately 300m south-east of the site. There are no other surface water features located within 1km of the site.

2.8.2 There are no active surface water abstraction licenses within 1km of the site.

2.9 Flood Risk

2.9.1 The site falls within a Flood Zone 1 area. This designation indicates there is less than a 0.1% chance of flooding from rivers or the sea in any year.

2.9.2 The site is generally not recorded to be at risk from surface water flooding. However, two small areas to the northwest of the site the potential for surface water flooding during a 1 in 30 year flood event.

2.9.3 The site is recorded in area shown to have a limited potential for groundwater flooding to occur.

2.9.4 It should be noted that this information does not constitute a site-specific Flood Risk Assessment and one may be required for the scheme.

2.10 Non-Mining Ground Instability Hazard

2.10.1 The Envirocheck Report includes hazard ratings due to natural ground instability, which have been derived by the BGS. These hazards have been summarised in the table below.

Hazard	Hazard Potential	Discussions
Collapsible ground	Very low	N/A
Compressible ground	No hazard	N/A
Ground dissolution	Very low	N/A
Landslide	Very low	N/A
Running sand	Very low	N/A
Shrinking or swelling clay	Low	N/A

Table 2-4: Non-Mining Ground Stability Hazards

2.10.2 Although the report indicates a very low risk of ground dissolution, CIRIA report C574 *"Engineering in Chalk"* indicates that the presence of dissolution features should be expected on all calcium carbonate rich chalk sites. The Holywell Nodular Chalk Formation and New Pit Chalk Formation (undifferentiated) is considered rich in calcium carbonate and therefore dissolution features should be anticipated and requires further consideration.

2.11 Quarrying and Mining

2.11.1 The site falls outside of a Coal Mining Reporting Area.

2.11.2 A former pit is shown within the south-eastern part of the site between from the 1920s to the 1970s. This is also recorded as a BGS recorded mineral site and area of infilled ground. The pit is recorded as Round Plantation Pit and extracted chalk.

2.11.3 In addition, there are a number of other small chalk and gravel pits in the local area, with the closest located some 220m from the site. All of these are also recorded as potentially infilled ground.

2.12 Landfill and infilled ground

2.12.1 No landfills or areas of infilled ground are recorded in addition to the backfilled quarries detailed above.

2.13 Recent industrial activity

2.13.1 There are no regulated facilities or activities in the vicinity of the site under IPPC or LAPPC control however, there are registered radioactive substances recorded for use on site associated with the Animal Health Trust.

2.13.2 The site is in a primarily residential/rural area. As such there are a limited number of commercial and industrial properties in close proximity to the site. The following table summarises the Contemporary Trade Directory entries within 100m of the site.

Name	Direction	Distance from site	Activity
Elite Stationary	Northeast	0	Office furniture and equipment
J M Rose Farriers	Northeast	0	Farriers
Eastern Business System Ltd	Southeast	65	Photocopiers
B S A S Telecoms Ltd	Southeast	65	Telecommunications Equipment and systems

Table 2-5: Summary of Contemporary Trade Directory Entries

2.13.3 It is considered unlikely that an office equipment suppliers or a farriers will be a significant source of contamination. In addition, the businesses recorded to the southeast are located within a gated residential area and are therefore considered likely to be administration centres rather than commercial premises so also not considered to be potential contamination sources.

2.13.4 A commercial point of interest (tank) is however recorded on site to the south and is considered a possible source. This tank was not observed on site during our investigations so we have no further information as to its purpose.

2.13.5 As the site is not located in close proximity to a watercourse (>300m), records held of discharge consents are not considered relevant to this desk study.

2.13.6 One pollution incident is recorded but it is excess of 450m from the site and was recorded as a category 3 (minor) incident. On this basis, it is not considered to be a potential contamination source.

2.14 Radon

2.14.1 The site is in an area where the above ground Radon Affected Area status is classed as a Lower Probability Radon Area.

2.15 Unexploded Ordnance (UXO) Hazard Screen

2.15.1 A preliminary risk review has been undertaken by a UXO specialist to assess the risk of encountering UXO during ground investigation works undertaken by Soiltechnics only and to identify any precautionary measures required. It should be noted that the risk assessment has not been carried out fully in accordance with CIRIA report C785 'Unexploded Ordnance (UXO) A guide for the construction Industry'.

2.15.2 The risk review concluded that there is a credible risk of encountering UXO during the ground investigation.

3 Tier 1 Preliminary Contamination Risk Assessment

3.1 Objectives

3.1.1 The objective of this preliminary risk assessment (PRA) is to determine the suitability of the site for the proposed redevelopment and end users, in terms of the risk from contamination. The assessment comprises the following steps:

- Identify potential contaminant linkages (PCLs) between sources, pathways and receptors.
- To provide data to assist in the design of potential exploratory and detailed intrusive investigations and to give an early indication of possible remedial requirements, if necessary.

3.2 Evaluation Criteria

3.2.1 The following assessment is undertaken within the legislative framework of the planning system. Therefore, the assessment needs to identify if land contamination could pose an unacceptable risk to human health or the environment, within the context of the proposed development site. In the context of the existing site use, as a minimum, land should not be capable of being determined as 'contaminated land' under Part IIA of the Environmental Protection Act 1990.

3.2.2 The risk criteria for the proposed development is based on a 'minimal risk' approach, whereas under the existing land use a designation of 'contaminated land' would only apply if there is a significant possibility of significant harm (SPOSH).

3.3 Methodology

3.3.1 The objectives listed above are achieved by utilising the information presented within the desk study to develop an initial conceptual site model (iCSM) and identification of potential unacceptable risks. Depending upon the outcome of the Tier 1 assessment, it may be necessary to undertake a Tier 2 generic quantitative risk assessment (GQRA).

3.3.2 An iCSM relies upon the identification and assessment of PCLs. A contaminant linkage comprises of three key components:

- Source – a contaminant or pollutant that is in, on or under the land and that has the potential to cause harm or pollution.
- Pathway – Current and post-development routes by which a receptor is, or could be, affected by a contaminant.
- Receptor – Something that could be adversely affected by a contaminant, for example a person (current and proposed end users or neighbours), controlled waters and ecosystems.

3.3.3 The Tier 1 risk assessment has been produced with reference to the following guidance:

- 'Land contamination risk management' (EA, 2021).
- BS 10175:2011+A2:2017 'Investigation of potentially contaminated sites – Code of Practice'.
- CIRIA C552 'Contaminated land risk assessment- a guide to good practice', 2001.
- BS EN ISO 21365:2020 'Soil quality – Conceptual site models for potentially contaminated sites'
- BS 8576:2013 'Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds (VOC)'.

3.4 Source Assessment

3.4.1 The table below summarises identified sources based on the findings of the desk study. Where appropriate, further discussion has been provided in the paragraphs which follow.

Potential Sources	Contaminant(s) of concern	Detail	Viable source?
On-site sources			
Electricity works in the south-eastern corner in the 1920s	PCBs, oils, solvents, metals, asbestos	The electricity works appeared to comprise two small buildings. Although not labelled after the 1920s, the buildings are still recorded on 1990s mapping. Given the age of the works, PCBs are a possibility as are the other possible contaminants although likely to be highly localised to this area.	Y
Sewage filter works in north-eastern part of the site (1920s-1970s)	Metals, inorganics, micro-organisms	Sewage filter works recorded in the north-eastern part of the site until the 1970s. This area of the site has not undergone any significant change since this date so possible that some contaminants persist. In addition, it is included on the council's Part 2A inspection list and is listed for strategic inspection by the Local Authority, although this does not imply it is contaminated.	Y
Plant nursery in north-eastern part of the site (1920s-1970s)	Pesticides, herbicides, asbestos	Nursery recorded in the far north-eastern corner of the site. No evidence of buildings on site therefore presence of asbestos is considered unlikely. Chemical pesticides/herbicides likely to have been used and could be present in the area local to the former nursery.	Y
Tank recorded on historical from the 1970s	Hydrocarbons	Contents of tank unknown. It is included on the council's Part 2A inspection list and is listed for strategic inspection by the Local Authority, although this does not imply it is contaminated.	Y
Infilled quarry recorded on site to the east.	Metals, polycyclic aromatic hydrocarbons (PAH), asbestos	Nature of material used to infill the former quarry is unknown and could contain various contaminants. In addition, it is included on the council's Part 2A inspection list and is listed for strategic inspection by the Local Authority, although this does not imply it is contaminated.	Y
	Permanent ground gases (CH4 and CO2)	Depth and nature of material used to infill the former quarry is unknown and could include organic rich materials.	Y
Raised area/bund to the northeast	Various inorganic and organic compounds (hydrocarbons, metals, asbestos),	Nature of material in this area unknown and therefore considered to be a potential source of contamination.	Y

Potential Sources	Contaminant(s) of concern	Detail	Viable source?
Former animal health facility including laboratories (Animal Health Trust)	Various inorganic and organic compounds (hydrocarbons, metals, asbestos), radioactive materials, bio-hazard waste.	Buildings and laboratories restricted to the eastern half of the site and contamination could be present across this area and localised to specific areas depending on former use. It is understood that radioactive material has been removed off site by specialists and therefore no further consideration given.	Y
Former horse incinerator	PAH, metals, inorganics, TPH	The former incinerator is located to the east of the site and localised contaminants could be present. It is also not known where waste materials were disposed of and buried waste material may be present on site.	Y
Above ground fuel storage tanks noted during site reconnaissance (spills and leaks)	Petroleum hydrocarbons (TPH)	There are multiple tanks on site. Some are contained in a brick bund with concrete slab and others are not. No obvious visual or olfactory evidence of spillages were observed around the majority of these locations. However, localised contamination could be present associated with tanks and pipework.	Y
Electricity sub-stations	PCBs	A number of sub-stations are present on site, the age of which is unknown although it is likely they post 1970s (assuming they were built at the same time as the main facility) and therefore the risk from PCBs is likely to be low.	N
Areas of car parking	Petroleum hydrocarbons (TPH)	Multiple car parking areas are present on site. Minor leaks from parked vehicles may be present.	Y
Made Ground within the east of the site associated with development, past development and bunds.	Metals, polycyclic aromatic hydrocarbons (PAH), asbestos	The west of the site has remained undeveloped and is unlikely to have any significant Made Ground. Development of the eastern site has been limited to current buildings and therefore significant Made Ground is unlikely (with the exception of the infilled quarry) although some localised, shallow deposits may be present in and around buildings. Made Ground may also be associated with the former filter beds to the north-east.	Y
	Permanent ground gases (CH4 and CO2)	Elevated concentrations of ground gas generated from thick Made Ground with high levels of putrescible material considered unlikely based on history of the site (excluding the infilled pit)	N
Radon	Radon	The site is recorded as being in a Lower Probability Radon Area.	N
Carbonate rich deposits (chalk)	Permanent ground gases (CO2)	Carbonate rich materials can generate carbon dioxide due to natural geochemical and weathering processes. Typically, volume generated are low and do not pose a viable risk for developments.	N
Off-site sources			

Potential Sources	Contaminant(s) of concern	Detail	Viable source?
Adjacent former pet care R&D facility	Various inorganic and organic compounds (hydrocarbons, metals)	Site is immediately adjacent to subject site. Nature and use of buildings unknown but site was redeveloped into residential in 2010. Contamination assessment undertaken for planning indicates no significant contamination present.	N

Table 3-1: Contamination source assessment

3.5 Receptor Assessment

3.5.1 The following table summarises the identified receptors based on current site conditions and our understanding of the proposed end use:

Receptor Category	Principal Receptor	Receptor present?	Detail
Human health	Users of the current site	No	Although security is present on site, the site as a whole is disused.
	End user of the developed site	Yes	Site to be developed for residential purposes.
	Construction operatives and other site investigators	Yes	Site to be developed
	Adjacent site users and off-site members of the public	Yes	Public footpath and residential properties present adjacent to site.
Controlled waters	Surface waters	No	Surface waters are remote from the site, in excess of 300m distance.
	Groundwater	Yes	Principal Aquifer located within the Chalk with SPZ on site. Secondary Aquifers present to the south of the site within the Lowestoft Formation.
Sensitive ecosystems and species	Current site	No	Site is not currently within, or proposed to form, a designated environmentally sensitive area (e.g. SSSI, RAMSAR, AONB, SPA, SAC)
	Developed site	No	
Property	Soft landscaping (current)	Yes	Vegetation is present on site.
	Soft landscaping (proposed)	Yes	Proposed development is assumed to contain vegetation.
	Building materials	No	Concrete classification to be assessed under the geotechnical investigation.

Table 3-2: Receptor assessment

3.6 Pathway Assessment

3.6.1 The following table summarises the generic human health pathway assessment for the site, assuming a range of contaminant sources within the underlying soils. Source-specific pathways are considered within the iCSM in subsequent report sections.

Human Health Exposure Pathway	Disused Commercial land use with fields (current)	Residential land with private gardens (proposed)	Construction operatives	Adjacent Site Users
Ingestion, inhalation and dermal contact with soils and dusts	×	✓	✓	✓
Ingestion, inhalation and dermal contact with site derived dusts indoors	×	✓	✓	×
Ingestion of home-grown vegetables	×	✓	×	×
Inhalation of vapours in outside spaces	×	✓	✓	✓
Intrusion and inhalation of vapours indoors	×	✓	✓	×
Accumulation and Inhalation of ground gas in enclosed structures	×	✓	✓	×
Permeation into below-ground drinking water pipes	×	✓	×	×

Table 3-3: Generic pathway assessment

3.6.2 The following table summarises generic pathways for the site which could be viable for the identified controlled water receptors, given our understanding of the hydrogeological model and assuming a range of contaminants in the sub-surface.

Controlled Water Exposure Pathways	Current Setting	Proposed Setting	Mechanism
Site characteristics			
Leaching via infiltration through unsurfaced areas, and surface run-off	✓	✓	Mobilisation
Leaching via infiltration through cracks/joints in hardstanding areas and drainage infrastructure	✓	✓	Mobilisation
Leaching via saturation from groundwater flooding and shallow/perched groundwater bodies	×	×	Mobilisation
Infiltration through sustainable drainage systems	✓	✓	Mobilisation
Preferential lateral pathways (e.g. underground services)	✓	✓	Migration
Preferential vertical pathways (e.g. piling, vibro-stone columns)	×	×	Migration
Hydrogeological characteristics			
Vertical migration through permeable strata into shallow aquifers and perched groundwater bodies	×	×	Migration
Vertical migration through permeable strata into sensitive aquifers at depth	✓	✓	Migration
Lateral migration within shallow and perched groundwater bodies into surface waters	×	×	Migration

Table 3-4: Generic pathway assessment

3.7 Initial Conceptual Site Model (iCSM)

3.7.1 The table below presents our approach to the assessment of risks associated with PCLs. The categories below are based upon the definitions within CIRIA C552 (2001), with the addition of a 'negligible likelihood' scenario, which is to be used where there is no realistic scenario in which harm could occur.

3.7.2 The initial conceptual site model (iCSM) is presented within the following tables overleaf.

		Consequence of harm			
		Severe	**Medium**	**Mild**	**Minor**
Probability of harm	**High likelihood**	**Risk: Very high** (high – severe)	**Risk: High** (high – medium)	**Risk: Moderate** (high – mild)	**Risk: Moderate/Low** (high – minor)
	Likely	**Risk: High** (likely – severe)	**Risk: Moderate** (likely – medium)	**Risk: Moderate/Low** (likely – mild)	**Risk: Low risk** (likely - minor)
	Low Likelihood	**Risk: Moderate** (low – severe)	**Risk: Moderate/Low** (low – medium)	**Risk: Low** (low – mild)	**Risk: Very low** (low – minor)
	Unlikely	**Risk: Moderate/Low** (unlikely – severe)	**Risk: Low** (unlikely – medium)	**Risk: Very low** (unlikely – mild)	**Risk: Very low** (unlikely – minor)
	Negligible Likelihood	**Risk: Low** (negligible– severe)	**Risk: Very Low** (negligible– medium)	**Risk: Very Low** (negligible– mild)	**Risk: Negligible** (negligible– minor)

Table 3-5: iCSM Risk Ratings

RECEPTOR: PROPOSED END USERS				
Potential Source	Contaminants of Concern	Pathway	Tier 1 Risk Assessment (probability of harm x consequence)	Discussion
Electricity works in the south-eastern corner in the 1920s	PCBs, oils, solvents, metals, asbestos	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Moderate/Low** (low – medium)	Contaminants could be present in the soil associated with this former site use but likely to be relatively localized to this corner of the site.
Sewage filter works in north-eastern part of the site (1920s-1970s)	Metals, inorganics, pathogens	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Moderate** (likely – medium)	Sewage filter works recorded in the north-eastern part of the site until the 1970s. This area of the site has not undergone any significant change since this date so possible some contaminants still persist although likely to be local to this area.
Plant nursery in north-eastern part of the site (1920s-1970s)	Pesticides, herbicides, asbestos	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Moderate/Low** (low – medium)	Nursery recorded in the far north-eastern corner of the site. No evidence of buildings on site therefore presence of asbestos is considered unlikely. Chemical pesticides/herbicides likely to have been used and could be present in the area local to the former nursery.
Infilled quarry recorded on site to the east.	Metals, polycyclic aromatic hydrocarbons (PAH), asbestos	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Moderate** (likely – medium)	Nature of material used to infill the former quarry is unknown and could contain various contaminants. Likely to be localized to this area only.
	Permanent ground gases (CH4 and CO2)	Inhalation of vapours	**Risk: Moderate/Low** (low – medium)	Depth and nature of material used to infill the former quarry is unknown and could include organic rich materials capable of producing landfill gases. However, given the age of the infill and the small size of the quarry, it is likely any gases would only impact a small area of the site.
Raised area/bund to the northeast	Various inorganic and organic compounds (hydrocarbons, metals, asbestos),	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Moderate/Low** (low – medium)	Nature of material in this area unknown and therefore considered to be a potential source of contamination. However, such material is likely to be excavated out during any redevelopment.
Former animal health facility including laboratories (Animal Health Trust)	Various inorganic and organic compounds (hydrocarbons, metals, asbestos), bio-hazard waste.	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Moderate** (likely – medium)	Buildings and laboratories restricted to the eastern half of the site and contamination could be present across this area, including being associated with drainage runs.
	Radioactive materials	Radiation	**Risk: Low** (unlikely – medium)	Although radioactive materials have been used at the site, it is understood that these have all been removed by a specialist and therefore the risk is considered low.

RECEPTOR: PROPOSED END USERS				
Former horse incinerator	PAH, metals, inorganics, TPH, pathogens	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Moderate** (likely – medium)	The former incinerator is located to the east of the site and localized contaminants could be present. It is also not known where waste materials were disposed of and buried waste material may be present on site.
Above ground fuel storage tanks noted during site reconnaissance (spills and leaks)	Petroleum hydrocarbons (TPH)	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Moderate** (likely – medium)	There are a number of tanks around the site, some bunded and on concrete and others not. Risk of significant hydrocarbon contamination would depend on containment and condition of the tanks. Also, possible risk of contamination from any underground pipework. Vapours arising from gross hydrocarbon contamination could intrude into proposed buildings.
Areas of car parking	Petroleum hydrocarbons (TPH)	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Low** (low – mild)	Multiple car parking areas are present on site. Minor leaks from parked vehicles may be present. However, these are likely to be small-scale given cars wouldn't be parked in the same place for any significant period of time and therefore risk to end users is considered to be low.
Made Ground within the east of the site associated with development, past development and bunds.	Metals, polycyclic aromatic hydrocarbons (PAH), asbestos	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Moderate/Low** (low – medium)	Nature of any Made Ground on site is currently unknown and therefore it is considered a potential risk to end users of the site. However, with the exception of the built up area, filter beds and backfilled quarry detailed above, Made Ground is likely to be relatively thin and likely a limited source of contamination.

Table 3-6: iCSM – Proposed End Users

RECEPTOR: CONSTRUCTION WORKERS				
Potential Source	Contaminants of Concern	Pathway	Tier 1 Risk Assessment (probability of harm x consequence)	Discussion
General Made Ground associated with historical uses	Asbestos fibres and ACMs	Inhalation of dusts	**Risk: Moderate** (likely – medium)	If present, asbestos in soils can present an acute risk to construction workers, particularly during the enabling works phases. Very low and trace concentrations often pose a low risk if appropriate controls are put in place.
	Metals, PAHs, TPHs	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Low** (low – mild)	No gross contamination of high-risk contaminants anticipated (e.g. cyanide, benzene, and vinyl chloride). Standard PPE and hygiene protocols for working on brownfield sites are likely to be sufficient to the mitigate risk.

RECEPTOR: CONSTRUCTION WORKERS				
Historical site uses (electricity works, filter beds, nursery)	PCBs, oils, solvents, metals, asbestos, micro-organisms, pesticides and hert	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Low** (low – mild)	Areas of contamination likely to be relatively localized and no significant concentrations of high-risk contaminants anticipated (e.g. cyanide, benzene, and vinyl chloride). Standard PPE and hygiene protocols for working on brownfield sites are likely to be sufficient to the mitigate risk from these historical sources.
Infilled quarry recorded on site to the east.	Asbestos fibres and ACMs	Inhalation of dusts	**Risk: Moderate** (likely – medium)	If present, asbestos in soils can present an acute risk to construction workers, particularly during the enabling works phases. Very low and trace concentrations often pose a low risk if appropriate controls are put in place.
	Various inorganic and organic compounds	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Low** (low – mild)	No gross contamination of high-risk contaminants anticipated (e.g. cyanide, benzene, and vinyl chloride). Standard PPE and hygiene protocols for working on brownfield sites are likely to be sufficient to the mitigate risk.
	Permanent ground gases (CH4 and CO2)	Inhalation of vapours	**Risk: Moderate/Low** (low – medium)	If deep Made Ground is present and elevated gas concentrations, could be a risk of reduced oxygen within confined spaces. However, probability of significant gas producing material being present is considered low-likelihood at this stage.
Raised area/bund to the north-east	Asbestos fibres and ACMs	Inhalation of dusts	**Risk: Moderate** (likely – medium)	If present, asbestos in soils can present an acute risk to construction workers, particularly during the enabling works phases. Very low and trace concentrations often pose a low risk if appropriate controls are put in place.
	Metals, PAHs, TPHs	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Moderate** (likely – medium)	Nature of material in this area unknown and could contain contaminants associated with recent site use as a research facility.
Former animal health facility including laboratories (Animal Health Trust)	Asbestos fibres and ACMs	Inhalation of dusts	**Risk: Moderate** (likely – medium)	If present, asbestos in soils can present an acute risk to construction workers, particularly during the enabling works phases. Very low and trace concentrations often pose a low risk if appropriate controls are put in place.
	Various inorganic and organic compounds, bio-hazard waste.	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Moderate** (likely – medium)	Buildings and laboratories restricted to the eastern half of the site and contamination could be present across this area and localised to specific areas depending on former use. General contaminants may be present but also more specialised contaminants associated with the site use, which may require specialist treatment/removal.
Above ground fuel storage tanks noted during site reconnaissance (spills and leaks)	Petroleum hydrocarbons (TPH)	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Moderate** (likely – medium)	Hydrocarbon and BTEX contamination may be present associated with fuel tanks and pipelines.
Unexploded Ordnance	UXO	Direct contact / explosion	**Risk: Moderate** (low – severe)	The Hazard Screen indicates there may be potential for encountering UXO..Further risk assessment is required, to be undertaken by a specialist.

RECEPTOR: CONSTRUCTION WORKERS				
All other contamination sources	Metals, PAHs, TPHs	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Low** (low – mild)	Considered to be localized and not in significant concentrations. No gross contamination of high-risk contaminants anticipated (e.g. cyanide, benzene, and vinyl chloride). Standard PPE and hygiene protocols for working on brownfield sites are likely to be sufficient to the mitigate risk.

Table 3-7: iCSM – Acute Exposure to Construction Workers

RECEPTOR: ADJACENT SITE USERS FOLLOWING COMPLETION				
Potential Source	Contaminants of Concern	Pathway	Tier 1 Risk Assessment (probability of harm x consequence)	Discussion
All potential contaminant sources	Metals, PAHs, TPH, PCBs, pathogens, bio-hazard waste	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Moderate/Low** (low – medium)	Based upon the anticipated contaminant types and levels, and the distance to off-site structures, the chance of a pollutant linkage causing harm is considered low-likelihood. However, given the nature of the site, it cannot be discounted at this stage and further assessment of ground conditions and contamination levels is needed to refine the assessment.

Table 3-8: iCSM – Chronic Exposure to Adjacent Site Users

RECEPTOR: ADJACENT SITE USERS DURING THE CONSTRUCTION PHASE				
Potential Source	Contaminants of Concern	Pathway	Tier 1 Risk Assessment (probability of harm x consequence)	Discussion
All potential contaminant sources	Metals, PAHs, TPH, PCBs, pathogens, bio-hazard waste	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Moderate/Low** (low – medium)	Based upon the anticipated contaminant types and levels, and the distance to off-site structures, the chance of a pollutant linkage causing harm is considered low-likelihood. However, given the nature of the site, it cannot be discounted at this stage and further assessment of ground conditions and contamination levels is needed to refine the assessment.

Table 3-9: iCSM – Acute Exposure to Adjacent Site Users

RECEPTOR: PROPOSED PLANTING				
Potential Source	Contaminants of Concern	Pathway	Tier 1 Risk Assessment (probability of harm x consequence)	Discussion
Contaminants within topsoil and the shallow sub-surface	Metals, pH and inorganics	Direct contact and root uptake	**Risk: Negligible** (negligible– minor)	Much of the site is laid to grass and various trees are present and during our site reconnaissance there were no significant barren areas, signs of poor growth, or evidence of significant vegetative stress.

Table 3-10: iCSM – Phytotoxic Risk to Proposed Planting Scheme

RECEPTOR: CONTROLLED WATERS				
Potential Source	Contaminants of Concern	Pathway	Tier 1 Risk Assessment (probability of harm x consequence)	Discussion
All potential contaminant sources identified	Various	Leaching and vertical migration (Groundwater)	**Risk: Moderate/Low** (low – medium)	Potential leachable contaminants within the Made Ground and surface soils. There is a potential for contaminants to be mobilised through the infiltration of rainwater and to impact groundwater at depth.

Table 3-11: iCSM – Controlled Waters Risk

3.8 Preliminary Risk Assessment Conclusions and Recommendations

3.8.1 In terms of the proposed development scheme, a minimal risk approach applies, and PCLs have been identified which require further consideration. All the identified PCLs are restricted to the eastern half of the site. No PCLs have been identified to the west, therefore this part of the site is considered suitable for development without any further investigation works or remedial action taking place.

3.8.2 In particular the historical site uses, particularly use as an animal health facility, could give rise to a wide range of contaminants. Further intrusive investigation works are recommended to further refine the assessment and to determine if any remedial measures are necessary.

3.8.3 No radon protection measures are necessary. Given the number of tanks on site and the potential for localised fuel contamination, there is considered a potential risk from vapour intrusion. There is also considered a potential risk from landfill gases associated with the backfilled quarry on site. Intrusive fieldworks are recommended to include a gas monitoring regime to further refine the risk and determine if ground gas protection measures are required.

3.8.4 Overall, each PCL identified as posing a risk of 'Moderate/Low' or higher should be considered as part of an intrusive Tier 2 generic quantitative risk assessment (GQRA). The following table summarises the principal receptors at risk which require further investigation to support the proposed development.

Receptor Category	Principal Receptor	PCL Present Requiring Further Investigation?
Human health	Current site users	No
	Proposed site users (soils, dusts, and vapour)	**Yes**
	Proposed site users (permanent ground gas)	**Yes**
	Proposed site users (radon)	No
	Adjacent site users and off-site members of the public (during the long-term use of the site)	**Yes**
	Adjacent site users and off-site members of the public (during the construction phase)	**Yes**
	Construction operatives	**Yes**
Controlled waters	Surface waters	No
	Groundwater	**Yes**
Property	Soft landscaping (current)	No
	Soft landscaping (proposed)	No
	Potable infrastructure	**Yes**
	Building materials	To be considered by the specifier

Table 3-12: Receptors at Risk Under The Proposed Scheme

3.8.5 In view of the above, potential PCLs are limited to the east of the site only where the site has been developed as an animal health research facility. The western half of the site has remained open fields/paddocks since the earliest available mapping and so the western site area is not considered to contain potential PCLs.

4 Ground Investigation

4.1 Objectives

4.1.1 The ground investigation scope and location of exploratory holes was determined by Soiltechnics Ltd, based upon our overall brief outlined in Section 1.

4.1.2 The objectives of the fieldwork were to:

a) Establish ground and groundwater conditions at the site.
b) Obtain samples for subsequent laboratory testing.
c) Install gas and groundwater monitoring wells and undertake a programme of monitoring visits.

4.1.3 Based on the Tier 1 assessment, potential PCLs are limited to the east of the site only where the site has been developed as an animal health research facility. The western half of the site has remained open fields/paddocks since the earliest available mapping. On this basis, fieldwork was limited to the the eastern part of the site only.

4.2 Fieldwork summary

4.2.1 Fieldwork was undertaken between 21st and 25th November 2022.

4.2.2 A summary of the works completed is set out in the table below, along with the location of the exploratory logs. The exploratory hole location plan is presented within Appendix A.

Exploratory Hole Logs	Method	Qty	Final Depth Range (m bgl)	Comments
Appendix B	Hand Pits	9	0.3 – 1.3	Terminated at scheduled depth.
Appendix B	Machine-excavated trial pits	15	1.2 – 3.50	Trial pits terminated at scheduled depth.
		1	0.7	Trail pit terminated due to presence of service (cable)
Appendix C	Dynamic windowless sampling boreholes	11	1.2 – 3.6	Boreholes terminated due to competency of ground and refusal of sampling equipment.

Table 4-1: Summary of fieldwork undertaken

4.2.3 All soils encountered were described in accordance with BS EN ISO 14688 "Identification and Classification of soil" and in accordance with CIRIA C574 'Engineering in chalk'.

4.3 Unexploded Ordnance (UXO)

4.3.1 In the absence of a UXO Risk Assessment in accordance with CIRIA C681, Soiltechnics commissioned a UXO specialist to undertake a preliminary risk review for the purpose of the ground investigation works phase only.

4.3.2 The review concluded that the UXO risk to the ground investigation works was moderate within the site boundary, and therefore the works were supervised by a UXO specialist.

4.4 Sampling

4.4.1 During the fieldwork, sampling of soil, rock and groundwater for geotechnical purposes has been undertaken in accordance with BS EN ISO 22475-1 *"Geotechnical Investigation and testing – sampling by drilling and excavation and groundwater measurements".*

4.4.2 Samples collected for chemical analysis have been taken and handled in accordance with BS ISO 18400-105:2017 *"Soil quality — Sampling Part 105: Packaging, transport, storage and preservation of samples".*

4.4.3 Various sampling and sub-sampling methodologies have been adopted as appropriate, with the primary aim of obtaining the highest quality sample class practicable.

4.4.4 Untested chemical and geotechnical samples will be held for a period of 4 weeks from the date of the first report issue, after which they will be disposed of with no further notice.

4.5 In-situ Testing

4.5.1 The following table summarises the field testing carried out. The results are summarised on individual exploratory hole logs where appropriate and detailed within the Appendices indicated.

Tests	Qty	Applicable standard / guidance	Location of Results
Standard penetration test (SPT)	19	BS EN ISO 22476-3	Included within logs Detailed in Appendix D
Pocket penetrometer	15	Manufacturer's instructions	Included within logs Detailed in Appendix D
Soakaway test	5	BRE 365	Appendix E

Table 4-2: Summary of field testing undertaken

4.6 Monitoring Installations

4.6.1 Instrumentation installed within exploratory holes during the fieldwork are shown on the logs within Appendix B and are summarised below:

Installation type	Target Stratum	Qty	Exploratory hole ID
Gas and groundwater monitoring well	Quaternary Deposits and Chalk	4	WS03, WS05, WS07, WS09

Table 4-3: Summary of monitoring installations

4.7 Monitoring visits and groundwater sampling

4.7.1 A summary of the gas and groundwater spot monitoring visits undertaken is outlined in the table below. Results of the post fieldwork monitoring are presented in Appendix G.

4.7.2 The preliminary risk assessment is low but to provide quantitative data to support this assessment, we have undertaken a single round of monitoring, outline below.

Date	Purpose
06/12/2022	Gas and groundwater spot monitoring

Table 4-4: Summary of post fieldwork spot monitoring

4.8 Investigation Constraints

4.8.1 Investigation was undertaken pre-purchase and therefore works were designed to limit damage as much as possible. Machine excavated trial pits were undertaken within fields only. Windowless sampler boreholes and hand pits were undertaken around buildings and car parking areas to reduce damage. Hand pits were undertaken within areas not accessible to mechanical excavation equipment.

5 Laboratory testing

5.1 Overview

5.1.1 Samples obtained from exploratory holes were sent to independent accredited laboratories for geotechnical and chemical testing.

5.2 Geotechnical Testing

5.2.1 The geotechnical testing schedule was prepared by Soiltechnics using a targeted and judgemental approach, based upon the scheme proposals and our initial understanding of the ground conditions.

5.2.2 Geotechnical laboratory test results are presented in Appendix F, and the total number of geotechnical tests undertaken is summarised below:

Qty	Test
4	Moisture content
4	Atterberg limits
1	Particle size distribution (coarse)
3	Intact dry density
2	BRE SD1 Suite A
2	BRE SD1 Suite B
1	BRE SD1 Suite D

Table 5-1: Summary of geotechnical laboratory testing

5.3 Chemical Testing

5.3.1 The chemical testing schedule was prepared by Soiltechnics using a targeted and judgemental approach, based upon the initial conceptual site model and fieldwork observations. It should be noted that, due to the nature of the former activities on site, industry specific contamination may still be present (e.g biohazard wastes, pathogens) that have not been tested for at this stage. Although such contaminants will likely degrade with age, some additional testing of these contaminants may be required should purchase and development of the site proceed. This is further elaborated on within subsequent report sections.

5.3.2 Chemical laboratory test results are presented in Appendix H, and the total number of chemical tests undertaken is summarised below:

Sample Type	Qty	Testing	Suite Name
Soils	10	*Basic Contamination Suite* [metals, cyanides, PAHs, phenol]	ST Suite 1
	4	*Comprehensive Contamination Suite* [metals, cyanides, PAHs, TPH CWG, (S)VOCs & inorganics]	ST Suite 17
	1	*PCB (WHO-12)*	-
	4	Total EPH	-
	14	Asbestos screening	-
	2	Full WAC Suite (2-stage leachate)	-

Table 5-2: Summary of chemical laboratory testing

6 Ground Investigation Findings

6.1 Ground Model

6.1.1 Ground conditions encountered were relatively consistent across the site and were broadly in line with those anticipated from the desk study.

6.1.2 The tables below present our generalised interpretation of geological and hydrogeological conditions at the site. Unless otherwise stated in subsequent interpretive report sections, this represents the adopted ground model.

6.1.3 Further detail about the ground conditions encountered is provided in the relevant sub-sections below.

Stratum	Brief description	Top depth range (m bgl)	Adopted model top depth (m bgl)	Adopted model thickness (m)
Topsoil	Dark brown gravelly sandy clay, gravel is flint.	G.L.	G.L.	0.4
Made Ground	Light brown and grey sandy gravelly clay with gravel of chalk, flint and brick.	G.L. – 0.3	G.L.	Generally absent but extending in excess of 1.2m in one location.
Quaternary Deposits	Brown and light brown clayey gravelly sand and soft gravelly very sandy clay. Gravel is flint and chalk.	0.10 –0.60	0.51	1.5
Holywell Nodular Chalk Formation and New Pit Chalk Formation	Structureless chalk composed of sandy gravelly clay.	0.3 – 2.90	1.80	>3m

Table 6-1: Ground Model

Type	Stratum	Groundwater depth and range
Confined water	Quaternary Deposits	0.8m

Table 6-2: Hydrogeological Model

6.2 Topsoil

6.2.1 Topsoil was encountered in all exploratory holes, with the exception of HP02, HP03 and TP04. The base of the unit varied between 0. 1m and 1.0m thick. The Topsoil comprises dark brown, gravelly, sandy clay with gravel consisting of flint.

6.2.2 A typical photograph of topsoil deposits encountered is presented below.

Figure 6-1: Topsoil within TP15

6.3 Made Ground

6.3.1 Made Ground is present to the east of the site, in five locations. Two of the locations are to the north of the former incinerator with Made Ground extending to depths in excess of 0.5m and 1.2m respectively. A thin layer is also present in WS07, located adjacent to the north-easternmost building. Made Ground is also present adjacent to and within the raised bund to the north-east of the site.

6.3.2 Made Ground is variable but generally comprises grey and light brown, slightly sandy to sandy, clayey gravel or gravelly, slightly clayey sand and light brown and light grey, slightly sandy, slightly gravelly clay. Gravels consist of chalk, flint, brick, clinker, concrete and sandstone. Occasional wood and fabric are present in the cohesive deposits in TP04 to the north of the incinerator building. Staining and a strong hydrocarbon odour were also noted between 0.6m and 1.20m in this area.

6.3.3 Photographs of the Made Ground encountered are presented below.

Figure 6-2: Made Ground in HP03

Figure 6-3: Made Ground in TP04

Figure 6-4: Made Ground in HP09 (raised/bunded area to the northeast)

6.4 Quaternary Deposits

6.4.1 Superficial, Quaternary Deposits are present across the site and extend to depths between 0.5m and 2.7m, with a general thickening toward the south and east. Generally, it is less than 2m thick.

6.4.2 The Quaternary Deposits generally comprise orangish brown and light brown, gravelly sands, with gravels consisting of flint and chalk. However locally, more cohesive soils were encountered comprising soft to firm, light brown sandy gravelly clay. Generally, the clay soils overlay the sands and did not extend beyond 1m depth. The exception is TP10, located towards the centre of the site, where deeper deposits were encountered (to 2.7m) and soils comprised sand over clay.

6.4.3 Such deposits are likely to be part of the Lowestoft Formation, though the variability and locally low strength provides some doubt, with such deposits also reminiscent of alluvial and/or Head deposits and as such have been given the more generic term of Quaternary Deposits.

6.4.4 A typical photograph of the Quaternary Deposits encountered is presented below.

Figure 6-5 Quaternary Deposits taken from TP14.

6.5 Chalk

6.5.1 Chalk was encountered across the site. The base of this unit was not penetrated and therefore the thickness is unknown.

6.5.2 Generally, the Chalk Formation comprised structureless chalk composed of sandy gravel with varying concentrations of clay (Grade Dc). Gravels were weak to moderately weak, low to medium density and varied in colour from light brown to white. Occasional to frequent flint gravels were also present. In two boreholes, the Chalk comprised a gravelly sandy clay (Grade Dm). However, SPTs refused at the base of the boreholes suggesting more competent Grade Dc soils below.

6.5.3 A typical photograph of the Chalk encountered is presented below.

Figure 6-6: Chalk – Grade Dm from WS03

Figure 6-7 Chalk - Grade Dc from TP12

6.6 Groundwater

6.6.1 Groundwater was not encountered in any of the excavations with the exception of WS07, with details presented below.

Exploratory hole ID	Groundwater observation
WS07	Groundwater encountered at 0.8m. Standing at 1.9m after 6 hours

Table 6-3: Summary of groundwater observations during the fieldworks

6.6.2 A summary of the groundwater level data obtained during the monitoring phase is presented below and is detailed within Appendix G.

Targeted strata / Aquifer	Exploratory hole ID	Instrument Type(s)	Water depth (m bgl)
Quaternary Deposits and Chalk	WS07	Well	1.95
Quaternary Deposits and Chalk	WS03	Well	Dry
Quaternary Deposits and Chalk	WS05	Well	Dry
Quaternary Deposits and Chalk	WS09	Well	Dry

Table 6-4: Summary of groundwater monitoring visits.

6.6.3 Superficial deposits were encountered across the site despite not being recorded on geological maps. Groundwater was encountered in one location suggesting there may be pockets of confined water or shallow water seepages within these deposits and some limited water strikes should be expected.

6.6.4 Groundwater levels are expected to vary seasonally and in response to recent weather conditions. Long term monitoring will provide a reasonable quantification of such variation.

6.7 Evidence of Possible Contamination

6.7.1 The table below summarises the potential contamination noted during the ground investigation works.

Exploratory hole ID / Area	Depth of observation (m bgl)	Stratum	Description
TP04	0.0-1.2	Made Ground	Made Ground with anthropogenic material
	0.60	Made Ground	Strong hydrocarbon odour and staining between 0.6-1.1m
WS07	0.30 – 0.40	Made Ground	Grey gravel of flint and brick
HP03	0 – 0.30	Made Ground	Light brown gravel of flint, brick and clinker
HP09	0.0-1.3	Made Ground	Made Ground with anthropogenic material

Table 6-5: Summary of potential contamination noted during the investigation works

6.8 Obstructions and Instability

6.8.1 The table below summarises the obstructions encountered that affected the progress of the investigation works.

Strata / Area	Depth range (m bgl)	Issue	Description
Quarternary deposits and Chalk	1.20 – 3.60	Obstruction to WLS rig	Hard stratum. Dense sands and gravels and competent chalk, leading to drill refusal.

Table 6-6: Summary of obstructions and instability encountered during the investigation works

6.8.2 The general stability of trial pits during excavation are also recorded on the trial pit logs. Generally, trial pits were upright and stable.

7 Geotechnical Discussion

7.1 Scheme Overview

7.1.1 The following assessments are made on the investigatory data presented in the preceding sections of this report and are made with reference to the specific nature of the development. Should scheme proposals change then it is recommended that the validity of the conclusions of this report in relation to the revised scheme are checked.

7.1.2 The project will comprise a residential development, although at the time of writing, there are no specific proposals.

7.1.3 In view of the scheme proposals, the geotechnical elements considered in this report are outlined below:

a) Building foundations
b) Drainage
c) Pavement
d) Floor slab

7.2 Geotechnical Category

7.2.1 In accordance with BS EN1997-1:2004 + A1:2013 (Eurocode 7), the project is designated as Geotechnical Category 2. This category includes projects with *conventional types of structures and foundations with no exceptional risk, or difficult ground or loading conditions*. Furthermore, *routine design procedures* are appropriate.

7.2.2 It should be noted that this Report does not constitute a Geotechnical Design Report (GDR) as defined in Eurocode 7. Accordingly, a GDR should be prepared by the designer during the detailed design phase

7.3 Key Geotechnical Issues

7.3.1 In view of the ground conditions, the following list summarises the key geotechnical issues that may impact the scheme and will therefore need to be appropriately managed during the lifecycle of the project:

- Made Ground
- Groundwater
- Chalk: Dissolution features and susceptibility to water
- Existing foundations

7.4 Made Ground

7.4.1 No significant Made Ground was encountered across the majority of the site. However, Made Ground to depths in excess of 1.2m was identified to the north of the incinerator building and around the northern most building and bund area to the north-east. The extent of it is unknown. These deposits are unsuitable for supporting concentrated foundation loads and foundations should extend, as a minimum, through such deposits. On this basis, additional investigations are likely to be required in this area to confirm lateral and vertical extent of such deposits. Should they extend in excess of 2.5m, a traditional spread foundation solution may not be viable in this area and an alternative, such as piling might be recommended. Alternatively, it may be proposed not to put buildings in this area.

7.4.2 Based on historical maps, a backfilled quarry is likely to be present on site as indicated by the red circle on Figure 7-1. This area lies below an existing building and access way and investigations have not been undertaken in this location at this time. This is likely to be an area of deep Made Ground and may require further investigation depending on development proposals. Again, a piled foundation solution may be required in this area should buildings be proposed over the former quarry.

Figure 7-1: Mapping overlays from 1926 and 2006 showing existing layout and location of former quarry

7.5 Groundwater

7.5.1 It is anticipated that significant groundwater will not be encountered during foundation excavations. However, we have observed an inflow in one location within the Quaternary Deposits and therefore localised seepages should be anticipated within shallow soils. We anticipate water, if/where encountered at shallow depth, will be controllable with standard pumping techniques.

7.5.2 Groundwater levels are expected to vary seasonally and in response to weather events.

7.5.3 The inflow of groundwater into excavations may lead to instability and excavation collapse, particularly within any looser sand deposits or Made Ground.

7.6 Chalk: Dissolution Features and susceptibility to water

7.6.1 Reference has been made to CIRIA report C574 *"Engineering in Chalk".* That report indicates that the presence of dissolution features should be expected on all calcium carbonate rich chalk sites. The Holywell Nodular Chalk Formation and New Pit Chalk Formation (undifferentiated) is considered rich in calcium carbonate and therefore dissolution features should be anticipated.

7.6.2 Dissolution features pose a hazard to foundations because of the presence of one or more of the following features, which are generally located above the groundwater table:

i) Large variations in intact chalk horizon
ii) Loose chalk or superficial deposits infilling pipes
iii) Cavities or caves within the chalk
iv) Dissolution widened discontinuities in the chalk affecting its load carrying capacity

7.6.3 The risk that these hazards present to a building relates to its vulnerability, which in turn relates to the foundation type. A building on shallow spread type foundations and ground bearing floors is more vulnerable than piled foundations extending through the base of these features supporting a suspended ground floor slab. A qualitative risk assessment has been undertaken and summarised below:

Item	Observation / enquiry	Assessed risk
Surface features	None observed	Low
Variation in density of near surface soils	Uniform density of near surface deposits	Low
Variation in intact chalk horizon	Depth generally between 1-2m with minor variation across the site	Low/medium
Adverse movement in nearby buildings	None recorded	Low
Envirocheck database	Recorded as no hazard to very low hazard	Low
Enquiries to Local Authority building control	Was not mentioned in correspondence and internet searches have not identified any report incidents.	Low

Table 7-1: Qualitative risk assessment of dissolution features

7.6.4 Based on the above, the risk of the site being subject to dissolution features is considered low. Although the risk is considered low, there remains a residual risk that dissolution features could be encountered in the construction phase, identified by voiding or locally loose soil. Accordingly, it is recommended that formation levels be inspected by a suitably competent geotechnical engineer.

7.6.5 During construction, competent chalk could rapidly lose structure/competency if exposed to water (i.e. heavy rain) especially where disturbance is also ongoing, such as tracking with machinery so careful consideration to construction methods is also required. It is recommended that a contractor familiar with similar ground conditions is used for construction works.

7.7 Effect of existing development on new foundations.

7.7.1 Demolition of the existing buildings and removal of existing foundations will disturb near surface soils requiring new foundations to extend into soils which have not been disturbed. Foundations in some areas will therefore need to extend beyond the minimum foundation depth required in order to penetrate Made Ground and extend into the natural deposits.

7.8 Building Foundation Strategy

7.8.1 In view of the key geotechnical issues discussed above and anticipated loadings, spread foundations are considered suitable for the project. If further investigations identify any areas of deep Made Ground (backfilled quarry, around the incinerator), alternative foundations may be required but this would be discussed in any future report.

7.9 Geotechnical Parameters

7.9.1 Characteristic values of geotechnical parameters have been derived, in accordance with Eurocode 7. The following tables present the recommended characteristic values for the strata encountered:

Variable	Characteristic value	Derivation
Weight density above water table, γ_b (kN/m^3)	18	BS8004:2015 Figure 1
Critical state angle of shearing resistance, ϕ_{cv} (°)	30	BS8004:2015 Equation 4

Table 7-2: Summary of characteristic geotechnical parameters – Quaternary Deposits

Variable	Characteristic value	Derivation
Weight density above water table, γ_b (kN/m^3)	18	BS8004:2015 Figure 1
Undrained shear strength, c_u (kN/m^2)	140	In situ testing
Undrained deformation modulus, E_u (MN/m^2)	7333.33	In situ testing

Table 7-3: Summary of characteristic geotechnical parameters – Chalk Grade Dm

7.10 Spread Foundations

7.10.1 Both the Quaternary Deposits and Chalk are considered to be of non-plastic or of low volume change potential when classified in accordance with NHBC Standards, Chapter 4.2. Accordingly, and in isolation of other considerations affecting foundation depth, foundations should be founded at a **minimum depth of 0.75 mbgl** to penetrate the zone of shrinkage and swelling caused by seasonal wetting and drying.

7.10.2 All foundations should extend through any Made Ground and into the underlying Quaternary Deposits by a minimum of 0.3m.

7.10.3 Ultimate limit state analyses (bearing capacity) for Quaternary Deposits have been undertaken in accordance with the approach outlined in Annex D of Eurocode 7 to derive the following design bearing resistances:

Type	Size / width (m)	Founding depth (m BGL)	Founding stratum	Bearing resistance	
				Combination 1	Combination 2
Strip	0.45	0.75	Quaternary Deposits	325 kN/m^2	235 kN/m^2
Strip	0.6	0.75	Quaternary Deposits	325 kN/m^2	235 kN/m^2
Strip	0.9	0.75	Quaternary Deposits	325 kN/m^2	235 kN/m^2

Table 7-4: Summary of foundation ultimate limit state analyses

7.10.4 Serviceability limit state (SLS) has been assessed by undertaking settlement analyses in accordance with the approach outlined in Annex F of Eurocode 7 and adopting the following variables:

Stratum	Variable	Value adopted	Derivation
Quaternary Deposits	SPT N Value	10	In situ testing
	Coefficient of volume compressibility, m_v (m^2/MN)	0.2	Literature
	Geological factor, μ_g	1	Literature

Table 7-5: Key geotechnical variables used in settlement analyses – Quaternary Deposits

7.10.5 It should be noted that the above values are reasonably conservative and based on relatively limited insitu testing in the near surface Quaternary deposits (generally due to their sandy nature and competence). If the following bearing resistances are insufficient, some further assurance testing may be possible within the shallow soils which might enable a refinement of the values provided.

7.10.6 The proposed loads are not known at this stage. Accordingly, the maximum bearing pressures have derived to ensure settlement is less than 25mm, which is typically adopted as a maximum tolerable limit. The following table summarises the results.

Foundation type	Founding Stratum	Size / width (m)	SLS bearing resistance
Strip	Quaternary Deposits	0.45	220 kN/m^2
Strip	Quaternary Deposits	0.6	170 kN/m^2
Strip	Quaternary Deposits	0.9	110 kN/m^2

Table 7-6: SLS bearing resistance to ensure total settlement to <25mm – granular Quaternary Deposits

7.10.7 Chalk is not specifically covered in Eurocode 7 or associated documents such as BS8004. Being a rock (or weak rock) the modulus and density of chalk are the driving factors in establishing an allowable bearing capacity of spread foundations limiting settlements to acceptable levels. Chalk has four classification types A to D, with class A to C relating to intact rock, (A being the strongest) and D being the more weathered classification.

7.10.8 Based on investigations completed at this site, and with reference to CIRIA C574 *"Engineering in Chalk"*, foundations will be constructed on chalk deposits which are conservatively considered to be medium density Grade Dc chalk.

7.10.9 Again, with reference to C574 **the suggested allowable bearing pressure for a grade Dc chalk is 225kN/m^2**. At this stress, the settlement is not anticipated to exceed 10-15mm.

7.10.10 Differential settlement is dependent upon the variation of loads imposed on the ground and consistency of the foundation supporting ground. Assuming foundation loads are reasonably uniform and in line with the values outlined above, it is estimated that differential settlement is unlikely to exceed say 25mm. It is likely settlement will be substantially achieved within say 10 years of construction.

7.10.11 It is anticipated that excavations to founding levels will encounter both fine grained and coarse grained soils. Whilst these soils will ultimately generate similar amounts of total settlement under applied foundation loads, the rate at which settlement will occur will differ. Granular soils will produce settlements almost immediately after loads are applied whereas fine grained soils continue to consolidate several years after completion of construction. Accordingly, traversing mixed soil types will be subject to differential settlement. **To minimise the effects of such movement it is recommended that foundation excavations are located on a single geological horizon (Quaternary Deposits or Chalk) and that they are reinforced.**

7.10.12 It should be noted that foundation design is iterative. Accordingly, a final check of ultimate and serviceability limit states should be undertaken following confirmation of foundation size and loads.

7.11 Residential Ground Floor Construction

7.11.1 Ground bearing floor slabs can be adopted where they are remote from trees and where Made Ground and Topsoil deposits are fully removed within the footprint of the building. Following completion of excavations to formation levels it is recommended that the formation is proof rolled to identify any soft areas, which if encountered should be excavated and replaced with suitably compacted engineered fill. It is further recommended that a layer of durable, well graded compacted granular material be placed prior to construction of the floor slabs.

7.11.2 In areas close to existing major vegetation at the site (or where ground floors are elevated requiring in excess of 600mm of fills) then it is recommended that suspended ground floors are adopted with a sub floor void determined in accordance with NHBC Standards.

7.11.3 Consideration should also be given to the loss of structure/competency in the Chalk if present at formation levels and exposed to water (i.e. heavy rain) especially where disturbance is also ongoing. It is recommended that a contractor familiar with similar ground conditions is used for construction works. In wet weather, we would recommend rolling ahead of floor formation.

7.12 Aggressiveness Of Ground To Buried Concrete

7.12.1 The aggressiveness of the ground with respect to buried concrete has been assessed in accordance with Building Research Establishment Special Digest 1: Concrete in Aggressive Ground Third Edition (2005).

7.12.2 The site is interpreted to be a brownfield site where pyrite is unlikely to be present in the natural soils but may be present in the limited Made Ground identified in this investigation.

7.12.3 Laboratory testing has been undertaken on soil samples obtained from the investigation works.

7.12.4 The Made Ground identified is classified as 'disturbed' ground. Accordingly, the amount of oxidizable sulphides has also been considered when categorising the strata.

7.12.5 The classification of all strata is tabulated below:

Stratum	Disturbed / Undisturbed	Design sulphate class	Aggressive chemical environment for concrete class
Topsoil	Undisturbed	DS-1	AC-1
Made Ground	Disturbed	DS-1	AC-1
Quaternary Deposits	Undisturbed	DS-1	AC-1
Chalk	Undisturbed	DS-1	AC-1

Table 7-7: Summary of the aggressiveness of the ground to buried concrete

7.12.6 It should be noted that at this stage, the above is based on limited testing of each soil type. Further testing of all soil types is recommended should the site be purchased and the development proceed to confirm that above assessments.

7.13 Drainage

7.13.1 Infiltration testing has been undertaken at the site in accordance with BRE 365: Soakaway Design (2016). The results are presented as Appendix E and summarised below:

Exploratory hole ID	Stratum tested	Cycle	Infiltration rate (m/s)
TP01	Chalk	1	$1.99x10^{-4}$
		2	$2.42x10^{-4}$
		3	$2.29x10^{-4}$
TP02	Chalk	1	Test failed
TP03	Chalk	1	$1.40x10^{-5}$ *(data extrapolated)*

Table 7-8: Summary of infiltration test results undertaken in accordance with BRE 365

7.13.2 Concentrated ingress of water into Chalk can initiate new dissolution features, particularly in low density Chalk, and destabilise loose backfill of existing ones. For this reason and following recommendations contained in CIRIA report C574 *'Engineering in Chalk'*, soakaways should be sited away from foundations for structures, roads or railways, as indicated below:

- In areas where dissolution features are known to be prevalent, soakaways should be avoided if at all possible, but if unavoidable, should be sited at least 20m away from any foundations.
- Where chalk is of low density, or its density is not known, soakaways should be sited at least 10m away from any foundations.
- Where chalk is of medium density (or higher) the closest part of the soakaway should be at least 5m away from buildings.

7.13.3 The Chalk was generally encountered as low and medium density and therefore for the purpose of soakaway design it is recommended that they are sited a minimum of 10m from foundations. Should soakaways need to be closer based on development proposals, we recommend further density testing of chalk be undertaken to refine the in situ determination of density.

7.13.4 Additionally, it is recommended that trench type soakaways are adopted to minimise the risk of promoting the formation of dissolution features

7.13.5 The Chalk is designated as a principal aquifer. Accordingly, the Environment Agency and Local Authority must be consulted when planning soakaway installations where chalk underlies the site.

7.14 Pavement Foundation

7.14.1 As part of the scheme development it is likely that access roads and hardstanding areas will be constructed at or about existing ground level. Accordingly, it is assumed that formation level will be within the Quaternary Deposits and potentially Chalk Formation. Equilibrium California Bearing Ratio (CBR) value for the subgrade has been estimated based on material composition and following the guidance in Transport Road Research Laboratory Report LR1132: Structural design of bituminous roads.

7.14.2 The subgrade is anticipated to comprise a mix of granular and clay based soils. The clay-based soils will govern the in situ CBR value. On this basis and assuming an average plasticity index of 10%, a low water table and 'thin' pavement the following CBR values are considered appropriate for a variety of construction conditions.

Construction conditions	Equilibrium CBR value (%)
Poor	2.5
Average	4.5
Good	6

Table 7-9: Estimated equilibrium CBR values based on soil conditions (average PI = 10%)

7.14.3 It is recommended that the design values are validated with in situ testing immediately prior to construction. Furthermore, it is recommended that the formation level is trimmed and rolled following the requirements outlined in the Specification for Highway Works Series 600.

7.14.4 The Quaternary Deposits and Chalk Formation deposits soils are considered frost susceptible and this may override the CBR criteria for pavement foundation design purposes.

7.14.5 The silty nature of the Quaternary Deposits and Chalk Formation deposits will render them moisture susceptible with small increases in moisture content giving rise to a rapid loss of support to construction plant. It is therefore recommended that the sub-base is laid as soon as practicable following establishment of formation.

7.15 Suitability For Material Re-use

7.15.1 Significant earthworks are not anticipated to be required at the site. Soils excavated at the site are likely to be suitable for re-use as a general bulk fill. It is recommended that the soils are classified and compacted in accordance with the Specification for Highway Works Series 600.

7.15.2 The silty nature of the Quaternary Deposits and Chalk Formation deposits are moisture susceptible with small increases in moisture content giving rise to a rapid loss of strength and potentially rendering them unacceptable for reuse. Accordingly, material should be placed and compacted as soon as practicable. It is therefore recommended that the sub-base is laid as soon as practicable following establishment of formation.

7.16 Constructability

7.16.1 Under most standard contracts it is the responsibility of the Contractor to design, construct and maintain temporary works. Accordingly, the following discussion is provided for information only.

7.16.2 Excavation sides are anticipated to be stable in the short term. However, some overbreak of the Made Ground and other more granular deposits may occur.

7.16.3 Groundwater may be encountered during excavations to form spread foundations. Flow rates are anticipated to relatively minor but may cause instability of the excavation sides. It is likely that groundwater can be controlled via conventional sump pumping techniques.

7.16.4 In the event that a soft area is located in the course of foundation excavations then excavation should continue to locate stiffer / denser soils.

7.16.5 It is recommended that foundation concrete be poured as soon as practicable after excavation to prevent deterioration of the formation.

7.16.6 It is anticipated that service trench excavations will remain stable in the short term. There is a possibility that locally, excavations may encounter more granular soils, which may include some water. In such cases trench sheet shoring may be required to maintain an open excavation. It is assumed that any water will be controlled with nominal pumping techniques.

7.16.7 During construction, competent chalk could rapidly lose structure/competency if exposed to water (i.e. heavy rain) especially where disturbance is also ongoing, such as tracking with machinery so careful consideration to construction methods is also required. It is recommended that a contractor familiar with similar ground conditions is used for construction works.

8 Tier 2 Generic Quantitative Risk Assessment

8.1 Objectives

8.1.1 The objective of this generic quantitative risk assessment (GQRA) is to further assess the potential contaminant linkages (PCLs) identified by the preliminary risk assessment using the following:

- The findings of the intrusive site investigation and resulting site specific ground and hydrogeological model.
- Laboratory analysis of soils and groundwater.
- Monitoring of ground gases and vapours.

8.2 Fieldwork Observations

8.2.1 Fieldwork observations on the potential for contamination and the underlying ground conditions did not identify any new contaminant sources or significant pathway alterations to the anticipated ground model. Therefore, no PCL additions or amendments are required to be made to the CSM at this stage.

8.3 Laboratory Testing Rationale

8.3.1 Laboratory testing has been scheduled by targeting potential contaminant linkages identified within the iCSM and observations made during fieldworks. The sampling and testing strategy is based on a judgemental approach.

8.3.2 As the site has not yet been purchased by the client, the purpose of the investigation to provide a general overview of contamination at the site. On this basis, it has not been possible to target all identified contamination sources at the site during this investigation. However, we have attempted to target the most likely sources of contamination as well as giving good spatial coverage across the site to characterise the strata encountered.

8.3.3 In addition to the above, the following potential sources of contamination were identified within the iCSM and were subject to targeted sampling and testing as summarised below.

Source	Strata/medium	Qty	Scheduled analysis	Exploratory IDs	Sample Depth Range (m bgl)
Localised hydrocarbon contamination	Made Ground	1	*Comprehensive Contamination Suite* [metals, cyanides, PAHs, TPH CWG, (S)VOCs & inorganics]	TP04	1.1m
Soil mounds/bund	Made Ground	2	*Basic contamination suite* [metals, cyanides, PAHs, phenol] Asbestos screening	HP09	0.6-1.3

Table 8-1: Summary of scheduled laboratory testing

8.3.4 Testing included a broad suites of analysis due to the potential for unknown contamination to be present. However, due to the nature of the former activities on site, industry specific contamination may still be present (e.g biohazard wastes, pathogens) that have not been tested for at this stage.

8.4 Generic Assessment Criteria

8.4.1 Assessment of laboratory test data has been carried out using published generic assessment criteria (GACs). The GACs act as screening values to provide a 'trigger' to an assessor that soil concentrations above these limits might present an unacceptable risk.

8.4.2 Various GAC sources are used within this report. Key assumptions are made in the derivation of screening values in regard to their use and application, and exposure modelling is based on precautionary national scenarios. This generic approach can result in an overly conservative assessment; therefore, the assessor is required to review the outcome of the GQRA screening in the context of the site specific CSM and identified potential contaminant linkages.

8.4.3 Asbestos does not currently have published GACs which can be used for generic assessment purposes, at this stage a present / absent trigger limit has been adopted.

8.4.4 Specific details regarding the published GAC sources chosen and any parameter refinements made are summarised within Appendix I, along with the order of preference where multiple GAC sources are available. The exposure models adopted are discussed in the relevant sections below.

8.5 Human Health GQRA (soils and vapour)

8.5.1 The results of the human health screening assessment for soils and vapours are detailed in Appendix I. The following table outlines the exposure models adopted, along with summarising the outcome of each screening assessment.

Receptor	Exposure Model	Outcome
All human health receptors	Presence of asbestos	No suspected ACMs observed during fieldworks. No fibres detected through laboratory analysis.
Proposed site users	Residential with plant uptake	1 sample showing arsenic exceedance. All other results below GAC screening values.
Construction operatives	Acute occupational exposure (assumed no PPE worn)	No exceedances.
Adjacent site users and the public	Acute off-site public exposure during construction phase	No exceedances.

Table 8-2: Human health GQRA models and outcomes

8.5.2 The table below summarises the instances where contaminants have exceeded the generic screening criteria.

Receptor	Strata	Contaminant	Locations & Depths	Test Result / Range (mg/kg)	GAC (mg/kg)
Proposed site users	Topsoil	Arsenic	HP07 at 0.2m	51	37

Table 8-3: Human health GQRA exceedances

8.6 Proposed Site Users Risk Assessment (soils and vapour)

8.6.1 All reported concentrations of contaminants are below the relevant generic assessment criteria for human health receptors with the exception of a single arsenic concentration. This was located within the treeline close to the former quarry. No other testing has currently been undertaken in this area and therefore additional sampling and testing is likely to be needed in this area to understand how localised the contamination is. All other concentrations of arsenic from elsewhere on site were well below the guideline value.

8.6.2 It should also be noted that fieldwork observations within the vicinity of the incinerator building detected some hydrocarbon odours/staining and exploratory work within this location was limited, and it is therefore possible that higher levels of hydrocarbon contamination may be present in unexplored areas in this location. In addition, there are a number of tanks/pipework/substations on site and although we have undertaken excavations and some testing to target some of these areas, again, there is a possibility that unidentified contamination is present local to these sources.

8.6.3 Overall, based on the laboratory data and field observations to date, we have not detected any significant areas of suspected contamination. However, it is acknowledged that given the history of the site and multiple possible sources of contamination, there are areas which will require further assessment should the development proceed and localised areas of contamination may still be present that would require further assessment. In addition, appropriate due diligence and a watching brief should be carried out during the demolition and enabling works, to identify any unexpected or previously unencountered contamination.

8.7 Construction Workers Risk Assessment

8.7.1 Analysis indicates that contaminant levels do not pose an acute risk to construction workers. In general, standard PPE and hygiene protocols for working on brownfield sites is considered adequate to mitigate against the potential risk from contaminants on site, and no special precautions are required.

8.7.2 Should any areas of possible waste/equipment dumping be identified on site during construction works that could be a source of specific contamination associated with the former site use, specialist decontamination/remediation may be required prior to removal of such wastes.

8.8 Adjacent Site Users Risk Assessment

8.8.1 Based upon the laboratory results and understanding of the site to date, there is not considered to be an unacceptable level of risk to adjacent site users, both during construction and following completion of the development.

8.9 Controlled Waters Risk Assessment

8.9.1 Investigative works undertaken to date have not encountered any suspected area of contamination, and no significant groundwater has been encountered. On this basis, the overall risk to controlled waters is considered to be low.

8.9.2 However, while we have attempted to target likely areas of contamination and give good spatial coverage, localised areas of contamination cannot be discounted based on the past history of the site. On this basis, further investigations may be required following purchase of the site. In addition, appropriate due diligence and a watching brief should be carried out during the demolition and enabling works, to identify any unexpected or previously unencountered contamination.

8.10 Existing drainage

8.10.1 Based on the site reconnaissance, it was considered likely that any biohazard waste would likely be predominantly present in drainage at the site. On this basis, during fieldwork, manhole covers down gradient of the main site were lifted to assess the presence of any obvious silts or sludge material that could potentially indicate waste products within the drainage.

8.10.2 Some drainage runs appeared to be clear although others included some soils/silts. No sampling or testing was undertaken due to possible risk to personnel. Further assessment of the materials within the drainage system may be required.

Figure 8-1: View of existing drainage

Figure 8-2: View of existing drainage

8.11 Ground Gas Monitoring Rationale

8.11.1 Four gas and groundwater monitoring wells were installed at the site. Although the preliminary risk assessment is low, in order to provide quantitative data to support this assessment, we have undertaken a single round of monitoring.

8.11.2 All gas monitoring wells were installed within the Quaternary Deposits and Chalk.

8.12 Ground Gas Monitoring Results

8.12.1 A summary of the gas monitoring results follows, with the full results detailed within Appendix G.

- Gas flow rates were detected up to 0.1 l/hr, which is the limit of detection (0.1 l/hr).
- Steady concentrations of methane were recorded at or below the limit of detection of 0.1%.
- Concentrations of carbon dioxide were in the range of 0.3% to 2%.
- Steady concentrations of oxygen ranged from 17.1% and 20.2%.

8.13 Updated Ground Gas Risk Assessment

8.13.1 Based upon the CSM and on the monitoring results obtained, there are no significant concerns regarding elevated carbon dioxide or depleted oxygen levels. No elevated gas flow rates were detected.

8.13.2 Due to the absence of a significant actively generating ground gas source and open migration pathway, it is considered very unlikely that ground gases could migrate into the proposed structures on site at sufficient speed and volume to pose any viable risk. A CS-1 classification applies.

8.13.3 However, it is acknowledged that deeper Made Ground is potentially present associated with a former quarry, and this has not yet been investigated. Depending on the depth and composition of Made Ground in this area, gas monitoring may be required in and around this area to refine the risk assessment locally.

8.14 Water Supply Pipes

8.14.1 A full site investigation as set out in the UK Water Industry Research (UKWIR) document *'Guidance for the selection of Water supply pipes to be used in Brownfield sites'* has not been undertaken.

8.14.2 The UKWIR document advises a trigger concentration of 0.125mg/kg for the 'extended VOC (volatile organic compounds) suite', which includes the PAH (polycyclic aromatic hydrocarbons) suite that has been included in the soil analysis during this investigation.

8.14.3 No specific testing has been undertaken at present from likely pipe depths (0.5-1.5m bgl) due to the preliminary nature of the investigation. However, it is likely that at these depths soils will be natural and it is unlikely the concentration of PAH congeners will exceed the trigger concentration of 0.125mg/kg. However, in areas of deeper Made Ground this may not be the case. In all cases, given the history of the site, it is likely the water company will require specific testing to be undertaken to confirm barrier pipes are not required. Alternatively, barrier pipes can be installed across the site as a precaution.

8.14.4 In all instances, it is advised to consult the water company for advice to determine if protective pipe is necessary or if further assessment and investigation works are warranted. Irrespective of the assessment made here, water companies may insist on barrier pipe being installed. Once the initial consultation has taken place, Soiltechnics can support you in any further assessments that may be required.

8.15 Updated Conceptual Site Model (uCSM)

8.15.1 Following on from the discussions above, an updated conceptual site model has been tabulated overleaf.

8.15.2 The table below presents our approach to the assessment of risks associated with potential contaminant linkages. The categories are based upon the definitions within CIRIA C552 (2001), with the addition of a 'negligible likelihood' scenario, which is to be used where there is no realistic scenario in which harm could occur.

		Consequence of harm			
		Severe	**Medium**	**Mild**	**Minor**
Probability of harm	**High likelihood**	**Risk: Very high** (high – severe)	**Risk: High** (high – medium)	**Risk: Moderate** (high – mild)	**Risk: Moderate/Low** (high – minor)
	Likely	**Risk: High** (likely – severe)	**Risk: Moderate** (likely – medium)	**Risk: Moderate/Low** (likely – mild)	**Risk: Low risk** (likely - minor)
	Low Likelihood	**Risk: Moderate** (low – severe)	**Risk: Moderate/Low** (low – medium)	**Risk: Low** (low – mild)	**Risk: Very low** (low – minor)
	Unlikely	**Risk: Moderate/Low** (unlikely – severe)	**Risk: Low** (unlikely – medium)	**Risk: Very low** (unlikely – mild)	**Risk: Very low** (unlikely – minor)
	Negligible Likelihood	**Risk: Low** (negligible– severe)	**Risk: Very Low** (negligible– medium)	**Risk: Very Low** (negligible– mild)	**Risk: Negligible** (negligible– minor)

Table 8-4: CSM Risk Ratings

RECEPTOR: PROPOSED END USERS				
Potential Source	**Contaminants of Concern**	**Pathway**	**Tier 2 Risk Assessment** (probability of harm x consequence)	**Discussion**
Electricity works in the south-eastern corner in the 1920s	PCBs, oils, solvents, metals, asbestos	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Moderate/Low** (low – medium)	Area is currently within the tree line with limited access and has therefore not been fully investigated at this time. Contaminants could be present in the soil associated with this former site use but likely to be relatively localized to this corner of the site.
Sewage filter works in north-eastern part of the site (1920s-1970s)	Metals, inorganics, pathogens	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Low** (unlikely – medium)	Excavations within this area identified Made Ground although this was generally Topsoil/subsoil with limited anthropogenic materials. No evidence of contamination was noted.
Plant nursery in north-eastern part of the site (1920s-1970s)	Pesticides, herbicides, asbestos	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Moderate/Low** (low – medium)	Nursery recorded in the far north-eastern corner of the site although the area is now wooded and with limited access the area has not been fully investigated at this time. No evidence of buildings on site therefore presence of asbestos is considered unlikely. Chemical pesticides/herbicides likely to have been used and could be present in the local area.
Infilled quarry recorded on site to the east.	Metals, polycyclic aromatic hydrocarbons (PAH), asbestos	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Moderate** (likely – medium)	Nature of material used to infill the former quarry is unknown and could contain various contaminants. Likely to be localized to this area only. Area currently located beneath building/yard area and therefore no investigation undertaken at this stage. Further investigation in this area is recommended post demolition to determine the nature and extent of any Made Ground.
	Permanent ground gases (CH_4 and CO_2)	Inhalation of vapours	**Risk: Moderate/Low** (low – medium)	Depth and nature of material used to infill the former quarry is unknown and could include organic rich materials capable of producing landfill gases. However, given the age of the infill and the small size of the quarry, it is likely any gases would only impact a small area of the site.
Raised area/bund to the north-east	Various inorganic and organic compounds (hydrocarbons, metals, asbestos),	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Low** (unlikely – medium)	Made Ground identified to depths in excess of 1.3m and included anthropogenic material. Excavations in this area limited and there may be some variation in the nature of soils used in the bund. However, current testing has not identified any elevated concentrations of contaminants and asbestos was not detected.

RECEPTOR: PROPOSED END USERS				
Former animal health facility including laboratories (Animal Health Trust)	Various inorganic and organic compounds (hydrocarbons, metals, asbestos).	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Low** (unlikely – medium)	Based on current investigations and testing, no contamination has been identified across the eastern part of the site. Should any areas of possible waste/equipment dumping be identified on site during construction works that could be a source of specific contamination associated with the former site use, specialist decontamination/remediation may be required prior to removal of such wastes.
	Biohazard waste/pathogens	Ingestion, inhalation and contact with soils and dusts	**Risk: Moderate/Low** (low – medium)	No evidence for such materials was observed at surface on site or within soils. However, there is some silts/soils within drainage that could contain such contaminants and may require further assessment.
Former horse incinerator	PAH, metals, inorganics, TPH	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Moderate/Low** (low – medium)	Made Ground to depths in excess of 1.2m has been identified to the north of the building although laboratory testing has not identified any specific contamination at this stage. Odours and staining were noted however and there is a possibility that contamination may be present in greater concentrations elsewhere in the area. Further investigations are recommended to determine the extent of Made Ground in this area and refine the assessment.
Above ground fuel storage tanks noted during site reconnaissance (spills and leaks)	Petroleum hydrocarbons (TPH)	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Moderate/Low** (low – medium)	Excavations undertaken near to tanks have not identified any evidence of leaks or spills and laboratory testing has not identified significant concentrations of TPH. On this basis, the risk can be reduced to moderate/low but cannot be reduced further as there remains a possibility of localized contamination associated with pipework/tanks that have not been fully investigated. However, any such contamination is considered likely to be localized.
Areas of car parking	Petroleum hydrocarbons (TPH)	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Low** (low – mild)	Multiple car parking areas are present on site. Minor leaks from parked vehicles may be present. However, these are likely to be small-scale given cars wouldn't be parked in the same place for any significant period of time and therefore risk to end users is considered to be low. Current investigations have not identified any visual or olfactory evidence of hydrocarbons within the areas investigated.
Made Ground within the east of the site associated with development, past development and bunds.	Metals, polycyclic aromatic hydrocarbons (PAH), asbestos	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Low** (unlikely – medium)	Made Ground on site has been identified as reasonably limited although localized deposits around some of the buildings is likely. Based on testing to date, general Made Ground does not contain elevated concentrations of contaminants and therefore poses a low risk to proposed end users.

RECEPTOR: PROPOSED END USERS				
Elevated arsenic within Topsoil at HP07 location	Arsenic	Ingestion, inhalation and contact with soils and dusts	**Risk: Moderate/Low** (low – medium)	Based on testing to date, elevated concentrations of arsenic are unlikely to be widespread and are likely limited to this locality. Further testing is required to determine the extent and refine the risk assessment to end users.

Table 8-5 : uCSM – Proposed End Users

RECEPTOR: CONSTRUCTION WORKERS				
Potential Source	**Contaminants of Concern**	**Pathway**	**Tier 2 Risk Assessment** (probability of harm x consequence)	**Discussion**
General Made Ground associated with historical uses	Asbestos fibres and ACMs	Inhalation of dusts	**Risk: Low** (unlikely – medium)	No asbestos or asbestos containing materials observed during excavations. Asbestos screening did not identify any asbestos fibres within the soils.
	Metals, PAHs, TPHs	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Low** (low – mild)	No gross contamination of high-risk contaminants anticipated (e.g. cyanide, benzene, and vinyl chloride). Standard PPE and hygiene protocols for working on brownfield sites are likely to be sufficient to the mitigate risk.
Historical site uses (electricity works, filter beds, nursery)	PCBs, oils, solvents, metals, asbestos, micro-organisms, pesticides and hert	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Low** (low – mild)	No significant concentrations of high-risk contaminants have been identified as part of this investigation and any unidentified areas of contamination that may be present are likely to be relatively localized. Standard PPE and hygiene protocols for working on brownfield sites are likely to be sufficient to the mitigate risk from these historical sources.
Infilled quarry recorded on site to the east.	Asbestos fibres and ACMs	Inhalation of dusts	**Risk: Moderate** (likely – medium)	If present, asbestos in soils can present an acute risk to construction workers, particularly during the enabling works phases. Very low and trace concentrations often pose a low risk if appropriate controls are put in place.
	Various inorganic and organic compounds	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Low** (low – mild)	No gross contamination of high-risk contaminants anticipated (e.g. cyanide, benzene, and vinyl chloride). Standard PPE and hygiene protocols for working on brownfield sites are likely to be sufficient to the mitigate risk.
	Permanent ground gases (CH4 and CO2)	Inhalation of vapours	**Risk: Moderate/Low** (low – medium)	If deep Made Ground is present and elevated gas concentrations, could be a risk of reduced oxygen within confined spaces. However, probability of significant gas producing material being present is considered low-likelihood at this stage.

RECEPTOR: CONSTRUCTION WORKERS				
Raised area/bund to the north-east	Asbestos fibres and ACMs	Inhalation of dusts	**Risk: Low** (unlikely – medium)	Made Ground identified to depths in excess of 1.3m and included anthropogenic material but no obvious evidence of ACM although its presence elsewhere cannot be excluded. Excavations in this area limited and there may be some variation in the nature of soils used in the bund. However, current testing has not identified the presence of asbestos.
	Metals, PAHs, TPHs	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Low** (unlikely – medium)	Made Ground identified to depths in excess of 1.3m and included anthropogenic material. Excavations in this area limited and there may be some variation in the nature of soils used in the bund. However, current testing has not identified any elevated concentrations of contaminants.
Former animal health facility including laboratories (Animal Health Trust)	Asbestos fibres and ACMs	Inhalation of dusts	**Risk: Low** (unlikely – medium)	No asbestos of asbestos containing materials observed during excavations. Asbestos screening did not identify any asbestos fibres within the soils.
	Various inorganic and organic compounds	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Low** (unlikely – medium)	Based on current investigations and testing, no contamination has been identified across the eastern part of the site. Should any areas of possible waste/equipment dumping be identified on site during construction works that could be a source of specific contamination associated with the former site use, specialist decontamination/remediation may be required prior to removal of such wastes.
	Biohazard waste/pathogens	Ingestion, inhalation and contact with soils and dusts	**Risk: Moderate/Low** (low – medium)	No evidence for such materials was observed at surface on site or within soils. However, there is some silts/soils within drainage that could contain such contaminants and may require further assessment.
Above ground fuel storage tanks noted during site reconnaissance (spills and leaks)	Petroleum hydrocarbons (TPH)	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Low** (unlikely – medium)	Based on current testing, no significant hydrocarbon and BTEX contamination has been identified although we cannot discount localized contamination. However, standard PPE and hygiene protocols for working on brownfield sites are likely to be sufficient to the mitigate risk.
Unexploded Ordnance	UXO	Direct contact / explosion	**Risk: Moderate** (low – severe)	The Hazard Screen indicates there may be potential for encountering UXO. Further risk assessment is required, to be undertaken by a specialist.
All other contamination sources	Metals, PAHs, TPHs	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Low** (low – mild)	Considered to be localized and not in significant concentrations. No gross contamination of high-risk contaminants anticipated (e.g. cyanide, benzene, and vinyl chloride). Standard PPE and hygiene protocols for working on brownfield sites are likely to be sufficient to the mitigate risk.

Table 8-6: iCSM – Acute Exposure to Construction Workers

RECEPTOR: ADJACENT SITE USERS FOLLOWING COMPLETION				
Potential Source	**Contaminants of Concern**	**Pathway**	**Tier 2 Risk Assessment** (probability of harm x consequence)	**Discussion**
All potential contaminant sources	Metals, PAHs, TPH, PCBs, micro-organisms, bio-hazard waste	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Low** (unlikely – medium)	No significant contamination has been identified in this investigation and together with the distance to off-site structures, the chance of a pollutant linkage causing harm is considered low.

Table 8-7: iCSM – Chronic Exposure to Adjacent Site Users

RECEPTOR: ADJACENT SITE USERS DURING THE CONSTRUCTION PHASE				
Potential Source	**Contaminants of Concern**	**Pathway**	**Tier 2 Risk Assessment** (probability of harm x consequence)	**Discussion**
All potential contaminant sources	Metals, PAHs, TPH, PCBs, micro-organisms, bio-hazard waste	Ingestion, inhalation and contact with soils, dusts and vapours	**Risk: Low** (unlikely – medium)	No significant contamination has been identified in this investigation and together with the distance to off-site structures, the chance of a pollutant linkage causing harm is considered low.

Table 8-8: iCSM – Acute Exposure to Adjacent Site Users

RECEPTOR: PROPOSED PLANTING				
Potential Source	**Contaminants of Concern**	**Pathway**	**Tier 2 Risk Assessment** (probability of harm x consequence)	**Discussion**
Contaminants within topsoil and the shallow sub-surface	Metals, pH and inorganics	Direct contact and root uptake	**Risk: Negligible** (negligible– minor)	Much of the site is laid to grass and various trees are present and during our site reconnaissance there were no significant barren areas, signs of poor growth, or evidence of significant vegetative stress.

Table 8-9: iCSM – Phytotoxic Risk to Proposed Planting Scheme

RECEPTOR: CONTROLLED WATERS				
Potential Source	**Contaminants of Concern**	**Pathway**	**Tier 2 Risk Assessment** (probability of harm x consequence)	**Discussion**
All potential contaminant sources identified	Various	Leaching and vertical migration (Groundwater)	**Risk: Low** (unlikely – medium)	No significant Made Ground or groundwater has been identified. In addition, laboratory testing has not identified any significant areas of contamination. Although there may be localised areas of contamination that have not been identified during this investigation, at this stage, the risk to groundwater is considered low.

Table 8-10: iCSM – Controlled Waters Risk

8.16 Risk Assessment Conclusions

8.16.1 Based on the investigation undertaken to date and the updated CSM, no potential contaminant linkages have been identified above the low-risk threshold for the investigated sources. However, it is acknowledged that this investigation was preliminary and that not all sources have currently been investigated fully. On this basis, PCLs do still remain, which exceed the low-risk threshold and require further investigation to refine the assessment. These are discussed in further detail below.

Contaminant Source	Receptor	Recommended Action	Discussion
Deep Made Ground in the vicinity of the incinerator building	Proposed end users	Supplementary Investigation	Additional investigations and potentially testing are recommended around the incinerator building to determine the extent of any Made Ground. There is a possibility that higher concentrations of TPH contamination are present as odours/staining were noted but concentrations were low in the excavations undertaken. Should additional contamination be identified, appropriate remedial action will need to be determined.
Backfilled quarry	Proposed end users and construction operatives	Supplementary Investigation	At present the nature and extent of backfill material within the quarry is unknown and further investigations are recommended to assess this source and refine the risk.
Arsenic in Topsoil around HP07 location	Proposed end users	Supplementary Investigation	A supplementary phase of investigation is recommended to delineate the extent of contamination and determine appropriate remedial action.
Former electricity works	Proposed end users	Supplementary Investigation	This area has not currently been investigated and it is recommended that any further investigation phase includes some limited sampling/testing in this area to refine the risk.
Former plant nursery	Proposed end users	Supplementary Investigation	This area has not currently been investigated and it is recommended that any further investigation phase includes some limited sampling/testing in this area to refine the risk.
Possible contamination within drainage	Proposed end users and construction operatives	Supplementary Investigation/testing	Some further investigation/testing of material within drainage may be required.
Hydrocarbon contamination in the vicinity of above ground storage tank/pipework	Proposed end users and potentially controlled waters	Supplementary Investigation	Currently no contamination has been identified associated with fuel storage and pipework although it is acknowledged that sampling and testing in the areas was relatively limited given the scope of the investigation. Although the presence of significant contamination is considered unlikely based on works to date. Following removal of tanks, further investigations/watching brief is recommended to refine the risk.

Contaminant Source	Receptor	Recommended Action	Discussion
Waste material/equipment left across the site.	Proposed end users and construction operatives	Watching brief/possible specialist removal	During our site investigation, it was noted that some waste material/equipment had been left stockpiled in areas of the site. Given the nature of the site, it is possible that this could be associated with specific contaminants. Should there be any indication that any of this waste/equipment could be a source of contamination or contain specific chemicals/wastes, specialists should be consulted prior to removal.

Table 8-11: GQRA Risk Assessment Conclusions

8.17 Unexpected and Previously Unencountered Contamination

8.17.1 With the development of any site, there is a residual risk of contamination being found that is unexpected or has not been encountered during investigation or other siteworks.

8.17.2 Should any previously unencountered and unexpected contamination be encountered, works should be temporarily halted and Soiltechnics informed. The Consultant should then assess the situation to determine what remedial action is required and inform the Local Authority at the earliest opportunity.

8.17.3 It is often a requirement of Local Authority planning conditions that the building/demolition contractor has a contamination discovery/contingency strategy in place for dealing with unexpected contamination. Soiltechnics are pleased to provide advice on such a strategy if required.

9 Soil and Waste Management

9.1 Sustainability

9.1.1 Where possible, disposal of soils to landfill should be avoided in preference for more sustainable alternatives. Such alternatives are set out below and rely on appropriate planning and design.

9.1.2 Soiltechnics can provide additional support and guidance to assist in overall material management and soil waste minimisation upon request.

9.2 Waste Hierarchy

9.2.1 Under the Waste Regulations, there is a requirement to apply (where reasonable) the waste management hierarchy, which is summarised below. Within the hierarchy, soil disposal to landfill should be limited to the necessary minimum.

Stage (in order of preference)	Example application
Prevention / Reduce	Design, planning, Site Waste Management Plans (SWMP).
Reuse	Reuse of soils under exemption, permit or Materials Management Plan (MMP), sorting at the point of excavation, screening of excavated material.
Recycling	Recycling aggregate, waste segregation, screening and sorting.
Recovery	Remediation works, transfer to a Soil Treatment Facility
Pre-treatment	Non-hazardous and hazardous soils do not need to be treated, where such treatment would not reduce the volume of waste.
Disposal	If the waste hierarchy steps outline above are followed, the remaining waste can be disposed of to a landfill without any further treatment.

Table 9-1: Waste management hierarchy

9.3 Liability Of Waste Management

9.3.1 Part III of the Finance Act was amended in 2018 to extend the scope of landfill tax to cover any site (not exclusively landfills) operating without an appropriate environmental permit, exemption, or MMP.

9.3.2 These changes have given HMRC the powers to work with the Environment Agency to identify non-compliant sites and pursue and penalise the person(s) illegally disposing of waste, and anyone who knowingly facilitates the disposal. This includes sites filling site-won soils which are surplus to requirement.

9.4 Materials Management

9.4.1 In terms of the development, where reasonably practicable, landfill disposal should be minimised through the reuse of site-won materials on site, or off-site transfer of surplus soils to other development schemes or Soil Treatment Facilities. Early consideration of the site's overall material balance at the design stage is also critical in reducing the need for off-site disposal, limiting costs, and increasing the overall sustainability of the development.

9.4.2 Where Made Ground soils are to be reused onsite or materials transferred between sites, a Materials Management Plan (MMP) or Waste Exemption is recommended.

9.4.3 The process of an MMP allows soils that are suitable for reuse and have a certainty of use to not be considered a waste, and therefore not fall under the waste regulations. This scheme is self-regulated within the industry and is supported in principle by the Environment Agency.

9.5 Waste Characterisation governance

9.5.1 The classification of soils for disposal to landfill is undertaken in accordance with WM3 (v1.2GB), and a Waste Acceptance Criteria assessment (WAC) undertaken in accordance with the limits in Annex II of the Landfill Directive (Directive 1999/31/EC).

9.6 Waste Populations

9.6.1 Based on the site observations, development proposals and laboratory results, the following potential waste populations have been identified for preliminary assessment purposes:

Potential Waste Population	Description
Topsoil	Dark brown gravelly slightly sandy clay, gravel is flint.
General Made Ground	Grey and light brown clays, sands and gravels. Gravels consisted of chalk, flint, brick, clinker, concrete and sandstone. Occasional wood and fabric
Made Ground within the bund	Grey and dark grey slightly gravelly slightly clayey sand. Gravel is flint, sandstone, clinker and concrete.
Hydrocarbon impacted soils	Grey and light brown clays, sands and gravels. Gravels consisted of chalk, flint, brick, clinker, concrete and sandstone. Occasional wood and fabric with staining and hydrocarbon odours.
Clean naturally occurring soils	Natural, uncontaminated clays and sands.

Table 9-2: Potential waste populations

9.6.2 Each of the potential waste populations can be readily identified and segregated at the point of excavation, based upon visual and olfactory observations.

9.7 Sampling And Testing

9.7.1 The hazardous waste classification assessment has been undertaken by adopting the maximum recorded concentration of each compound from all the samples tested within the identified waste population, as outlined in WM3, Approach D.

9.7.2 In addition, sample-specific assessments have been completed for reference.

9.7.3 For the Waste Acceptance Criteria (WAC) assessment a representative composite sample of the general Made Ground was obtained combining soils from multiple exploratory holes. A sample from HP03 was also tested.

9.7.4 At this stage, a sample from the Made Ground in the bund has not been submitted for WAC assessment as soils appeared similar in nature to the general Made Ground. PAHs in the samples taken from one trial pit within the bund were slightly higher than elsewhere (total concentrations were <10mg/kg compared to concentrations <2mg/kg), but are still considered relatively low and consistent with variability of Made Ground.

9.7.5 The rate of testing has been chosen to provide a preliminary waste categorisation only.

9.8 Waste Characterisation

9.8.1 Where testing has been carried out, the waste classification assessment sheets are enclosed within Appendix J, and a summary of the findings is presented in the table below.

9.8.2 Observations from the fieldwork indicate that the underlying natural soils are not impacted by contamination, and therefore are considered suitable for disposal as non-hazardous waste in an inert landfill site without the requirement for further testing.

9.8.3 Due to the elevated organic content of topsoil materials in general, they are typically unsuitable for disposal at an inert landfill, therefore disposal to a non-hazardous waste landfill site is likely to be the appropriate disposal route. However, topsoil is also a nationally limited resource and efforts should be made to avoid landfill disposal where possible. Where topsoil is in surplus, it should be separated from the underlying natural soils and set aside to be recovered elsewhere, for instance through a Direct Transfer scenario or to a Soil Treatment Facility under the DoW CoP.

Potential Waste Population	Hazardous Classification (LoW code)	Landfill Classification	Comments
Topsoil	Non-hazardous (17-05-04)	No WAC testing undertaken	Topsoil typically unsuitable for disposal to inert landfill sites due to high organic carbon content
General Made Ground	Non-hazardous (17-05-04)	Inert	-
Made Ground in the bund	Non-hazardous (17-05-04)	No WAC testing undertaken	Considered similar in composition to general Made Ground based on visual inspection and test data. However, possibility there is variation within soils used in the bund and further testing is recommended to confirm the assessment.
TPH impacted soils	-	-	Although impacted soils were observed, concentrations were below detectable limits and therefore can be disposed of as general Made Ground. However, any similar soils encountered will need additional testing.
Clean, uncontaminated, natural materials	Non-hazardous (17-05-04)	Inert	Considered non-hazardous and inert without any testing required.

Table 9-3: Waste characterisation summary

9.9 Application Of Advice

9.9.1 There is no obligation on any waste operator to accept our waste characterisation assessments. Landfill operators may consider your waste to fall under a different classification and/or may require additional testing of waste soils prior to acceptance. It is therefore recommended that this report along with the chemical results is provided to the preferred facility to confirm (or otherwise) it can accept the waste.

9.9.2 It should be noted that there remains the potential for unexpected or previously unencountered contamination to be encountered. Any such materials intended for waste disposal should be segregated and tested to determine the appropriate classification and disposal route.

9.10 Further Recommendations

9.10.1 Given the history of the site and inherent variability of Made Ground deposits, it is possible that previously unencountered contamination may be present, including asbestos containing materials (ACMs) and more extensive/intensive TPHs around old tanks and pipework. Therefore, it is advisable to provide a watching brief during excavation works to identify and segregate any soils at the point of excavation with visual or olfactory evidence of contamination, in order to minimise the overall volume of any impacted material. Any such materials, if encountered, are likely to require further testing to determine the appropriate disposal route.

9.10.2 As the waste classifications provided are preliminary only and based on limited sampling of soils in-situ, it is recommended to undertake additional sampling and testing during the construction works to fully characterise the waste soils intended for disposal. The overall frequency of testing should be dependent upon the composition, volume and variability of the material excavated.

10 Recommendations for further works

10.1.1 The following table summarises the additional works which should be undertaken prior to commencement of any construction works and in support of the planning conditions.

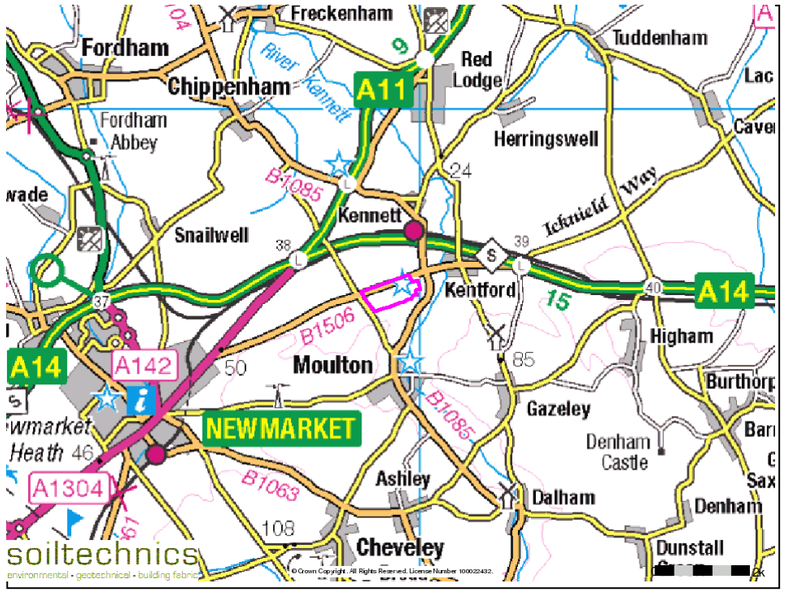
Aspect	Delivered By	Description	Necessity
Supplementary exploratory Investigation and refinement of GQRA	Soiltechnics	The current GQRA has not identified any contamination on site which poses a risk to identified receptors. However, this is a preliminary assessment (pre-purchase) and given the history of the site, there are a number of areas that have not been investigated at this stage and could be a source of localised contamination. On this basis, further targeted investigations are recommended to refine the assessment. This may also include some targeted geotechnical boreholes to refine the foundation strategy for the site i.e in areas where deep Made Ground has been identified or could exist (below existing buildings).	**REQUIRED**
Discovery Strategy	Principal Contractor	The Principal Contractor should have a discovery strategy in place in the event of exposing unexpected or previously unencountered contamination. Soiltechnics should be informed at the earliest opportunity to undertake an assessment, and to inform the Local Authority as appropriate.	**REQUIRED**
Arsenic contamination delineation	Soiltechnics	Elevated arsenic was present in one sample and is considered to be localised contamination. Further investigations should target this area to establish the extent of such contamination and determine what, if any, remedial action is necessary.	**REQUIRED**
Detailed UXO Risk Assessment	3rd Party	The Preliminary Risk Assessment identified that bombing may have occurred in the vicinity of the site, therefore a Detailed UXO Risk Assessment should be undertaken in accordance with CIRIA C785. This must be commissioned directly with a specialist	**RECOMMENDED**
UXO Emergency Response Plan	3rd Party	Regardless of the outcome of UXO risk assessments, UXO may still be encountered unexpectedly. The Principal Contractor should consider the inclusion of an Emergency Response Plan as a precaution.	**RECOMMENDED**
Materials Management Plan	Soiltechnics	Once the overall designs and cut-and-fill requirements for the scheme have been finalised, and before excavation works commence, an MMP is recommended to facilitate the reuse of soils on site and the transfer of materials on or off-site.	**RECOMMENDED**

Table 10-1: Recommended Further Works (Pre-Commencement)

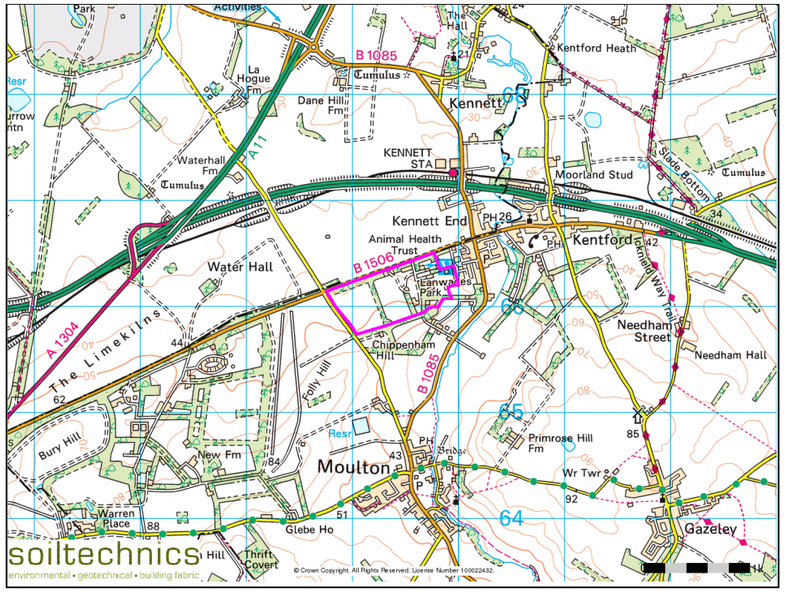
soiltechnics
environmental ▪ geotechnical ▪ building fabric

Appendix A Drawings

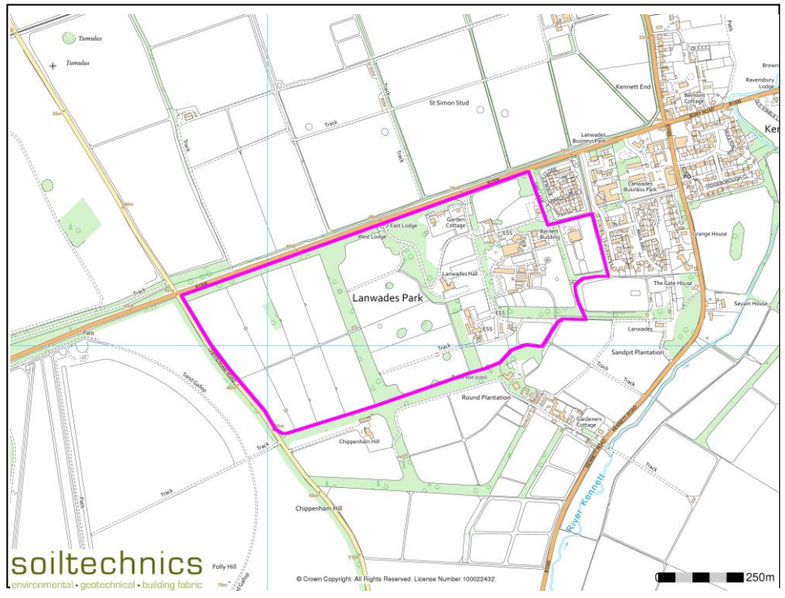
soiltechnics
environmental ▪ geotechnical ▪ building fabric



Neighbourhood extract from Ordnance Survey map



Town extract from Ordnance Survey map



Detail extract from Ordnance Survey map

Title	Scale	Drawing number
Site location plan	Not to scale	01

Revision: A

Created: January 2023

Key:

Exploratory Holes

- Hand Pit
- Machine Excavated Trial Pit
- Windowless Sampling Borehole
- Monitoring Installation
- Soakaway / Permeability Testing

Site Features

- Extent of investigation area

Notes

1) Base image provided by Google.

2) All drawn features are approximate.

REV	DATE	COMMENT ON VARIATION
A	Jan 2023	First issue

soiltechnics
environmental ▪ geotechnical ▪ building fabric

PROJECT
Lanwades Park, Newmarket

TITLE
Exploratory Hole Location Plan

PROJECT No.	DRAWING	REVISION
STU5875	02	A