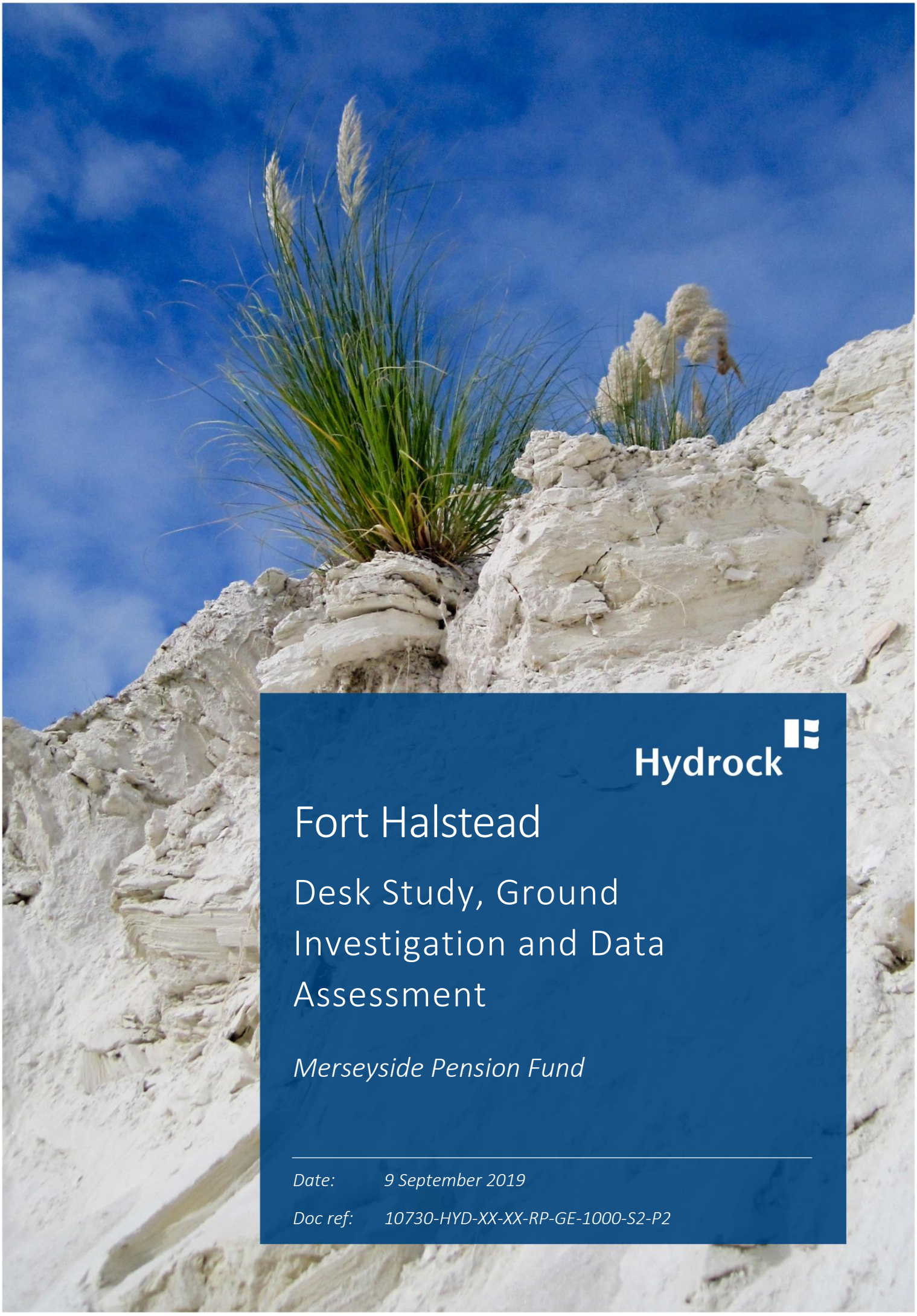
13. Ground Conditions & Contamination

Appendix 13.1

DESK STUDY, GROUND INVESTIGATION AND DATA ASSESSMENT



Hydrock

Fort Halstead

Desk Study, Ground Investigation and Data Assessment

Merseyside Pension Fund

Date: *9 September 2019*

Doc ref: *10730-HYD-XX-XX-RP-GE-1000-S2-P2*

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CONTENTS

Appendices

EXECUTIVE SUMMARY

SITE INFORMATION AND SETTING	
Client	Merseyside Pension Fund
Site name and location	Fort Halstead, Crow Drive, Sevenoaks, Kent. TN14 7BP.
Objectives	To undertake additional site investigation to assist in the characterisation of the underlying ground conditions. To combine this data with previous works undertaken by Hydrock and others, to further develop and refine the conceptual model for the site against the Parameter Plans; To support Merseyside Pension Fund in their planning application.
GROUND MODEL	
Desk study summary	Fort Halstead is currently owned by Merseyside Pension Fund but it is currently occupied by DSTL and QinetiQ on a long lease. DSTL and QinetiQ provide scientific and technical research to the Ministry of Defence. Since 2011 DSTL has been relocating from the application site to Porton Down and Portsdown West via a staged withdrawal with complete vacation anticipated by 2021. A number of the buildings are no longer in operational use and have been decommissioned. The site contains over 300 structures including offices, laboratories, warehouses, a firing range, explosive storage facilities, machine shops, x-ray facilities, a fuel station, burning grounds, a waste compound and storage tanks. Structures are grouped into the A, F, H, M, N, Q, R, S and X Areas. The geology at the site consists of Clay-with-Flints formation overlying Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated). Made Ground is anticipated across the Site. The superficial deposits are an unproductive strata and the Chalk is a Principal Aquifer. The site is not within a Source Protection Zone and there are no groundwater abstractions within 1km of the site.
Ground and groundwater conditions encountered by investigation (all data)	The ground conditions as proven by the investigation(s) undertaken at the site comprise: • Made Ground – a variety of types of Made Ground were encountered from ground level to a maximum proven depth of 3.5m bgl. On average Made Ground was encountered to around 0.5 – 1.2m bgl; over • Clay-with-Flints – to between 0.3 and 12.4m bgl, generally comprising firm to stiff red brown mottled orange brown sandy gravelly clay. Gravel is fine to course angular to sub rounded flint with frequent flint cobbles; over • Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated) – to between 0.4 and >15m bgl. Groundwater was not encountered and is anticipated to be at greater than 90m bgl.
GEOTECHNICAL CONCLUSIONS	
Conclusions of geotechnical assessment	Obstructions associated with the current development, including foundations, floor slabs, basements and services, should be anticipated. Excavation should generally be readily achievable with standard excavation plant. However, heavy duty excavation plant/breaking equipment may be required to excavate the obstructions associated with the existing structures and abundant concrete yard areas. Excavated soils should be reuseable as follows: • Made Ground – not suitable for reuse on site (contains asbestos); • Clay-with-Flints – reuseable as General Fill. • Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated) – reusable as General Fill. Strip, shallow pad or raft foundations are likely to be suitable for all land use areas depending on specific design considerations and loads.

	Ground bearing floor slabs can be considered where they bear directly onto the Clay-with-Flints. However, the potential for heave will need to be considered in the floor slab design. Where Made Ground is present, suspended floors are recommended. The final profile of the development is unknown and so it is not possible to provide a definitive CBR value. The CBR achieved will be a function of the material handling and placement methodology employed during earthworks. A CBR of 2.5% should however, be achievable in the Clay-with-Flints. Design Sulfate Class - DS-1 and ACEC Class AC-2z for Clay-with-Flints. Design Sulfate Class - DS-1 and ACEC Class AC-1 for the Chalk Formation.
GEO-ENVIRONMENTAL CONCLUSIONS	
Conclusions of contamination Generic risk assessment	Human health: • Residential: Made Ground within the existing waste compound is a source of lead, PAH and petroleum hydrocarbons. • Public Open space (Residential): Made Ground around BH556 is a source of PAH. • Scheduled Monument: Made Ground is a source of Nickel, PAH and petroleum hydrocarbons. • Site Wide: Asbestos has been encountered in Made Ground at various locations across the site. Plant growth: • No significant risk identified. Controlled Waters: • No significant risk identified. Ground gases or vapours: • No significant risk identified. Radon: • The site is not in a Radon Affected Area.
Proposed mitigation measures	• Subject to approval, the following remedial strategy is considered merited. • Residential: Further site investigation is required to support detailed design. The recent chemical data suggests concentrations of copper, nickel, PAH and petroleum hydrocarbons are lower in value and number than those reported historically. Further SI should substantiate this finding and permit targeted mitigation solutions. It is anticipated that where required, mitigation will entail the use of a clean cover capping solution in areas of gardens and landscaping. • Public Open space (Residential: Further site investigation is required to support detailed design. The recent chemical data suggests concentrations of PAH within Made Ground are lower in value and number than those reported historically. Further SI should substantiate this finding and permit targeted mitigation solutions. It is anticipated that where required, mitigation will entail the use of a clean cover capping solution in areas of gardens and landscaping. • Scheduled Monument: Investigations within the scheduled monument was not possible within the current phase of works. Consequently, due to low sample numbers within historical investigations, it is recommended further site investigation and validation sampling be undertaken to quantify the existing level of nickel, PAH and petroleum hydrocarbons identified historically. If mitigation is necessary following this, this can be achieved through industry proven techniques. Consent from Heritage England will be required for works in this area. • Site Wide: Asbestos has been identified within the Made Ground and shallow natural soils at a number of locations across the site. Further site investigation comprising validation sampling and gravimetric analyses to refine the extent to which asbestos fibres are present is required as part of detailed design. Following this, a detailed risk assessment should be undertaken and an appropriate targeted mitigation solution designed. This is likely to entail removal of identifiable asbestos fragments and use of a clean cover capping solution in areas of gardens and landscaping. • Utilities: Utilities should be placed within clean service corridors. Barrier pipe is considered necessary given the contaminants identified and history of the site.

	• Management of areas of former explosive areas and depleted uranium should be supervised as a precautionary measure during groundworks. • A remediation method statement and construction environmental management plan should be prepared for the works. • Regulatory agreement should be sought on the works and associated documents.
Waste management	Excavated soils to be disposed of as waste, are likely to be classed as non-hazardous. Further confirmatory testing should be carried out on any material that may need to be disposed to landfill.
FUTURE CONSIDERATIONS	
Further work	Following the ground investigation works undertaken to date, the following further works will be required: • pre-demolition asbestos survey; • further site investigation in areas that to date have not been accessible. Beneath building footprints etc. • further site investigation during detailed design to delineate the extent of asbestos fibres within shallow soils; • further site investigation during detailed design to delineate the concentrations of metals, PAH and petroleum hydrocarbons where identified. Works will also validate the data obtained within the 2016 and 2018 investigation compared to the historical investigations; • further site investigation during detailed design to provide suitable parameters for foundation (including pile and ground improvement) design and soil characterisation; • infiltration testing at various depths within the chalk formation across the extent of the Site to inform on site drainage strategies; • design and implementation of a comprehensive ground gas monitoring regime; • production of a formal Remediation Method Statement (RMS), detailing the remedial works considered necessary to break the identified potential pollutant linkages; • design of a suitable cover system in areas of landscaping, gardens and public open space; • foundation depth in relation to trees assessment, following a tree survey to BS 5837:2012; • upon completion of development design, provision of a geotechnical design report for Category 2 structures; • discussions with service providers regarding the materials suitable for pipework etc.; • verification of the remedial works to allow regulatory sign off.

This Executive Summary forms part of Hydrock Consultants Limited report number 10730-HYD-XX-XX-RP-GE-1000-S2-P2 and should not be used as a separate document.

1.0 INTRODUCTION

1.1 Terms of reference

In October 2018, Hydrock Consultants Limited (Hydrock) was commissioned by CBRE as agent for Merseyside Pension Fund (the Client) to undertake a desk study and additional ground investigation works at Fort Halstead, Crow Drive, Sevenoaks, Kent TN14 7BS.

Hydrock understands that there has been existing planning consent for the site and that this report will support a revised planning application to comprise 650-750 residential units and 23,000-27,650sqm of commercial floorspace.

A copy of the parameter plans and site plans are presented within Appendix A.

The works have been undertaken in accordance with Hydrock's proposal referenced (C-10730-C_Fort_Halstead_2018_BelowGroundServicesFee_002, 24/09/18).

1.2 Objectives

The objectives of the appointed phase of works were:

- to undertake additional site investigation to assist in the characterisation of the underlying ground conditions;
- to combine this data with previous works undertaken by Hydrock and others, to further develop and refine the conceptual model for the site against the Parameter Plans; and
- to support Merseyside Pension Fund in their planning application.

1.3 Constraints

Whilst the proposed works have been designed to be comprehensive, and significant support has been provided by DSTL and QinetiQ, the operational nature of the site means that there were a number of constraints to undertaking the investigation. These include:

- access to operational areas, proximity around buildings and within buildings;
- the type of investigation methodology appropriate given programme, operational constraints and space limitations;
- protection of heritage assets; and
- known or suspected services.

1.4 Scope

The site investigation includes a Phase 1 Desk Study and a Phase 2 Ground Investigation.

The scope of the Phase 1 Desk Study comprises:

- a field reconnaissance (walkover) to determine the nature of the site and its surroundings including current and former land uses, topography, geology and hydrology;
- acquisition and review of:
  - historical Ordnance Survey maps, to identify former potentially contaminative uses at the site and immediately surrounding it, and an assessment of the associated contamination risks;

  - a third party environmental database search to identify flooding warning areas, local landfills, pollution incidents, abstractions, environmental permits etc. which may have had the potential to have environmental impact on the site;
  - topographical, geological and hydrogeological maps;
- a summary and review of previous investigations carried out at the site;
- development of a preliminary Conceptual Site Model (CSM), including identification of potential pollution linkages; and
- a qualitative assessment of any risks identified;

The scope of the Phase 2 Ground Investigation comprises:

- a ground investigation including trial pitting, window sampling and cable percussive boring to:
  - obtain additional data on the ground and groundwater conditions of the site;
  - allow collection of samples for geotechnical and chemical laboratory analysis;
  - allow geotechnical field tests to be undertaken;
  - install gas and groundwater wells;
- gas and groundwater monitoring;
- geotechnical and chemical laboratory analysis;
- a Ground Model;
- a geotechnical risk register;
- initial geotechnical design recommendations;
- an updated Conceptual Site Model (CSM), including identification of plausible pollution linkages;
- generic quantitative risk assessment of potential chemical contaminants to establish 'suitability for use' under the current planning regime;
- discussion of potential environmental liabilities associated with land contamination (soil, water and gas); and
- outline mitigation requirements to ensure the site is 'suitable for use'.

1.5 Available information

The following have been provided to Hydrock for use in the preparation of this report:

- Aspinwall. April 1999. 'DERA Fort Halstead, Land quality Assessment, Phase I Desk Study', Ref: 10469;
- Environmental Resources Management. July 2001. 'Project Lamb: Phase I Environmental Assessment: Fort Halstead, Kent' UK', Ref: 7923;
- Environmental Resources Management. July 2001. 'Project Lamb: Phase II Environmental Assessment: Fort Halstead, Kent, UK', Ref: 7923;
- Enviros Aspinwall. March 2002. 'DERA Fort Halstead Land Quality Assessment Phase II Site Investigation, Land Quality Assessment Report', Ref: 11469;
- RWE Nukem. January 2005. 'Radiological Investigation for QinetiQ at Fort Halstead, Kent', Ref: 96034;

- Jacobs. September 2005. 'QinetiQ Fort Halstead, Documents Review and Intrusive Investigations', Ref: J23008G0;
- Waterman. February 2015. 'Data Review, Preliminary and Generic Environmental Risk Assessments', Ref: EED12715-100.R.1.9.1.KH;
- Waterman. February 2015. 'Outline Remediation Strategy', Ref: EED12715-100.S.1.4.1.KH;
- Hydrock, October 2016. 'Ground Investigation and Data Review', Ref: FHK-HYD-XX-GI-RP-G-2.2.1; and
- John Thompson and Partners. 13th June 2019. 'Land Use and Green Infrastructure Plan', Ref: 00556I_PP01.

1.6 Regulatory context and guidance

The investigation work has been carried out in general compliance with recognised best practice, including (but not limited to) BS 5930:2015, BS 10175:2011+A2:2017 and the AGS (2006) Good Practice Guidelines for Site Investigations.

The geo-environmental section of this report is written in broad agreement with BS 10175:2011+ A2:2017, the CLR 11 Model Procedures (Environment Agency 2004), GOV.UK Land contamination: risk management guidance and the AGS (2006) Good Practice Guidelines for Site Investigations.

The methods used follow a risk-based approach, with the first stage being a Phase 1 desk study and field reconnaissance with the potential geo-environmental risk assessed qualitatively using the 'source-pathway-receptor contaminant linkage' concept to assess risk as introduced in the Environmental Protection Act 1990 (EPA, 1990). Potential geotechnical risks are also assessed.

Phase 2 comprises intrusive ground investigation work and testing. The factual data from Phase 1 and Phase 2 are used to develop the Conceptual Site Model (CSM). This comprises a ground model of the physical conditions and an exposure model of the possible contaminant linkages. The CSM forms the basis for Generic Quantitative Risk Assessment (GQRA) in accordance with current guidelines. This GQRA might lead to more Detailed Quantitative Risk Assessment (DQRA).

Professional judgement is then used to evaluate the findings of the risk assessments and to provide recommendations for the project.

This geotechnical section of this report is undertaken in general accordance with BS EN 1997-1 and BS EN 1997-2 and BS 8004:2015. This report forms a Ground Investigation Report (GIR) as described in Part 2 of Eurocode 7 (BS EN 1997-2) (EC7). However, it is not intended to fulfil the requirements of a Geotechnical Design Report (GDR) as detailed in EC7.

The geo-environmental and geotechnical aspects are discussed in separate sections. Throughout the report the term 'geotechnical' is used to describe aspects relating to the physical nature of the site (such as foundation requirements) and the term 'geo-environmental' is used to describe aspects relating to ground-related environmental issues (such as potential contamination). However, it should be appreciated that this is an integrated investigation and these two main aspects are inter-related. Designers should take all aspects of the investigation into account.

Remaining uncertainties and recommendations for further work are listed in Section 11.0 and Section 12.0.

Reference to the technical details of the approach and the methodologies adopted are provided in Appendix I.

1.7 Report Structure

To aid the reader, given the scale and complexity of the site, the report has been broken down into the following sections:

- An overview of the historical site investigation data and presentation of the preliminary conceptual site model of the entire site. (Chapter 3)
- A more detailed review of each of the current operational areas (A, H, M, N, Q, R, S and X) detailing their environmental setting and describing the site investigation works that have been undertaken historically and more recently. (Chapter 4)
- An assessment of the findings of the Hydrock site investigation, combined with the historical data, against the proposed end uses identified on the consented land use parameter plan. (Chapter 5)
- A summary of the geotechnical parameters identified across the site. (Chapter 7)
- Conclusions and recommendations based on the findings of the assessment including presentation of a refined conceptual model of the entire site. (Chapter 9)

2.0 PHASE 1 STUDY (DESK STUDY AND FIELD RECONNAISSANCE)

2.1 Data

A number of desk study sources have been used to assemble the following information. Database searches and historical maps are presented in Appendix C and D and include:

- Previous reports listed in Section 1.5;
- Third party environmental database search (Groundsure report, reference GS-5746911);
- Third party geological database search (Groundsure report, reference GS-5746912); and
- Historical Ordnance Survey mapping (Groundsure report, reference GS-5746913).

As part of the desk study data, a number of previous ground investigations undertaken at the site have been reviewed (see Section 1.5). Where suitable the data from the previously referenced reports is included within this Phase 1 study in the relevant section. The previous site investigation works are summarised in Section 3.0.

2.2 Site referencing

The site is referenced in Table 2.1.

Table 2.1: Site referencing information

Item	Brief Description
Site name	Fort Halstead
Site address	Crow Drive, Halstead, Sevenoaks, Kent. TN14 7BS
Site location and grid reference	The site is located 7.5km north of Sevenoaks, west of the M25. The National Grid Reference of the approximate centre of the site is 159348N, 549845E.

A site location plan is presented in 0.

2.3 Site description and field reconnaissance survey

A field reconnaissance survey was undertaken to visually assess potential geotechnical hazards, contaminant sources and receptors. A basic site description is presented in Table 2.2.

Table 2.2: Site description

Item	Brief Description
Site access	Via security entrance gate on Crow Drive. A secondary access point is located on Starhill Road.
Site area	The site has an area of approximately 62ha.
Elevation, topography and any geomorphic features	The site occupies a hilltop which is typically 190m-215m above Ordnance Datum (OD). The northern finger of the site encompassing Crow Road, slopes downwards to 165m OD at the northernmost extent of the site. The site is bordered to the south and east by a ridgeline.
Present land use	Fort Halstead is currently owned by Merseyside Pension Fund but it is currently occupied by DSTL and QinetiQ on a long lease. DSTL and QinetiQ provide scientific and technical research to the Ministry of Defence. Since 2011 DSTL has been relocating from the application site to Porton Down and Portsdown West via a staged withdrawal with

Item	Brief Description
	complete vacation anticipated by 2021. A number of the buildings are no longer in operational use and have been decommissioned.
General site sensitivity	Ancient woodlands are located within and bordering the site. The site is within an Area of Outstanding Natural Beauty (AONB) and is within the London Green Belt. Halstead Fort is a scheduled monument.
Site boundaries and surrounding land	The site boundary consists of security fencing around the perimeter. The surrounding land is primarily fields interspersed with residential villages and industrial units. The M25 runs approximately 600m from the south and eastern site boundaries.

2.4 Site history

A study of historical Ordnance Survey maps has been undertaken to identify any former land uses at the site and surrounding areas which may have geotechnical or geo-environmental implications for the proposed development. The key findings are summarised in Table 2.3.

It should be noted that it is common for military sites not to be shown on Ordnance Survey maps and so details with a security significance may not be picked up in this review.

Table 2.3: Site history review

Reference	Key Features on Site	Key Features off Site
OS Map[1] 1869 - 1870: 1:10,560	Site comprised primarily of woodland; Dutchmore Wood (west), Beanmont Wood (north), Anisbirches Wood (east). Farmland is present at the northern finger and western and southern extents of site.	Four Chalk mines are visible outside of the site boundary. A topographic depression to the west of the site appears to be a disused historic quarry. The Beacon, a quarry and lime kiln are located to the south of the site. Dunton Green Lime Works comprising of a quarry and kilns lies to the south-east of the site boundary and Hangman Down Shaw Chalk pit to the east of the site. The site is generally bordered by woodlands to the north and east and farmland to the west and south. The South-Eastern Main Line runs from north to south into a tunnel east of the site boundary.
OS Map 1896 1:1250	Future Fort Halstead site shown on map, access roads/tracks to Fort constructed. Historic records indicate that the fort was constructed from 1895-1897.	The Beacon Quarry appears to be no longer in use. Quarry at Dunton Green Lime Works expands to the north.
OS Map 1907: 1:10,560	A number of paths and tracks have been constructed across the site.	Quarry at Dunton Green Lime Works expands to the north.

[1] Ordnance Survey Historical Map Information provided by Groundsure

[2] 'Fort Halstead', Wikipedia https://en.wikipedia.org/wiki/Fort_Halstead

Reference	Key Features on Site	Key Features off Site
OS Map 1968: 1:10,560	Crow Drive constructed at the northern finger of the site. A nursery is established at the northern finger of the site. Fort Halsted housed military research and development facilities from 1938, structures associated with these facilities are not shown on the OS Map.	Approximately 48 residential dwellings with adjoining roads constructed at the northern site boundary. Additional structures constructed at Dunton Green Lime Works.
OS Map 1988: 1:2500	Starhill Road is constructed running north south adjacent to the western site boundary.	M25 constructed to the east of the site boundary. Dunton Green quarry no longer mined.
OS Map 2002: 1:10,000	A number of structures, paved roads and carparks are shown on the OS Map for the first time.	North Downes Business Park constructed within Dunston Green Limeworks.
OS Map 2014: 1:10,000	Additional structures have been constructed within the site. The site continues to be occupied by QinetiQ and DSTL. Since 2011 DSTL began to relocate from the site.	No significant change.

2.5 Geology

The general geology of the site area is shown on the 1:10,000 British Geological Survey (BGS) map extract reproduced as part of the Groundsure report and is summarised in Table 2.4.

Table 2.4: Geology

Location	Stratigraphic Name	Description
On site	Clay-with-flints Formation.	Orange-brown and red-brown sandy clay with abundant nodules and rounded pebbles of flint.
On site.	Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated)	Lewes - Hard to very hard nodular chalks and hardgrounds with interbedded soft to medium hard chalks and marls. Seaford - Firm white chalk with conspicuous semi-continuous nodular and tabular flint seams Newhaven - Soft to medium hard, smooth white chalks with numerous marl seams and flint bands.

The ground conditions proven by the ground investigation detailed in Hydrock Report: FHK-HYD-XX-GI-RP-G-2.2.1 are summarised in Table 2.5 below.

Table 2.5: Identified Geology

Area	Stratum	Depth, metres below ground level (m bgl)
Area 'A'	Made Ground/Topsoil	0.0 – 5.0
	Clay-with-Flints	0.4 – >5.0
	Chalk*	1.9 – >5.0
Area 'H'	Made Ground/Topsoil	0.0 – 3.5
	Clay-with-Flints	0.4 – >5.0
	Chalk*	3.6 – >5.0
Area 'M'	Made Ground/Topsoil	0.0 – 1.1
	Clay-with-Flints	0.05 – >3.6
	Chalk*	1.2 – >2.7
Area 'N'	Made Ground/Topsoil	0.0 – 1.2
	Clay-with-Flints	0.2 – 6.5
	Chalk*	0.9 – >5.0
Area 'Q'	Made Ground/Topsoil	0.0 – 2.3
	Clay-with-Flints	0.2 – >5.0
	Chalk*	0.5 – >5.0
Area 'R'	Made Ground/Topsoil	0.0 – 1.5
	Clay-with-Flints	0.2 – >5.0
Area 'S'	Made Ground/Topsoil	0.0 – 1.8
	Clay-with-Flints	0.4 – >5.0
Area 'X'	Made Ground/Topsoil	0.0 – 1.1
	Clay-with-Flints	0.3 – >5.0
	Chalk*	4.0 - >15

*Where Chalk is referred to in Table 2.5, this should be read as the Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated)

2.6 Groundwater system

Based on the inferred geological sequence presented in Section 2.5 and the Environment Agency's interactive aquifer designation map, the aquifer system presented in Table 2.6 applies.

Table 2.6: Aquifer system

Stratum	Aquifer Designation	Hydraulic Characteristics
Clay-with-flints Formation.	Unproductive Strata	Low permeability, negligible significance for water supply or river base flow. May contain a perched water table.
Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated)	Principal Aquifer	High fracture permeability, usually providing a high level of water storage and may support water supply/river base flow on a strategic scale.

The groundwater body beneath the site (West Kent Darent and Cray Chalk) is currently (2016 Cycle 2) classified under the Water Framework Directive as 'poor'. The water body is currently poor status due to the agriculture and rural land management sector, urban and transport sector and the water industry. There are no active licensed groundwater abstractions within 1000m of the site. The site is not located within a groundwater Source Protection Zone (SPZ).

Groundwater associated with principal aquifers was not encountered during previous site investigations. Based on BGS Hydrogeological map of the Chalk and Lower Greensand of Kent, Sheet 3b, 1970, ground water level is anticipated to be approximately at least 90m bgl.

2.7 Surface Water System

There are no mapped watercourses within the site boundary. The closest mapped watercourses are unnamed inland rivers, 495m north and 497m north east of the site boundary.

There are no active licensed surface water abstractions or discharges within 1km of the site.

Reference to the Environment Agency website shows the site is located within the catchment of the Thames River Basin, with the specific river water body being the Darent and Cray Catchment. The current (2016 cycle 2) overall status under the Water Framework Directive is 'good'.

The desk study information indicates the proposed development is in Flood Zone 1 (with a low probability of flooding from rivers or the sea). No further consideration of flood risk is undertaken in this report. Specialist flood risk advice should be sought with regard to drainage and flooding.

2.8 Chalk quarries

Five historic chalk quarries exist within 500m of the site boundary, an additional potential quarry has been identified outside of the site boundary. All quarries are no longer being worked.

With regard to the quarries, the BGS considers that "sporadic underground mining of restricted extent may have occurred. Potential for difficult ground conditions are unlikely and localised and are at a level where they need not be considered".

Hydrock considers it is unlikely that mine workings exist below the current study site.

2.9 Natural ground instability

The British Geological Survey (BGS) hazard rating for natural ground stability data sets at the site are presented in Table 2.7 below.

Table 2.7: Natural Ground Subsidence Hazard Ratings

Ground Stability Hazard	Hazard Rating	Reference
Ground Dissolution of Soluble Rocks	Moderate	Section 2.10
Landslides	Low/Moderate	Section 2.11
Shrink-Swell clays	Low	Section 2.12
Collapsible Deposits	Very Low	No further consideration in Desk Study
Running Sands	Negligible	No further consideration in Desk Study
Compressible Deposits	Negligible	No further consideration in Desk Study

2.10 Natural Chalk Cavities

2.10.1 Background

The site is underlain at shallow depth by potentially soluble strata (Chalk), overlain by sandy clay (Clay-with-Flints Formation) with a deep groundwater table.

The environmental database report indicates a 'moderate' risk of soluble rocks, close to surface. The Chalk is noted as being at risk of the formation of voids by the dissolution of the chalk. Groundwater derived from rainwater is naturally slightly acidic from the presence of dissolved carbon dioxide, which forms carbonic acid.

Dissolution features can include voids, collapse sinkholes, and dissolution widened discontinuities in the chalk with dissolution pipes. Subsidence sinkholes are caused by overlying granular materials collapsing into the chalk dissolution features. These often originate by material at depth collapsing into a dissolution void, causing a void to migrate upwards to form a subsidence feature at the surface.

The presence of layers of dense or cemented materials or cohesive layers can prevent or restrict the void reaching the surface, but creating a potential for surface subsidence in the future when conditions change. The collapse of materials into voids can cause either voids, or loosened material which can extend in a zone surrounding the central core of the collapsed material. These features are illustrated in Figure 2.11 of CIRIA C574 which is reproduced as Figure 2.1 below:

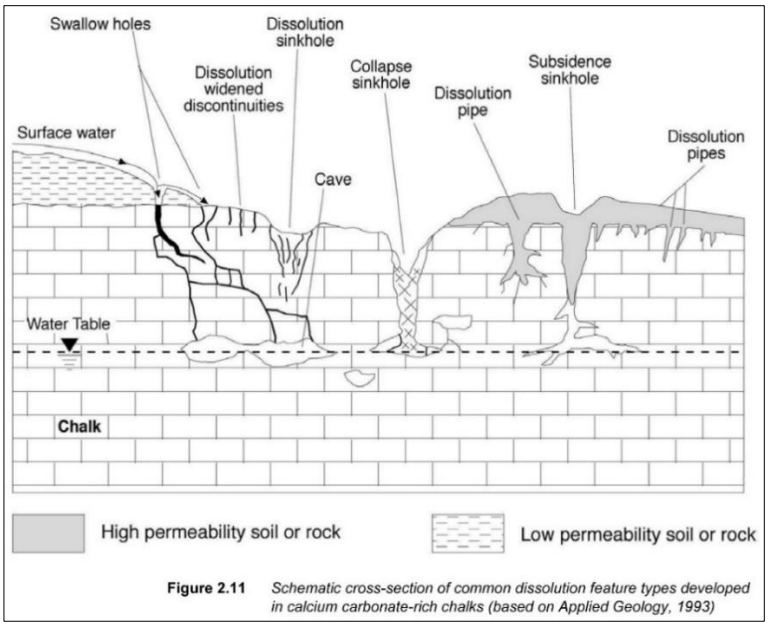


Figure 2.1: Chalk Dissolution Features (from CIRIA C574 Engineering in Chalk)

2.10.2 Dissolution of Soluble Rocks

Records from the Peter Brett Associates natural cavities database indicate that solution pipes are present at a single location on site with five further records of solution pipes within 500m of the site.

167m and 296m south of the site with three further records of natural cavities within 500m of the site.

There is documented evidence in the vicinity of the site of ground instability due to the collapse of voids within the gravels and Chalk. On this basis, further consideration of the risk posed by solution features will need to be taken into account at the ground investigation and construction phases.

2.11 Landslide Hazard

Records from the BGS database indicate that landslide features are present along the southern and eastern extent of the site boundary at the base of existing Chalk Formation slopes. The hazard rating assigned to these features is generally 'low' with some features assigned a hazard rating of 'moderate' to the east of the northern finger of the site.

The BGS considers that where a moderate hazard is present there may be 'significant potential for slope instability with relatively small changes in ground conditions' in some areas.

Further consideration of the risk posed by landslide features will need to be taken into account at the ground investigation, geotechnical design and construction phases.

2.12 Shrink – Swell Potential

The Clay-with-Flints Formation is noted by the BGS as having a low potential for shrinking or swelling of clays with ground conditions comprising predominantly medium plasticity soils. Although the hazard potential of shrink-swell on site is noted by the BGS as low, based on experience, Hydrock consider the risk of shrink-swell in the presence of vegetation to be moderate to high and further consideration of shrink-swell potential will need to be taken into account during the design and construction phases.

2.13 Waste management

There are no historical waste management sites recorded within 250m of the site. Previous reports note a number of onsite waste management facilities which are not registered in the Environment Agency database.

2.14 Regulatory Consultation

Information in the GroundSure Report, relating to various regulatory controls has been reviewed, with a summary presented below in Table 2.8.

Table 2.8: Regulatory information within 200m of the site

Regulatory Data	Distance from Site	Details	Potential Risk	Comment
RAS Licence (3 or 4)	Onsite	Ministry of Defence - Disposal of Radioactive Waste 13/5/1994 – Superseded by Variation (Permission Number - BB3786, AY5701, AM5785)	Yes	Radioactive substance
	Onsite	Ministry of Defence - Keeping and Use of Radioactive Materials. 21/5/1997 – Effective (Permission Number, AY1480)	Yes	Radioactive substance
	Onsite	QinetiQ Ltd - Disposal of Radioactive Waste 13/2/2006– Effective (Permission Number, CA0417)	Yes	Radioactive substance

Regulatory Data	Distance from Site	Details	Potential Risk	Comment
Discharge Consents	Onsite	DSTL - Treated Effluent received by Groundwater via Soakaway 10/02/2009 to present. Permit Number: NPSWQD006490.	Yes	Due to nature of previous land use.
	35m North	DSTL - Treated Effluent received by Groundwater via Soakaway 02/02/2009 to present. Permit Number: NPSWQD006491.	Yes	Due to nature of previous land use.
	94m north, 96m north	7 Hotel Diner, London Road, Polhill Final - Treated Effluent received by Groundwater via Soakaway 12/05/2010 to present. Permit Number: EPRBP3520XW	No	Due to being down gradient of the site.
Pollution Incidents	41m north west	16 July 2003, tyres. Category 3 – minor incident (Land Impact only).	No	Due to the Category 3 classification of the incident.
	99m southeast	15 April 2002, general biodegradable. Category 3 – minor incident.	No	Due to the Category 3 classification of the incident.
	109m north	16 March 2003, tyres. Category 3 – minor incident (Land Impact only).	No	Due to the Category 3 classification of the incident.
	111m north	13 December 2002, tyres. Category 3 – minor incident (Land Impact only).	No	Due to the Category 3 classification of the incident.

2.15 Evidence of historical contamination

A number of potentially contaminative historic land uses are identified in the Groundsure Report. Within the site boundary there are two plant nurseries, a number of buried tanks and potentially infilled land (Made Ground). In addition, radioactive materials have been stored and used at the site.

Outside of the site boundary chalk quarries (see Section 2.8) and associated kilns, ground workings, cuttings and the railway line, tunnel and embankments and cuttings associated with these features are also potentially contaminative.

2.16 Radon

The radon risk is reported in the environmental data. This indicates that the site is not in a Radon Affected Area and no radon protection measures are required.

2.17 Suitability of previous data

Data from the historical site investigation reports detailed in Section 1.5 have been taken into account during the preparation of this report where considered to be relevant or appropriate. The section below provides comment as to the applicability of the various data available.

Geological data

The geological data from historical works is consistent with the anticipated ground conditions from BGS sources. As the site conditions during the current investigation are similar to those when historical investigations were undertaken, Hydrock consider the geological data is suitable for use and has been utilised in this report.

Chemical test data

The 2001 to 2005 data sets will be subject to the limitations in the analytical methodologies of the time (with some testing methods no longer best practice and having been superseded with more accurate methodologies) and the data may be considered less reliable than that achieved via current day techniques. However, it is Hydrock's opinion that the chemical test data do have value as an indicator of expected contamination distributions and, together with other previously acquired information, will help to characterise the site and act as an aid to directing the additional investigations required. Hydrock has utilised the historic soils data during the ongoing site investigation and assessment. However, it is recognised that additional supplementary investigation is required to confirm historical data and delineation will be required during any potential remediation works.

The most recent investigation on the site containing chemical test data for soil was conducted in 2016 and is MCERTS accredited. It is Hydrock's opinion that the chemical test data for soil from historical report(s) are able to be used as part of the current site investigation.

Ground gas data

There is a single round of reliable gas data available for the site, recorded during the 2016 Hydrock investigation. This reliable data (Hydrock, 2016), has been used as part of the assessment. However, data deemed to be unreliable has not be used in this report.

Geotechnical data

Whilst the available geotechnical information is sparse, it will not become out of date and is still relevant as a guide to physical ground conditions. However, significant supplementary investigations will be required as related to the new development proposals.

3.0 HISTORICAL SITE INVESTIGATIONS AND PRELIMINARY CONCEPTUAL SITE MODEL

3.1 Historical Investigations

A desk based review and detailed summary of previous works are presented within the Waterman Data Review (Ref: EED12715-100.R.1.9.1.KH) submitted to support a past planning application at the site (Ref: 15/00628/OUT).

In addition, the 2016 Hydrock Ground Investigation and Data Assessment report (Ref: FHK-HYD-XX-GI-RP-G-2.2.1) summarises the Waterman Data Review and includes the findings of the 2016 Hydrock ground investigation.

The historical investigations at the site are summarised in Table 3.1.

Table 3.1: Summary of Historical Investigations

Historical Investigation	Summary of the Investigation	Key Findings of the Investigation
Ground Investigation		
Enviros Aspinwall (1999) Phase 1 Land Quality Assessment	Desk study and land quality assessment on the site and wider survey area.	It was concluded that: • areas outside the site unlikely to have been contaminated by historical activities; • potential sources of contamination include explosive residues, radioactivity, storage of oils, solvents and waste chemicals, ad-hoc storage of chemicals/oils, PCBs and other hazardous materials; and • greatest environmental risks are to current workers and visitors and the Principal Aquifer underlying the site.
Enviros Aspinwall (2002) Phase 2 Site Investigation and Land Quality Assessment	Explosives Ordnance Disposal Assessment. Site investigation including: • 8 trial pits; • 79 window sample boreholes; • 7 solid stem auger boreholes; • a soil vapour survey; and • a radiological survey.	It was concluded unlikely that there would be any significant environmental or health and safety constraints on decommissioning or redeveloping the site, provided that the potentially significant risks identified are managed and mitigated. Significant risks identified included: • possibility of explosive contamination; • certain elevated heavy metals in soils; and • further investigation into presence of depleted uranium within the site drainage.
ERM (2001) Phase 1 Environmental Assessment	Environmental due diligence assessment.	It was recommended that: • Due to concerns that the drainage system beneath buildings Q6 and Q7, used for release of radioactive substances, was inadequate a recommendation for cleaning of drains the installation of a sediment filter to collect contaminated sediments for disposal. • An historical review of past building uses specific to the proposed end use be undertaken to determine the potential for building contamination. • Unexploded ordnance surveys be undertaken.

Historical Investigation	Summary of the Investigation	Key Findings of the Investigation
ERM (2001) Phase 2 Environmental Assessment	Limited site investigation targeting the A, Q, R and X areas including: • 12 window sample locations to 4m bgl; and • 6 cable percussive boreholes to a maximum depth of 20m bgl.	It was identified that a minor number of elevated metals were encountered, though the investigation itself was limited in scale.
Jacobs (2005) Document Review and Intrusive Investigations Report.	Review of previous report pertaining to the site. Site investigation including: • 34 window sample boreholes; • 63 hand dug pits; and • 4 surface samples.	The following were identified: • Elevated PAH. • Elevated metals. • Elevated petroleum hydrocarbons. • Asbestos in building bunds and blast walls.
Hydrock (2016) Ground Investigation and Data Assessment	The Hydrock ground investigation comprised: • 39 window sample boreholes to a maximum depth of 8m bgl; • 43 trial pits to a maximum depth of 3.7m bgl; • 6 hand dug pits to a maximum depth of 0.5m bgl; • 20 gas monitoring installations to a maximum depth of 5.0m bgl.	The investigation broadly demonstrated reduced levels of contaminants in comparison to previous historic data. Significant widespread contamination was not encountered. Localised exceedances over generic assessment criteria have been identified, however it is considered that these can be addressed by industry standard remedial techniques. Asbestos fibres were encountered in Made Ground at various locations across the site.
Drainage Investigations		
Enviros Aspinwall (2001) Investigation of Depleted Uranium Debris	Collect samples from the depleted uranium weir trap. Collect samples from drains downstream of the weir trap	Uranium was identified in four samples taken. One of which recorded activity that would require control under the Radioactive Substances Act 1993 and the Ionising Radiations Regulations 1994. The risk of radiation exposure on the Site was considered negligible, unless the material was disturbed during maintenance.
Jacobs (2005) Drainage Review	Desk based review of the foul and surface water drainage plans and discharge consents. Review of drainage issues highlighted in earlier desk studies and site investigation.	Recommendations for drainage investigation, cleaning and sediment sampling within drains were made.
RWE Nukem (2005) Fort Halstead Drainage survey	A drainage survey to investigate the levels of possible depleted uranium within the drainage system surrounding building Q7.5, Q6.3 and N19/20. Direct probe monitoring, smear monitoring and sediment samples were undertaken.	It was concluded that decontamination had proceeded satisfactorily and any previous radiological risks identified had been dealt with.

Historical Investigation	Summary of the Investigation	Key Findings of the Investigation
	Following this a drain clean up in the vicinity of buildings Q6, Q7 and N19 was undertaken	

3.2 Preliminary Conceptual Site Model

The preliminary exposure model is used for geo-environmental hazard identification and establishing potential contaminant linkages based on the contaminant-pathway receptor approach.

The preliminary conceptual model for the site based on the historical site investigations, is detailed Table 3.2.

Table 3.2: Preliminary Conceptual Model

Contaminant Linkage			
Receptor	Source	Pathway	Risk
Human Health (End Users)	Elevated metals, hydrocarbons, PAHs, VOCs, SVOCs, asbestos in soils, other solvents and chemicals, explosive residues.	Ingestion, inhalation or direct contact.	Medium
	Residual radioactive material (depleted uranium)	Direct contact	Low
	Explosive devices	Direct contact/Explosion	Low
	Ground Gas	Migration through soils to indoor air.	Low
Human Health (Construction Workers)	Elevated metals, hydrocarbons, PAHs, VOCs, SVOCs, asbestos in soils, other solvents and chemicals, explosive residues.	Ingestion, inhalation or direct contact.	Medium
	Residual radioactive material (depleted uranium)	Direct contact	Low
	Explosive devices	Direct contact/Explosion	Medium
Human Health (Site Neighbours)	Elevated metals, hydrocarbons, PAHs, VOCs, SVOCs, asbestos in soils, solvents, explosive residues.	Ingestion, inhalation or direct contact.	Low
	Ground gas	Migration off site through soils.	Low
Plant Life	Elevated metals, hydrocarbons, PAHs, VOCs, SVOCs, asbestos in soils, solvents, explosive residues.	Root uptake	Low
Controlled Waters	Elevated metals, hydrocarbons, PAHs, VOCs, SVOCs, asbestos in soils, solvents, explosive residues.	Surface water runoff	Low
Buried Services	Elevated metals, hydrocarbons, PAHs, VOCs, SVOCs, asbestos in soils, solvents, explosive residues.	Direct contact with pipework and ducts	Medium

4.0 SITE ENVIRONMENTAL SETTING AND REVIEW OF CURRENT AND PREVIOUS SITE INVESTIGATIONS

In the following section each of the current operational areas of the site are described as are the historical and current site investigation works undertaken in each area. A summary of the current operational areas is presented in Table 4.1.

Table 4.1: Summary of Current Operational Areas

Operational Area	Summary of Operations
A	Offices and laboratories.
H	Offices and laboratories. The fire station.
M	The Magazines containing buildings used for the storage of higher risk explosives. A small burning ground is located in the north.
N	Offices, including site reception and the restaurant. A gym and playing fields. Large warehouses including N2 used for tank dismantling.
Q	Offices, laboratories, warehouses and workshops.
R	Offices, laboratories, firing ranges and a large burning ground.
S	Offices, laboratories and the site waste compound.
X	Offices, laboratories, explosives handling.

4.1 'A' Area

The 'A' area is located to the east of the site as shown in Figure 4.1.

Figure 4.1: The 'A' Area

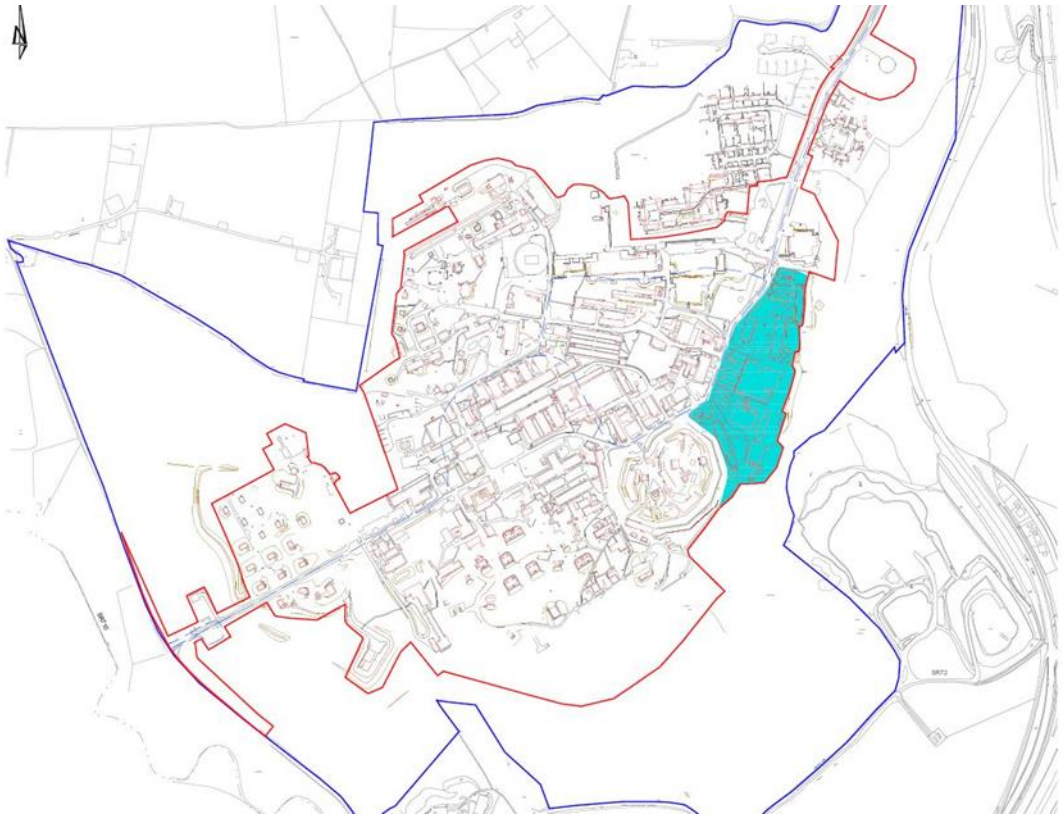


Table 4.2: 'A' Area Overview

Item	Brief Description
Present land use	Combination of office buildings and laboratories with a large car parking area along the eastern boundary. Several buildings have been used as laboratories resulting in chemical use or handling. There are several vacant buildings; the remainder were occupied by DSTL.
Potential Contamination	Waste chemical tanks beneath and above ground fuel storage at A28. Former waste disposal adjacent to A5. Former boiler house at A12. Former workshop at A5. Solvent, chemical and oil storage at A28.2

4.1.1 'A' Area - Historical and Hydrock 2016/2018 Ground Investigations

For the purpose of this assessment, the potential contaminants have been separated according to whether they are likely to have originated from on-site or off-site sources.

Historical ground investigations undertaken by Enviros Aspinwall (2002) and Jacobs (2005) relating to Area A are detailed in Table 4.3 and Hydrock investigations (2016 and 2018) in Table 4.4. Locations are shown on drawing 10730-HYD-XX-ZZ-DR-GE-1002 presented in Appendix A.

Table 4.3: 'A' Area Historical Ground Investigation Details

Activity	Method	No.	Max. Depth (m bgl)	Purpose
Enviros Aspinwall (2002) Phase 2 Site Investigation and Land Quality Assessment				
Window Sampling	Window sampler rig	9	6.0	To assess shallow ground conditions whilst minimising ground disturbance.
Solid Stem Auger Borehole	Solid stem auger drilling	1	7.5	To gain an understanding of the depth of chalk.
Jacobs (2005) Document Review and Intrusive Investigations Report				
Window Sampling	Window sampler rig	2	3.0	To assess shallow ground conditions whilst minimising ground disturbance.
Hand Dug Pits	Hand tools	6	1.2	Collection of shallow samples for analyses.

The logs from the Hydrock investigations, including details of ground conditions, soil sampling and in situ testing are presented in Appendix B.

Table 4.4: Hydrock 2016 and 2018 Ground Investigation Summaries and Rationale

Activity	Method	No.	Max. Depth (m bgl)	Purpose	Notes
Window Sampling	Window sampler rig	10	5.0	To assess shallow ground conditions and allow collection of samples for contamination testing. To allow dynamic probing for strength profiling of soils.	These positions were designed to target the following: • Former main workshop. • Generator House. • Below ground waste chemical tanks. • Heating oil tank. • Potential asbestos in building rubble • Former above ground fuel storage tank • Former boiler house Screening of soils with a photo ionising detector (PID) to identify volatile organic compounds (VOC) and semi volatile organic compounds (SVOC). 4 dynamic probes undertaken. 4 monitoring wells installed.
Trial Pits	JCB 3CX	5	3.7	To assess shallow ground conditions. To allow collection of samples for	These positions are investigating beneath the building slabs of demolished buildings.

Activity	Method	No.	Max. Depth (m bgl)	Purpose	Notes
				contamination testing.	Screening of soils with a PID to identify VOCs and SVOCs.
Hand Pits	Hand excavation	2	0.5	To allow collection of samples from building abutments.	Screening of soils with a PID to identify VOCs and SVOCs.

4.1.2 *Summary of Ground Conditions Encountered*

Table 4.5 presents a summary of the ground conditions encountered during the Hydrock ground investigations. These observations, in general, concur with the historical ground investigations.

Table 4.5: Summary of Ground Conditions Within the 'A' Area.

Stratum	Brief Description	Depth to Top (m bgl)	Depth to Base (m bgl)
Topsoil	Brown clayey slightly gravelly TOPSOIL. Gravel of fine to coarse angular to sub rounded flint, brick and concrete.	0.0	5.0
Made Ground 1	Loosely packed brown black sandy GRAVEL of fine to coarse angular to sub rounded flint, concrete and brick with frequent whole bricks.		
Made Ground 2	Loosely packed brown grey sandy slightly clayey GRAVEL of fine to coarse angular to sub rounded flint, concrete and brick with frequent whole bricks.		
Made Ground 3	Soft to firm orange brown gravelly clay. Gravel of fine to coarse angular to sub rounded flint, ash and brick.		
Clay-with-Flints	Stiff red brown mottled orange brown sandy gravelly CLAY. Gravel of fine to coarse angular to sub rounded flint with frequent cobbles of flint. Occasional red yellow slightly clayey SAND.	0.4	>5.0
Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated)	Weak to moderately strong partly weathered white with occasional yellow staining CHALK. Closely spaced fractures infilled with soft remoulded chalk fragments (Grade IV).	1.9	>5.0

Groundwater was not encountered in any of the investigation locations.

Surface material of asphalt or concrete was noted to a maximum depth of 0.4m bgl in ungrassed areas.

A number of trial pits and boreholes across the site, encountered large flint cobbles that hindered progress.

There are several large structures including office buildings, laboratories and warehouses within this area. No investigation was possible beneath these building footprints. There are also a number of demolished buildings within the area. Trial pitting through several of the remaining floor slabs was undertaken to identify ground conditions beneath them.

4.2 'H' Area

The 'H' area is located towards the centre of the site, adjacent to the western boundary of the 'A' area as shown in Figure 4.2.

Figure 4.2: The 'H' Area

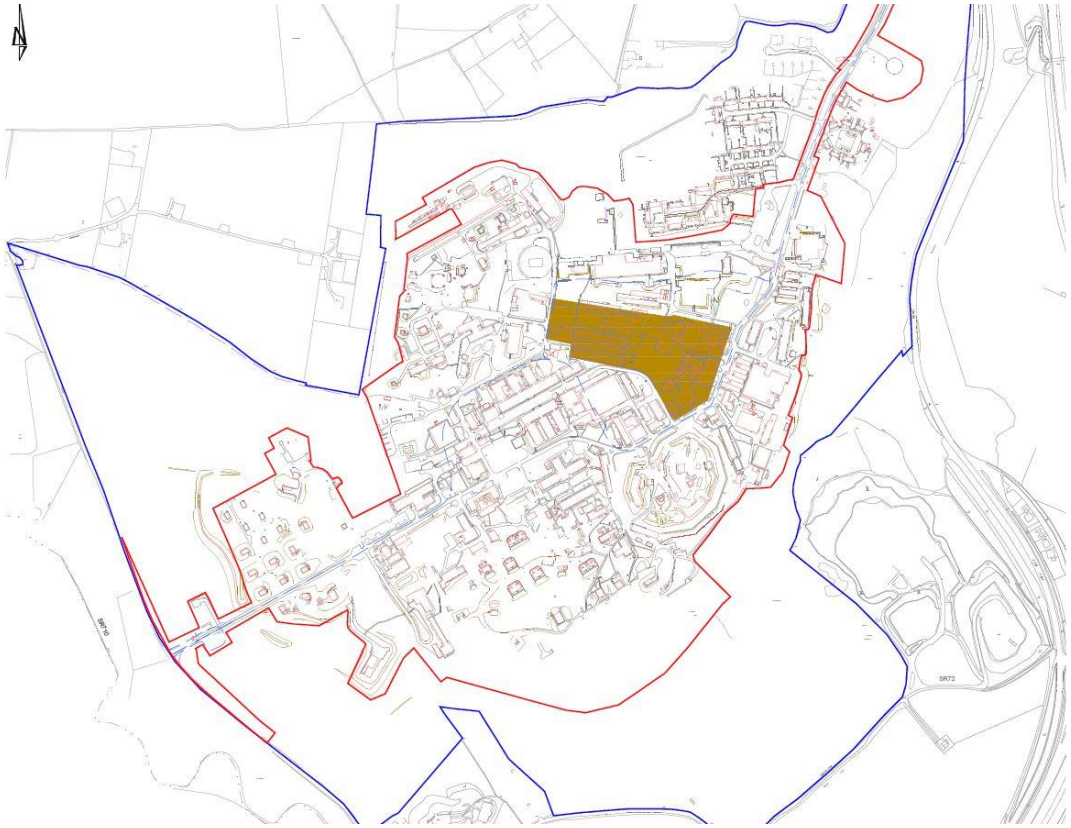


Table 4.6: 'H' Area Overview

Item	Brief Description
Present land use	Combination of office buildings and laboratories with a large car park in the centre of the area. The fire station is located at H1.1. There are several demolished buildings within this area.
Potential contamination	Former garage at H16. Former coal store at H20. Underground fuel tanks adjacent to H7. Former boiler house.

4.2.1 'H' Area - Historical and Hydrock 2016/2018 Ground Investigations

Historical ground investigations undertaken by Enviros Aspinwall (2002) and Jacobs (2005) are detailed Table 4.7. Locations are shown on drawing 10730-HYD-XX-ZZ-DR-GE-1002 presented in Appendix A.

Table 4.7: 'H' Area Historical Ground Investigation Details

Activity	Method	No.	Max. Depth (m bgl)	Purpose
Enviros Aspinwall (2002) Phase 2 site investigation and Land Quality Assessment				
Window Sampling	Window sampler rig	6	4.0	To assess shallow ground conditions whilst minimising ground disturbance.
Solid Stem Auger Borehole	Solid stem auger drilling	1	4.5	To gain an understanding of the depth of chalk.

The logs from the Hydrock investigations, including details of ground conditions, soil sampling and in situ testing are presented in Appendix B.

Table 4.8: Hydrock 2016 and 2018 Ground Investigations Summary and Rationale

Activity	Method	No.	Max. Depth (m bgl)	Purpose	Notes
Window Sampling	Window sampler rig	5	5.0	To assess shallow ground conditions. To allow collection of samples for contamination testing. To allow dynamic probing for strength profiling of soils.	These positions were designed to target the following: • a disused boiler house • a former coal store • the former main garage • a former incinerator • a former acid store • generator house • above ground tanks Screening of soils with a photo ionising detector (PID) to identify volatile organic compounds (VOC) and semi volatile organic compounds (SVOC) undertaken. 1 dynamic probe undertaken. 3 monitoring wells installed.
Trial Pits	JCB 3CX	2	3.0	To assess shallow ground conditions. To allow collection of samples for contamination testing.	These positions were designed to target the residue from a recorded spill of uranium salt Screening of soils with a PID to identify VOCs and SVOCs undertaken.

4.2.2 Summary of Ground Conditions Encountered

Table 4.9 presents a summary of the ground conditions encountered during the Hydrock ground investigation. These observations, in general, concur with the historical ground investigations.

Table 4.9: Summary of Ground Conditions Within the 'H' Area.

Stratum	Brief Description	Depth to Top (m bgl)	Depth to Base (m bgl)
Topsoil	Dark brown gravelly clayey TOPSOIL. Gravel of fine to coarse angular brick, concrete and flint.	0.0	0.2
Made Ground 1	Loosely packed brown grey sandy slightly clayey GRAVEL of fine to coarse angular to sub rounded flint, concrete and brick with frequent whole bricks and cobbles of concrete.	0.2	3.5
Made Ground 2	Firm to stiff brown grey gravelly CLAY. Gravel of fine to coarse angular to sub rounded flint, brick and concrete. Slight hydrocarbon odour in TP539.	0.7	1.9
Made Ground 3	Stiff red brown mottled orange brown sandy gravelly flint CLAY. Gravel of fine to coarse angular to sub rounded flint and brick.	0.2	2.3
Clay-with-Flints	Soft to stiff red brown mottled orange brown sandy gravelly CLAY. Gravel of fine to coarse angular to sub rounded flint with occasional to frequent cobbles of flint.	0.4	>5.0
Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated)	Weak to moderately strong partly weathered white with occasional yellow staining CHALK. Closely spaced fractures infilled with soft remoulded chalk fragments (Grade IV).	3.6	>5.0

Groundwater was not encountered in any investigation locations.

Surface material of asphalt or concrete was noted to a maximum depth of 0.4m bgl in ungrassed areas.

A number of trial pits and boreholes across the site, encountered large flint cobbles that hindered progress.

Other obstructions encountered are detailed in Table 4.10.

Table 4.10: Obstructions Encountered During Hydrock Investigations

Exploratory Hole	Depth(m bgl)	Description	Stratum
BH529	0.8m	Terminated due to dense flint, brick and concrete hampering progress of starter pit.	Made Ground

There are several large structures including office buildings, laboratories and the fire station within this area. No investigation was possible beneath these building footprints. There are also a number of demolished buildings within the area. Trial pitting through several of the remaining floor slabs was undertaken to identify ground conditions beneath them.

4.3 M' Area

The upper and lower 'M' areas (the magazines) are located to the west of the site as shown in Figure 4.3.

Figure 4.3: The 'M' Areas

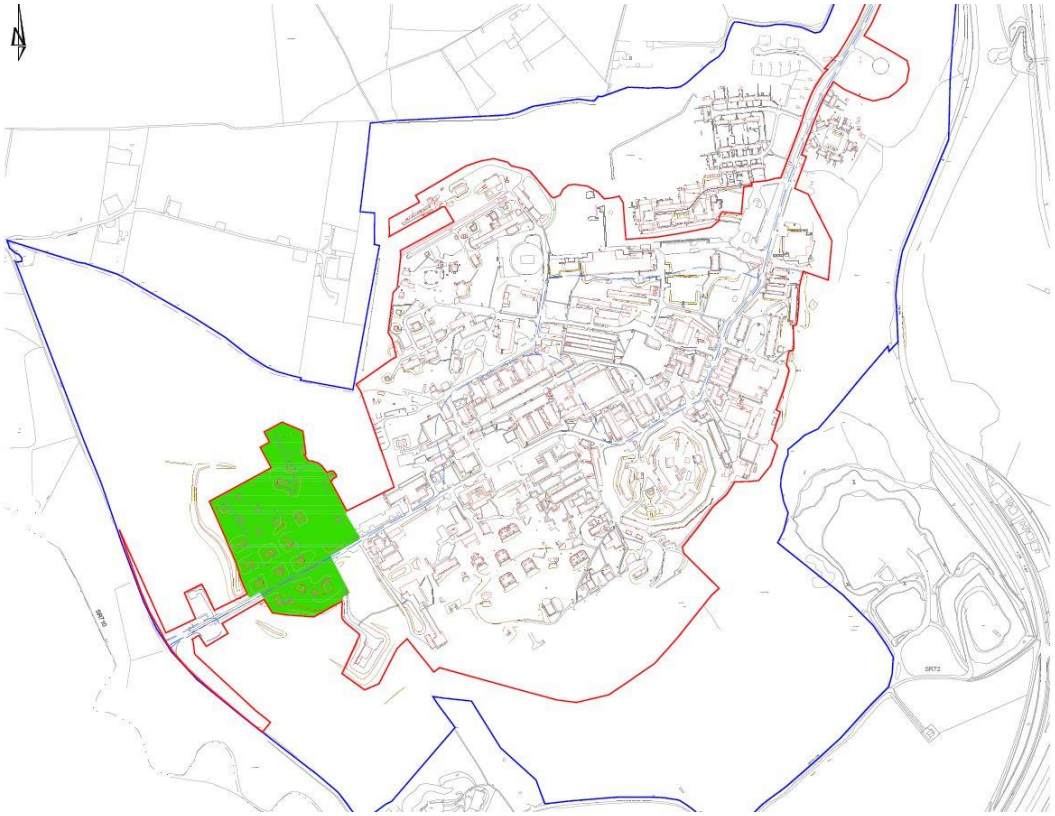


Table 4.11: 'M' Area Overview

Item	Brief Description
Present land use	The current occupiers are the Defence Science and Technology Laboratory (DSTL). Within the area there are a series of buildings used for the storage of higher risk explosives. Between the buildings are grassed areas with several mature trees. A small 'burning ground' is located in the north. Crow Drive bisects the upper and lower M areas, each of which has its own gated access point.
Potential Contamination	Area used for storage of explosives. Burning ground.

4.3.1 'M' Area - Historical and Hydrock 2016/2018 Ground Investigations

Historical Ground Investigations undertaken by Enviros Aspinwall (2002) and Jacobs (2005) are detailed in Table 4.12. Locations are shown on drawing 10730-HYD-XX-ZZ-DR-GE-1002 presented in Appendix A.

Table 4.12: 'M' Area Historical Ground Investigation Details

Activity	Method	No.	Max. Depth (m bgl)	Purpose
Enviros Aspinwall (2002) Phase 2 Site Investigation and Land Quality Assessment				
Window Sampling	Window sampler rig	2	4.0	To assess shallow ground conditions whilst minimising ground disturbance.
Trail Pitting	Machine Excavator	4	4.0	To assess shallow ground conditions
Jacobs (2005) Document Review and Intrusive Investigations Report.				
Window Sampling	*Window sampler rig*	*2*	*5.0*	*To assess shallow ground conditions whilst minimising ground disturbance.*
Hand Dug Pits and near surface samples	*Hand tools*	*12*	*1.2*	*Collection of shallow samples for analyses.*

The logs from the Hydrock investigations, including details of ground conditions, soil sampling and in situ testing are presented in Appendix B.

Table 4.13: Hydrock 2016/2018 Ground Investigation Summary and Rationale

Activity	Method	No.	Max. Depth (m bgl)	Purpose	Notes
Trial Pits	JCB 3CX	9	3.6	To assess shallow ground conditions. To allow collection of samples for contamination testing.	These positions were designed to target primarily the potential for explosive residues within the M area. Screening of soils with a photo ionising detector (PID) to identify volatile organic compounds (VOC) and semi volatile organic compounds (SVOC) undertaken.
Window Sampling	Window sampler rig	1	1.7	To assess shallow ground conditions. To allow collection of samples for contamination testing.	These positions were designed to target primarily the potential for explosive residues within the M area. Screening of soils with a photo ionising detector (PID) to identify volatile organic compounds (VOC) and semi volatile organic compounds (SVOC) undertaken.

Activity	Method	No.	Max. Depth (m bgl)	Purpose	Notes
Cable Percussive Drilling	Cable Percussive Rig	1	15m	To assess deeper ground conditions. To allow collection of samples for contamination and geotechnical testing.	This borehole was located to assess geotechnical properties up to 15m bgl in this area of the site.
Hand Pits	Hand excavation	3	0.5	To allow collection of samples from soil building abutments.	Screening of soils with a PID to identify VOCs and SVOCs.

4.3.2 *Summary of Ground Conditions Encountered*

Table 4.14 presents a summary of the ground conditions encountered during the Hydrock ground investigations. These observations, in general, concur with the historical ground investigations.

Table 4.14: Summary of Ground Conditions Within the 'M' area.

Stratum	Brief Description	Depth to Top (m bgl)	Depth to Base (m bgl)
Topsoil	Brown sandy gravelly slightly clayey TOPSOIL. Gravel of fine to coarse angular to sub rounded flint.	0.0	0.2
Made Ground 1	Loosely packed brown grey GRAVEL of fine to coarse angular to sub rounded brick and concrete.	0.2	0.5
Made Ground 2	Firm to stiff brown gravelly CLAY. Gravel of fine to coarse angular to sub rounded flint, brick and concrete.	0.2	1.1
Clay-with-Flints	Firm to stiff red brown mottled orange brown sandy gravelly flint CLAY. With gravel of fine to coarse angular to sub rounded flint. Areas of frequent flint cobbles.	0.05	>3.6

Stratum	Brief Description	Depth to Top (m bgl)	Depth to Base (m bgl)
Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated)	Weak to moderately strong partly weathered white with occasional yellow staining CHALK. Closely spaced fractures infilled with soft remoulded chalk fragments (Grade IV).	1.2	>15m

Groundwater was not encountered in any investigation locations.

Surface material of asphalt or concrete was noted to a maximum depth of 0.4m bgl in ungrassed areas.

A number of trial pits and boreholes across the site, encountered large flint cobbles that hindered progress.

There are several large structures including office buildings and the magazines within this area. No investigation was possible beneath these building footprints.

4.4 'N' Area

The 'N' area is located in the north of the site, it extends outside of the secure perimeter to the surrounding land including the restaurant as shown in Figure 4.4.

Figure 4.4: The 'N' Area

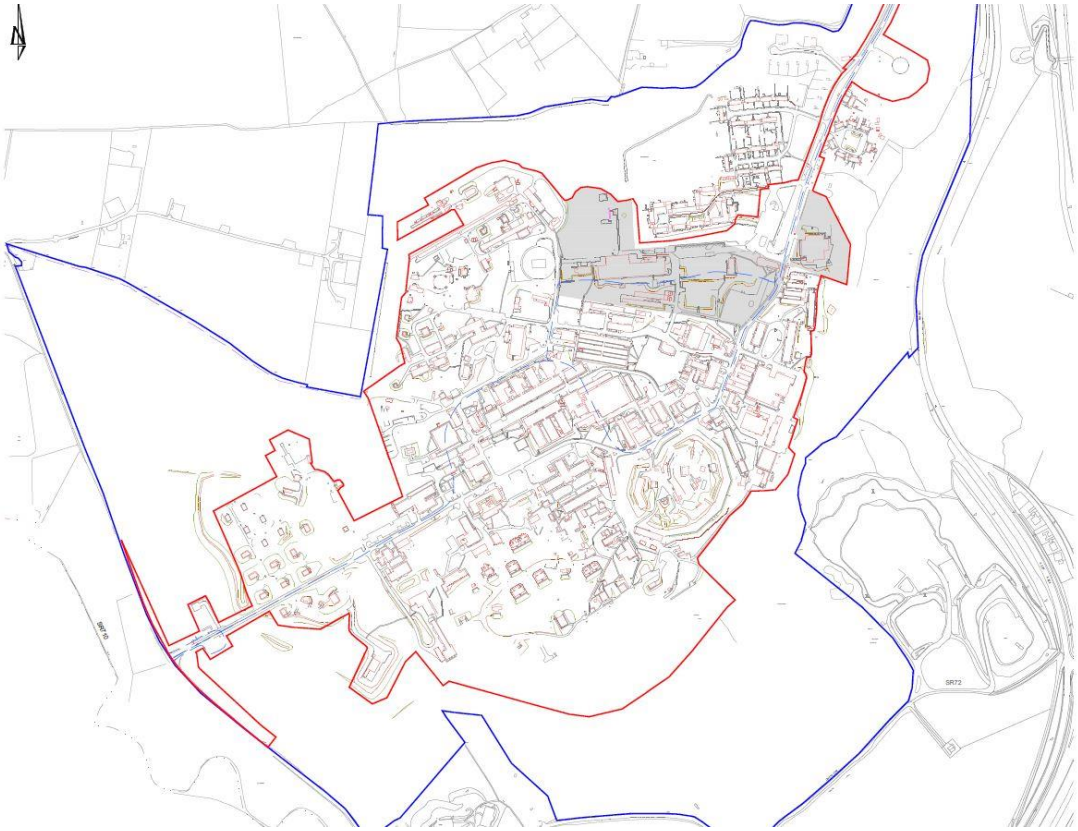


Table 4.15: 'N' Area Overview

Item	Brief Description
Present land use	Area is occupied by the large warehouse building N2 and several smaller buildings including the site reception and gym and grassed playing fields. There are also several demolished buildings with this area.
Potential Contamination	Tank dismantling undertaken at N2. Residual depleted uranium within drains of the former N19.

4.4.1 'N' Area - Historical and Hydrock 2016/2018 Ground Investigations

Historical Ground Investigations undertaken by Enviros Aspinwall (2002) and Jacobs (2005) are detailed in Table 4.16. Locations are shown on drawing 10730-HYD-XX-ZZ-DR-GE-1002 presented in Appendix A.

Table 4.16: 'N' Area Historical Ground Investigation Details

Activity	Method	No.	Max. Depth (m bgl)	Purpose
Enviros Aspinwall (2002) Phase 2 Site Investigation and Land Quality Assessment				
Window Sampling	Window sampler rig	2	3.7	To assess shallow ground conditions whilst minimising ground disturbance.

The logs from the Hydrock investigations, including details of ground conditions, soil sampling and in situ testing are presented in Appendix B.

Table4.17: Hydrock 2016/2018 Ground Investigations Summary and Rationale

Activity	Method	No.	Max. Depth (m bgl)	Purpose	Notes
Window Sampling	Window sampler rig	2	5.0	To assess shallow ground conditions. To allow collection of samples for contamination testing. To allow dynamic probing for strength profiling of soils.	These positions were designed to target the tank dismantling facility in N2. Screening of soils with a photo ionising detector (PID) to identify volatile organic compounds (VOC) and semi volatile organic compounds (SVOC) undertaken. 2 dynamic probes undertaken. 1 monitoring well installed.
Cable Percussive Drilling	Cable Percussive Rig	2	15m	To assess deeper ground conditions. To allow collection of samples for contamination and geotechnical testing.	These boreholes were located to assess geotechnical properties up to 15m bgl in this area of the site.
Trial Pits	JCB 3CX	10	3.5	To assess shallow ground conditions. To allow collection of samples for contamination testing.	These positions were designed to investigate within the footprint of former buildings. Screening of soils with a PID to identify VOCs and SVOCs undertaken. Infiltration tests were carried out within TP615 in the visitor car park and TP616 adjacent to the helipad.

4.4.2 Summary of Ground Conditions Encountered

Table 4.18 presents a summary of the ground conditions encountered during the Hydrock ground investigation. These observations, in general, concur with the historical ground investigations.

Table 4.18: Summary of Ground Conditions Within the 'N' Area.

Stratum	Brief Description	Depth to Top (m bgl)	Depth to Base (m bgl)
Topsoil	Brown sandy gravelly TOPSOIL. Gravel of fine to coarse angular to sub rounded flint, brick and concrete.	0.0	0.2
Made Ground 1	Loosely packed black fine to coarse ash GRAVEL.	0.2	0.3
Made Ground 2	Loosely packed brown sandy GRAVEL of fine to coarse angular to sub rounded brick, concrete and frequent whole bricks.	0.2	0.7
Made Ground 3	Light brown very gravelly SAND. Gravel of fine to coarse angular to sub rounded concrete, brick, plastic and flint.	0.05	0.5
Made Ground 4	Stiff dark brown gravelly CLAY. Gravel of fine to course angular to sub rounded flint with occasional brick.	0.7	1.2
Clay-with-Flints 1	Stiff red brown mottled orange brown sandy gravelly CLAY. Gravel of fine to coarse angular to sub rounded flint.	0.2	6.5
Clay-with-Flints 2	Orange yellow slightly silty clayey fine SAND.	1.0	>3.0
Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated)	Weak to moderately strong partly weathered white with occasional yellow staining CHALK. Closely spaced fractures infilled with soft remoulded chalk fragments (Grade IV).	0.9	>15

Groundwater was not encountered in any investigation locations.

Surface material of asphalt or concrete was noted to a maximum depth of 0.4m bgl in ungrassed areas.

A number of trial pits and boreholes across the site, encountered large flint cobbles that hindered progress.

There are several large structures including warehouses, workshops and office buildings within this area. No investigation was possible beneath these building footprints.

Several buildings within the area have been demolished. Trial pitting was undertaken in these locations.

4.5 'Q' Area

The Q area is located in the centre of the site as shown in Figure 4.5.

Figure 4.5: The 'Q' Area

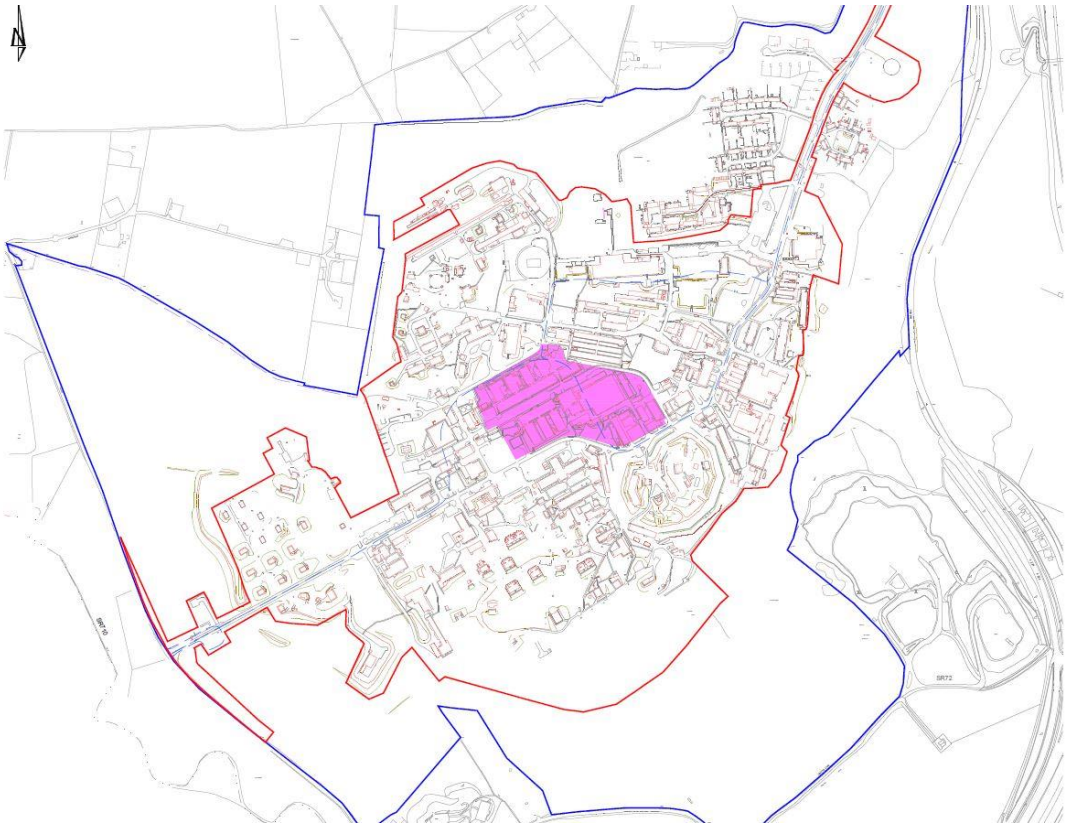


Table 4.19: 'Q' Area Overview

Item	Brief Description
Present land use	Occupied by buildings containing offices, laboratories, workshops and warehouses.
Potential Contamination	Former vehicle wash down area. Research into radioactive materials at Q6 and Q7. Former paint spray workshop at Q6.2. Solvent, chemical and oil storage at Q20. Workshop at Q4. Chemical laboratory at Q13.

4.5.1 'Q' Area Historical and Hydrock 2016/2018 Ground Investigations

Historical Ground Investigations undertaken by Enviros Aspinwall (2002) and Jacobs (2005) are detailed in Table 4.20. Locations are shown on drawing 10730-HYD-XX-ZZ-DR-GE-1002 presented in Appendix A.

Table 4.20: 'Q' Area Historical Ground Investigation Details

Activity	Method	No.	Max. Depth (m bgl)	Purpose
Enviros Aspinwall (2002) Phase 2 Site Investigation and Land Quality Assessment				

Window Sampling	Window sampler rig	4	6.0	To assess shallow ground conditions whilst minimising ground disturbance.
Surface Samples	Hand tools	2	0.5	To collect shallow samples.
Jacobs (2005) Document Review and Intrusive Investigations Report				
Window Sampling	Window sampler rig	2	5.0	To assess shallow ground conditions whilst minimising ground disturbance.

The logs from the Hydrock investigations, including details of ground conditions, soil sampling and *in situ* testing are presented in Appendix B.

Table 4.21: Hydrock 2016/2018 Ground Investigation Summary and Rationale

Activity	Method	No.	Max. Depth (m bgl)	Purpose	Notes
Window Sampling	Window sampler rig	12	5.0	To assess shallow ground conditions. To allow collection of samples for contamination testing. To allow dynamic probing for strength profiling of soils.	These positions were designed to target the following: • vehicle wash areas • generator house • main workshop and waste hydraulic oil tank • former paint spray shop • decommissioned oil tank • solvent and oil store Screening of soils with a photo ionising detector (PID) to identify volatile organic compounds (VOC) and semi volatile organic compounds (SVOC) undertaken. 5 dynamic probes undertaken. 5 monitoring wells installed.
Cable Percussive Drilling	Cable Percussive Rig	1	15m	To assess deeper ground conditions. To allow collection of samples for contamination and geotechnical testing.	This borehole was located to assess geotechnical properties up to 15m bgl in this area of the site.

Trial Pits	JCB 3CX	2	3.6	To assess shallow ground conditions. To allow collection of samples for contamination testing.	Position penetrating the floor slab of demolished Q27. Screening of soils with a PID to identify VOCs and SVOCs undertaken.

4.5.2 Summary of Ground Conditions Encountered

Table 4.22 presents a summary of the ground conditions encountered during the Hydrock ground investigations. These observations, in general, concur with the historical ground investigations.

Table 4.22: Summary of Ground Conditions Within the 'Q' Area.

Stratum	Brief Description	Depth to Top (m bgl)	Depth to Base (m bgl)
Topsoil	Grass over brown gravelly clayey TOPSOIL. Gravel of fine to coarse angular brick, concrete and flint.	0.0	0.3
Made Ground 1	Loosely packed brown grey sandy slightly clayey GRAVEL of fine to coarse angular to sub rounded brick, concrete and frequent whole bricks.	0.25	0.6
Made Ground 2	Firm to stiff red brown mottled orange brown sandy gravelly CLAY. Gravel of fine to coarse angular to sub rounded brick, concrete and flint.	0.3	1.0
Made Ground 3	Loosely packed black grey sandy GRAVEL. Gravel of fine to coarse angular to sub rounded concrete, brick, ash and flint.	0.3	0.9
Made Ground 4	Soft to firm brown grey gravelly CLAY. Gravel of fine to coarse angular to sub rounded concrete, brick and ash.	0.9	2.3
Clay-with-Flints	Stiff red brown mottled orange brown sandy gravelly CLAY. Gravel of fine to coarse angular to sub rounded flint. Often with frequent flint cobbles.	0.2	>5.0
Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated)	Weak to moderately strong partly weathered white with occasional yellow staining CHALK. Closely spaced fractures infilled with soft remoulded chalk fragments (Grade IV).	0.5	>15

Groundwater was not encountered in any investigation locations.

Surface material of asphalt or concrete was noted to a maximum depth of 0.4m bgl in ungrassed areas.

A number of trial pits and boreholes across the site, encountered large flint cobbles that hindered progress.

BH535 and BH567 were abandoned due to the thickness of reinforced re-bar encountered whilst attempting to hand dig the service inspection pits. Both boreholes were adjacent to the south east corner of Q4.

There are several large structures including office buildings, laboratories and warehouses within this area. No investigation was possible beneath these building footprints.

4.6 'R' Area

The 'R' area is located in the north west of the site as shown in Figure 4.6.

Figure 4.6: The 'R' Area

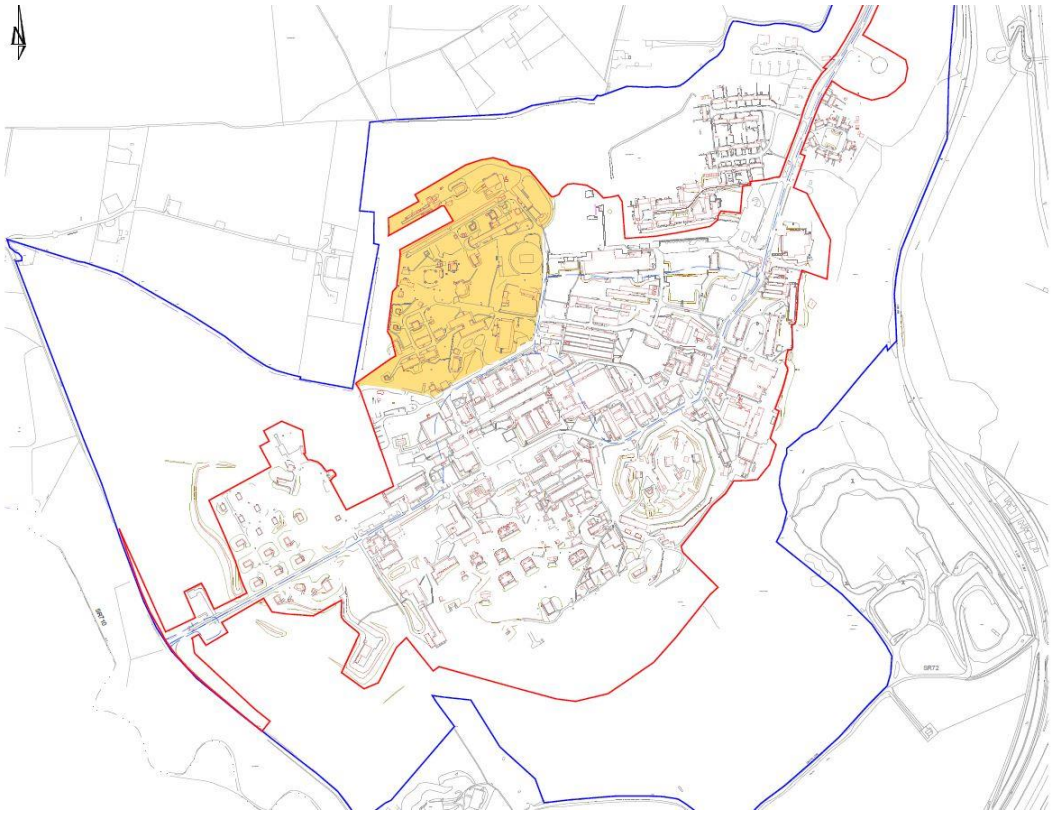


Table 4.23: 'R' Area Overview

Item	Brief Description
Present land use	This area contains offices, laboratories, firing ranges and a burning ground. Large parts of the 'R' area are decommissioned and no longer in use.
Potential Contamination	Asbestos in building rubble beneath demolished R21. Vehicle wash down area. Pyrotechnic waste at the burning ground. Explosive residues on the firing ranges.

4.6.1 'R' Area Historical and Hydrock 2016/2018 Ground Investigations

Historical Ground Investigations undertaken by Enviros Aspinwall (2002) and Jacobs (2005) are detailed in Table 4.24. Locations are shown on drawing 10730-HYD-XX-ZZ-DR-GE-1002 presented in Appendix A.

Table 4.24: 'R' Area Historical Ground Investigation Details

Activity	Method	No.	Max. Depth (m bgl)	Purpose
Enviros Aspinwall (2002) Phase 2 Site Investigation and Land Quality Assessment				

Window Sampling	Window sampler rig	12	6.0	To assess shallow ground conditions whilst minimising ground disturbance.
Trial Pits	Machine Excavated	4	4.0	To assess shallow ground conditions.
Solid Stem Auger Borehole	Solid stem auger drilling	1	15	To gain an understanding of the depth of chalk.
Jacobs (2005) Document Review and Intrusive Investigations Report				
Window Sampling	Window sampler rig	6	5.0	To assess shallow ground conditions whilst minimising ground disturbance.
Hand dug pits	Hand tools	8	1.2	To assess shallow ground conditions.

The logs from the Hydrock investigations, including details of ground conditions, soil sampling and *in situ* testing are presented in Appendix B.

Table4.25: Hydrock 2016/2018 Ground Investigation Summary and Rationale

Activity	Method	No.	Max. Depth (m bgl)	Purpose	Notes
Window Sampling	Window sampler rig	8	8.0	To assess shallow ground conditions. To allow collection of samples for contamination testing. To allow dynamic probing for strength profiling of soils.	These positions were designed to target the following: • enclosed rifle ranges • ammunition stores • the pyrotechnic burning area • waste burning area Screening of soils with a photo ionising detector (PID) to identify volatile organic compounds (VOC) and semi volatile organic compounds (SVOC) undertaken. 4 dynamic probes undertaken. 2 monitoring wells installed.
Cable Percussive Drilling	Cable Percussive Rig	1	15m	To assess deeper ground conditions. To allow collection of samples for contamination and geotechnical testing.	This borehole was located to assess geotechnical properties up to 15m bgl in this area of the site.

Trial Pits	JCB 3CX	13	3.3	To assess shallow ground conditions. To allow collection of samples for contamination testing.	These positions were designed to target the following: • above ground fuel store and generator • chemical store • workshops handling explosives • pyrotechnic burning area • waste burning area • vehicle wash • buried asbestos rubble Screening of soils with a PID to identify VOCs and SVOCs. Infiltration tests were carried out within TP610 and TP611.
Hand Pits	Hand excavation	1	0.5	To allow collection of samples from soil building abutments.	Screening of soils with a PID to identify VOCs and SVOCs.

4.6.2 Summary of Ground Conditions Encountered

Table 4.26 presents a summary of the ground conditions encountered during the Hydrock ground investigations. These observations, in general, concur with the Historical ground investigations.

Table 4.26: Summary of Ground Conditions Within the 'R' Area.

Stratum	Brief Description	Depth to Top (m bgl)	Depth to Base (m bgl)
Topsoil	Brown clayey gravelly TOPSOIL.	0.0	0.2
Made Ground 1	Stiff red brown mottled orange brown sandy gravelly CLAY. Gravel of fine to coarse angular to sub rounded brick, wood, concrete and flint.	0.2	1.5
Made ground 2	Loosely packed gravel of sub angular concrete, brick, metal pieces, clinker and whole bricks.	0.3	1.2
Made Ground 3	Loosely packed yellow SAND.	0.4	1.0
Clay-with-Flints	Firm to stiff red brown mottled orange brown sandy gravelly flint CLAY. Gravel of fine to coarse angular to sub rounded flint with frequent flint cobbles.	0.2	>5.0
Lewes Nodular Chalk Formation, Seaford	Weak to moderately strong partly weathered white with occasional yellow staining CHALK.	12.4	>15

Chalk Formation and Newhaven Chalk Formation (undifferentiated)	Closely spaced fractures infilled with soft remoulded chalk fragments (Grade IV).		

Groundwater was not encountered in any investigation locations.

Surface material of asphalt or concrete was noted to a maximum depth of 0.4m bgl in ungrassed areas.

A number of trial pits and boreholes across the site, encountered large flint cobbles that hindered progress.

There are several large structures including office buildings, laboratories, firing ranges and the burning ground within this area. No investigation was possible beneath these building footprints.

Two of the trial pits encountered obstructions during excavation as summarised in Table 4.27.

Table 4.27: Obstructions Encountered During Hydrock Investigations

Exploratory Hole	Depth (m bgl)	Description	Stratum
TP505	1.5	Terminated upon uncovering a 4'' (100mm) pipe not marked on service plans.	Made Ground
TP547	1.2	Terminated at 1.2m on a large concrete obstruction.	Made Ground

4.7 'S' Area

The 'S' area is located to the west of the site as shown in Figure 4.7.

Figure 4.7: The 'S' Area

Table 4.28: 'S' Area Overview

Item	Brief Description
Present land use	This area contains offices, laboratories and several demolished buildings. The waste storage compound is also in this area.
Potential Contamination	Above ground fuel storage in vicinity of the boiler house at S2. Generators across 'S' area. Storage of liquid and scrap waste in a secure compound.

4.7.1 'S' Area – Historical and Hydrock 2016/2018 Ground Investigations

Historical Ground Investigations undertaken by Enviros Aspinwall (2002) and Jacobs (2005) are detailed in Table 4.29. Locations are shown on drawing 10730-HYD-XX-ZZ-DR-GE-1002 presented in Appendix A.

Table 4.29: 'S' Area Historical Ground Investigation Details

Activity	Method	No.	Max. Depth (m bgl)	Purpose
Enviros Aspinwall (2002) Phase 2 Site Investigation and Land Quality Assessment				

Window Sampling	Window sampler rig	5	6.0	To assess shallow ground conditions whilst minimising ground disturbance.
Trial Pits	Machine Excavated	2	4.0	To assess shallow ground conditions.
Jacobs (2005) Document Review and Intrusive Investigations Report				
Window Sampling	Window sampler rig	7	5.0	To assess shallow ground conditions whilst minimising ground disturbance.

The logs from the Hydrock 2018 investigation, including details of ground conditions, soil sampling and *in situ* testing are presented in Appendix B.

Table 4.30: Hydrock 2016/2018 Ground Investigation Summary and Rationale

Activity	Method	No.	Max. Depth (m bgl)	Purpose	Notes
Window Sampling	Window sampler rig	7	5.0	To assess shallow ground conditions. To allow collection of samples for contamination testing. To allow dynamic probing for strength profiling of soils.	These positions were designed to target the following: • area of burnt out cars • liquid waste and scrap storage • hazardous waste (fridges etc) • oil fuel tanks Screening of soils with a photo ionising detector (PID) to identify volatile organic compounds (VOC) and semi volatile organic compounds (SVOC) undertaken. 2 dynamic probes undertaken. 3 monitoring well installed.
Trial Pits	JCB 3CX	11	4.1	To assess shallow ground conditions. To allow collection of samples for contamination testing.	These positions were designed to target the following: • area of burnt out cars • liquid waste and scrap storage • hazardous waste (fridges etc) Screening of soils with a PID to identify VOCs and SVOCs.

					Infiltration testing was carried out within TP609.

4.7.2 *Summary of Ground Conditions Encountered*

The following presents a summary of the ground conditions encountered during the Hydrock ground investigations. These observations, in general, concur with the Historical ground investigations.

Table 4.31: Summary of Ground Conditions Within the 'S' Area.

Stratum	Brief Description	Depth to Top (m bgl)	Depth to Base (m bgl)
Topsoil	Brown sandy gravelly clayey TOPSOIL. Gravel of fine to coarse angular to sub rounded flint, brick and concrete.	0.0	0.2
Made Ground 1	Loosely packed black brown slightly clayey GRAVEL. Gravel of fine to coarse angular to sub rounded brick, concrete, ash and flint.	0.7	1.8
Made Ground 2	Firm light brown sandy gravelly CLAY. Gravel of fine to coarse angular to sub rounded brick, concrete and flint.	0.1	0.8
Made Ground 3	Loosely packed brown grey sandy GRAVEL. Gravel of brick, concrete, metal pieces, wood fragments with frequent whole bricks.	0.0	1.1
Made Ground 4	Firm to stiff brown black gravelly CLAY. Gravel of fine to coarse ash.	0.7	1.8
Clay-with-Flints	Firm to stiff red brown mottled orange brown sandy gravelly CLAY. Gravel of fine to coarse angular to sub rounded flint with frequent flint cobbles.	0.4	>5.0
Clay-with-Flints	Firm to stiff orange yellow silty sandy CLAY.	2.0	>5.0

Groundwater was not encountered in any investigation locations.

Surface material of asphalt or concrete was noted to a maximum depth of 0.4m bgl in ungrassed areas.

A number of trial pits and boreholes across the site, encountered large flint cobbles that hindered progress.

There are several large structures including office buildings and laboratories within this area. No investigation was possible beneath these building footprints. There are also a number of demolished buildings within the area. Trial pitting through several of the remaining floor slabs was undertaken to identify ground conditions beneath them.

Two of the trial pits encountered obstructions during excavation and are summarised in Table 4.32.

Table 4.32: Obstructions Encountered During Hydrock Investigations

Exploratory Hole	Depth (m bgl)	Description	Stratum
TP520	0.4	Terminated at 0.4m on brick structure obstruction.	Made Ground
TP549	1.6	Terminated at 1.6m on concrete and reinforcing bar obstructions.	Made Ground

4.8 'X' Area

The 'X' area is located to the south of the site as shown in Figure 4.8.

Figure 4.8: The 'X' Area

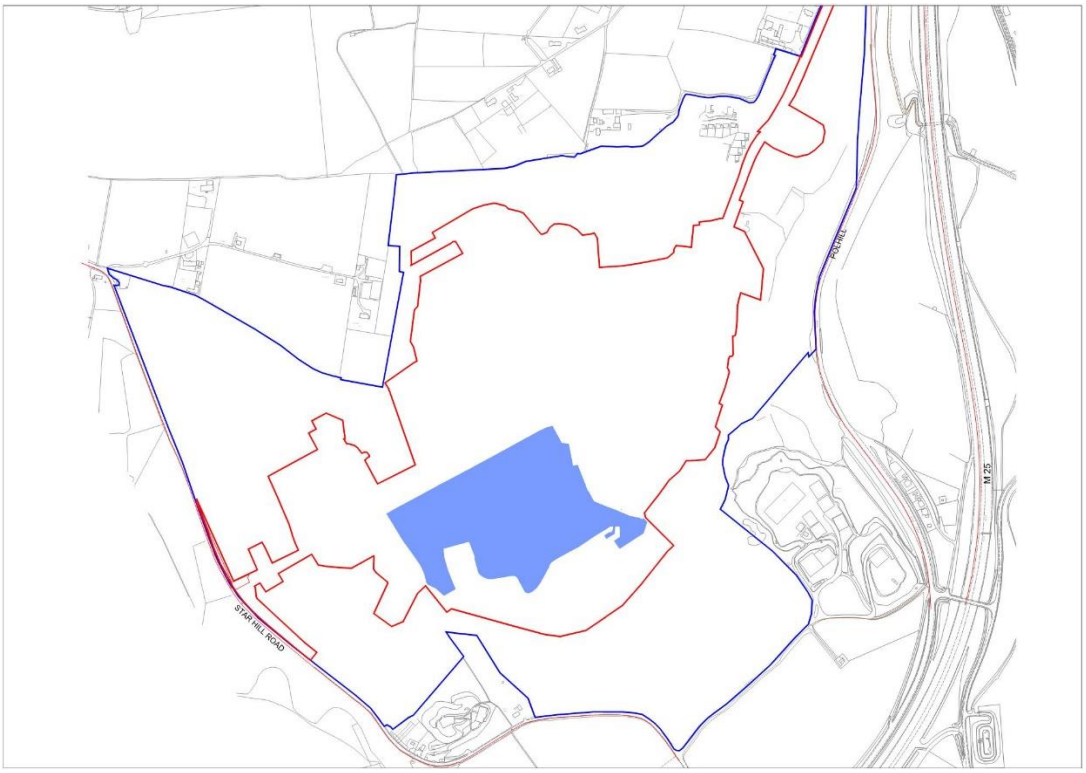


Table 4.33: 'X' Area Overview

Item	Brief Description
Present land use	The current occupiers are QinetiQ. Within the area there are a series of buildings used for the storage of higher risk explosives. Between the buildings are grassed areas with several mature trees. The area has its own gated access points.
Potential Contamination	Solvents and chemical wastes Explosive residues Asbestos rubble

4.8.1 'X' Area – Historical and Hydrock 2016/2018 Ground Investigations

Historical Ground Investigations undertaken by Enviros Aspinwall (2002) and Jacobs (2005) are detailed in Table 4.34. Locations are shown on drawing 10730-HYD-XX-ZZ-DR-GE-1002 presented in Appendix A.

Table 4.34: 'X' Area Historical Ground Investigation Details

Activity	Method	No.	Max. Depth (m bgl)	Purpose
Enviros Aspinwall (2002) Phase 2 Site Investigation and Land Quality Assessment				

Window Sampling	Window sampler rig	26	6.0	To assess shallow ground conditions whilst minimising ground disturbance.
Trial Pits	Machine Excavated	5	4.0	To assess shallow ground conditions.
Jacobs (2005) Document Review and Intrusive Investigations Report				
Window Sampling	Window sampler rig	4	5.0	To assess shallow ground conditions whilst minimising ground disturbance.
Hand dug pits	Hand tools	8	1.2	To assess shallow ground conditions.

The logs from the Hydrock investigations, including details of ground conditions, soil sampling and in situ testing are presented in Appendix B.

Table 4.35: Hydrock 2016/2018 Ground Investigation Summary and Rationale

Activity	Method	No.	Max. Depth (m bgl)	Purpose	Notes
Window Sampling	Window sampler rig	18	5.0	To assess shallow ground conditions. To allow collection of samples for contamination testing. To allow dynamic probing for strength profiling of soils.	These positions were designed to target the following: • Potential asbestos rubble • Heating oil and solvent stores • Solvent storage • Pink water area • Explosive testing/firing areas Screening of soils with a photo ionising detector (PID) to identify volatile organic compounds (VOC) and semi volatile organic compounds (SVOC) undertaken.
Trial Pits	JCB 3CX	8	3.1	To assess shallow ground conditions. To allow collection of samples for contamination testing.	These positions were designed to target the following: • area of burnt out cars • chemical storage and waste tanks • Downs range Screening of soils with a PID to identify VOCs and SVOCs. Infiltration testing was carried out within TP601.

4.8.2 Summary of Ground Conditions Encountered

The following presents a summary of the ground conditions encountered during the Hydrock ground investigations. These observations, in general, concur with the Historical ground investigations.

Table 4.36: Summary of Ground Conditions Within the 'X' Area.

Stratum	Brief Description	Depth to Top (m bgl)	Depth to Base (m bgl)
Topsoil	Brown sandy gravelly clayey TOPSOIL. Gravel of fine to coarse angular to sub rounded flint, brick and concrete.	0.0	0.2
Made Ground 1	Loosely packed black brown slightly clayey GRAVEL. Gravel of fine to coarse angular to sub rounded brick, concrete, ash and flint.	0.7	1.8
Made Ground 2	Firm light brown sandy gravelly CLAY. Gravel of fine to coarse angular to sub rounded brick, concrete and flint.	0.1	0.8
Clay-with-Flints	Firm to stiff red brown mottled orange brown sandy gravelly CLAY. Gravel of fine to coarse angular to sub rounded flint with frequent flint cobbles.	0.4	>5.0
Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated)	Weak to moderately strong partly weathered white with occasional yellow staining CHALK. Closely spaced fractures infilled with soft remoulded chalk fragments (Grade IV).	0.2	>15

Groundwater was not encountered in any investigation locations.

Surface material of asphalt or concrete was noted to a maximum depth of 0.4m bgl in ungrassed areas.

A number of trial pits and boreholes across the site, encountered large flint cobbles that hindered progress.

There are several large structures including office buildings and laboratories within this area No investigation was possible beneath these building footprints. There are also a number of demolished buildings within the area. Trial pitting through several of the remaining floor slabs was undertaken to identify ground conditions beneath them.

5.0 GEO-ENVIRONMENTAL ASSESSMENT

In this chapter the site is considered in reference to the proposed land use and green infrastructure parameter plan. (Drawing ref: 005561_PP01 Rev D10). The site has been separated into seven zones each of which is discussed separately, and the relevant analyses screened against the proposed end use for that zone.

The seven land use zones are:

1. Public open space Park, to include;

- Ecologically enhanced grassland / Mitigation Zone;
- Existing chalk grassland;
- Existing woodland;
- Existing ancient woodland;
- Proposed woodland gap planting/screening;
- Community Recreation zone;
- Retained bunkers.
- Village green.

2. Public open space Residential, to include;

- Public Open Space (including woodland buffer, Children's Play Area)

3. Commercial, to include;

- Employment;
- Mixed use;
- Village Square;
- Area of road infrastructure / hardstanding

4. Residential with plant uptake, to include;

- Residential.

5. Primary School.
6. QinetiQ
7. Scheduled Monument

The parameter plan drawing is presented in Appendix A.

5.1 Approach

A number of generic risk assessments have been undertaken in accordance with the principles of CLR 11 (Environment Agency 2004 and GOV.UK Land contamination: risk management guidance) using the CSM that has been updated following the ground investigation. Firstly, the risks associated with the identified potential contaminant linkages are estimated using standardised methods (typically involving comparison of site data with published 'screening values'. Secondly, where screening values are exceeded, the risks are evaluated in an authoritative review of the findings with other pertinent information to determine if exceedance may be acceptable in the particular circumstances. For details please refer to Appendix I.

Wherever possible, UKAS accredited procedures have been used. Chemical test certificates are provided in Appendix G.

The data sets used comprise the appropriate analytical results obtained by Hydrock plus any suitable data from previous sources. In some instances, historical analyses were not as rigorous as the testing undertaken during the Hydrock investigation and gaps have been left on the assessment sheets when that is the case.

In cases where unacceptable risks are indicated, mitigation measures such as more advanced stages of risk assessment or remediation will be proposed.

There is considered to be no significant risk to controlled waters, given the anticipated depth of groundwater at approximately 90m bgl, and the nearest surface water feature being over 1km away. For this reason, controlled waters have not considered within the land use risk assessments.

5.2 Human Health Risk Assessment

This is a Tier 2 assessment using soil screening values for a variety of the CLEA land use scenarios.

The soil screening values used are generic assessment criteria (GAC) and results are given in Appendix G. The Category 4 Screening Levels (C4SL) for lead have been used as there are no recognised GACs and the use of the term 'GAC' in this report includes these.

Individual sample test results are compared directly with the screening values. In view of the targeted nature of the investigation statistical analysis of the data prior to screening was not considered appropriate.

5.3 Public open space Park

The proposed land uses assessed as public open space park are located across the site as illustrated in Figure 5.1.

Figure 5.1: Public open space Park

5.3.1 Geo-environmental Laboratory Analyses

The geo-environmental analyses undertaken on soils from all investigations to date, are summarised in Table 5.1.

Table 5.1: Summary of Sample Numbers for Geo-environmental Analyses of Soils

Determinand Suite	Made Ground	Natural Soils
Metals suite of determinands for solids	34	13
Polyaromatic hydrocarbon suite for solids	18	13
Total petroleum hydrocarbons by GC-FID (Hydrock Level 2 suite)	9	5
Petroleum hydrocarbon suite (C12-C35)	2	4
Benzene, toluene, ethylbenzene and xylene (BTEX) by GC-MS)	11	6

5.3.2 Risk Estimation and Evaluation

Samples have been assessed using soil screening values for the CLEA land use scenario: public open space-park.

Metals and PAH

The individual analytical results of the Hydrock investigation and the historical investigations provided to Hydrock have been compared with the relevant GACs in the summary table in Appendix G.

Based on a direct exceedance of the GAC, the pervasive chemicals of potential concern that require further assessment are summarised in Table 5.2.

Table 5.2: Pervasive Chemicals of Potential Concern for Which Further Assessment is Required (Human Health)

Chemical of Potential Concern	Generic Criterion (mg/kg)	Basis for Generic Criterion	No. Samples	Min. (mg/kg)	Max. (mg/kg)	No. Samples Exceeding Generic Criterion
Made Ground						
Benzo(a)pyrene	4.5	GAC	13	0.027	17	1

Asbestos

Asbestos (loose fibres of chrysotile and amosite) was detected in one of the samples (out of twenty five tested) at a depth of 0.30 bgl in TP566. The gravimetric weighting value of the sample is 0.001%.

Further validation sampling will be required pre-construction to determine the appropriate level of mitigation required. Where asbestos is identified it is considered likely that a clean capping layer will be necessary in areas of gardens and open landscaping.

Petroleum Hydrocarbons (PHC)

Eighteen samples (13 of Made Ground and 7 natural materials) were scheduled for a Petroleum Hydrocarbon (PHC) assessment (carbon banding with aliphatic-aromatic split). A further two Made Ground samples and four natural material samples were scheduled historically for hydrocarbon fractions C12-35. The results have been compared to the relevant GACs. The summary sheets are presented in Appendix G.

No exceedances of the GAC for hydrocarbons are recorded.

BTEX concentrations were also analysed with no results exceeding the relevant GAC's.

Volatile Organic Substances (VOC)

Volatile and semi volatile compound concentrations within soils were analysed. No results exceeded relevant GAC.

No visual or olfactory evidence of contamination was identified during the investigation and no readings were recorded with the on site Photo Ionisation Detector.

Plant Life

Priority phytotoxic chemical concentrations have been screened against published values to determine the likely risk to plant growth and the findings presented in Appendix G.

Based on test results that exceed the GAC, the pervasive chemicals of potential concern that require further assessment are summarised in Table 5.3.

Table 5.3: Pervasive Chemicals of Potential Concern for Which Further Assessment is Required (Risk to Plants)

Chemical of Potential Concern	Generic Criterion (mg/kg)	No. Samples	Min. (mg/kg)	Max. (mg/kg)	No. Samples Exceeding Generic Criterion
Made Ground					
Boron	3	62	0.2	5	2
Chromium (III)	400	62	1.2	841	1
Chromium (VI)	25	30	1.2	44	2
Nickel	75	62	1	411	5
Zinc	300	62	12	4705	1

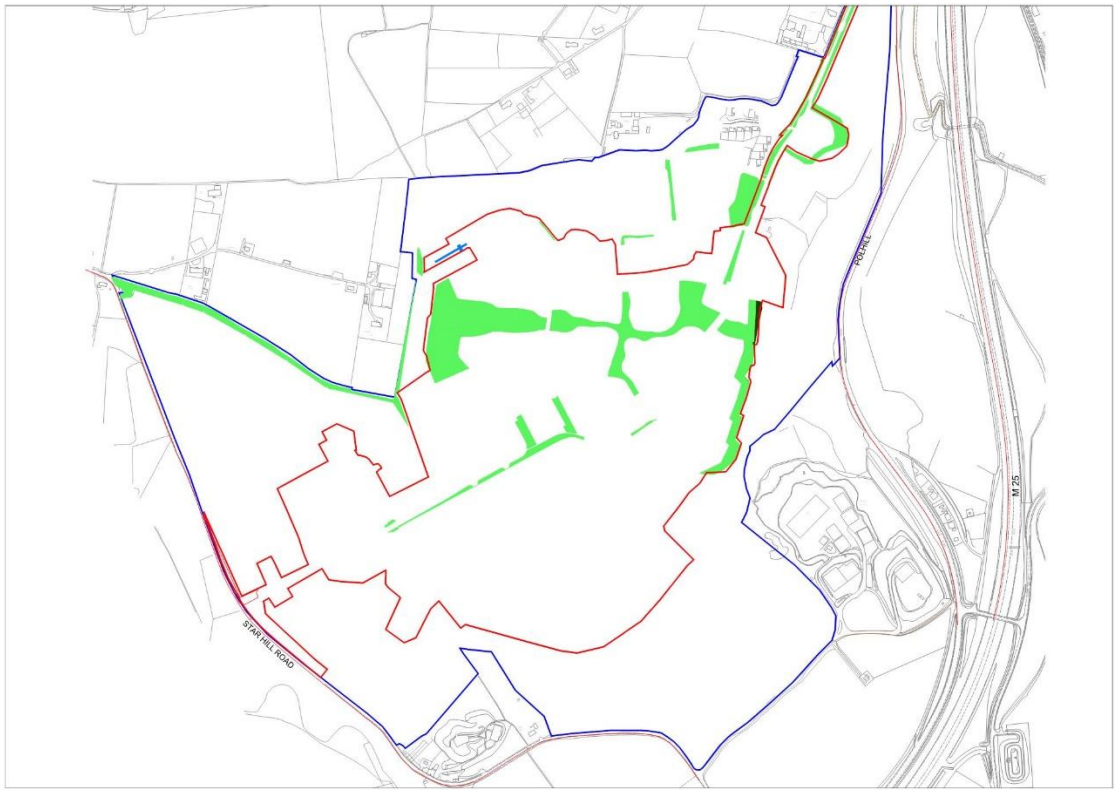
Two samples collected within natural soils recorded concentrations of nickel at 110mg/kg and 140mg/kg which are slightly elevated when compared to the GAC of 75mg/kg.

Detriment to plant life is hard to quantify and many of the GACs are based on agricultural crop yields rather than serious harm of death of a species. The number of exceedances compared with the overall volume of samples is very low and vegetation on site did not show any signs of physical distress. Hydrock does not believe any additional consideration is required with regards to risks to plant life.

5.4 Public open space Residential

The proposed land uses assessed as public open space residential are located across the site as illustrated in Figure 5.2.

Figure 5.2: Public open space Residential



5.4.1 Geo-environmental Laboratory Analyses

The geo-environmental analyses undertaken on soils from all investigations to date, are summarised in Table 5.4.

Table 5.4: Summary of Sample Numbers for Geo-environmental Analyses of Soils

Determinand Suite	Made Ground	Natural Soils
Metals suite of determinands for solids	33	35
Polyaromatic hydrocarbon suite for solids	33	34
Total petroleum hydrocarbons by GC-FID (Hydrock Level 2 suite)	36	21
Petroleum hydrocarbon suite (C12-C35)	8	-
Benzene, toluene, ethylbenzene and xylene (BTEX) by GC-MS)	35	20

5.4.2 Risk Estimation

Samples have been assessed using soil screening values for the CLEA land use scenario: public open space-residential.

Hydrock Default List of Determinands

The individual analytical results of the Hydrock investigation and the historical investigations provided to Hydrock have been compared with the relevant GACs in the summary table in Appendix G.

Based on a direct exceedance of the GAC, the pervasive chemicals of potential concern that require further assessment are summarised in Table 5.5.

Table 5.5: Pervasive Chemicals of Potential Concern for Which Further Assessment is Required (Human Health)

Chemical of Potential Concern	Generic Criterion (mg/kg)	Basis for Generic Criterion	No. Samples	Min. (mg/kg)	Max. (mg/kg)	No. Samples Exceeding Generic Criterion
Chromium (VI)	7.7	GAC	64	1.2	52	6
Benz(a)anthracene	17	GAC	62	0.05	59	1
Benzo(a)pyrene	2.6	GAC	62	0.05	49	5
Benzo(b)fluoranthene	18	GAC	62	0.05	57	1
Benzo(k)fluoranthene	26	GAC	62	0.05	27	1
Chrysene	25	GAC	62	0.05	49	1
Dibenz(a.h)anthracene	2.3	GAC	62	0.05	7.4	1
Indeno(1,2,3,cd)pyrene	11	GAC	62	0.05	22	1

Asbestos

Asbestos (loose fibres of chrysotile, crocidolite and amosite) was detected in thirteen out of the sixty three samples tested. Eleven samples from Made Ground, two samples from natural soils. These are summarised in Table 5.6.

Table 5.6: Asbestos Gravimetric Weighting

Location	Depth (m bgl)	Asbestos Fibres Detected	Gravimetric Weighting Value (%)
Made Ground			
BH522	0.1	Chrysotile, amosite and crocidolite	<0.001
BH522	0.3	Chrysotile and amosite	0.001
BH526	0.3	Amosite	<0.001
BH526	1.0	Chrysotile	0.121
BH539	0.2	Chrysotile and amosite	<0.001
BH543	0.3	Chrysotile and amosite	<0.001
BH556	0.1	Chrysotile	<0.001
BH556	0.4	Chrysotile	<0.001
TP507	0.2	Chrysotile and amosite	0.001
TP519	0.1	Chrysotile	<0.001
TP533	0.2	Chrysotile	<0.001
Natural Soils			
TP518	0.3	Chrysotile and amosite	0.001
TP566	0.3	Chrysotile and amosite	0.001

Petroleum Hydrocarbons (PHC)

Fifty seven samples (thirty six of Made Ground and twenty one natural materials) were scheduled for a Petroleum Hydrocarbon (PHC) assessment (carbon banding with aliphatic-aromatic split). A further eight Made Ground samples were scheduled historically for hydrocarbon fractions C12-35. The results have been compared to the relevant GACs. The summary sheets are presented in Appendix G.

No exceedances of the GAC for hydrocarbons are recorded.

BTEX concentrations were also analysed with no results exceeding the relevant GAC's.

Volatile Organic Substances (VOC)

Volatile and semi volatile compound concentrations within soils were analysed. No results exceeded relevant GAC.

No visual or olfactory evidence of contamination was identified during the investigation and no readings were recorded with the on site Photo Ionisation Detector.

5.4.3 Risk Evaluation

The screening exercise identified the following substances at concentrations above the GAC. These are considered further in Table 5.7 to assess if the exceedance may be acceptable with respect to the proposed development and propose mitigation where necessary.

Table 5.7: Elevated PAH within Made Ground

Chemical of Potential Concern	Review	Comment
Chromium (VI)	Six exceedances were recorded in the 2016 investigation.	The concentrations recorded are considered to represent natural levels in this area. The highest concentration was identified in the natural soils. Mitigation is not considered merited. The exceedances represent a low percentage of the overall sample testing density and are considered not to represent a significant risk.
PAH	Seven of the sixteen individual PAH species are recorded at concentrations in excess of their respective GAC in one location (BH556 at 0.4m). Benzo(a)pyrene was also encountered at four other locations, none of which are considered not to pose a significant risk.	Due to the exceedances around BH556 mitigation is considered necessary. It is likely this will entail a clean cover system. For the remainder of the green space, no exceedances are considered significant. Furthermore, they represent a low percentage of the overall sample testing density.

Asbestos

Approximately 20% of samples screened for asbestos returned a positive identification of either amosite, chrysotile or crocidolite fibres. Due to existing structures and areas of vegetation, the sample coverage has not been of a density to inform final mitigation measures. There is no relevant guideline value for the assessment of asbestos in soils and no clear pattern is apparent.

Quantification using gravimetric analysis indicated that all positive identifications were at a weighting value of between 0.121 and <0.001% per sample.

Further validation sampling will be required pre-construction to determine the level of mitigation required. Where asbestos is identified it is considered likely that a clean capping layer will be necessary in areas of gardens and open landscaping.

Plant Life

Priority phytotoxic chemical concentrations have been screened against published values to determine the likely risk to plant growth and the findings presented in Appendix G.

Based on test results that exceed the GAC, the pervasive chemicals of potential concern that require further assessment are summarised in Table 5.8.

Table 5.8: Pervasive Chemicals of Potential Concern for Which Further Assessment is Required (Risk to Plants)

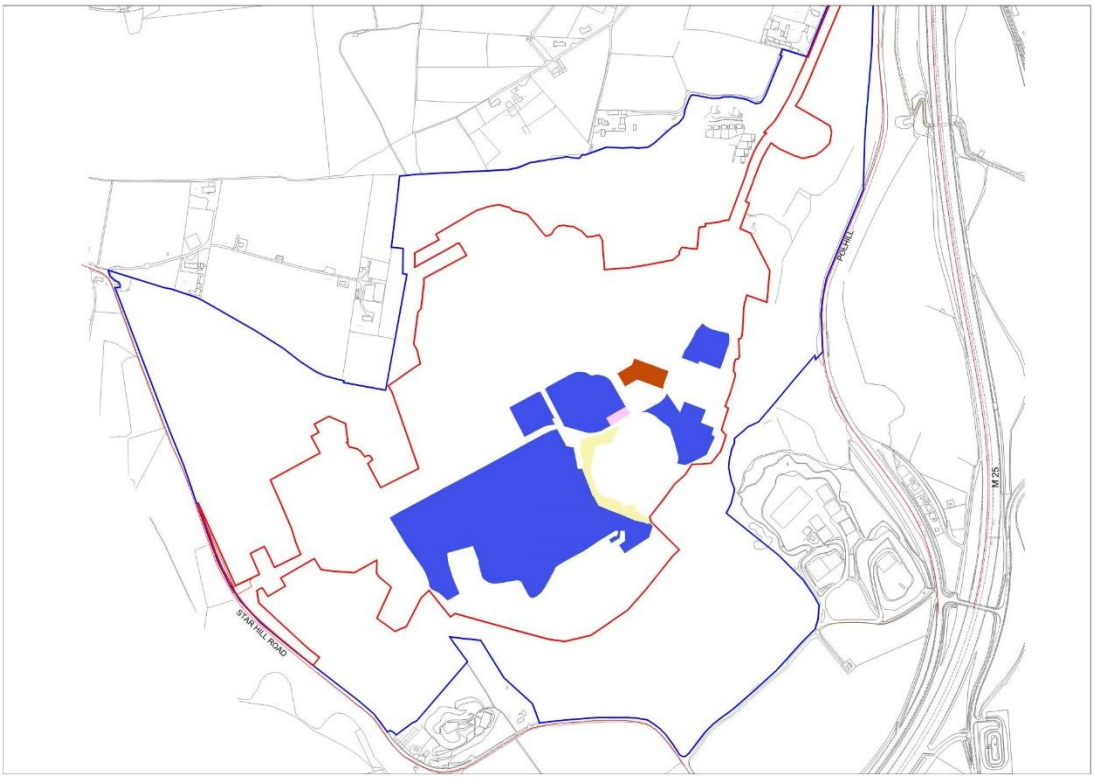
Chemical of Potential Concern	Generic Criterion (mg/kg)	No. Samples	Min. (mg/kg)	Max. (mg/kg)	No. Samples Exceeding Generic Criterion
Boron	3	67	0.2	8.8	3
Chromium (VI)	25	65	1.2	52	6
Copper	135	68	1	390	3
Nickel	75	68	4	170	3
Zinc	300	68	12	3900	4

Detriment to plant life is hard to quantify and many of the GACs are based on agricultural crop yields rather than serious harm of death of a species. The number of exceedances compared with the overall volume of samples is very low and vegetation on site did not show any signs of physical distress. Hydrock does not believe any additional consideration is required with regards to risks to plant life.

5.5 Commercial

The proposed land uses assessed as commercial are located across the site as illustrated in Figure 5.3.

Figure 5.3: Commercial Land



5.5.1 Geo-environmental Laboratory Analyses

The geo-environmental analyses undertaken on soils from all investigations to date, are summarised in Table 5.9.

Table 5.9: Summary of Sample Numbers for Geo-environmental Analyses of Soils

Determinand Suite	Made Ground	Natural Soils
Metals suite of determinands for solids	38	39
Polyaromatic hydrocarbon suite for solids	27	31
Total petroleum hydrocarbons by GC-FID (Hydrock Level 2 suite)	20	14
Petroleum hydrocarbon suite (C12-C35)	2	4
Benzene, toluene, ethylbenzene and xylene (BTEX) by GC-MS)	16	16
Volatile organic compounds (VOC target list by GC-MS	5	3
Semi-volatile organic compounds (SVOC target list by GC-MS)	5	3
Polychlorinated biphenyl (PCB)	1	-

5.5.2 Risk Estimation

Samples have been assessed using soil screening values for the CLEA land use scenario: commercial.

Metals and PAH List of Determinands

The individual analytical results have been compared with the relevant GACs in the summary table in Appendix G.

Based on a direct exceedance of the GAC, the pervasive chemicals of potential concern that require further assessment are summarised in Table 5.10.

Table 5.10: Pervasive Chemicals of Potential Concern for Which Further Assessment is Required (Human Health)

Chemical of Potential Concern	Generic Criterion (mg/kg)	Basis for Generic Criterion	No. Samples	Min. (mg/kg)	Max. (mg/kg)	No. Samples Exceeding Generic Criterion
Benzo(a)pyrene	14	GAC	29	0.05	21.847	2

Asbestos

Asbestos (loose fibres of chrysotile, crocidolite, anthophylite and amosite) was detected in eight out of the forty seven Made Ground samples tested as summarised in Table 5.11.

Table 5.11: Summary of samples containing asbestos fibres.

Location	Asbestos fibres detected	Gravimetric weighting value (%)
Made Ground		
BH521 at 0.4m	Chrysotile	0.004
BH521 at 0.5m	Chrysotile and anthophylite	<0.001
BH543 at 0.3m	Chrysotile and amosite	<0.001
BH529 at 0.2m	Chrysotile and amosite	<0.001
BH536 at 0.3m	Chrysotile and crocidolite	0.002
BH537 at 0.4m	Chrysotile	0.001
BH602 at 0,8m	Chrysotile	0.004
WS603 at 0.8m	Chrysotile	0.004

Further validation sampling will be required pre-construction to determine the appropriate level of mitigation required. Where asbestos is identified it is considered likely that a clean capping layer will be necessary in areas of gardens and open landscaping.

Petroleum Hydrocarbons (PHC)

Eighteen samples (12 of Made Ground and 6 natural materials) were scheduled for a Petroleum Hydrocarbon (PHC) assessment (carbon banding with aliphatic-aromatic split). The results have been compared to the relevant GACs. The summary sheets are presented in Appendix G.

No results exceeded the GAC.

Eight Made Ground samples were analysed for hydrocarbon fractions C12-35. BH536 at 0.3m bgl recorded an elevated concentration of 42mg/kg for ali>EC12-EC16 compared with a GAC of 24mg/kg.

BTEX concentrations were also analysed with no results exceeding the relevant GAC's.

Volatile Organic Substances (VOC)

Volatile and semi volatile compound concentrations within soils were analysed. No results exceeded relevant GAC's.

Several SVOC compounds for which there are no published GACs recorded values above the laboratory limit of detection, however these values are considered very small. No visual or olfactory evidence was identified during the investigation and no readings were recorded with the on site Photo Ionisation Detector.

Polychlorinated biphenyls (PCB)

A sample located in the vicinity of an electricity transformer was analysed for the presence of polychlorinated biphenyls.

No results exceeded the GAC.

5.5.3 Risk Evaluation

The screening exercise identified the following substances at concentrations above the GAC. These are considered further in Table 5.12 to assess if the exceedance may be acceptable with respect to the proposed development and propose mitigation where necessary.

Table 5.12: Elevated PAH within Made Ground

Chemical of Potential Concern	Review	Comment
Benzo(a)pyrene	Recorded concentrations in two samples of Made Ground slightly exceeds the GAC.	The concentrations recorded are considered minor and represent a low percentage of the samples tested. Mitigation is not considered merited.

Asbestos

Due to existing structures and areas of vegetation the sample coverage has not been of a density to inform final mitigation measures and no clear pattern is apparent. There is no relevant guideline value for the assessment of asbestos in soils.

Quantification using gravimetric analysis indicated that all positive identifications were at a weighting value of between 0.004% and <0.001% per sample.

Further validation sampling will be required pre-construction, to determine the appropriate level of mitigation required. Where asbestos is identified in areas of gardens and open landscaping, it is considered likely that a clean capping layer will be necessary.

Petroleum Hydrocarbons

The GAC for the hydrocarbon fraction Ali >EC12-EC16 was exceeded in BH536 at 0.3m with a recording of 42mg/kg compared against the GAC of 24mg/kg. This exceedance is considered not be significant. No hydrocarbon odour was noted and it is considered that this is a localised exceedance of the GAC.

Plant Life

Priority phytotoxic chemical concentrations have been screened against published values to determine the likely risk to plant growth and the findings presented in Appendix G.

Based on test results that exceed the GAC, the pervasive chemicals of potential concern that require further assessment are summarised in Table 5.13.

Table 5.13: Pervasive Chemicals of Potential Concern for Which Further Assessment is Required (Risk to Plants)

Chemical of Potential Concern	Generic Criterion (mg/kg)	No. Samples	Min. (mg/kg)	Max. (mg/kg)	No. Samples Exceeding Generic Criterion
Made Ground					
Boron	3	10	0.3	6.2	2
Copper	135	25	4	390	1
Zinc	300	25	28	580	2
Natural Soils					
Boron	3	19	0.2	3.1	1
Nickel	75	29	3	790	3

Detriment to plant life is hard to quantify and many of the GACs are based on agricultural crop yields rather than serious harm of death of a species. The number of exceedances compared with the overall volume of samples is very low and vegetation on site did not show any signs of physical distress, Hydrock does not believe any additional consideration is required with regards to risks to plant life.

5.6 Residential

The proposed residential land occupies areas of the north of the site as illustrated in Figure 5.4.

Figure 5.4: Residential Land

5.6.1 Geo-environmental Laboratory Analyses

The geo-environmental analyses undertaken on soils from all investigations to date, are summarised in Table 5.14.

Table 5.14: Summary of Sample Numbers for Geo-environmental Analyses of Soils

Determinand Suite	Made Ground	Natural Soils
Metals suite of determinands for solids	60	64
Polyaromatic hydrocarbon suite for solids	53	56
Total petroleum hydrocarbons by GC-FID (Hydrock Level 2 suite)	41	26
Petroleum hydrocarbon suite (C12-C35)	6	9
Benzene, toluene, ethylbenzene and xylene (BTEX) by GC-MS)	41	26

5.6.2 Risk Estimation

Samples have been assessed using soil screening values for the CLEA land use scenario: residential with plant uptake.

Metals and PAH

The individual analytical results of the Hydrock investigation and the historical investigations provided to Hydrock have been compared with the relevant GACs in the summary table in Appendix G.

Based on a direct exceedance of the GAC, the pervasive chemicals of potential concern that require further assessment are summarised in Table 5.15.

Table 5.15: Pervasive Chemicals of Potential Concern for Which Further Assessment is Required (Human Health)

Chemical of Potential Concern	Generic Criterion (mg/kg)	Basis for Generic Criterion	No. Samples	Min. (mg/kg)	Max. (mg/kg)	No. Samples Exceeding Generic Criterion
Made Ground						
Arsenic	37	GAC	61	1	52	3
Lead	200	GAC	61	9.9	3,116	13
Cadmium	14	GAC	61	0.2	125	2
Copper	2,500	GAC	61	1	7,330	1
Nickel	130	GAC	61	3	1,707	4
Zinc	3900	GAC	61	22	5,550	3
Benz(a)anthracene	4.2	GAC	53	0.1	110	9
Benzo(a)pyrene	1.5	GAC	53	0.012	120	20
Benzo(b)fluoranthene	7.6	GAC	53	0.01	110	9
Benzo(ghi)perylene	64	GAC	53	0.01	81	2
Benzo(k)fluoranthene	12	GAC	53	0.016	100	6
Chrysene	7.7	GAC	53	0.01	102	8
Dibenz(a,h)anthracene	1.1	GAC	53	0.01	81	10
Indeno(1, 2, 3, cd)pyrene	4.3	GAC	53	0.011	81	8
Napthalene	2.2	GAC	53	0.01	2.9	1
Phenanthrene	97	GAC	56	0.021	112	1
Natural Soils						
Lead	200	GAC	64	2.8	330	2
Cadmium	14	GAC	64	0.2	16	2
Chromium (VI)	6.1	GAC	48	1.2	65	7
Nickel	130	GAC	64	2.4	460	2
Benz(a)anthracene	4.2	GAC	56	0.1	11	1
Benzo(a)pyrene	1.5	GAC	56	0.01	11	5
Benzo(b)fluoranthene	7.6	GAC	56	0.01	14	1
Chrysene	7.7	GAC	56	0.01	9.4	1
Dibenz(a,h)anthracene	1.1	GAC	56	0.01	2.5	3
Indeno(1, 2, 3, cd)pyrene	4.3	GAC	56	0.011	4.7	1
Napthalene	2.2	GAC	56	0.01	4.4	1

Asbestos

Asbestos (loose fibres of chrysotile, crocidolite and amosite) were detected in thirteen out of forty nine Made Ground samples tested and one out of forty eight natural soil samples tested. Asbestos was identified at depths of between 0.1m and 1.0m bgl and are summarised in Table 5.16.

Table 5.16: Asbestos Gravimetric Weighting

Location	Depth (m bgl)	Asbestos Fibres Detected	Gravimetric Weighting Value (%)
Made Ground			
BH505	0.2	Chrysotile	-
BH515	0.3	Chrysotile and Crocidolite	0.015
BH530	0.2	Chrysotile and Amosite	<0.001
BH530	0.4	Chrysotile	0.236
BH538A	0.2	Chrysotile and amosite	0.009
BH538A	0.8	Crocidolite	-
TP508	0.4	Chrysotile	0.001
TP510	0.1	Chrysotile	<0.001
TP521	0.3	Chrysotile and Amosite	0.003
TP522	1.0	Chrysotile	<0.001
TP539	0.4	Amosite	<0.001
TP555	0.4	Chrysotile	0.030
Natural soils			
BH606	0.5	Chrysotile	<0.001

Petroleum Hydrocarbons (PHC)

Sixty eight samples (forty one of Made Ground and twenty seven natural materials) were scheduled for a Petroleum Hydrocarbon (PHC) assessment (carbon banding with aliphatic-aromatic split). A further fifteen samples (six of Made Ground and nine of natural materials) were scheduled historically for hydrocarbon fractions C12-35. The results have been compared to the relevant GACs. The summary sheets are presented in Appendix G.

Within the Made Ground, elevated Petroleum Hydrocarbon (PHC) fractions were recorded within eight samples as summarised in Table 5.17.

Table 5.17: Elevated Petroleum Hydrocarbon Fractions Within Made Ground

Petroleum Hydrocarbon Fraction	GAC mg/kg	Concentration mg /kg								
		S-WS1 0.15m	S-WS2 0.1m	S-WS4 0.3m	S-WS5 0.3m	S-WS6 0.3m	S-WS7 0.3m	TP52 1 0.3m	TP555 0.4m	BH538 A 0.2m
Ali >EC12-EC16	24	85.8	66.0	154.8	44.2	90.5	28.8	24	-	70
Aro >EC16-EC21	260	-	-	266.5	-	-	-	290	970	-
Aro >EC21-EC35	1100	1742.2	1748.8	2116.8	-	1347.9	-	-	3100	-
Aro >EC35-EC44	1100	-	-	-	-	-	-	-	1700	-

Within the natural soils, elevated fractions were recorded in one sample, TP508 at 0.5m. The recorded elevations were 26mg/kg for the Aliphatic>EC12-EC16 TPH species, which has a GAC value of 24 mg/kg.

BTEX concentrations were also analysed with no results exceeding the relevant GAC.

Volatile Organic Substances (VOC)

Volatile and semi volatile compound concentrations within soils were analysed. No results exceeded relevant GAC.

Several SVOC compounds for which there are no published GACs are recorded at values above the laboratory limit of detection. However, these concentrations are considered very low.

No visual or olfactory evidence of hydrocarbon contamination was identified during the investigation and no elevated readings were recorded with the on-site Photo Ionisation Detector.

5.6.3 Risk Evaluation

The screening exercise identified a number of substances at concentrations above the GAC. These are considered further here to assess if the exceedance may be acceptable with respect to the proposed development and propose mitigation where necessary. A summary is in Table 5.18.

Table 5.18: Summary of Concentrations Above GAC.

Chemical of Potential Concern	Review	Comment
Arsenic	Concentrations exceeding the GAC were recorded in three samples of the Made Ground. Two of the exceedances were recorded during the 2005 investigation within the waste compound in the 'S' area.	The concentrations recorded are considered minor and represent a low percentage of the overall sample density. Mitigation is not required.
Lead	Concentrations exceeding the GAC were recorded in thirteen samples of Made Ground. Two were recorded within the waste compound in the 'S'	Given the lack of samples exceeding the GAC within the 2016 and 2018 investigation mitigation would not normally be merited. However, because

	area, and are considered significant. The remaining eleven exceedances are not considered significant, and represent a small percentage of the overall samples tested. Only one minor exceedance is recorded from the samples taken from within the waste compound during the 2016 investigation.	of the significant exceedances recorded historically within the waste compound, further validation testing will be necessary, pre-construction, to confirm whether or not mitigation may be required.
Copper	A concentration exceeding the GAC was recorded in one sample of Made Ground from within the waste compound in the 'S' area during the 2005 investigation. No exceedances were recorded during the 2016 investigation.	Given the lack of samples exceeding the GAC within the 2016 and 2018 investigation mitigation would not normally be merited. However, because of the significant exceedance recorded historically within the waste compound further validation testing will be necessary, pre-construction, to confirm whether or not mitigation may be required.
Nickel	Concentrations significantly exceeding the GAC were recorded in four samples of Made Ground. These samples were recovered from within the waste compound in the 'S' area. Two minor exceedance were recorded within the waste compound during the 2016 investigation.	Given the minor exceedance of the GAC in the samples from the 2016 and 2018 investigation mitigation would not normally be merited. However, because of the more significant exceedances recorded historically within the waste compound further validation testing will be necessary, pre-construction phase, to confirm whether or not mitigation may be required.
Zinc	Three minor exceedances of the GAC were recorded. Two samples from recovered from within the waste compound in the 'S' area.	The concentration recorded is considered minor and represents a low percentage of the samples tested. Mitigation is not considered to be merited.
PAH	Ten of the sixteen individual PAH species are recorded at concentrations in excess of their respective GAC. Significant exceedances were recorded within the waste compound in the 'S' area; in four locations during the 2005 investigation and one during the 2016 investigation. All other exceedances of PAH across the residential zone are considered not to pose a significant risk.	Due to the exceedances within the waste area mitigation is considered necessary. It is likely this will entail a clean cover system. Outside the waste compound, no exceedances are considered significant. Furthermore, they represent a low percentage of the overall sample testing density. Therefore mitigation outside the waste compound is considered not necessary.

Asbestos

Approximately 25% of samples screened for asbestos returned a positive identification of either amosite, chrysotile or crocidolite fibres. Due to existing structures and areas of vegetation the sample coverage has not been of a density to inform final mitigation measures and no clear pattern is apparent. There is no relevant guideline value for the assessment of asbestos in soils.

Quantification using gravimetric analysis indicated that all positive identifications were at a weighting value of between 0.236 and <0.001% per sample.

Further validation sampling will be required pre-construction, to determine the appropriate level of mitigation required. Where asbestos is identified in areas of gardens and open landscaping, it is considered likely that a clean capping layer will be necessary.

Petroleum Hydrocarbons

The screening exercise identified the following petroleum hydrocarbon fractions at concentrations above the GAC. These are considered further here to assess if the exceedance may be acceptable with respect to the proposed development and propose mitigation where necessary.

Concentrations exceeding the relevant GACs were recorded from nine Made Ground samples from within the waste compound in the 'S' area. An exceedance was also recorded within one sample of natural material. These are summarised in Table 5.19.

Table 5.19: Summary of Concentrations Above GAC

Petroleum Hydrocarbon Fraction	Exceedance	Review	Comment
Made Ground			
Ali >EC12-EC16	Recorded concentrations in seven samples from the 2005 investigation, exceed the GAC. The recorded concentration in one sample from the 2016 equals the GAC. Of the seven exceedances from 2005, six are considered significant.	Across these four hydrocarbon fractions exceedances of the GAC have been recorded in both the 2005 and 2016 investigations. The exceedances are at levels considered to represent a potentially significant risk to human health.	Due to the exceedances within the waste area mitigation is considered necessary. It is likely this will entail a clean cover system, possibly with hydrocarbon resistant membranes incorporated below floor slabs, or treatment of the soils to reduce concentrations to below GAC criteria. No cover system is required across the remainder of the residential land.
Aro >EC16-EC21	Recorded concentrations in one sample from the 2005 investigation, and two from the 2016 investigation exceed the GAC. One of these is considered significant.		
Aro >EC21-EC35	Recorded concentrations in four sample from the 2005 investigation, and one from the 2016 investigation exceed the GAC. All are considered significant.		
Aro >EC35-EC44	The recorded concentration in one sample from the 2016		

	investigation significantly exceeds the GAC.		
Natural soils			
Ali >EC12-16	The recorded concentration in one sample from the 2016 investigation slightly exceeds the GAC.	The Made Ground directly above the natural clay in which the sample was collected contained clinker and it is likely a stray particle has migrated into the top of the natural material. The exceedance is considered minor and does not present a significant risk.	The concentration recorded is considered minor and direct mitigation is not required.

Plant Life

Priority phytotoxic chemical concentrations have been screened against published values to determine the likely risk to plant growth and the findings presented in Appendix G.

Based on test results that exceed the GAC, the pervasive chemicals of potential concern that require further assessment are summarised in Table 5.20.

Table 5.20: Pervasive Chemicals of Potential Concern for Which Further Assessment is Required (Risk to Plants)

Chemical of Potential Concern	Generic Criterion (mg/kg)	No. Samples	Min. (mg/kg)	Max. (mg/kg)	No. Samples Exceeding Generic Criterion
Made Ground					
Boron	3	55	0.2	17	6
Copper	135	55	1	7330	8
Nickel	75	55	3	1707	8
Zinc	300	55	12	5500	11
Natural Soils					
Boron	3	55	0.2	3.7	3
Chromium (VI)	25	47	1.2	65	5
Nickel	75	55	2.4	460	4
Zinc	300	55	12	340	1

Within the Made Ground, recorded concentrations of boron are slightly elevated and recorded concentrations of copper, nickel and zinc are significantly elevated, when compared to the GAC.

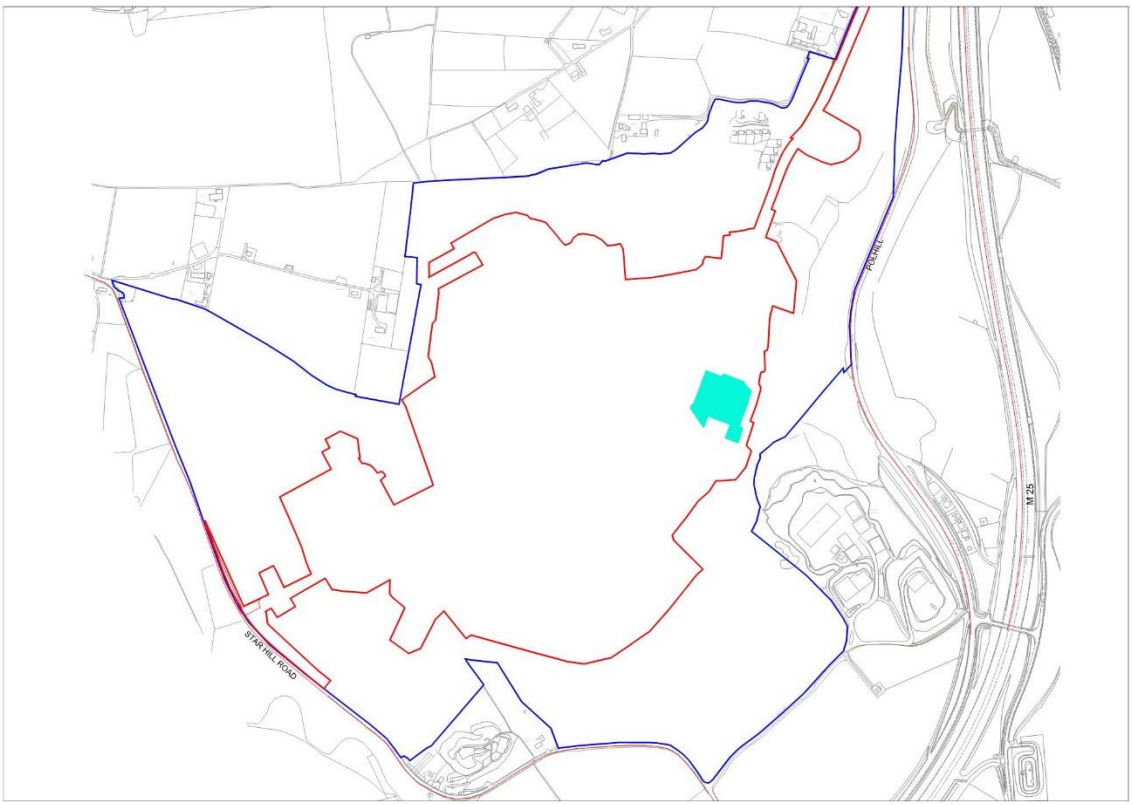
Within the natural soils recorded concentrations of boron and zinc are slightly elevated, concentrations of chromium (VI) and nickel are more significantly elevated when compared to the GAC.

Detriment to plant life is hard to quantify and many of the GACs are based on agricultural crop yields rather than serious harm of death of a species. The number of exceedances compared with the overall volume of samples is very low and vegetation on site did not show any signs of physical distress, Hydrock does not believe any additional consideration is required with regards to risks to plant life.

5.7 Primary School

The potential location for a Primary school is located towards the east of the site as illustrated in Figure 5.5.

Figure 5.5: Potential location for a primary school



5.7.1 Geo-environmental Laboratory Analyses

The geo-environmental analyses undertaken on soils from all investigations to date, are summarised in Table 5.21.

Table 5.21: Summary of Sample Numbers for Geo-environmental Analyses of Soils

Determinand Suite	Made Ground	Natural Soils
Metals suite of determinands for solids	5	2
Polyaromatic hydrocarbon suite for solids	2	1
Total petroleum hydrocarbons by GC-FID (Hydrock Level 2 suite)	4	-

5.7.2 Risk Estimation

There are no soil screening values for use in assessing the school land use. In this instance a conservative screening option has been adopted by using the residential without plant uptake scenario.

Metals and PAH

The individual analytical results of the Hydrock investigation and the historical investigations provided to Hydrock have been compared with the relevant GACs in the summary table in Appendix G.

No results exceeded the relevant GACs.

Asbestos

Asbestos (loose fibres of chrysotile and anthophylite) were detected in two out of the five samples tested. These are summarised in Table 5.22.

Table5.22: Asbestos Gravimetric Weighting

Location	Depth (m bgl)	Asbestos Fibres Detected	Gravimetric Weighting Value (%)
Made Ground			
BH521 at 0.4m	Chrysotile	0.004	BH521 at 0.4m
BH521 at 0.5m	Chrysotile and anthophylite	<0.001	BH521 at 0.5m

Petroleum Hydrocarbons (PHC)

Four Made Ground and two natural soil samples were scheduled for a Petroleum Hydrocarbon (PHC) assessment (carbon banding with aliphatic-aromatic split). The results have been compared to the relevant GACs. The summary sheets are presented in Appendix G.

No exceedances of the GAC for hydrocarbons are recorded.

Volatile Organic Substances (VOC)

Volatile and semi volatile compound concentrations within soils were analysed. No results exceeded relevant GAC.

No visual or olfactory evidence of contamination was identified during the investigation and no readings were recorded with the on site Photo Ionisation Detector.

5.7.3 Risk Evaluation

Asbestos

Due to existing structures and areas of vegetation the sample coverage has not been of a density to inform final mitigation measures and no clear pattern is apparent. There is no relevant guideline value for the assessment of asbestos in soils.

Quantification using gravimetric analysis indicated that all positive identifications were at a weighting value of between 0.004 and <0.001% per sample.

Further validation sampling will be required pre-construction, to determine the appropriate level of mitigation required. Where asbestos is identified in areas of gardens and open landscaping, it is considered likely that a clean capping layer will be necessary.

Plant Life

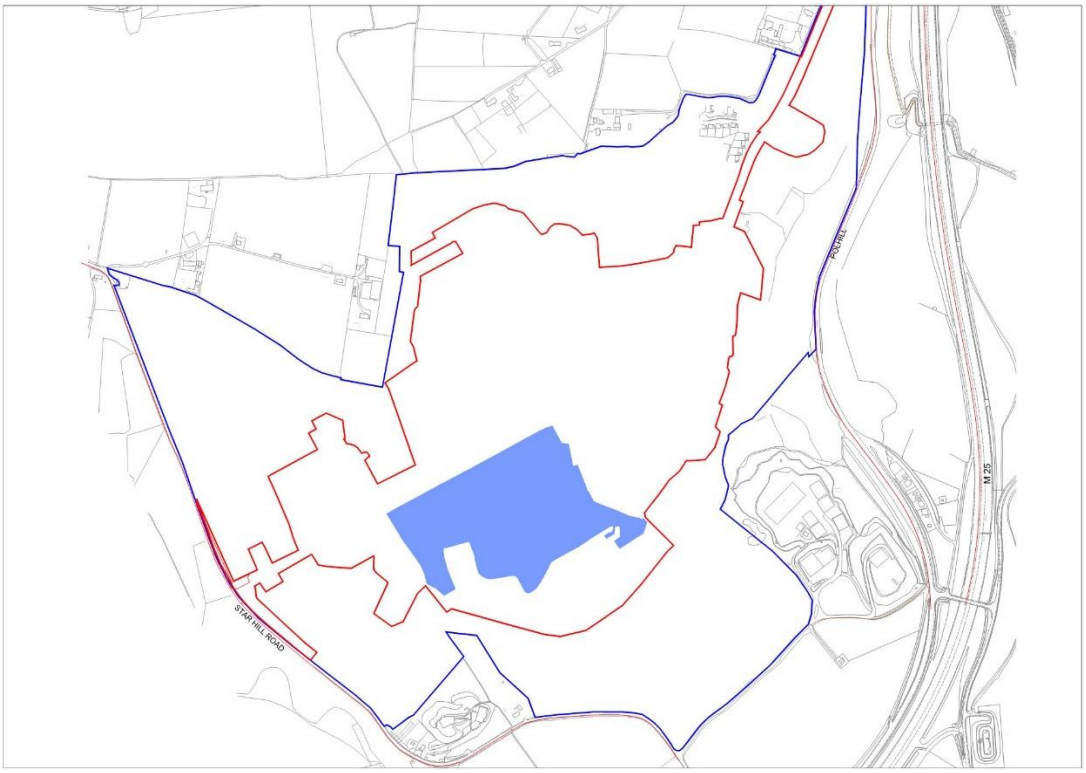
Priority phytotoxic chemical concentrations have been screened against published values to determine the likely risk to plant growth and the findings presented in Appendix G.

No exceedances of the GAC for plant life are recorded.

5.8 QinetiQ

The QinetiQ site is located towards the south of the site as illustrated in Figure 5.6.

Figure 5.6: QinetiQ site



5.8.1 Geo-environmental Laboratory Analyses

The geo-environmental analyses undertaken on soils from all investigations to date, are summarised in Table 5.23.

Table 5.23: Summary of Sample Numbers for Geo-environmental Analyses of Soils

Determinand Suite	Made Ground	Natural Soils
Metals suite of determinands for solids	36	32
Polyaromatic hydrocarbon suite for solids	26	19
Total petroleum hydrocarbons by GC-FID (Hydrock Level 2 suite)	8	12
Petroleum hydrocarbon suite (C12-C35)	10	3
Benzene, toluene, ethylbenzene and xylene (BTEX) by GC-MS)	26	19

5.8.2 Risk Estimation

Samples have been assessed using soil screening values for the CLEA land use scenario: commercial.

Metals and PAH

The individual analytical results of the Hydrock investigation and the historical investigations provided to Hydrock have been compared with the relevant GACs in the summary table in Appendix G.

Based on a direct exceedance of the GAC, the pervasive chemicals of potential concern that require further assessment are summarised in Table 5.24.

Table 5.24: Pervasive Chemicals of Potential Concern for Which Further Assessment is Required (Human Health)

Chemical of Potential Concern	Generic Criterion (mg/kg)	Basis for Generic Criterion	No. Samples	Min. (mg/kg)	Max. (mg/kg)	No. Samples Exceeding Generic Criterion
Benzo(a)pyrene	14	GAC	45	0.012	49	1

Asbestos

Asbestos (loose fibres of chrysotile, crocidolite and amosite) were detected in four out of the thirty samples tested. Three samples from Made Ground, one from natural soils. These are summarised in Table 5.25.

Table 5.25: Asbestos Gravimetric Weighting

Location	Depth (m bgl)	Asbestos Fibres Detected	Gravimetric Weighting Value (%)
Made Ground			
BH548	0.3	Amosite	<0.001
BH556	0.1	Chrysotile	<0.001
BH556	0.4	Chrysotile	<0.001
Natural Soils			
BH550	0.5	Chrysotile	<0.001

Petroleum Hydrocarbons (PHC)

Twenty samples (eight of Made Ground and twelve of natural materials) were scheduled for a Petroleum Hydrocarbon (PHC) assessment (carbon banding with aliphatic-aromatic split). A further thirteen samples (three of Made Ground and ten of natural materials) were scheduled historically for hydrocarbon fractions C12-35. The results have been compared to the relevant GACs. The summary sheets are presented in Appendix G.

No substances exceed the GAC.

BTEX concentrations were also analysed with no results exceeding the relevant GAC's.

Volatile Organic Substances (VOC)

Volatile and semi volatile compound concentrations within soils were analysed. No results exceeded relevant GAC.

No visual or olfactory evidence of contamination was identified during the investigation and no readings were recorded with the on site Photo Ionisation Detector.

5.8.3 Risk Evaluation

The screening exercise identified the following substances at concentrations above the GAC. These are considered further in Table 5.26 to assess if the exceedance may be acceptable with respect to the proposed development and propose mitigation where necessary.

Table 5.26: Elevated PAH within Made Ground

Chemical of Potential Concern	Review	Comment
Benzo(a)pyrene	Recorded concentrations in one samples of Made Ground slightly exceeds the GAC.	The concentration recorded is considered minor and represent a low percentage of the samples tested. Mitigation is not considered merited.

Asbestos

Due to existing structures and areas of vegetation the sample coverage has not been of a density to inform final mitigation measures and no clear pattern is apparent. There is no relevant guideline value for the assessment of asbestos in soils.

Quantification using gravimetric analysis indicated that all positive identifications were at a weighting value of <0.001% per sample.

Further validation sampling will be required pre-construction, to determine the appropriate level of mitigation required. Where asbestos is identified in areas of gardens and open landscaping, it is considered likely that a clean capping layer will be necessary.

Plant Life

Priority phytotoxic chemical concentrations have been screened against published values to determine the likely risk to plant growth and the findings presented in Appendix G.

Based on test results that exceed the GAC, the pervasive chemicals of potential concern that require further assessment are summarised in Table 5.27.

Table 5.27: Pervasive Chemicals of Potential Concern for Which Further Assessment is Required (Risk to Plants)

Chemical of Potential Concern	Generic Criterion (mg/kg)	No. Samples	Min. (mg/kg)	Max. (mg/kg)	No. Samples Exceeding Generic Criterion
Made Ground					
Boron	3	36	0.2	16	4
Copper	135	36	1	320	1
Nickel	75	36	1	174	3
Natural Soils					
Boron	3	33	0.2	3.1	2
Nickel	75	33	1	130	2

Within the Made Ground boron, copper and nickel are elevated when compared to the GAC.

Within the natural soils boron and nickel are elevated when compared to the GAC.

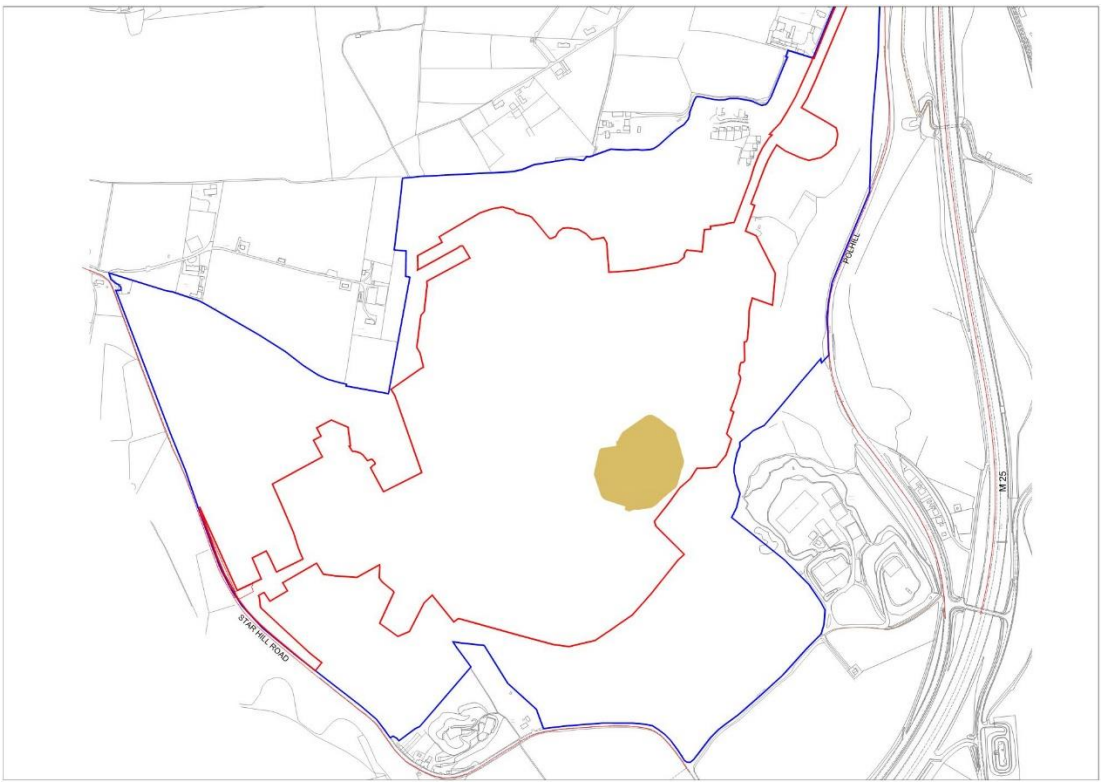
Detriment to plant life is hard to quantify and many of the GACs are based on agricultural crop yields rather than serious harm of death of a species. The number of exceedances compared with the overall

volume of samples is very low and vegetation on site did not show any signs of physical distress. Hydrock does not believe any additional consideration is required with regards to risks to plant life.

5.9 Scheduled Monument

The scheduled monument remains in its existing position and the buildings would be incorporated into a Historical Interpretation Centre for the general public area as illustrated in Figure 5.7.

Figure 5.7: Scheduled Monument



5.9.1 Geo-environmental Laboratory Analyses

Hydrock were unable to undertake any works within the scheduled ancient monument. Consequently this section considers analyses from the historical site investigations only. The geo-environmental analyses undertaken on soils are summarised in Table 5.28.

Table 5.28: Summary of Sample Numbers for Geo-environmental Analyses of Soils

Determinand Suite	Made Ground	Natural Soils
Metals suite of determinands for solids	5	5
Polyaromatic hydrocarbon suite for solids	2	-
Petroleum hydrocarbon suite (C12-C35)	2	-

5.9.2 Risk Estimation

Samples have been assessed using soil screening values for the CLEA land use scenario: commercial.

Metals and PAH List of Determinands

The individual analytical results of the historical investigations provided to Hydrock have been compared with the relevant GACs in the summary table in Appendix G.

Based on a direct exceedance of the GAC, the pervasive chemicals of potential concern that require further assessment are summarised in Table 5.29.

Table 5.29: Pervasive Chemicals of Potential Concern for Which Further Assessment is Required (Human Health)

Chemical of Potential Concern	Generic Criterion (mg/kg)	Basis for Generic Criterion	No. Samples	Min. (mg/kg)	Max. (mg/kg)	No. Samples Exceeding Generic Criterion
Made Ground						
Nickel	1700	GAC	5	10	8303	1
Benz(a)anthracene	86	GAC	2	1.1	253.6	1
Benzo(a)pyrene	14	GAC	2	1.1	186.4	1
Benzo(b)fluoranthene	97	GAC	2	0.9	151.4	1
Chrysene	140	GAC	2	1.2	229.7	1

Asbestos

Asbestos fibres were detected in two samples during the Enviros Aspinwall investigation in 2002. Quantification of the fibres was not undertaken.

Further validation sampling will be required pre-development to determine the level of mitigation required. Where asbestos is identified it is considered likely that a clean capping layer will be necessary in areas of gardens and open landscaping.

Petroleum Hydrocarbons (PHC)

Two Made Ground samples were analysed historically for hydrocarbon fractions C12-35. The results have been compared to the relevant GACs and are summarised in Table 5.30. The summary sheets are presented in Appendix G.

Table 5.30: Elevated Petroleum Hydrocarbon Fractions Within Made Ground

Petroleum Hydrocarbon Fraction	GAC mg/kg	Concentration mg /kg
		A-WS3 1.6-1.7m
Ali >EC12-EC16	48	241.6
Aro >EC16-EC21	24	706.1

5.9.3 Risk Evaluation

The screening exercise identified the following substances at concentrations above the GAC. These are considered further in Table 5.31 to assess if the exceedance may be acceptable with respect to the proposed development and propose mitigation where necessary.

Table 5.31: Elevated concentrations of metals and PAH.

Chemical of Potential Concern	Review	Comment
Nickel	Recorded concentrations within one sample of Made Ground significantly exceed the GAC.	This exceedance appears to represent a hotspot of nickel within the shallow Made Ground. Further validation sampling is required to conclude whether mitigation measures will be necessary.
Benz(a)anthracene	Recorded concentrations within one sample of Made Ground significantly exceed the GAC.	Due to the depth of the exceedances and the isolated nature of the sample in which they occur, no significant risk is anticipated. Mitigation is not considered merited
Benzo(a)pyrene	Recorded concentrations within one sample of Made Ground significantly exceed the GAC.	
Benzo(b)fluoranthene	Recorded concentrations within one sample of Made Ground significantly exceed the GAC.	
Chrysene	Recorded concentrations within one sample of Made Ground moderately exceed the GAC.	

Petroleum Hydrocarbons

The screening exercise identified petroleum hydrocarbon fractions at concentrations above the GAC as listed in Table 5.32. Assessment to assess if the exceedances may be acceptable with respect to the proposed development has been undertaken and mitigation proposed where necessary.

Concentrations exceeding the relevant GACs were recorded in one Made Ground sample, A-WS3 at 1.6-1.7m.

Table 5.32: Elevated concentrations of petroleum hydrocarbons

Petroleum Hydrocarbon Fraction	Exceedance	Review	Comment
Ali >EC12-EC16	Recorded concentrations within one sample of Made Ground significantly exceed the GAC.	The borehole log for this location recorded a sandy gravelly ash at the depth this sample was collected. The log does not note any visual or olfactory evidence of contamination.	Due to the depth of the exceedances and the isolated nature of the sample in which the exceedances occur no significant risk is anticipated. Mitigation is not considered merited.
Aro >EC16-EC21	Recorded concentrations within one sample of Made Ground significantly exceed the GAC.	The borehole log for this location recorded a sandy gravelly ash at the depth this sample was collected. The log does not note any visual or olfactory evidence of contamination.	Due to the depth of the exceedances and the isolated nature of the sample in which the exceedances occur no significant risk is anticipated. Mitigation is not considered merited.

Plant Life

Priority phytotoxic chemical concentrations have been screened against published values to determine the likely risk to plant growth and the findings presented in Appendix G.

Based on test results that exceed the GAC, the pervasive chemicals of potential concern that require further assessment are summarised in Table 5.33.

Table 5.33: Pervasive Chemicals of Potential Concern for Which Further Assessment is Required (Risk to Plants)

Chemical of Potential Concern	Generic Criterion (mg/kg)	No. Samples	Min. (mg/kg)	Max. (mg/kg)	No. Samples Exceeding Generic Criterion
Made Ground					
Copper	135	5	11	1504	2
Nickel	75	5	10	8303	1
Zinc	300	5	52	399	2

Within the Made Ground, zinc is slightly elevated and copper and nickel are significantly elevated when compared to the GAC.

Detriment to plant life is hard to quantify and many of the GACs are based on agricultural crop yields rather than serious harm of death of a species. The number of exceedances compared with the overall volume of both Made Ground and natural soil samples is low and vegetation on site did not show any signs of physical distress.

Hydrock does not believe any additional consideration is required with regards to risks to plant life.

5.10 Depleted Uranium

During the Hydrock 2016 investigation the historical use and storage of uranium in laboratories at the site was identified. This activity was recorded within the Q area and the now demolished building N19.

A drainage survey by Enviros Aspinwall in 2001 and a drainage review by Jacobs in 2005 recommended the cleaning of drains and sediment sampling for the residual presence of depleted uranium. In September 2005 at the request of QinetiQ, decommissioning of buildings that housed depleted uranium operations was undertaken by RWE Nukem, including a drainage clean up beneath buildings Q7, Q6.3 and N19. Following completion of the works, it was concluded by RWE Nukem that the decontamination work had proceeded satisfactorily.

On 27th July 2016 Hydrock supervised a drainage inspection by Aurora Health Physics Services Limited. All accessible drains surrounding building Q7, Q6.3 and the now demolished N19, were inspected, as well as the drains surrounding the demolished H19 where a uranium salt spill had been recorded historically.

In total 39 drain covers were lifted and surveyed for levels of alpha, beta and gamma emissions. All alpha and beta emission recorded were at background levels. Gamma emission was recorded between 120-330cps (counts per second) which was attributed to natural radiation in the brick making up the drain walls and the geometry of the drain surrounding the probe.

Sediment samples were collected for analysis of uranium by alpha spectrometry and ICP-MS (Inductively Coupled Plasma Mass Spectrometry), where available. Four sediment samples (three from drains surrounding Q7 and one from a drain in the area of the demolished H19) were obtained. The results are presented in Appendix G and are summarised in Table 5.34 and 5.35.

Table 5.34: U by Alpha Spectrometry

Sample	234U (Bq/g dry)	235, 236U (Bq/g dry)	238U (Bq/g dry)
Q7D1	0.017	<0.003	0.019
Q7D2	0.006	<0.002	0.005
Q7D3	0.067	0.0073	0.45
H19D1	0.015	<0.002	0.015

Table 5.35: U by ICP-MS

Sample	235U (Bq/g dry)	236U (Bq/g dry)
Q7D1	<0.001	<0.005
Q7D2	<0.001	<0.005
Q7D3	0.006	<0.003
H19D1	<0.001	<0.005

All radionuclide concentrations are 'outside of scope' of the current legislation, the Radioactive Substances Act 1993 and the Environmental Permitting Regulations 2010, as all concentrations recorded were at levels not deemed to be radioactive.

5.11 Explosives

Within the 'R' area pyrotechnic activities were undertaken including burning explosives and obscurants. A disused firing range is located in the north of the R area. The magazines within the M area are used for the storage of higher risk explosives.

Shallow soils were analysed for traces of explosive residues in twenty-four locations across the site, these were concentrated in the R and M areas due to the use and storage of explosive materials within those areas. The testing is summarised in Table 5.36.

Table 5.36: Summary of samples tested for an extended explosives suite

Location	Extended Explosives Suite
HP507 at 0.3m	NC Colour: NC Colourimetric; HMX; RDX; EGDN; 1, 3, 5 – Trinitrobenzene; Tetryl; 1, 3 – Dinitrobenzene; Nitrobenzene; NG; 4 – Amino – 2, 6 – DNT; TNT; 2 – Amino – 4, 6 – DNT; 2, 6 – DNT; 2, 4 – DNT; HNS; 2 – Nitrotoluene; 4 – Nitrotoluene; PETN; 3 – Nitrotoluene; Picrite; and Picric Acid.
TP502 at 0.4m	
TP503 at 0.1m	
TP505 at 0.1m	
TP506 at 0.3m	
TP523 at 0.1m	
TP526 at 0.1m	
TP529 at 0.3m	
TP529 at 0.2m	
TP530 at 0.1m	
TP531 at 0.1m	
TP547 at 0.1m	
TP548 at 0.2m	
TP552 at 0.1m	
TP552 at 0.4m	
TP565 at 0.3m	
BH501 at 0.2m	
BH505 at 0.2m	
BH505 at 0.6m	
BH506 at 0.5m	
BH507 at 0.3m	
BH507 at 0.8m	
BH508 at 0.4m	
BH546 at 0.3m	
BH601 at 0.2m	
BH602 at 0.2m	
WS601 at 0.25m	
WS602 at 0.2m	
WS603 at 0.4m	

Samples were analysed for an extended explosives suite using method ESAL/QC/4 parts a, j and k LCMS soils HPLC soils. Test certificates are presented in Appendix G.

Concentrations of the explosives analysed were below the laboratory limit of detection in all but one sample, TP523 at 0.1m, located in the M area.

Explosives residues are therefore not considered a significant risk.

5.12 Ground gases risk assessment

5.12.1 Data

It is judged from the available evidence that the gas generation potential at the site is moderate (due the underlying chalk formation having the potential to generate carbon dioxide) and the sensitivity of the development ranges from low to high (dependant on the proposed end use). Consequently, and in accordance with CIRIA C665 (Table 5.5a and 5.5b), an appropriate minimum monitoring regime is twelve readings over six months, provided other monitoring requirements are also met, such as prevailing atmospheric pressure conditions (for example, BS 8485:2015 suggests monitoring should include a period of falling atmospheric pressure).

Hydrock has undertaken the four readings. The first round as part of the 2016 investigation and 3 further rounds as part of the 2018 investigation. As such, the conclusions presented below are considered interim and further rounds will be required to fully characterise the site.

5.12.2 Assessment

The risks associated with the ground gases methane (CH4) and carbon dioxide (CO2) have been assessed using BS 8485:2015+A1:2019, which cites the guidelines published by CIRIA (Wilson et al 2007) (known as Situation A).

There is an alternative assessment method detailed by the NHBC (Boyle and Witherington 2007) (known as Situation B). Whilst 'Situation B' may also be suitable for the assessment, it is Hydrock's opinion that the NHBC Guidelines are not at the current time fully aligned with current ground gas risk assessment principles (as detailed in BS 8485:2015+A1:2019). As such, 'Situation A' has been chosen as a conservative assessment of risk.

The assessment guidelines published by CIRIA are based on interpretation of the gas concentrations and the gas flow rates, amongst other variables, and are compliant with the model procedures of CLR11. The modified Wilson and Card assessment has been used by comparing the maximum gas concentrations and gas screening values (GSV2) in Appendix F with the published table (CIRIA Table 8.5, reproduced below as Table 5.4) and the assessment is summarised in Appendix F.

The typical worst case GSV to date have been calculated as <0.04l/hr for carbon dioxide.

The site is provisionally classified as Characteristic Situation 1 (Situation A) and therefore presents a very low risk with respect to ground gases.

5.12.3 Gas Protection Measures

Based on the data to date no mitigation measures against permanent ground gas entry to the proposed development are required. Further monitoring is required in order to meet CIRIA best practice.

5.13 Waste Management

Any material excavated on site may be classified as waste and it is the responsibility of the holder of a material to form its own view on whether or not it is waste. This includes determining when waste that

[2] Note: GSV is synonymous with 'site characteristic hazardous gas flow rate' (Q_{hgs}) of BS 8485:2015.

has been treated in some way can cease to be classed as waste for a particular purpose. Further details are included in Appendix H.

If material is to be removed from the site (e.g. foundation arisings) the laboratory test results in Appendix G should be presented to the proposed receiving landfill site (to aid Waste Characterisation), prior to export, to confirm that it is suitably licensed to accept them. Some additional testing may be necessary at the time of disposal for the receiving landfill to confirm the Waste Acceptance Criteria (WAC) are acceptable for it to receive the waste.

It is anticipated that clean natural excavated soils will be classified as inert for off-site disposal purposes.

Non-hazardous soils require pre-treatment prior to disposal. Effective pre-treatment, involving separation, sorting and screening can offer cost reductions through reducing the hazardous nature and volume of soil waste. Costs for disposal of non-hazardous/hazardous soils are significant compared to disposal of inert material.

5.13.1 HazWasteOnline™Assessment

In order to inform the waste characterisation process, Hydrock has undertaken a preliminary exercise using the proprietary web-based tool HazWasteOnline™, to characterise the soils encountered during the 2016 and 2018 investigations should they be disposed of as a waste.

Table 5.37 summarises the output based on the HazWasteOnline™.

Table 5.37: HazWasteOnline Waste Summary

	Made Ground	Natural Soil
Non Hazardous	77	60
Potentially Hazardous	66	22
Hazardous	7	1

The results of the HazWasteOnline output are included in Appendix H and the following paragraphs provide further details.

Potentially Hazardous Waste

Within the Made Ground and natural soils eighty-eight potentially hazardous materials were reported on the basis of HP 3(i) flammable.

No significant visual or olfactory evidence of hydrocarbon contamination was identified and all on site screening of samples with a photo ionisation detector recorded no reading of VOCs or SVOCs.

The moisture content of the soils ranges from 5.4% to 34% and therefore the potential for the soil being hazardous on the basis of HP 3(i) flammable can all but be discounted, as the nature moisture content of the soil will retard the risk of ignition.

Confirmation of this approach will be necessary with the receiving waste management entity.

Hazardous Waste

Eight samples during the 2016 investigation identified potentially hazardous materials these are summarised in Table 5.38.

Table 5.38: HazWasteOnline Waste Summary for Hazardous Material

Hazardous Property	Made Ground (7 Samples)	Natural Soil (1 sample)
HP3(i) - Flammable	6	1
HP 7 - Carcinogenic	4	1
HP 11 - Mutagenic	4	-
HP 14 - Ecotoxic	5	-

Full Waste Acceptance Criteria (WAC) analyses was undertaken on two of the Made Ground samples categorised as hazardous. The results indicated that the Made Ground in those samples should be suitable for disposal at a hazardous landfill if disposal is required. Due to the small data set, further confirmatory testing should be carried out on any material that may need to be disposed to landfill.

5.13.2 Waste Recommendations

Prior to disposal, the characteristics of any excavated soils will need classification in consultation with landfill sites and waste disposal contractors. Testing and analysis will be required on the actual soil arisings, which will constitute the waste.

5.13.3 Materials Management

Any material excavated on site may be classified as waste and it is the responsibility of the holder of a material to form its own view on whether or not it is waste. This includes determining when waste that has been treated in some way can cease to be classed as waste for a particular purpose.

If site-won material is to be reused on site, a Materials Management Plan will be required, signed off by a Qualified Person as defined in the 'Development Industry Code of Practice' (CL:AIRE, March 2011).

6.0 GEOTECHNICAL DATA

6.1 Physical ground conditions

The following presents a summary of the properties of the ground and groundwater conditions encountered, based on field observations, interpretation of the field data and laboratory test results, taking into account drilling, excavation and sampling methods, transport, handling and specimen preparation.

All relevant data from the Hydrock investigation detailed in Section 3 as well as any suitable previous investigations mentioned in Section 2 are used from this point forward. Derived geotechnical parameters are presented also.

For the purposes of property designation, soils are divided into fine soils (clays and silts) and coarse soils (sands, gravels, cobbles and boulders) in accordance with BS 5930.

Soil plasticity class for fine soils is based on the classification system of BS 5930, adopting modified plasticity index values (based on percentage passing 425µm sieve). Volume change potential of fine soils on change of moisture content has been assessed using guidance provided in NHBC Standards/BRE Digest 240 - Part 1.

The nature of the investigation techniques employed makes it difficult to determine with accuracy the Grade of the structured Chalk (structureless Chalk can be generally reasonable accurately graded based on visual observation of disturbed samples), which is best determined from significantly more costly, rotary cored boreholes. Therefore, the Chalk Grades assigned to the structured Chalk strata are based on visual observations of the recovered material.

The ground conditions proven during the current investigation are in general accordance with the published geological literature and expectations from previous investigation works.

Details are provided in the logs in Appendix B.

6.1.1 Topsoil

For the purposes of this report, topsoil is defined as the upper layer of an in situ soil profile, usually darker in colour and more fertile than the layer below (subsoil), and which is a product of natural chemical, physical, biological and environmental processes, but does not imply compliance with BS 3882:2015.

6.1.2 Made Ground

Made Ground across the site is inherently variable and as such representative values of geotechnical properties are impracticable to determine. On this basis, the only laboratory geotechnical testing that has been undertaken on it is sulfate and aggressive chemical environment classification for buried concrete (BRE SD-1 suite).

6.1.3 Clay-with-Flints

Clay-with-Flints was encountered underlying the Made Ground and/or Topsoil across the whole site. The majority of the exploratory holes were terminated within these materials at depths ranging from 0.50m to 12.4m bgl.

Natural moisture contents in the fine units of these materials range from 10% to 44%, and modified plasticity indices range from 9% to 79%. On this basis, these soils are classified as of low to extremely high plasticity (CL to CE soils) and of low to high volume change potential. For the purposes of design, it is recommended that a high volume change potential be assumed.

Particle size distribution tests were undertaken on samples of the Clay-with-Flints where a considerable gravel component had been noted during the fieldwork. The results indicate that these materials comprise 23 - 92% silt and clay, 1 - 69% sand: 0 - 62% gravel and 0 – 46% cobbles and boulders. These results were in line with the site engineer's descriptions.

Undrained shear strength parameters of the cohesive units of these materials based on in situ testing are presented in Table 6.1.

Table 6.1: Soil Strength Results and Derived Values

Stratum	Shear Strength (Range)	Method	No. of Results
	cu (kPa)		
Clay-with-Flints	70 - 140	In situ hand shear vane	26

6.2 Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated)

The Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated) was encountered underlying the Made Ground/Topsoil or the Clay-with-Flints (where fully penetrated), at depths ranging from 0.05m to 12.40m bgl. No notable pattern for the depth to the chalk was identified. However, this type of variation is not uncommon. The chalk was identified to a depth of 15m bgl where the deepest boreholes were terminated.

The cable percussive drilling recovered the chalk as gravel due the drilling method. The chalk generally consisted of a weathered upper horizon, CIRIA weathering Grade Dc. This generally became more competent with depth, CIRIA weathering Grade C.

SPT N-values within these materials range from 3 to 50, generally increasing with depth, averaging between 15 to 25.

The techniques employed were reflective of this and were not suitable to provide a full characterisation of the Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated).

6.3 Obstructions

Cobbles and occasional boulders of flint were encountered throughout the Clay-with-Flints. In addition, other obstructions were encountered in several locations, as summarised in Table 6.2.

Table 6.2: Obstructions Encountered During Hydrock Investigations

Exploratory Hole	Depth (m bgl)	Description	Stratum
BH503	0.7m	Starter pit terminated at 0.7m due to dense flint, brick and concrete.	Made Ground
BH529	0.8m	Starter pit terminated at 0.8m due to dense flint, brick and concrete.	Made Ground
BH543	0.6m	Asbestos tile identified.	Made Ground
TP505	1.5m	Unmarked 4'' pipe in excavation.	Made Ground
TP520	0.4m	Brick obstruction. Could not relocate due to surrounding utilities and woodland.	Made Ground
TP522	0.7m	Concrete slab encountered at 0.7m. Full extent of slab undetermined due to constraints due to trees and fence lines. Eastern edge identified and excavation continued.	Made Ground
TP539	2.3m	Concrete obstruction, appeared to be curved, possible pipe/chamber.	Made Ground
TP549	1.6m	Concrete with re-bar.	Made Ground
WS605	1.7m	Borehole terminated on very dense flint gravel band.	Clay-with flints

6.4 Infiltration tests

The results of the infiltration testing undertaken are summarised in Table 6.3.

Testing was carried out in accordance with Hydrock's 1-day assessment methodology). This is in general accordance with BRE Digest 365 (BRE DG 2016) where infiltration rates allow three test runs during a working day (or where there is no infiltration), but where low infiltration rates were encountered the available time may not have been sufficient to fully comply with the BRE test method.

Table 6.3: Infiltration test results

Stratum	Trial Pit no.	Depth to base of pit (m bgl)	Infiltration rate (m/s)			
			Run 1	Run 2	Run 3	Range
Clay with Flints	TP606	2.10	Failed tests. No infiltration.			-
	TP610	2.40				
	TP611	2.10				
	TP615	2.20				
	TP616	2.00				
Chalk Formation	TP601	2.50	Failed test. No infiltration.			-

*Where less than three tests were possible in a particular location the results provided should be considered indicative only and should not be used for design purposes. If infiltration is critical to the development of the site, multi-day infiltration testing should be undertaken.

6.5 California Bearing Ratio (CBR)

CBR results within the Clay-with-Flints and the chalk formation are summarised in Table 6.4.

Table 6.4: CBR Results and Derived Values

Stratum	Method	No. Tests	CBR (%) (Range)
Clay-with-Flints	Laboratory remoulded sample	20	0.4 - 14
Chalk Formation	Laboratory remoulded sample	2	0.1 – 9.6

6.6 Sulfate Content

In accordance with BRE (Special Digest 1), the Design Sulfate (DS) classification and the Aggressive Chemical Environment for Concrete (ACEC) classification are presented in Table 6.5. The assessment summary sheets presented in Appendix E.

Table 6.5: Aggressive Chemical Environment Concrete Classification

Stratum	No. Tests	DS	ACEC
Made Ground	12	DS-3	AC-2s
Clay-with-Flints	37	DS-1	AC-2z
Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated).	11	DS-1	AC-1

6.7 Groundwater

Groundwater was not encountered during the ground investigations. It is anticipated to be at approximately 90m bgl.

7.0 GEOTECHNICAL ASSESSMENT

7.1 Geotechnical categorization of the proposed development

Eurocode 7, Section 2 advocates the use of geotechnical categorization of any proposed structures to establish the design requirements. Whilst Hydrock has no information on the proposed structures they are likely to be classed as Geotechnical Category 1 and 2. A Geotechnical Design Report is required for Geotechnical Category 2 structures to finalise designs and measurements of movements of selected points on the structure may be needed.

7.2 Groundwork

7.2.1 Site preparation

Prior to the start of the development phase, site preparation works are required. The site is currently occupied by a wide range of buildings and structures including office buildings, boiler houses, warehouses and buildings designed for storage of explosives. There are large areas of hardstanding much of which is anticipated to be a significant thickness of concrete. The explosives storage buildings are also expected to contain significant volumes of concrete. There is also associated infrastructure and underground services. These features will need clearing before development can commence.

7.2.2 Groundworks

Following breaking out of hardstanding and/or obstructions, excavation of shallow soils generally should be feasible by conventional plant and equipment. However, excavation through any buried construction is likely to require heavy-duty excavation and/or the use of specialist breaking equipment.

A risk assessment of the stability of any open excavation should be undertaken by a competent person and appropriate measures adopted to ensure safe working practise in and around open excavations. Further guidance on responsibilities and requirements for working near, and in, excavations can be obtained from the Construction Design and Management Regulations (2015).

Earthworks are anticipated, an earthworks specification will be necessary to ensure the appropriate management and reuse of the existing soils. Once site proposals have been further defined, more specific consideration will need to be given to the reuse of materials and whether an earthworks specification is required. The earthworks may need to be undertaken under a Materials Management

A risk assessment of the stability of any open excavation should be undertaken by a competent person and appropriate measures adopted to ensure safe working practise in and around open excavations. Further guidance on responsibilities and requirements for working near, and in, excavations can be obtained from the Construction Design and Management Regulations (2015); Construction Information Sheet 47: Inspections and Reports (2005) and HSG47: Avoiding Danger from Underground Services.

To ensure no loads are imposed on the sides of the excavation, spoil should not be placed immediately adjacent to the excavation. Spoil should be placed a suitable distance from the side of the excavation (as assessed by a competent person).

7.2.3 *Earthworks/reuse of site-won materials*

Spoil resulting from excavations within the Made Ground and natural soils may be suitable for reuse as general fill subject to further testing and specification. However, the Made Ground will not be a suitable as a founding stratum, due to its variable nature.

Where it is proposed to reuse site won materials as an engineered fill, it will be necessary to develop an appropriate Site Specific Earthworks Specification as part of the contract documentation. The basis for the Specification should be BS 6031:2009 and the latest version of the SHW, Series 600 Earthworks.

7.3 Foundations

Hydrock has not been provided with a final design for the development. However, an indication of development proposals for the different areas of the site is outlined in earlier sections of this report. Once a final design with finished floor levels and loadings are available, a more detailed appraisal should be undertaken beginning with further site investigation and geotechnical testing to fully characterise the ground conditions. However, based on the available data, it is anticipated that strip/trench fill or pad foundations will be suitable for many of the proposed structures. For heavily loaded commercial structures, piling may be required.

Where deep Made Ground is encountered consideration should be given to piling or ground improvement, dependent on the form of development and required allowable bearing capacity.

The Clay-with Flints soils are of low to high volume change potential, but for design purposes it is recommended that high volume change conditions be assumed across the site.

Trees are noted across the site, although they are of unknown size, species or maturity. Structures (residential or commercial/industrial) constructed within influencing distance of these trees (whether on- or off-site and whether to remain or be removed), should be constructed in accordance with NHBC Standards or (for non-residential buildings) the recommendations of BRE Digest 240 (BRE 1980).

On the basis of the above, minimum founding depths are likely to range from 1.0m bgl to >2.5m bgl. Foundations that are carried deep to allow for the influence of trees may be stepped up, in accordance with the requirements of EC7, BS EN 1997 as long as a suitable founding stratum is present at shallower depth.

If trees are to be removed, the roots should be grubbed out and foundations extended to below the zone of disturbance created by this activity.

The indicative allowable bearing pressures for foundations take into consideration the risk of shear failure of the ground (ultimate limit state) and acceptable limits of settlement (serviceability limit state).

The preliminary foundation designs in this section are based on the parameters given in previous section of this report. Recommendations for Geotechnical Category 2 structures (according to EC7, BS EN 1997) are presented to aid development proposals only. However, selection of geotechnical design parameters should be undertaken in conjunction with the design process and discussed in a separate Geotechnical Design Report.

Foundations which span founding materials of different stiffness (e.g Clay-with-Flints and Chalk) should have mesh reinforcement placed at the top and bottom.

The depth of foundations should be designed, and the formations inspected by, a Geotechnical Engineer. Any sub-formation materials deemed as unsuitable such as soft or loose zones should be excavated and replaced with well compacted suitable granular fill or lean mix concrete.

Foundation excavations, particularly those in Chalk, should be protected from water and inclement weather including frost and any water should be removed by pumping from a sump in the base of the excavation.

The following recommendations are preliminary and further investigation and testing will be required before final recommendations can be made.

7.3.1 Strip or Trench Fill Foundations

Traditional strip or trench fill foundations are considered suitable for low rise (up to 2.5 storey) residential properties and may, dependent on the form of construction and required bearing capacities, be suitable for low rise commercial/industrial buildings.

Where Chalk is encountered at founding level, based on CIRIA Report C574 (Lord et al 2002), as a guide, an allowable net bearing capacity of 125kN/m2 is likely to be available for a strip or trench fill foundation bearing on the natural Grade Dm and above Chalk. This value should result in total settlements of not more than 20mm for foundations up to 1m wide, keeping differential settlements within acceptable limits.

Where Clay-with–Flints is encountered at founding level, as a guide, an allowable net bearing pressure of 125kN/m2 should be available for a strip or trench fill foundation bearing at least 300mm into the founding stratum. This value should result in total settlements of not more than 20mm for foundations up to 1m wide, keeping differential settlements within acceptable limits.

Residential foundations in excess of 2.5m depth should be designed by an Engineer in accordance with the requirements of NHBC Standards.

Excavation of trench fill foundations to depths in excess of 2.5m bgl is unlikely to be economical and may be impracticable to undertake. Care should be taken to ensure the verticality of deep, narrow foundations to prevent eccentric loading.

Should enlarging the foundations be considered (for example because loads are such that the quoted bearing pressure is inadequate based on the size of foundation identified) this will probably lead to increased settlements and the above recommendations should be reviewed.

7.3.2 Pad Foundations

Pad foundations are considered an appropriate solution for the commercial/industrial buildings, dependent on the form of construction and required bearing capacities.

Where Chalk is encountered at founding level, based on CIRIA Report C574 (Lord et al 2002), as a guide, an allowable net bearing capacity of 150kN/m2 is likely to be available for a pad foundation up to 3m square, bearing on the natural Grade Dm and above Chalk. This value should result in total settlements of not more than 25mm, keeping differential settlements within acceptable limits.

Where Clay-with–Flints is encountered at founding level, as a guide, an allowable net bearing pressure of 150kN/m2 is likely to be available for a pad foundation up to 3m square, bearing on the natural

Grade Dm and above Chalk. This value should result in total settlements of not more than 25mm, keeping differential settlements within acceptable limits.

Should enlarging the foundations be considered (for example because loads are such that the quoted bearing pressure is inadequate based on the size of foundation identified) this will probably lead to increased settlements and the above recommendations should be reviewed.

7.3.3 Piled Foundations

Where the soils at traditional founding depths are inadequate to provide suitable bearing capacity for the proposed development (such as in the areas of boreholes BH514, 525 and 538A) or where residential foundations (designed in accordance with NHBC Standards) exceed 2.5m, piled foundations should be considered.

Bored piles with the use of casing or CFA piles should be suitable for this site. However, the choice of piling system and detailed design of piles are beyond the scope of this report and should be undertaken by the specialist piling contractor taking into account the following considerations.

- Obstructions in the ground, such as old foundations can cause piles to stop at shallower than design depth, or deviate from the vertical, thereby reducing their capacity. Where penetration to design depth is not possible, the obstructions should be removed, or if this is not practicable, the column layout redesigned to allow foundations to span/cantilever between piles.

- Pile, and in particular bored pile, installation can create preferential pathways for the migration of contaminants to the groundwater.

- Piles should extend a minimum of five pile diameters into the bearing stratum to fully mobilise end-bearing resistance.

- The potential effects of negative skin friction on piles.

- Care should be taken for bored and cast in situ piles taken through the Made Ground where collapse of the pile shaft or running sand conditions could lead to 'necking' of the pile.

Piles in Chalk should be designed adopting the parameters and recommendations provided in earlier sections of this report and CIRIA C574 (Lord et al 2002).

7.3.4 Ground Improvement

As an alternative to piling, deep Made Ground may be treated in situ to improve its bearing characteristics to allow shallow foundations to be constructed.

Treatment by vibroreplacement (stone columns) at suitable spacing (to be determined by a specialist contractor) should lead to significant improvement of the soils by the creation of stone columns. Full depth treatment of the Made Ground will be required and pre-boring may be required locally at least to ensure penetration through the denser Made Ground, or to penetrate, push aside or break up, obstructions. Where penetration to full depth is not possible, the obstructions should be removed, or if this is not practicable, the column layout redesigned to allow foundations to span/cantilever over the untreated area.

Following treatment, an allowable net bearing pressure of 125kN/m2 should be available for a ring beam or semi-raft foundation. Confirmation of this allowable net bearing pressure should be confirmed by in situ maintained load testing.

Different VSC contractors use different methods of emplacing the stone columns and it would be prudent to ensure that the method deployed ensures that the soils surrounding the stone columns are given a high level of compaction from horizontal vibrations by the vibrating poker.

Foundations laid on soil reinforced with stone columns are still susceptible to clay volume change and should be designed accordingly where they are within the zone of influence of existing or proposed trees.

Unlike piles, stone columns will not affect consolidation settlement due to the ground level raising. They may, however, shorten the consolidation period by shortening the seepage paths.

7.3.5 Heave Protection

Deepening of foundations in accordance with NHBC Standards/BRE 298 will be required where foundations are within the zone of influence of existing, removed or proposed trees and proposed shrub planting. For existing (and any known removed) trees this will require a tree survey to be undertaken by an arboriculturist in accordance with BS 5873:2012 which must include off-site trees that could have an effect on foundation design, in addition to trees on site. Where foundations are within the influence of trees and are deeper than 1.5m bgl, a suitable compressible material or void former will be required.

Where piled foundations are constructed on clay soils within the influencing distance of trees including proposed planting, the upper section of the pile (to the recommended minimum founding depth) should be sleeved or overbored to allow for clay volume change.

7.4 Roads and Pavements

At the time of writing, the final profile of the development is unknown and it is not possible to provide a definitive CBR value for the purpose of pavement design. The CBR achieved will be a function of the material handling and the placement methodology employed during any earthworks. It is recommended that when the formation level is reached, in situ testing should be undertaken to inform the final design.

Proof rolling of the formation level will be required, followed by the removal of any loose or soft spots and replacement with an engineered fill, in accordance with a suitable specification. The formation level will also need to be protected during inclement weather from deterioration. All slopes should be trimmed to falls to shed rainwater and the surface sealed to limit infiltration.

7.5 Buried Concrete

Based on guidelines provided in BRE Special Digest 1 (BRE 2005), as a preliminary guide the Clay-with-Flints can be classified as Design Sulfate Class DS-1 and ACEC Class AC-2z. Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated). can be classified as Design Sulfate Class of DS-1 and ACEC Class AC-1.

8.0 FINAL CONCEPTUAL MODEL

Following a review of historical reports and geo environmental data along with an assessment of the Hydrock site investigation data from 2016 and 2018 the conceptual site model in Table 8.1 has been updated. The revised conceptual site model is assessed against the proposed end use parameter plans and presented in Table 8.1.

Table 8.1: Final conceptual model and residual risks following risk evaluation

Contaminant Linkage				Comments		
Pollutant Linkage	Sources	Pathways	Receptors	General	Mitigation	Land Use Zone Affected
PL 1.	Asbestos fibres from asbestos-containing materials in the Made Ground and natural soils.	Inhalation of fugitive dust.	Human Health (End users)	Made Ground seen to contain asbestos-containing materials. Asbestos fibres measured in soil samples.	Following further validation sampling to delineate the extent of ACM within soils, mitigation to be provided by way of a clean capping system in areas of gardens and open landscaping.	• Employment • Mixed Use • Public open space (Park) • Public open space (Residential) • QinetiQ • Residential • Scheduled monument
PL 2.	Elevated asbestos fibres.	Inhalation of fugitive dust	Human Health (Neighbours)	Elevated concentrations have been recorded.	Potential for generation of contaminated dust. Suitable mitigation measures for dust suppression should be employed during construction.	• Employment • Mixed Use • Public open space (Park) • Public open space (Residential) • QinetiQ
PL 3.	Elevated asbestos fibres.	Inhalation of fugitive dust	Human Health (Construction Workers)	Elevated concentrations have been recorded.	Construction workers to adopt good hygiene and safe working practices.	• Employment • Mixed Use • Public open space (Park) • Public open space (Residential)

Contaminant Linkage				Comments		
Pollutant Linkage	Sources	Pathways	Receptors	General	Mitigation	Land Use Zone Affected
PL 4.	Elevated PAH	Ingestion, inhalation or direct contact.	Human Health (End users) Human Health (Construction workers)	Elevated PAH concentrations have been recorded around BH556 and proposed Mixed use. Remainder of green space has no significant exceedances.	Following further delineation mitigation to be provided by way of a clean capping system in the area of BH556. Construction workers to adopt good hygiene and safe working practices.	• Public open space (Residential)
PL 5.	Lead, copper and nickel in the Made Ground.	Ingestion, inhalation or direct contact.	Human Health (site users)	Significant exceedance of the GACs for these metals were recorded during the historical investigations, principally in the former waste compound. However, the 2016 investigation did not record any exceedances of Lead and Copper	As recorded concentrations of these metals are generally below the GAC in the 2016 and 2018 investigation, mitigation would not normally be merited. However, because of the significant exceedances recorded historically within	• Residential

Contaminant Linkage				Comments		
Pollutant Linkage	Sources	Pathways	Receptors	General	Mitigation	Land Use Zone Affected
				and only a minor exceedance of Nickel.	the waste compound, further validation testing will be necessary, pre-construction, to confirm whether or not mitigation may be required.	
PL 6.	Hotspots of Petroleum Hydrocarbons, PAH and asebestos fibres within Made Ground.	Ingestion, inhalation or direct contact.	Human Health (End users, neighbours, construction workers)	Significant exceedances of the GACs have been recorded within the waste compound of the 'S' Area.	Mitigation by way of a clean cover system and barrier pipe are recommended. Further assessment warranted given current SI density. Outside of the waste compound no mitigation is required. Construction workers to adopt good hygiene and safe working practices.	• Residential

Contaminant Linkage				Comments		
Pollutant Linkage	Sources	Pathways	Receptors	General	Mitigation	Land Use Zone Affected
PL 7.	Elevated metals, hydrocarbons, PAH and asbestos fibres.	Direct Contact	New buildings and infrastructure.	Elevated concentrations have been recorded.	Concrete for new foundations to be designed to withstand chemical concentrations. Underground services to be constructed with appropriate barrier piping where necessary.	• Residential
PL 8.	Nickel in the Made Ground.	Ingestion, inhalation or direct contact.	Human Health (End users)	Nickel has been recorded at approximately 5 times the GAC. There is a low volume of samples within the Made Ground.	Increased density of validation sampling is required to conclude whether it will be necessary for mitigation measures. If mitigation is required a clean cover system will be the likely solution.	• Scheduled monument

Contaminant Linkage				Comments		
Pollutant Linkage	Sources	Pathways	Receptors	General	Mitigation	Land Use Zone Affected
PL 9.	Elevated metals and asbestos fibres.	Inhalation of fugitive dust	Human Health (Neighbours)	Elevated concentrations have been recorded.	Potential for generation of contaminated dust. Suitable mitigation measures for dust suppression should be employed during construction.	• Scheduled monument
		Ingestion, inhalation or direct contact.	Human Health (Construction Workers)	Elevated concentrations have been recorded.	Construction workers to adopt good hygiene and safe working practices.	
		Direct Contact	New buildings and infrastructure.	Elevated concentrations have been recorded.	Concrete for new foundations to be designed to withstand chemical concentrations. Underground services to be constructed with appropriate barrier piping where necessary.	

9.0 GEO-ENVIRONMENTAL CONCLUSIONS AND RECOMMENDATIONS

Site investigation works during 2016 and 2018 have broadly demonstrated reduced levels of contaminants in comparison to historic data. Significant widespread contamination has not been encountered. Localised exceedances over generic assessment criteria have been identified, however it is considered that these can be addressed by industry standard remedial techniques.

Consequently the site is considered to be a low risk based on the end use parameter plans and following implementation of the recommended mitigation measures.

Further conclusions are presented below for each of the proposed end use areas.

9.1 Key Risk Drivers

9.1.1 Human Health

Residential

The Made Ground within the existing waste compound is a source of lead, copper, PAH, petroleum hydrocarbons.

Public Open Space (Residential)

The Made Ground around BH556 is a source of PAH.

Scheduled Monument

The Made Ground is a source of nickel, PAH and petroleum hydrocarbons.

Site Wide

Asbestos has been encountered in Made Ground at various locations across the site.

9.1.2 Plant Life

No significant risk to plant life have been identified and therefore no further assessment required.

9.1.3 Ground Gases

No significant risk due to ground gases identified and therefore no further assessment required.

9.2 Mitigation Measures

Site Wide - Remediation Method Statement

The production of a formal Remediation Method Statement (RMS), detailing the remedial works necessary to break the identified asbestos, metals, petroleum hydrocarbon and PAH hotspot pollutant linkages will be required. This will need to be submitted to the NHBC and Sevenoaks District Council for approval. In addition, the writing and approval of a Materials Management Plan will be required, to allow reuse of suitable material at the site.

The remedial strategy should also address the management of unforeseen contamination.

Verification reports by a suitably qualified independent geo-environmental specialist will be required following completion of any remedial works.

Residential Area

The 2016 and 2018 investigation data has identified significantly lower concentrations of copper, nickel, PAH and petroleum hydrocarbon than those recorded historically. Further site investigation during detailed design is merited to confirm these findings and target areas not previously accessible.

It is anticipated that where identified, soils containing elevated concentrations of contaminants requiring remediation can be stockpiled, screened and treated on site. Suitable material can be reused where appropriate under the terms of a Materials Management Plan and the unsuitable material removed from site.

Within areas of landscaping, gardens or public open space, that lie within the current waste compound, a suitable capping layer should be placed over the Made Ground with a no dig marker.

Public Open Space (Residential)

The 2016 and 2018 investigation data has identified lower concentrations of PAH than those recorded historically. Further site investigation in the vicinity of areas not previously accessible is merited.

It is anticipated that where identified, soils containing elevated concentrations of contaminants requiring remediation can be stockpiled, screened and treated on site. Suitable material can be reused where appropriate under the terms of a Materials Management Plan and the unsuitable material removed from site.

Scheduled Monument Area

Due to low sample numbers within historical investigations it is recommended further site investigation and validation testing be undertaken to quantify the existing level of nickel, PAH and petroleum hydrocarbons. If mitigation is necessary following this, a solution can be designed based on the findings. Consent from Heritage England will need to be sought in order to do this.

Site Wide - Asbestos

Asbestos has been identified within the Made Ground and locally within the shallow natural soils across the site. Further site investigation during detailed design is merited comprising validation sampling and gravimetric analyses to refine the extent to which asbestos fibres are present. Following this a detailed risk assessment can be undertaken relative to the specific proposals for the end use. An appropriate mitigation solution can then be implemented. In areas of gardens this is likely to result in the installation of a clean capping layer.

Site preparation works will require removal by specialist contractors of asbestos from buildings, in accordance with the asbestos survey and relevant legislation, followed by controlled decommissioning, decontamination and demolition of site buildings and ancillary structures such as tanks and the existing drainage system.

Site Wide - Utilities

The use of barrier pipe for potable water supplies is recommended.

Services should be installed within clean service corridors.

Site Wide - Soakaways

Where proposed, soakaways should be designed with due regard to the site specific ground conditions.

Depleted Uranium

Works undertaken to date have not indicated the presence of elevated radionuclide concentrations. As a precautionary measure it is recommended that a suitable contractor be appointed to oversee the slab removal, foundation grub out and drains excavation associated with those buildings with a potential history of using depleted uranium.

Explosives

Works undertaken to date have not indicated the presence of elevated explosive residues. As a precautionary measure it is recommended that a suitable contractor be appointed to oversee groundworks in areas where explosive residues are possible within the soils.

Site Wide - Environmental Management

A Construction Environmental Management Plan (CEMP) should be prepared, setting out measures to minimise dust generation, manage drainage and the storage of contaminants / hazardous material. All works should be agreed with SDC in advance of demolition, refurbishment and construction works.

10.0 WASTE AND MATERIALS MANAGEMENT

10.1 Waste

10.1.1 Introduction

Any material excavated on site may be classified as waste and it is the responsibility of the holder of a material to form their own view on whether or not it is waste. For further details, please refer to 0.

Prior to removal from site, any waste material must be classified as being either hazardous or non-hazardous, using the characterisation assessment and analysis described by the WM3 technical guidance. Then, if a waste hierarchy assessment determines that disposal to landfill is the appropriate option for the waste, chemical WAC testing must be undertaken on the actual soils designated as waste and destined for inert, stable non-reactive hazardous or hazardous classes of landfill.

The following section is a preliminary classification of waste based on the site investigation data. However, the actual classification can only be undertaken by the receiving landfill as licence conditions vary from landfill to landfill. If material is to be removed from the site, prior to export, the data in this report should be presented to the proposed receiving landfill site for it to confirm that it is suitably licensed to accept them. Additional testing on the actual excavated soils to be disposed of, will be necessary at the time of disposal.

10.1.2 Preliminary waste classifications

Based on the site history and the HazWasteOnline™ assessment (see Appendix H), if suitable segregation of different types of waste is put in place, for soils to be disposed of, it is considered that:

- the natural soils are likely to be classified as non-hazardous waste and may be able to be disposed of at an inert landfill.
- the general Made Ground where not containing asbestos >0.1% is likely to be classified as non-hazardous waste and may be able to be disposed of at an inert landfill.

Any soils containing > 0.1% asbestos or visible asbestos containing materials would be considered as hazardous.

It should be noted that:

- The above preliminary assessment has been made on the basis of the soils tested as part of the ground investigation. Prior to disposal, the characteristics of the actual soils to be disposed of will need testing and classification in consultation with landfill sites and waste disposal Contractors. The receiving landfill will make the final decision on the classification and acceptability of the waste.
- Non-hazardous soils require pre-treatment (separation, sorting and screening) prior to disposal.
- The costs for disposal of non-hazardous and hazardous soils are significant compared to disposal of inert material.
- In addition to disposal costs, landfill tax will be applicable. Non-hazardous and hazardous waste will generally be subject to the Standard Rate Landfill Tax (£84.40 per tonne as at 1 April 2017). Inert waste will generally be subject to the Lower Rate Landfill Tax (£2.70 per tonne as at 1 April 2017).

10.2 Materials management

10.2.1 Introduction

From 1 April 2018, the scope of Landfill Tax has been extended to sites operating without the appropriate environmental disposal permit, and operators of illegal waste sites will now be liable for Landfill Tax. Full details are available at: https://www.gov.uk/government/publications/landfill-tax-disposals-not-made-at-landfill-sites/landfill-tax-disposals-not-made-at-landfill-sites.

HM Revenue and Customs (HMRC) will be charging landfill tax on illegal waste deposits on construction sites and HMRC also has the ability to prosecute for landfill tax evasion fines for any illegal deposits. However, where an operator can demonstrate they are compliant with a recognised waste exemption, Code of Practice, or Quality Protocol, they will remain outside the scope of the tax.

In summary, if non-natural or contaminated soils are excavated and reused on sites (or soils are moved to or from another site for reuse), without a MMP or appropriate Permit in place, anyone who knowingly facilitates the disposal may be jointly and severally liable to any assessment of tax, fines, or prosecution.

It is worth noting that the legislation covering waste management has not changed. However, the mechanism that the Environment Agency and HMRC will use to enforce it has changed.

However, provided that soils are managed in accordance with 'The Definition of Waste: Development Industry Code of Practice', Version 2 (CL:AIRE), known as the DowCoP, the soils will never become a waste.

10.2.2 Materials management scenarios

Naturally occurring, uncontaminated soils

Where soils are naturally occurring, uncontaminated and are reused on the site they are excavated (i.e. completely uncontaminated greenfield site, with no Made Ground), they will fall outside the Waste Framework Directive (WFD) (i.e. they will not be a waste when reused on the site of origin).

However, there needs to be certainty of that reuse, and evidence is necessary to support this strategy. As such, Hydrock would recommend that a Materials Management Strategy document is prepared to prove certainty.

Where soils are naturally occurring and uncontaminated, they only become a waste on leaving the site.

When moving uncontaminated, naturally occurring soils between sites, it must be ensured they are being transferred under an MMP.

Made Ground or contaminated soils

On sites where Made Ground or contaminated (including by naturally occurring chemicals) soils are present, any soils excavated may be a waste.

As such, for any site where Made Ground is present and soils are being moved and reused on, or off site, it could be deemed a waste, and subject to either:

- a Materials Management Plan (MMP), to prevent the material ever being classified as a waste; or
- an exemption (for limited volumes); or
- a permit, dependant on its status.

If Made Ground is being moved between sites, it must be ensured that appropriate permits are in place to ensure the soils are not classified as a waste.

All recycled materials (6F2 etc.) must be produced under the 2013 Aggregates Protocol, whether on site or off site. If it is not, then it will be deemed a waste and can only be used on site under a permit. More information can be found at https://www.gov.uk/government/publications/quality-protocol-production-of-aggregates-from-inert-waste.

If materials are not managed as above, all materials placed would be deemed a waste and subject to Landfill Tax at the Standard Rate (£91.35 per tonne as at 1 April 2019).

10.2.3 Materials management plan

Where required, to prevent soils being classified as waste, all materials / soils movements should be managed under the CLAIRE Definition of Waste: Development Industry Code of Practice (DoWCoP) and a Materials Management Plan (MMP).

Under DoWCoP, to prevent materials being classified as waste, the following factors need to be proven to ensure the soils to be excavated are not waste:

- Factor 1: Protection of human health and protection of the environment.
- Factor 2: Suitability for use, without further treatment.
- Factor 3: Certainty of Use.
- Factor 4: Quantity of Material.

Hydrock recommend that the reuse of soils at sites should be considered during the planning and development process.

Under the DoWCoP, all soils reused must be tested post-excavation to prove they are fit for use.

Construction activities carried out on uncontaminated soils solely for the purpose of improving geotechnical properties e.g. lime / cement modification, are not generally regarded as waste treatment operations and do not require a permit. Should processing be needed (such as screening, treatment or improvement), that would constitute a waste activity and require a mobile treatment permit. This may be as simple as removing oversize material with an excavator bucket, to using a riddle bucket to remove hardcore to full mechanical screening.

Once the MMP is collated, it must be declared by a Qualified Person:

- before soils are placed (where soils are naturally occurring, uncontaminated and reused on the site of origin); or
- before excavation of soils is undertaken (on sites where Made Ground or contaminated soils are present, or soils are to be imported).

Once all material movements have been completed in accordance with the MMP a verification report must be produced, kept for 2 years and provided to the EA on request.

10.2.4 Conclusions

In summary, with regard to materials management:

- The reuse of soils at sites should be considered during the planning and development process.
- If uncontaminated, naturally occurring soils are being excavated and reused on the site of origin in the course of construction activities (i.e. the site is greenfield), a MMP is not required. However, Hydrock would recommend that documentation is prepared that sets out the reasoning for why excavated soils considered not to be a waste.
- If non-natural or contaminated soils are excavated and reused on sites without a MMP, exemption, or appropriate Permit in place, anyone who knowingly facilitates the disposal may be jointly and severally liable to any assessment of tax, fines or prosecution.
- If soils are being moved from one site to another, they need to be uncontaminated, naturally occurring soils and a MMP needs to be in place; or, if Made Ground, appropriate permits must be in place to ensure the soils are not classified as a waste.
- If processing is being undertaken, an appropriate permit must be in place.
- The MMP must have a declaration by a Qualified Person, and verified to ensure it has been undertaken as planned.
- All recycled materials (6F2 etc.) must be produced under the 2013 Aggregates Protocol, whether on site or off site, certificates will be required to prove this.

11.0 UNCERTAINTIES AND LIMITATIONS

11.1 Site-specific comments

The scheduled monitoring is complete but is insufficient at this stage to fully characterise the site in accordance with CIRIA Report 665. Additional monitoring is required and the conclusions of this report will need to be updated following completion of the additional monitoring.

11.2 General comments

Hydrock Consultants Limited (Hydrock) has prepared this report in accordance with the instructions of CBRE as agent for Merseyside Pension Fund (the Client), under the terms of appointment for Hydrock. Hydrock shall not be responsible for any use of the report or its contents for any purpose other than that for which it was prepared and provided.

This report details the findings of work carried out in 2016 and 2018 by Hydrock and a review and incorporation of historic data where deemed suitable. The report has been prepared by Hydrock on the basis of available information obtained during the study period. Although every reasonable effort has been made to gather all relevant information, all potential environmental constraints or liabilities associated with the site may not have been revealed.

Hydrock has used reasonable skill, care and diligence in the design of the investigation of the site. The inherent variation of ground conditions allows only definition of the actual conditions at the locations and depths of trial pits and boreholes at the time of the investigation. At intermediate locations, conditions can only be inferred.

Groundwater findings described are only representative of the dates on which they were made and levels may vary.

Unless otherwise stated, the recommendations in this report assume that ground levels will remain as existing. If there is to be any re-profiling (e.g. to create development platforms or for flood alleviation) then the recommendations may not apply.

Information provided by third parties has been used in good faith and is taken at face value; however, Hydrock cannot guarantee its accuracy or completeness.

Where the existing report(s) prepared by others have been provided by the Client, it is assumed that these have been either commissioned by the Client, or can be assigned to the Client, and can be relied upon by Hydrock. Should this not be the case Hydrock should be informed immediately as additional work may be required. Hydrock is not responsible for any factual errors or omissions in the supplied data, or for the opinions and recommendations of others. It is possible that the conditions described may have since changed through natural processes or recent activities.

The work has been carried out in general accordance with recognised best practice. The various methodologies used are referenced in 0. Unless otherwise stated, no assessment has been made for the presence of radioactive substances or unexploded ordnance. Where the phrase ‘suitable for use’ is used in this report, it is in keeping with the terminology used in planning control and does not imply any specific warranty or guarantee offered by Hydrock.

The chemical analyses reported were scheduled for the purposes of risk assessment with respect to human health, plant life and controlled waters as discussed in the report. Whilst the results may be

useful in applying the Hazardous Waste Assessment Methodology given in Environment Agency Technical Guidance WM3, they are not primarily intended for that purpose and additional analysis will be required at the time of disposal to fully classify waste.

Unless otherwise stated, at the time of this investigation the future routes of water supply pipes had not been established. This investigation and sampling strategy may not be fully compliant with UKWIR recommendations. Consequently, a targeted investigation and specific sampling and chemical testing may be required at a later date once the routes of the supply pipes are known. In addition, it is recommended that the relevant water supply company be contacted at an early stage to confirm its requirements for assessment, which may not necessarily be the same as those recommended by UKWIR.

Whilst the preliminary risk assessment process has identified potential risks to construction workers, consideration of occupational health and safety issues is beyond the scope of this report.

Please note that notwithstanding any site observations concerning the presence or otherwise of archaeological sites, asbestos-containing materials or invasive weeds, this report does not constitute a formal survey of these potential hazards and specialist advice should be sought.

Any site boundary line depicted on plans does not imply legal ownership of land.

12.0 RECOMMENDATIONS FOR FURTHER WORK

Following the ground investigation works undertaken to date, the following further works will be required:

- pre-demolition asbestos survey;
- further site investigation in areas that to date have not been accessible. Beneath building footprints etc.
- further site investigation during detailed design to delineate the extent of asbestos fibres within shallow soils;
- further site investigation during detailed design to delineate the concentrations of metals, PAH and petroleum hydrocarbons where identified. Works will also validate the data obtained within the 2016 and 2018 investigation compared to the historical investigations;
- further site investigation during detailed design to provide suitable parameters for foundation (including pile and ground improvement) design and soil characterisation;
- infiltration testing at various depths within the chalk formation across the extent of the Site to inform on site drainage strategies;
- design and implementation of a comprehensive ground gas monitoring regime;
- production of a formal Remediation Method Statement (RMS), detailing the remedial works considered necessary to break the identified potential pollutant linkages;
- design of a suitable cover system in areas of landscaping, gardens and public open space;
- foundation depth in relation to trees assessment, following a tree survey to BS 5837:2012;
- upon completion of development design, provision of a geotechnical design report for Category 2 structures;
- discussions with service providers regarding the materials suitable for pipework etc.;
- verification of the remedial works to allow regulatory sign off.

13.0 REFERENCES

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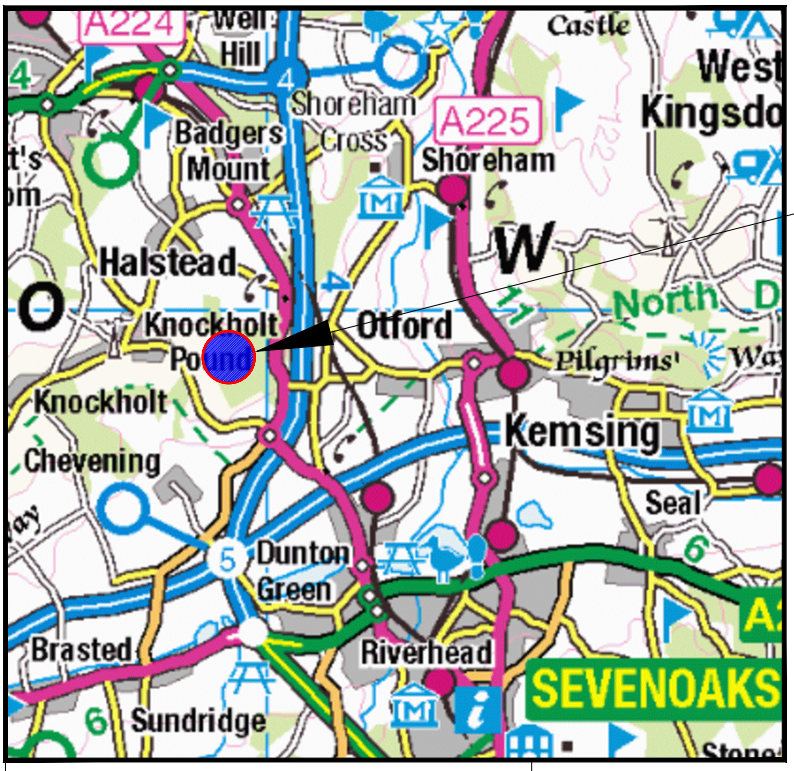
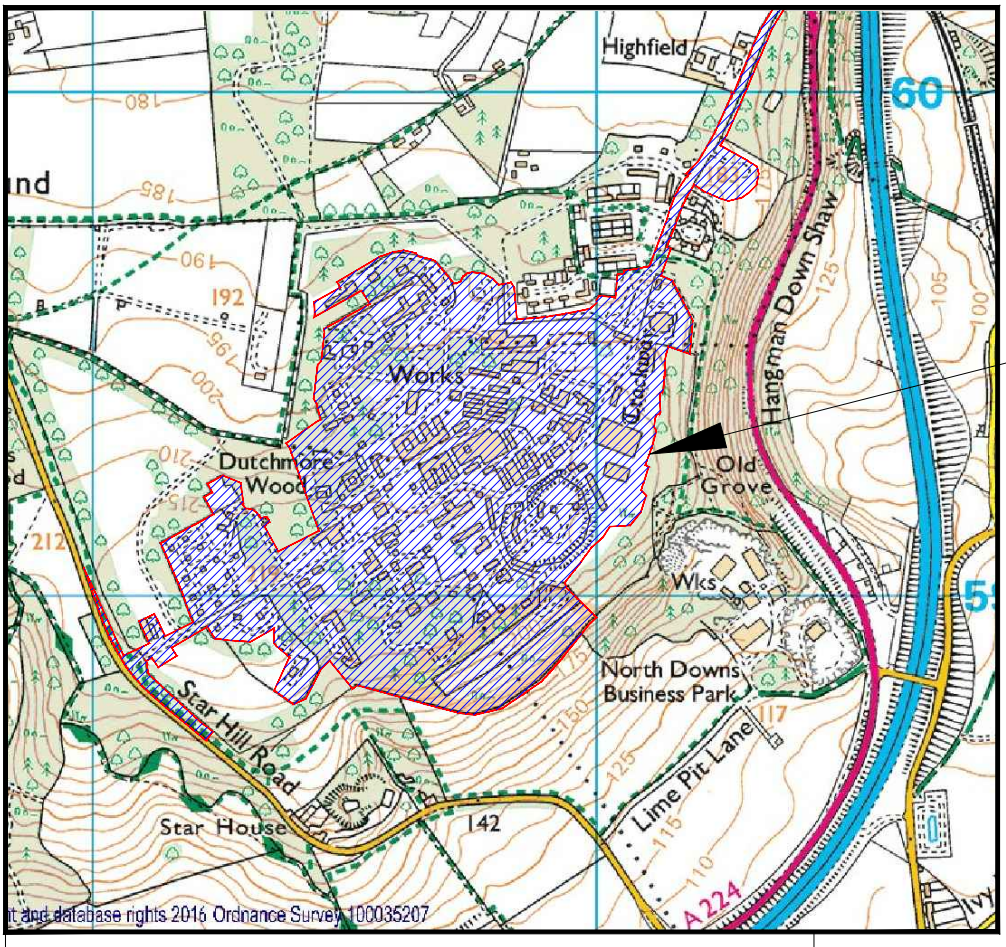
Appendix A

Drawings

Notes:

1. Contains Ordnance Survey data © Crown copyright and database right 2015





Rev	Date	Description	By	Ckd

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Client :

Merseyside Pension Fund

Project Title:

FORT HALSTEAD, KENT

Drawing Title:

Site Location Plan

Reference:

10730-HYD-XX-ZZ-DR-GE-1000

Hydrock Job No:

C-10730-C

Drawn	Checked	Scale @ A4	Date	Issue Date
SD	WL	See Drawing	18/12/18	18/12/18

Drawing Number:

P1

Revision:

S2

Notes:

1. All dimensions are to be checked on site before the commencement of works. Any discrepancies are to be reported to the Architect & Engineer for verification. Figured dimensions only are to be taken from this drawing.
2. This drawing is to be read in conjunction with all relevant Engineers' and Service Engineers' drawings and specifications.
3. Based on Topographical Survey drawing No: 10323 Master Rev 1 by Greenhatch Group. Drawing dated: 11-12-07

Legend

- Land ownership boundary
- Application boundary

Hydrock 2018

- BHXX Cable Percussion Borehole
- TPXX Trial Pit
- WSXX Window Sampler Borehole

Hydrock 2016

- TPXX Trial Pit
- BHXX Window Sampler Borehole
- HPXX Hand Dug Trial Pit

Historical Investigations

- XXX Window Sampler Borehole
- XXX Hand Dug Trial Pit
- XXX Window Sampler Borehole
- XXX Machine Dug Trial Pit
- Indicative boundary fence to Qinetic'Q's demise

Rev	Date	Description	By	Ckd

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Client :

Merseyside Pension Fund

Project Title:

FORT HALSTEAD, KENT

Drawing Title:

Exploratory Hole Location Plan

Reference:

10730-HYD-XX-ZZ-DR-GE-1001

Hydrock Job No:

C-10730-C

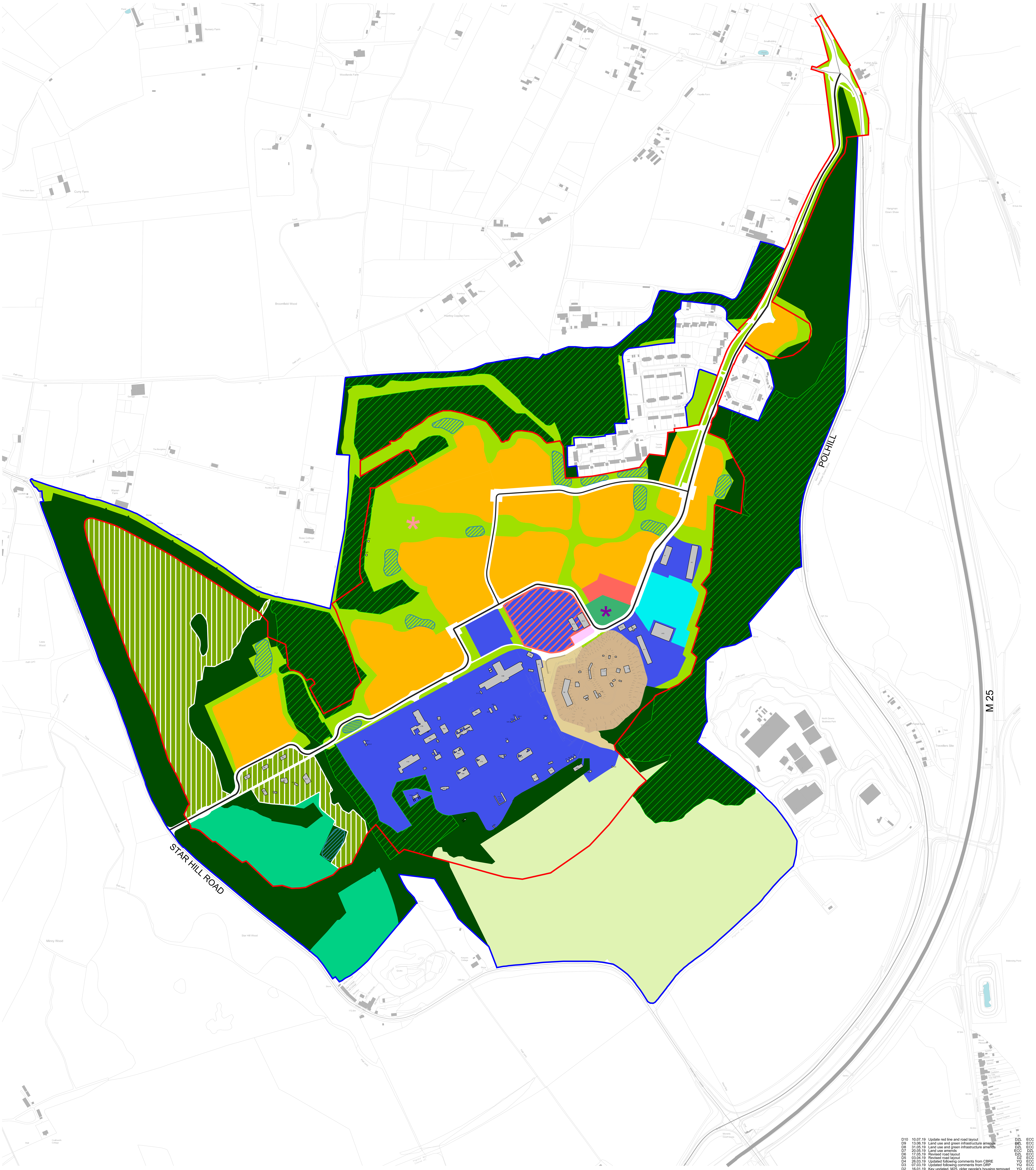
Drawn	Checked	Scale @ A1	Date	Issue Date
SD	WL	1:2500	14/12/18	14/12/18

Revision: P1

Status: S2

Notes:
Do not scale from this drawing.
All contractors must visit the site and be responsible for taking and checking Dimensions.
All construction information should be taken from figured dimensions only.
Any discrepancies between drawings, specifications and site conditions must be brought to the attention of the supervising officer.
This drawing and the works depicted are the copyright of JTP.

This drawing is for planning purposes only. It is not intended to be used for construction purposes. Whilst all reasonable efforts are used to ensure drawings are accurate, JTP accept no responsibility or liability for any reliance placed on, or use made of, this plan by anyone for purposes other than those stated above.



KEY

- Application boundary
- Applicant's land ownership boundary
- Existing buildings for retention
- Proposed vehicular routes
- Scheduled monument (The Fort)
- Residential
- Mixed Use
- Employment
- Employment / Mixed Use
- Primary school
- Village Square
- Hardstanding
- Village Green
- Public Open Space (incl. woodland buffer, SuDs, Children's play area)
- Community Recreation Area
- Existing Woodland
- Existing Ancient Woodland
- Ecologically Enhanced Grassland / Mitigation Zone
- Existing Chalk Grassland
- Indicative Neighbourhood Equipped Area for Play (NEAP)
- Indicative Local Equipped Area for Play (LEAP)
- Indicative location for SuDS ponds

Notes:
All land uses can deviate +/-3m within the application boundary, subject to on-site constraints.

*The shapes and sizes of the ponds as shown on the plan are indicative only.

Rev	Date	Description	Drawn	Chkd
D10	10.07.19	Update red line and road layout	DZL	ECC
D9	13.06.19	Land use and green infrastructure amends	DZL	ECC
D8	31.05.19	Land use and green infrastructure amends	DZL	ECC
D7	20.05.19	Land use amends	ECC	DZL
D6	17.05.19	Revised road layout	DZL	ECC
D5	03.04.19	Revised road layout	DZ	ECC
D4	26.03.19	Updated following comments from CBRE	YQ	ECC
D3	07.03.19	Updated following comments from DRP	YQ	ECC
D2	16.01.19	Key updated, M25, older people's housing removed	YQ	ECC
D1	15.01.19	Road network, VC and QQ updated, fence added	YQ	ECC
-	07.12.18	First issue	YQ	ECC

Drawing Status
DRAFT

Client
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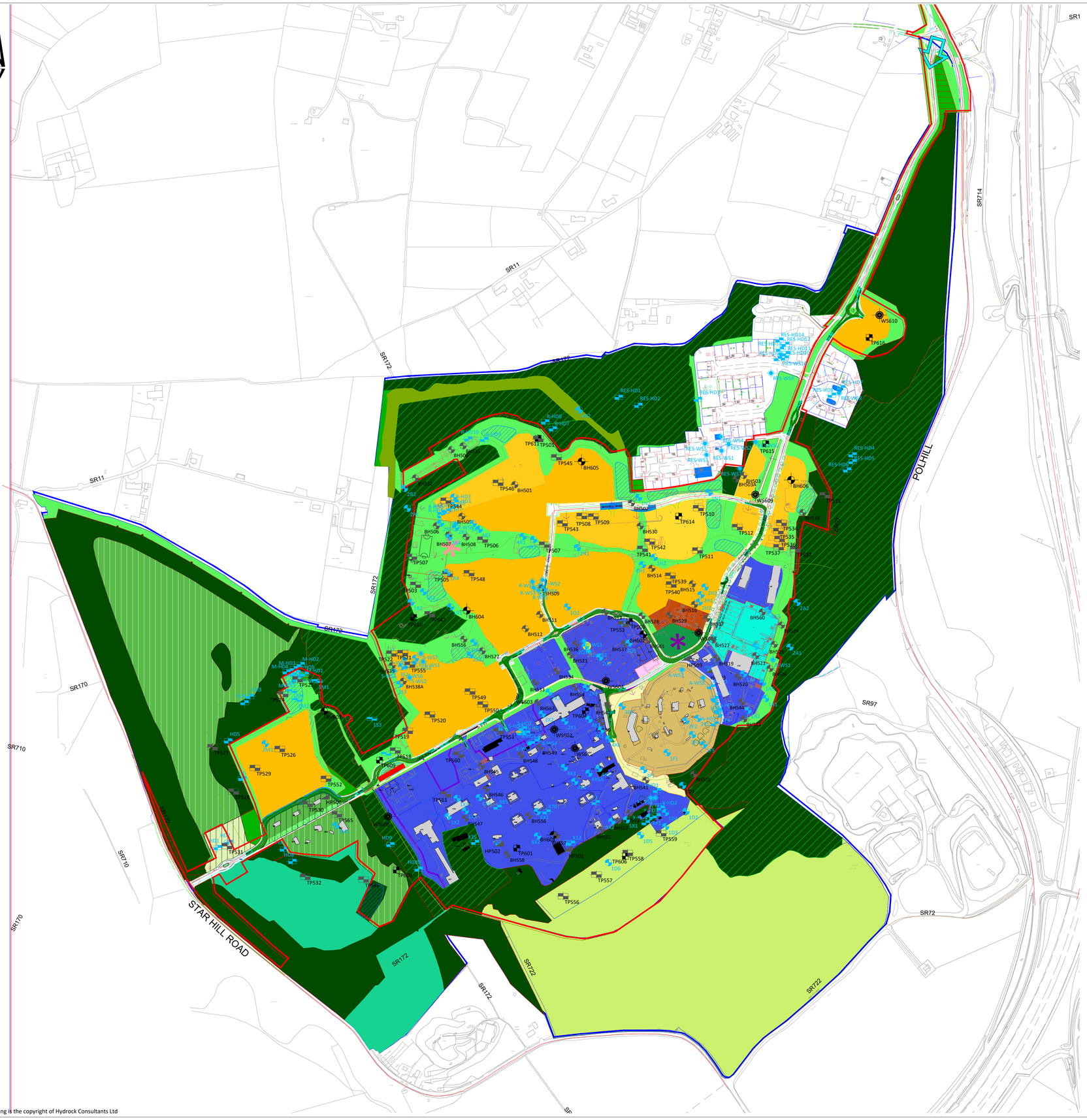
Project
Fort Halstead

Drawing Title
Land Use and Green Infrastructure Plan

Scale @ A0: 1:2500
Job Ref. 00556I
Drawing No. 00556I_PP01
Revision D10
Scale Bar: 0 20 40 60 80 100m



KEY

- Existing buildings for retention
- Scheduled monument (The Fort)
- Residential
- Mixed Use
- Employment
- Employment / Mixed Use
- Primary school
- Village Square
- Hardstanding
- Village Green
- Public Open Space (inc', woodland buffer, SuDs, Children's play area)
- Community Recreation Area
- Proposed Woodland Gap Planting/Screening
- Existing Woodland
- Existing Ancient Woodland
- Ecologically Enhanced Grassland / Mitigation Zone
- Existing Chalk Grassland
- Indicative Neighbourhood Equipped Area for Play (NEAP)
- Indicative Local Equipped Area for Play (LEAP)
- Indicative location for SuDS ponds

Notes:

1. All dimensions are to be checked on site before the commencement of works. Any discrepancies are to be reported to the Architect & Engineer for verification. Figured dimensions only are to be taken from this drawing.
2. This drawing is to be read in conjunction with all relevant Engineers' and Service Engineers' drawings and specifications.
3. Based on Topographical Survey drawing No: 10323 Master Rev 1 by Greenhatch Group. Drawing dated: 11-12-07
4. Land use information based on drawing Number: 005561 by John Thompson & Partners dated: 07-12-18. Drawing for planning purposes only, it is not intended to be used for construction purposes.

Legend

- Land ownership boundary
- Application boundary

Hydrock 2018

- BHXX Cable Percussion Borehole
- TPXX Trial Pit
- WSXX Window Sampler Borehole

Hydrock 2016

- TPXX Trial Pit
- BHXX Window Sampler Borehole
- HPXX Hand Dug Trial Pit

Historical Investigations

- XXX Window Sampler Borehole
- XXX Hand Dug Trial Pit
- XXX Window Sampler Borehole
- XXX Machine Dug Trial Pit
- Indicative boundary fence to Qinetic'Q's demise

Rev	Date	Description	By	Ckd
P2.1 S02	04/07/19	Changes to Land use and key	SD	WL
P2-S2	15/01/19	Amendments to Key, Legend & descriptions	SD	WL

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Client :

Merseyside Pension Fund

Project Title:

FORT HALSTEAD, KENT

Drawing Title:

Land Use Plan

Reference:

10730-HYD-XX-ZZ-DR-GE-1002

Hydrock Job No:

C-10730-C

Drawn	Checked	Scale @ A1	Date	Issue Date
SD	WL	1:3500	15/01/19	04/07/19

Revision: P2

Status: S02

Appendix B

Ground Investigation Plan and Exploratory Hole Logs

Notes:

1. All dimensions are to be checked on site before the commencement of works. Any discrepancies are to be reported to the Architect & Engineer for verification. Figured dimensions only are to be taken from this drawing.
2. This drawing is to be read in conjunction with all relevant Engineers' and Service Engineers' drawings and specifications.
3. Based on Topographical Survey drawing No: 10323 Master Rev 1 by Greenhatch Group. Drawing dated: 11-12-07

Legend

- Land ownership boundary
- Application boundary

Hydrock 2018

- BHXX Cable Percussion Borehole
- TPXX Trial Pit
- WSXX Window Sampler Borehole

Hydrock 2016

- TPXX Trial Pit
- BHXX Window Sampler Borehole
- HPXX Hand Dug Trial Pit

Historical Investigations

- XXX Window Sampler Borehole
- XXX Hand Dug Trial Pit
- XXX Window Sampler Borehole
- XXX Machine Dug Trial Pit
- Indicative boundary fence to Qinetic'Q's demise

Rev	Date	Description	By	Ckd

Architect :

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Client :

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Project Title:

FORT HALSTEAD, KENT

Drawing Title:

Exploratory Hole Location Plan

Reference:

10730-HYD-XX-ZZ-DR-GE-1001

Hydrock Job No:

C-10730-C

Drawn	Checked	Scale @ A1	Date	Issue Date
SD	WL	1:2500	14/12/18	14/12/18

Revision: P1

Status: S2

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Cable Percussion

Borehole No. BH601 Sheet 1 of 2

Project Name:	Fort Halstead	**Co-ords:**	549701E, 158945N
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Ground Level:** 211.93m OD
Client:	Merseyside Pension Fund	**Date(s):**	19/11/18 - 20/11/18
Hole Type:	CP	**Scale:**	1:50
Hole Diameter:			

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m OD)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.00-0.50	B					Brown slightly sandy slightly gravelly silt/clay with frequent cobbles of flint. Gravel is subangular and angular fine to coarse of flint with occasional brick and concrete. (MADE GROUND)
		0.20	ES					
		0.60	D		0.65	211.28		
		0.70	ES					
		0.70-1.30	B					Firm light brown slightly sandy slightly gravelly SILT/CLAY with frequent cobbles of flint. Gravel is subangular to subrounded fine to coarse of flint. (CLAY WITH FLINTS FORMATION)
		1.20	ES					
		1.40	D					
		1.50-2.00	B					
		1.50	SPT	N=24 (4,4/7,5,6,6)				
		2.40	D					
		2.50-3.00	B					
		2.50	SPT	N=25 (6,5/7,6,5,7)				
		3.40	D					
		3.50-4.00	B					
		3.50	SPT	N≥50 (2,2/6 for 157mm)				
					4.00	207.93		Structureless CHALK composed of slightly sandy slightly silty subangular to rounded GRAVEL & COBBLES. Clasts are weak low to medium density cream with occasional orange staining. Matrix is cream locally dark brown and orange with occasional flints. (CIRIA GRADE Dc). Occasionally recovered as weak medium density white frequently stained orange CHALK. Fractures possibly extremely closely to closely spaced (10/30/90) infilled with cream comminuted chalk. (CIRIA GRADE C4) (LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMARTION, NEWHAVEN CHALK FORMATION - UNDIFFERENTIATED)
		4.40	D					
		4.50	SPT	N=13 (2,2/3,3,3,4)				
		5.90	D					
		6.00-6.50	B					
		6.00	SPT	N=13 (3,3/3,3,3,4)				
		7.40	D					
		7.50	SPT	N=16 (4,3/5,4,3,4)				
		8.90	D					
		9.00-9.50	B					
		9.00	SPT	N=29 (5,5/6,6,7,10)				

1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0

Remarks: Borehole complete at 15.0m bgl. Groundwater not encountered. No visual or olfactory evidence of contamination noted in arisings. Borehole fitted with monitoring installation upon completion.

B = Bulk Sample
D = Disturbed Sample
U = Undisturbed Sample
UT = Undisturbed Sample (Thin Wall)
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
SPT = Standard Penetration Test
AB = Asbestos Bulk Sample

Groundwater:

Logged: GDC **Checked:** WL

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Cable Percussion

Borehole No. BH601 Sheet 2 of 2

Project Name:	Fort Halstead		**Co-ords:**	549701E, 158945N	**Hole Type:** CP
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Ground Level:**	211.93m OD	**Scale:** 1:50
Client:	Merseyside Pension Fund		**Date(s):**	19/11/18 - 20/11/18	**Hole Diameter:**

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m OD)	Legend	Stratum Description
		Depth (m)	Type	Results				
		10.40 10.50	D SPT	N=34 (6,6/7,8,8,11)				Structureless CHALK composed of slightly sandy slightly silty subangular to rounded GRAVEL & COBBLES. Clasts are weak low to medium density cream with occasional orange staining. Matrix is cream locally dark brown and orange with occasional flints. (CIRIA GRADE Dc). Occasionally recovered as weak medium density white frequently stained orange CHALK. Fractures possibly extremely closely to closely spaced (10/30/90) infilled with cream comminuted chalk. (CIRIA GRADE C4) (LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMARTION, NEWHAVEN CHALK FORMATION - UNDIFFERENTIATED)
		11.90 12.00-12.75 12.00	D B SPT	N=14 (3,3/3,3,4,4)				*frequent cobbles of flint from between 11.5 - 12.0m bgl*
		13.40 13.50	D SPT	N=21 (4,4/5,4,5,7)				
		14.40 14.50-15.00 14.50	D B SPT	N=13 (1,2/2,3,3,5)				
					15.00	196.93		End of Borehole at 15.00m

11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0

Remarks: Borehole complete at 15.0m bgl. Groundwater not encountered. No visual or olfactory evidence of contamination noted in arisings. Borehole fitted with monitoring installation upon completion.

B = Bulk Sample
D = Disturbed Sample
U = Undisturbed Sample
UT = Undisturbed Sample (Thin Wall)
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
SPT = Standard Penetration Test
AB = Asbestos Bulk Sample

Groundwater:

Logged: GDC **Checked:** WL

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Cable Percussion

Borehole No. BH602

Sheet 1 of 2

Project Name:	Fort Halstead		**Co-ords:**	549859E, 159296N	**Hole Type:** CP
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Ground Level:**	210.93m OD	**Scale:** 1:50
Client:	Merseyside Pension Fund		**Date(s):**	20/11/18 - 21/11/18	**Hole Diameter:**

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m OD)	Legend	Stratum Description
		0.00-0.30	B		0.10	210.83		Brown slightly gravelly sandy SILT/CLAY. Gravel is angular to subrounded fine to coarse of flint, concrete and brick. (MADE GROUND)
		0.20	ES		0.15	210.78		
		0.40	D					
		0.50-1.00	B					
		0.80	ES		0.85	210.08		Brown grey fine to coarse SAND. (MADE GROUND)
		1.10	D					Brown slightly gravelly sandy SILT/CLAY. Gravel is angular to subrounded fine to coarse of flint, concrete, brick and metal fragments. (MADE GROUND)
		1.10	ES					*large concrete boulder at 0.5m bgl*
		1.10-1.40	B					*becoming blackish brown from 0.6m bgl*
		1.50	D					*becoming orangish brown from 0.8m bgl*
		1.50-2.00	B					
		1.50	SPT	N=19 (3,2/5,5,4,5)				
		2.00	ES					Firm light orangish brown slightly sandy gravelly SILT/CLAY with occasional cobbles of flint. Gravel is subangular to subrounded fine to coarse of flint. (CLAY WITH FLINTS FORMATION)
		2.40	D		2.40	208.53		
		2.50-3.00	B					*becoming stiff locally orange and sandy from 1.2m bgl*
		2.50	SPT	N=23 (5,5/7,7,5,4)				
		3.40	D		3.40	207.53		Structureless CHALK composed of slightly sandy silty subangular to rounded GRAVEL with occasional cobbles of chalk and flint. Clasts are weak low to medium density white with occasional orange staining. Matrix is cream locally orange. (CIRIA GRADE Dc) (LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMARTION, NEWHAVEN CHALK FORMATION - UNDIFFERENTIATED)
		3.50	SPT	N=18 (3,2/5,5,3,5)				
					4.00	206.93		
		4.40	D					Extremely weak low density white frequently stained orange CHALK. Fractures extremely closely spaced (1/5/10) clean or infilled with white and brown comminuted chalk. (CIRIA GRADE C5) (LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMARTION, NEWHAVEN CHALK FORMATION - UNDIFFERENTIATED)
		4.50-5.00	B					
		4.50	SPT	N=15 (2,2/3,3,4,5)				
		5.90	D					Structureless CHALK composed of slightly sandy silty subangular to rounded GRAVEL with occasional cobbles of chalk and flint. Clasts are weak low to medium density white with occasional orange staining. Matrix is cream locally orange. (CIRIA GRADE Dc). Occasionally recovered as weak medium density white frequently stained orange CHALK. Fractures possibly extremely closely to closely spaced (5/20/60) infilled with cream comminuted chalk. (CIRIA GRADE C4) (LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMARTION, NEWHAVEN CHALK FORMATION - UNDIFFERENTIATED)
		6.00	SPT	N=21 (4,3/7,4,4,6)				
		7.40	D					*frequent cobbles of flint from between 5.5 - 6.0m bgl*
		7.50-8.00	B					
		7.50	SPT	N=25 (3,2/6,6,7,6)				
		8.90	D					
		9.00	SPT	N=24 (3,3/5,5,6,8)				*frequent cobbles of flint from between 9.5 - 10.0m bgl*

1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0

Remarks: Borehole complete at 15.0m bgl. Groundwater not encountered. No visual or olfactory evidence of contamination noted in arisings. Borehole fitted with monitoring installation upon completion.

B = Bulk Sample
D = Disturbed Sample
U = Undisturbed Sample
UT = Undisturbed Sample (Thin Wall)
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
SPT = Standard Penetration Test
AB = Asbestos Bulk Sample

Groundwater:

Logged: GDC **Checked:** WL

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Cable Percussion

Borehole No. BH602 Sheet 2 of 2

Project Name:	Fort Halstead		**Co-ords:**	549859E, 159296N	**Hole Type:** CP
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Ground Level:**	210.93m OD	**Scale:** 1:50
Client:	Merseyside Pension Fund		**Date(s):**	20/11/18 - 21/11/18	**Hole Diameter:**

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m OD)	Legend	Stratum Description
		Depth (m)	Type	Results				
		10.40	D					Structureless CHALK composed of slightly sandy silty subangular to rounded GRAVEL with occasional cobbles of chalk and flint. Clasts are weak low to medium density white with occasional orange staining. Matrix is cream locally orange. (CIRIA GRADE Dc). Occasionally recovered as weak medium density white frequently stained orange CHALK. Fractures possibly extremely closely to closely spaced (5/20/60) infilled with cream comminuted chalk. (CIRIA GRADE C4) (LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMARTION, NEWHAVEN CHALK FORMATION - UNDIFFERENTIATED)
		10.50-11.00	B					
		10.50	SPT	N=25 (5,5/6,5,5,9)				
		11.90	D					
		12.00	SPT	N=30 (6,6/8,8,6,8)				
		13.40	D					
		13.50-14.00	B					
		13.50	SPT	N=19 (3,3/3,4,6,6)				
		14.90	D					
		15.00	SPT	N=23 (4,3/5,5,6,7)	15.00	195.93		End of Borehole at 15.00m

11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0

Remarks: Borehole complete at 15.0m bgl. Groundwater not encountered. No visual or olfactory evidence of contamination noted in arisings. Borehole fitted with monitoring installation upon completion.

B = Bulk Sample
D = Disturbed Sample
U = Undisturbed Sample
UT = Undisturbed Sample (Thin Wall)
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
SPT = Standard Penetration Test
AB = Asbestos Bulk Sample

Groundwater:

Logged: GDC **Checked:** WL

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Cable Percussion

Borehole No. BH603 Sheet 1 of 2

Project Name:	Fort Halstead	**Co-ords:**	549299E, 159162N
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Ground Level:** 215.11m OD
Client:	Merseyside Pension Fund	**Date(s):**	21/11/18 - 22/11/18
Hole Type:	CP	**Scale:**	1:50
Hole Diameter:			

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m OD)	Legend	Stratum Description
		0.00-0.30	B					Dark brown slightly sandy slightly gravelly SILT/CLAY with occasional cobbles of flint. Gravel is subangular and subrounded fine to coarse of flint with occasional brick and rare metal fragments. (MADE GROUND)
		0.10	ES					
		0.40	D					
		0.70	ES					
		0.90	D		0.90	214.21		*becoming orangish brown from 0.45m bgl*
		1.00-1.40	B					*occasional boulders of flint from 0.6m bgl*
		1.40	ES					Stiff orangish brown slightly gravelly sandy SILT/CLAY with rare cobbles of flint. Gravel is subangular to subrounded fine to coarse of flint. (CLAY WITH FLINTS FORMATION)
		1.50	D					
		1.50-2.00	B					
		1.50	SPT	N=15 (3,2/3,3,4,5)				*locally red and light grey from 1.8m bgl*
		2.00	ES					*becoming firm to stiff with no gravel from 2.0m bgl*
		2.40	D					
		2.50-3.00	B					
		2.50	SPT	N=14 (2,2/4,2,4,4)	2.70	212.41		Interbedded light orangish brown locally light grey and yellow very silty/clayey fine to coarse SAND and firm sandy SILT/CLAY. (CLAY WITH FLINTS FORMATION)
		3.40	D					
		3.50-4.00	B					
		3.50	SPT	N=24 (3,2/5,5,6,8)				
		4.40	D					
		4.50-5.00	B					
		5.00	B					
		5.90	D					
		6.00-6.50	B					
		6.00	SPT	N=29 (3,3/6,7,7,9)				*sands increasing in density from 6.0m bgl with frequent orange and red laminations*
		7.00	D		7.00	208.11		Brown light grey sandy silty/clayey angular and subangular fine to coarse GRAVEL of flint and occasional chalk with frequent cobbles of flint. (CLAY WITH FLINTS FORMATION)
		7.10-7.60	B					
		7.10	SPT	N=31 (9,9/13,5,6,7)				
					7.60	207.51		*recovered as sandy angular and subangular fine to coarse GRAVEL & COBBLES of flint from between 7.3 - 7.6m bgl*
		7.90	D					Weak low to medium density white with occasional orange staining CHALK. Fractures possibly very closely/ extremely closely spaced (10/20/50) infilled with white comminuted chalk. (CIRIA GRADE C4). Frequently recovered as structureless CHALK composed of slightly sandy silty GRAVEL and COBBLES. Clasts are weak medium density white. Matrix is cream and white. (CIRIA GRADE Dc.) (LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMARTION, NEWHAVEN CHALK FORMATION -
		8.00-8.50	B					
		8.00	SPT	N=33 (5,5/10,7,7,9)				
		9.40	D					
		9.50-10.00	B					
		9.50	SPT	N=18 (3,3/5,4,4,5)				

1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0

Remarks: Borehole complete at 15.0m bgl. Groundwater not encountered. No visual or olfactory evidence of contamination noted in arisings. Borehole fitted with monitoring installation upon completion.

B = Bulk Sample
D = Disturbed Sample
U = Undisturbed Sample
UT = Undisturbed Sample (Thin Wall)
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
SPT = Standard Penetration Test
AB = Asbestos Bulk Sample

Groundwater:

Logged: GDC **Checked:** WL

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Cable Percussion

Borehole No. BH603 Sheet 2 of 2

Project Name:	Fort Halstead		**Co-ords:**	549299E, 159162N	**Hole Type:** CP
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Ground Level:**	215.11m OD	**Scale:** 1:50
Client:	Merseyside Pension Fund		**Date(s):**	21/11/18 - 22/11/18	**Hole Diameter:**

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m OD)	Legend	Stratum Description
		Depth (m)	Type	Results				
		10.90 11.00	D SPT	N=15 (3,2/3,3,4,5)				Weak low to medium density white with occasional orange staining CHALK. Fractures possibly very closely/ extremely closely spaced (10/20/50) infilled with white comminuted chalk. (CIRIA GRADE C4). Frequently recovered as structureless CHALK composed of slightly sandy silty GRAVEL and COBBLES. Clasts are weak medium density white. Matrix is cream and white. (CIRIA GRADE Dc.) (LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMARTION, NEWHAVEN CHALK FORMATION - UNDIFFERENTIATED)
								clasts becoming medium strong medium to high density from 11.0m bgl.
		12.40 12.50-13.00 12.50	D B SPT	N=26 (5,5/7,7,6,6)				
		13.40 13.50	D SPT	N=27 (3,3/7,7,7,6)				
								Chalk becoming high density/very high density from 14.0m bgl with occasional flints. Possibly no discontinuities and no infill. Inferred GRADE A 1/2?
		14.40 14.50-15.00 14.50	D B SPT	N≥50 (10,10/17,12,12,9)				
					15.00	200.11		End of Borehole at 15.00m

11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0

Remarks: Borehole complete at 15.0m bgl. Groundwater not encountered. No visual or olfactory evidence of contamination noted in arisings. Borehole fitted with monitoring installation upon completion.

B = Bulk Sample
D = Disturbed Sample
U = Undisturbed Sample
UT = Undisturbed Sample (Thin Wall)
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
SPT = Standard Penetration Test
AB = Asbestos Bulk Sample

Groundwater:

Logged: GDC **Checked:** WL

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Cable Percussion

Borehole No. BH604 Sheet 1 of 2

Project Name:	Fort Halstead	**Co-ords:**	549549E, 159338N
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Ground Level:** 205.85m OD
Client:	Merseyside Pension Fund	**Date(s):**	22/11/18 - 23/11/18

Hole Type: CP
Scale: 1:50
Hole Diameter:

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m OD)	Legend	Stratum Description
		0.00-0.30	B		0.05	205.80		Dark brown slightly gravelly slightly sandy SILT/CLAY. Gravel is subangular fine to coarse of rare flint. (MADE GROUND)
		0.20	ES					
		0.40	D		0.45	205.40		
		0.50-1.00	B					
		0.55	ES		0.65	205.20		Brown slightly gravelly sandy SILT/CLAY. Gravel is subangular and subrounded fine to coarse of flint and occasional concrete with rare cobbles of concrete. (MADE GROUND)
		0.90	ES					
		1.10	D					
		1.10-1.30	B					
		1.40	D					White and brown slightly sandy silty/clayey subangular and subrounded fine to coarse GRAVEL of chalk and flint. (MADE GROUND)
		1.50-2.00	B					
		2.00	ES					
		2.10	D		2.10	203.75		Brown locally orange brown slightly sandy silty/clayey subangular and subrounded fine to coarse gravel of flint, chalk and polystyrene fragments. (MADE GROUND)
		2.20-2.70	B					*becoming dark red/orangish brown from 1.0m bgl*
		2.20	SPT	N=13 (3,2/3,3,3,4)				
		2.40	ES					Firm locally stiff reddish brown locally orange brown slightly gravelly sandy SILT/CLAY. Gravel is rare subangular fine to coarse of flint. (CLAY WITH FLINTS FORMATION)
		2.90	D					*locally red and light grey from 3.0m bgl*
		3.00-3.50	B					*becoming stiff from 3.2m bgl*
		3.00	SPT	N=17 (2,2/3,4,5,5)				
		3.90	D					
		4.00-4.50	B					
		4.00	SPT	N=18 (3,2/4,4,5,5)				
		5.40	D					
		5.50-6.00	B					
		5.50	SPT	N=17 (3,3/4,4,4,5)				
		6.90	D					
		7.00-7.50	B					
		7.00	SPT	N=25 (3,2/4,6,7,8)				
		8.00	D		7.80	198.05		Dark grey orangish brown sandy very silty/clayey subangular to rounded fine to coarse GRAVEL of flint and occasional chalk with frequent cobbles of flint. (CLAY WITH FLINTS FORMATION)
		8.10-8.60	B					
		8.10	SPT	N=42 (6,6/9,9,12,12)				
		9.40	D					
		9.50-10.00	B					
		9.50	SPT	N=25 (5,5/5,5,6,9)				

Remarks: Borehole complete at 15.50m bgl. Groundwater not encountered. No visual or olfactory evidence of contamination noted in arisings. Borehole fitted with monitoring installation upon completion.

B = Bulk Sample
D = Disturbed Sample
U = Undisturbed Sample
UT = Undisturbed Sample (Thin Wall)
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
SPT = Standard Penetration Test
AB = Asbestos Bulk Sample

Groundwater:

Logged: GDC **Checked:** WL

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Cable Percussion

Borehole No. BH604 Sheet 2 of 2

Project Name:	Fort Halstead		**Co-ords:**	549549E, 159338N	**Hole Type:** CP
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Ground Level:**	205.85m OD	**Scale:** 1:50
Client:	Merseyside Pension Fund		**Date(s):**	22/11/18 - 23/11/18	**Hole Diameter:**

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m OD)	Legend	Stratum Description
		Depth (m)	Type	Results				
		10.90	D					Dark grey orangish brown sandy very silty/clayey subangular to rounded fine to coarse GRAVEL of flint and occasional chalk with frequent cobbles of flint. (CLAY WITH FLINTS FORMATION)
		11.00	B					
		11.00	SPT	N=32 (6,6/6,7,8,11)				
		12.40	D		12.40	193.45		
		12.50	SPT	N=6 (1,2/1,1,2,2)				Structureless CHALK composed of slightly sandy slightly silty subangular to rounded GRAVEL & COBBLES. Clasts are weak medium density. Matrix is cream and white with occasional flints. (CIRIA GRADE Dc). Fractures possibly very closely spaced to extremely closely spaced (10/30/50) infilled with white and cream comminuted chalk. (CIRIA GRADE C4). (LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMARTION, NEWHAVEN CHALK FORMATION - UNDIFFERENTIATED)
		13.00-13.50	B					
		13.90	D					
		14.00-14.50	B					
		14.00	SPT	N=13 (2,2/3,3,3,4)				
		15.40	D					
		15.50	SPT	N=21 (5,5/5,5,5,6)	15.50	190.35		End of Borehole at 15.50m

11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0

Remarks: Borehole complete at 15.50m bgl. Groundwater not encountered. No visual or olfactory evidence of contamination noted in arisings. Borehole fitted with monitoring installation upon completion.

B = Bulk Sample
D = Disturbed Sample
U = Undisturbed Sample
UT = Undisturbed Sample (Thin Wall)
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
SPT = Standard Penetration Test
AB = Asbestos Bulk Sample

Groundwater:

Logged: GDC **Checked:** WL

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Cable Percussion

Borehole No. BH605 Sheet 1 of 2

Project Name:	Fort Halstead	**Co-ords:**	549750E, 159599N
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Ground Level:** 195.08m OD
Client:	Merseyside Pension Fund	**Date(s):**	23/11/18 - 26/11/18
Hole Type:	CP	**Scale:**	1:50
Hole Diameter:			

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m OD)	Legend	Stratum Description
		0.00-0.20	B					Dark brown locally orange slightly sandy slightly gravelly SILT/CLAY with occasional cobbles of flint and brick. Gravel is subangular to subrounded fine to coarse of flint with occasional brick and concrete. (MADE GROUND)
		0.20	ES		0.20	194.88		
		0.30	D					
		0.30-0.60	B					
		0.60	ES					
		0.70	D		0.70	194.38		
		0.70-1.40	B					Orangish brown locally grey red and black slightly gravelly sandy SILT/CLAY. Gravel is subangular and subrounded fine to coarse of flint, brick and concrete with frequent cobbles of flint and brick. (MADE GROUND)
		1.00	ES					
		1.50	D					Firm orangish brown locally red yellow and grey slightly gravelly sandy SILT/CLAY. Gravel is angular and subrounded fine to coarse of flint with frequent cobbles and occasional boulders of flint. (CLAY WITH FLINTS FORMATION)
		1.50-2.00	B					
		1.50	SPT	N=10 (1,2/2,2,3,3)				
		2.40	D					*becoming stiff and orangish brown red and locally gravelly from 1.3m bgl*
		2.50-3.00	B					
		2.50	SPT	N=13 (3,2/3,2,4,4)				
		3.40	D					
		3.50-4.00	B					
		3.50	SPT	N=23 (3,3/6,6,6,5)				
		4.40	D					
		4.50-5.00	B					
		4.50	SPT	N=31 (3,2/7,8,8,8)				
		5.90	D					*becoming gravelly with frequent cobbles of flint from 6.0m bgl*
		6.00-6.50	B					
		6.00	SPT	N=42 (6,6/8,10,10,14)				
		7.40	D		7.40	187.68		Structureless CHALK composed of slightly sandy silty subangular to rounded GRAVEL and COBBLES. Clasts are weak medium density white frequently stained orange. Matrix is cream. (CIRIA GRADE Dc). Occasionally recovered as weak medium density white frequently stained orange CHALK. Fractures possibly very closely spaced (10/30/60) infilled with cream comminuted chalk. (CIRIA GRADE C4). (LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMARTION, NEWHAVEN CHALK FORMATION - UNDIFFERENTIATED)
		7.50-8.00	B					
		7.50	SPT	N=36 (11,10/12,14,7,3)				
		8.90	D					
		9.00-9.50	B					
		9.00	SPT	N=29 (3,2/6,6,6,11)				

1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0

Remarks: Borehole complete at 15.0m bgl. Groundwater not encountered. No visual or olfactory evidence of contamination noted in arisings. Borehole fitted with monitoring installation upon completion.

B = Bulk Sample
D = Disturbed Sample
U = Undisturbed Sample
UT = Undisturbed Sample (Thin Wall)
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
SPT = Standard Penetration Test
AB = Asbestos Bulk Sample

Groundwater:

Logged: GDC **Checked:** WL

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Cable Percussion

Borehole No. BH605 Sheet 2 of 2

Project Name:	Fort Halstead		**Co-ords:**	549750E, 159599N	**Hole Type:** CP
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Ground Level:**	195.08m OD	**Scale:** 1:50
Client:	Merseyside Pension Fund		**Date(s):**	23/11/18 - 26/11/18	**Hole Diameter:**

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m OD)	Legend	Stratum Description
		Depth (m)	Type	Results				
		10.40 10.50	D SPT	N=37 (1,2/9,9,9,10)				Structureless CHALK composed of slightly sandy silty subangular to rounded GRAVEL and COBBLES. Clasts are weak medium density white frequently stained orange. Matrix is cream. (CIRIA GRADE Dc). Occasionally recovered as weak medium density white frequently stained orange CHALK. Fractures possibly very closely spaced (10/30/60) infilled with cream comminuted chalk. (CIRIA GRADE C4). (LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMARTION, NEWHAVEN CHALK FORMATION - UNDIFFERENTIATED)
		11.90 12.00-12.50 12.00	D B SPT	N=36 (3,2/8,7,9,12)				
		13.40 13.50	D SPT	N=34 (3,4/7,8,8,11)				
		14.40 14.50-15.00 14.50	D B SPT	N=41 (6,6/20,7,3,11)				
					15.00	180.08		End of Borehole at 15.00m

11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0

Remarks: Borehole complete at 15.0m bgl. Groundwater not encountered. No visual or olfactory evidence of contamination noted in arisings. Borehole fitted with monitoring installation upon completion.

B = Bulk Sample
D = Disturbed Sample
U = Undisturbed Sample
UT = Undisturbed Sample (Thin Wall)
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
SPT = Standard Penetration Test
AB = Asbestos Bulk Sample

Groundwater:

Logged: GDC **Checked:** WL

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Cable Percussion

Borehole No. BH606

Sheet 1 of 2

Project Name:	Fort Halstead	**Co-ords:**	550118E, 159567N
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Ground Level:** 197.31m OD
Client:	Merseyside Pension Fund	**Date(s):**	26/11/18 - 27/11/18

Hole Type: CP

Scale: 1:50

Hole Diameter:

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m OD)	Legend	Stratum Description
		0.00-0.20	B					Dark brown slightly sandy slightly gravelly SILT/CLAY. Gravel is subangular and subrounded fine to coarse of flint concrete and brick with occasional cobbles of flint. (MADE GROUND)
		0.10	ES					
		0.25	D					
		0.30-0.80	B					
		0.50	ES					
		0.90	D		0.90	196.41		Orangish brown slightly sandy silty/clayey subangular and subrounded fine to coarse GRAVEL of flint with frequent cobbles of flint. (CLAY WITH FLINTS FORMATION)
		0.90-1.40	B					
		1.10	ES					
					1.40	195.91		*recovered as cobbles of flint from 1.0 - 1.0m bgl*
		1.50	D					Stiff orangish brown slightly sandy slightly gravelly locally gravelly SILT/CLAY. Gravel is subangular and subrounded fine to coarse of flint with occasional cobbles of flint. (CLAY WITH FLINTS FORMATION)
		1.50-2.00	B					
		1.50	SPT	N=26 (3,2/5,6,7,8)				
		2.40	D					
		2.50-3.00	B		2.50	194.81		Orangish brown sandy very silty/clayey subangular and subrounded fine to coarse GRAVEL of flint with frequent cobbles of flint. (CLAY WITH FLINTS FORMATION)
		2.50	SPT	N=38 (4,4/7,9,11,11)	2.80	194.51		
		3.40	D					Stiff dark brown red mottled black slightly sandy slightly gravelly locally gravelly SILT/CLAY. Gravel is angular to subrounded fine to coarse of flint with frequent cobbles of flint. (CLAY WITH FLINTS FORMATION)
		3.40-4.00	B					
		3.50	SPT	N=26 (2,3/4,6,7,9)				
		4.40	D					
		4.50-5.00	B					
		4.50	SPT	N=25 (5,5/5,7,5,8)				
		5.90	D					
		6.00-6.50	B					
		6.00	SPT	N=12 (2,1/3,3,3,3)				
		7.00	D		7.00	190.31		Structureless CHALK composed of slightly sandy silty subangular to rounded fine to coarse GRAVEL and COBBLES. Clasts are weak medium density white frequently stained orange and brown. Matrix is cream. (CIRIA GRADE Dc). Frequently recovered as weak medium density white frequently stained orange CHALK. Fractures possibly extremely closely and closely spaced (10/30/80) infilled with cream comminuted chalk. (CIRIA GRADE C4). (LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMARTION, NEWHAVEN CHALK FORMATION - UNDIFFERENTIATED)
		7.10-7.60	B					
		7.10	SPT	N=3 (0,1/1,0,1,1)				
		8.40	D					
		8.50	SPT	N=7 (1,2/3,2,1,1)				
		9.90	D					
		10.00-10.50	B					

1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0

Remarks: Borehole complete at 15.0m bgl. Groundwater not encountered. No visual or olfactory evidence of contamination noted in arisings. Borehole fitted with monitoring installation upon completion.

B = Bulk Sample
D = Disturbed Sample
U = Undisturbed Sample
UT = Undisturbed Sample (Thin Wall)
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
SPT = Standard Penetration Test
AB = Asbestos Bulk Sample

Groundwater:

Logged: GDC **Checked:** WL

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Cable Percussion

Borehole No. BH606 Sheet 2 of 2

Project Name:	Fort Halstead		**Co-ords:**	550118E, 159567N	**Hole Type:** CP
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Ground Level:**	197.31m OD	**Scale:** 1:50
Client:	Merseyside Pension Fund		**Date(s):**	26/11/18 - 27/11/18	**Hole Diameter:**

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m OD)	Legend	Stratum Description
		Depth (m)	Type	Results				
		10.00	SPT	N=16 (3,3/3,5,4,4)				Structureless CHALK composed of slightly sandy silty subangular to rounded fine to coarse GRAVEL and COBBLES. Clasts are weak medium density white frequently stained orange and brown. Matrix is cream. (CIRIA GRADE Dc). Frequently recovered as weak medium density white frequently stained orange CHALK. Fractures possibly extremely closely and closely spaced (10/30/80) infilled with cream comminuted chalk. (CIRIA GRADE C4). (LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMARTION, NEWHAVEN CHALK FORMATION - UNDIFFERENTIATED)
		11.40	D					
		11.50	SPT	N=23 (2,2/3,8,5,7)				
		12.90	D					
		13.00-13.50	B					
		13.00	SPT	N=29 (3,3/8,7,7,7)				
		14.40	D					
		14.50-15.00	B					
		14.50	SPT	N=28 (4,5/3,7,8,10)				
					15.00	182.31		End of Borehole at 15.00m

11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0

Remarks: Borehole complete at 15.0m bgl. Groundwater not encountered. No visual or olfactory evidence of contamination noted in arisings. Borehole fitted with monitoring installation upon completion.

B = Bulk Sample
D = Disturbed Sample
U = Undisturbed Sample
UT = Undisturbed Sample (Thin Wall)
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
SPT = Standard Penetration Test
AB = Asbestos Bulk Sample

Groundwater:

Logged: GDC **Checked:** WL

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Window Sampler

Borehole No. WS601 Sheet 1 of 1

Project Name:	Fort Halstead		**Co-ords:**	549739E, 159097N	**Hole Type:** WS
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Ground Level:**	216.68m OD	**Scale:** 1:25
Client:	Merseyside Pension Fund		**Date(s):**	21/11/18	**Hole Diameter:**

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m OD)	Legend	Stratum Description
					0.30	216.38		Grass over soft brown sandy gravely CLAY. Gravel of fine to coarse angular to sub-rounded brick and flint with some rootlets. (MADE GROUND)
					0.80	215.88		Soft to firm brown slightly sandy gravelly CLAY. Gravel fine to coarse angular sub-rounded flint and chalk, With some rootlets. (CLAY WITH FLINTS)
					1.85	214.83		Soft brown mottled red brown slightly sandy gravelly CLAY occasionally friable. Gravel of fine to coarse angular sub-rounded flint occasional dark brown mottling. (CLAY WITH FLINTS)
					2.00	214.68		Structureless CHALK composed of silty sandy gravel and cobbles. Clasts are weak to medium density with occasional black speckles. Matrix is white mottled orange brown and brown, with occasional rootlets (CIRIA GRADE D). (LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMARTION, NEWHAVEN CHALK FORMATION - UNDIFFERENTIATED)
					2.60	214.08		Structureless CHALK composed of gravelly sandy SILT. Clasts are very weak, white with some yellow staining. Matrix is white mottled grey (CIRIA GRADE D). (LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMARTION, NEWHAVEN CHALK FORMATION - UNDIFFERENTIATED)
								Moderately weak to medium density, white stained orange CHALK. 5cm fractures (CIRIA GRADE C5). (LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMARTION, NEWHAVEN CHALK FORMATION - UNDIFFERENTIATED)
								CHALK getting less orange brown stained from 3.5m. Drilling affected at 4-5m.
					5.00	211.68		End of Borehole at 5.00m

1.0 2.0 3.0 4.0 5.0

Remarks: No visual or olfactory evidence of contamination.

B = Bulk Sample
D = Disturbed Sample
U = Undisturbed Sample
UT = Undisturbed Sample (Thin Wall)
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
SPT = Standard Penetration Test
AB = Asbestos Bulk Sample

Groundwater: Not encountered

Logged: AL **Checked:** WL

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Window Sampler

Borehole No. WS602 Sheet 1 of 1

Project Name:	Fort Halstead		**Co-ords:**	549703E, 159129N	**Hole Type:** WS
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Ground Level:**	216.60m OD	**Scale:** 1:25
Client:	Merseyside Pension Fund		**Date(s):**	21/11/18	**Hole Diameter:**

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m OD)	Legend	Stratum Description
					0.30	216.30		Grass over soft brown sandy gravelly CLAY with frequent roots and rootlets. Gravel fine to coarse angular to sub-rounded flint and brick. (MADE GROUND)
					1.10	215.50		Firm brown mottled orange brown sandy gravelly CLAY. Gravel fine to coarse angular to sub-rounded flint. Some roots and rootlets to 0.5m. (CLAY WITH FLINTS)
					1.50	215.10		Firm brown mottled orange brown gravelly CLAY. Gravel fine to coarse sub-rounded flint with chalk. (CLAY WITH FLINTS)
					2.65	213.95		Structureless CHALK composed of silty sandy gravel and cobbles. Clasts are weak to medium density with occasional black speckles. Matrix is white mottled orange brown and brown with occasional rootlets (CIRIA GRADE D). (LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMARTION, NEWHAVEN CHALK FORMATION - UNDIFFERENTIATED)
					3.50	213.10		Moderately weak to medium density, white stained orange CHALK. 5cm fractures (CIRIA GRADE C5). (LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMARTION, NEWHAVEN CHALK FORMATION - UNDIFFERENTIATED)
					4.20	212.40		Structureless CHALK composed of silty gravel of chalk. Clasts are white very weak low density and matrix is orange brown/light orange with some flint cobbles (CIRIA GRADE D). (LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMARTION, NEWHAVEN CHALK FORMATION - UNDIFFERENTIATED)
					5.00	211.60		White weak medium density CHALK with occasional light orange staining. Fractures <5cm infilled with white silt chalk (CIRIA GRADE C5). (LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMARTION, NEWHAVEN CHALK FORMATION - UNDIFFERENTIATED)
								End of Borehole at 5.00m

1.0 2.0 3.0 4.0 5.0

Remarks: No visual or olfactory evidence of contamination.

B = Bulk Sample
D = Disturbed Sample
U = Undisturbed Sample
UT = Undisturbed Sample (Thin Wall)
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
SPT = Standard Penetration Test
AB = Asbestos Bulk Sample

Groundwater: Not encountered

Logged: RP **Checked:** WL

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Window Sampler

Borehole No. WS603 Sheet 1 of 2

Project Name:	Fort Halstead		**Co-ords:**	549633E, 159188N	**Hole Type:** WS
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Ground Level:**	214.10m OD	**Scale:** 1:25
Client:	Merseyside Pension Fund		**Date(s):**	22/11/18	**Hole Diameter:**

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m OD)	Legend	Stratum Description
					0.10	214.00		Soft black slightly organic CLAY. (MADE GROUND)
								Dark brown clayey slightly sandy fine angular GRAVEL of flint and brick (MADE GROUND)
					0.90	213.20		Soft to firm red brown mottled orange brown gravelly CLAY. Gravel of fine to coarse angular flint. (CLAY WITH FLINTS)
					1.30	212.80		Light grey with occasional brown patches of clayey fine to coarse angular GRAVEL of flint. (CLAY WITH FLINTS)
					2.30	211.80		Firm dark red brown gravelly CLAY. Gravel of fine to coarse angular flint. (CLAY WITH FLINTS)
					3.00	211.10		Low density white putty chalk with some chalk clasts and occasional flints (CIRIA GRADE DC). (LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMARTION, NEWHAVEN CHALK FORMATION - UNDIFFERENTIATED)
					4.60	209.50		Medium density white structureless chalk 10mm, discontinuity spacing with 5mm aperture (CIRIA GRADE C5). (LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMARTION, NEWHAVEN CHALK FORMATION -
					5.00	209.10		

1.0 2.0 3.0 4.0 5.0

Remarks: No visual or olfactory evidence of contamination. Terminated at 5m.

B = Bulk Sample
D = Disturbed Sample
U = Undisturbed Sample
UT = Undisturbed Sample (Thin Wall)
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
SPT = Standard Penetration Test
AB = Asbestos Bulk Sample

Groundwater: Not encountered

Logged: AL **Checked:** WL

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Window Sampler

Borehole No. WS603 Sheet 2 of 2

Project Name:	Fort Halstead		**Co-ords:**	549633E, 159188N	**Hole Type:** WS
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Ground Level:**	214.10m OD	**Scale:** 1:25
Client:	Merseyside Pension Fund		**Date(s):**	22/11/18	**Hole Diameter:**

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m OD)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Medium density white structureless chalk 10mm, discontinuity spacing with 5mm aperture (CIRIA GRADE C5). (LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMARTION, NEWHAVEN CHALK FORMATION - UNDIFFERENTIATED)
								End of Borehole at 5.00m

6.0
7.0
8.0
9.0
10.0

Remarks: No visual or olfactory evidence of contamination. Terminated at 5m.

B = Bulk Sample
D = Disturbed Sample
U = Undisturbed Sample
UT = Undisturbed Sample (Thin Wall)
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
SPT = Standard Penetration Test
AB = Asbestos Bulk Sample

Groundwater: Not encountered

Logged: AL **Checked:** WL

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Window Sampler

Borehole No. WS604 Sheet 1 of 1

Project Name:	Fort Halstead		**Co-ords:**	549793E, 159214N	**Hole Type:** WS
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Ground Level:**	213.02m OD	**Scale:** 1:25
Client:	Merseyside Pension Fund		**Date(s):**	23/11/18	**Hole Diameter:**

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m OD)	Legend	Stratum Description
					0.35	212.67		Soft dark brown slightly gravelly slightly organic CLAY. Gravel of fine sub-rounded to sub-angular flint. (MADE GROUND)
					2.00	211.02		Soft to firm red brown mottled dark brown gravelly CLAY. Gravel of fine to coarse angular flint. (CLAY WITH FLINTS)
					3.90	209.12		Light grey clayey fine to coarse angular GRAVEL of flint. (CLAY WITH FLINTS)
					5.00	208.02		Low density white structureless chalk (CIRIA GRADE Dc). (LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMARTION, NEWHAVEN CHALK FORMATION - UNDIFFERENTIATED) *Flint band between 4.80-4.90m* End of Borehole at 5.00m

1.0 2.0 3.0 4.0 5.0

Remarks: No visual or olfactory evidence of contamination.

B = Bulk Sample
D = Disturbed Sample
U = Undisturbed Sample
UT = Undisturbed Sample (Thin Wall)
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
SPT = Standard Penetration Test
AB = Asbestos Bulk Sample

Groundwater: Not encountered

Logged: AL **Checked:** WL

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Window Sampler

Borehole No. WS605 Sheet 1 of 1

Project Name:	Fort Halstead		**Co-ords:**	549248E, 159105N	**Hole Type:** WS
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Ground Level:**	217.49m OD	**Scale:** 1:25
Client:	Merseyside Pension Fund		**Date(s):**	22/11/18	**Hole Diameter:**

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m OD)	Legend	Stratum Description
		0.20	ES		0.20	217.29		Soft black slightly organic CLAY. (MADE GROUND)
					0.60	216.89		Soft dark brown gravelly CLAY. Gravel of fine to coarse angular flint. (MADE GROUND)
		0.70 0.70	B ES					Soft to firm red brown mottled dark brown gravelly CLAY. Gravel of fine to coarse angular flint. (CLAY WITH FLINTS)
		1.50-1.70	B		1.50	215.99		Very dense light grey clayey medium to coarse angular GRAVEL with flint. (CLAY WITH FLINTS)
					1.70	215.79		End of Borehole at 1.70m

1.0 2.0 3.0 4.0 5.0

Remarks: No visual or olfactory evidence of contamination. Refused at 1.70m on a band of GRAVEL.

B = Bulk Sample
D = Disturbed Sample
U = Undisturbed Sample
UT = Undisturbed Sample (Thin Wall)
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
SPT = Standard Penetration Test
AB = Asbestos Bulk Sample

Groundwater: Not encountered

Logged: AL **Checked:** WL

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Window Sampler

Borehole No. WS606 Sheet 1 of 1

Project Name: Fort Halstead		**Co-ords:** 549411E, 158977N	**Hole Type:** WS
Location: Fort Halstead, Kent	**Project No:** C-10730-C	**Ground Level:** 223.55m OD	**Scale:** 1:25
Client: Merseyside Pension Fund		**Date(s):** 22/11/18	**Hole Diameter:**

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m OD)	Legend	Stratum Description
		0.30	ES		0.40	223.15		Soft dark brown black sandy gravelly CLAY. Gravel with fine to angular flint (CLAY WITH FLINTS)
		0.70	ES					Soft to firm red brown mottled orange brown gravelly CLAY. Gravel of fine to coarse angular flint. (CLAY WITH FLINTS)
		1.00	B					
		1.50-2.00	B		1.40	222.15		Light grey clayey fine to coarse angular GRAVEL with flint. (CLAY WITH FLINTS)
					4.00	219.55		End of Borehole at 4.00m

1.0 2.0 3.0 4.0 5.0

Remarks: No visual or olfactory evidence of contamination. Unable to progress past 4.0m due to having to reduce sample size to get though flint bands.

B = Bulk Sample
D = Disturbed Sample
U = Undisturbed Sample
UT = Undisturbed Sample (Thin Wall)
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
SPT = Standard Penetration Test
AB = Asbestos Bulk Sample

Groundwater: Not encountered

Logged: AL **Checked:** WL

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Window Sampler

Borehole No. WS607 Sheet 1 of 1

Project Name:	Fort Halstead		**Co-ords:**	549490E, 159246N	**Hole Type:** WS
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Ground Level:**	211.74m OD	**Scale:** 1:25
Client:	Merseyside Pension Fund		**Date(s):**	22/11/18	**Hole Diameter:**

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m OD)	Legend	Stratum Description
					0.15	211.59		Soft black organic CLAY (MADE GROUND)
		0.30 0.40	ES B					Brick fragments at 0.80m. Soft orange brown gravelly CLAY. Gravel of medium to coarse angular flint (MADE GROUND)
					1.30	210.44		No gravel from 1.70m. Firm red brown mottled orange brown slightly gravelly CLAY. Gravel of fine to medium angular flint. (CLAY WITH FLINTS)
					3.70	208.04		Firm yellow mottled orange brown slightly gravelly CLAY. Gravel with fine to coarse angular flint. (CLAY WITH FLINTS)
		4.00-5.00	B					
					5.00	206.74		End of Borehole at 5.00m

1.0 2.0 3.0 4.0 5.0

Remarks: No visual or olfactory evidence of contamination.

B = Bulk Sample
D = Disturbed Sample
U = Undisturbed Sample
UT = Undisturbed Sample (Thin Wall)
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
SPT = Standard Penetration Test
AB = Asbestos Bulk Sample

Groundwater: Not encountered

Logged: AL **Checked:** WL

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Window Sampler

Borehole No. WS608 Sheet 1 of 1

Project Name:	Fort Halstead		**Co-ords:**	549955E, 159299N	**Hole Type:** WS
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Ground Level:**	210.04m OD	**Scale:** 1:25
Client:	Merseyside Pension Fund		**Date(s):**	23/11/18	**Hole Diameter:**

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m OD)	Legend	Stratum Description
					0.05	209.99		Soft dark brown slightly organic CLAY. (CLAY WITH FLINTS)
								Soft to firm light brown gravelly CLAY. Gravel of fine to medium angular flint. (CLAY WITH FLINTS)
					0.35	209.69		Firm red brown gravelly CLAY. Gravel of fine to coarse angular flint. (CLAY WITH FLINTS)
					2.30	207.74		Low density white and brown structureless CHALK (CIRIA GRADE DC). (LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMARTION, NEWHAVEN CHALK FORMATION - UNDIFFERENTIATED)
					2.70	207.34		Low density white structured CHALK, 10-15 cm discontinuity 5mm aperture (CIRIA GRADE C5). (LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMARTION, NEWHAVEN CHALK FORMATION - UNDIFFERENTIATED)
								Layer of flint 3.25-3.50
					5.00	205.04		End of Borehole at 5.00m

1.0 2.0 3.0 4.0 5.0

Remarks: No visual or olfactory evidence of contamination.

B = Bulk Sample
D = Disturbed Sample
U = Undisturbed Sample
UT = Undisturbed Sample (Thin Wall)
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
SPT = Standard Penetration Test
AB = Asbestos Bulk Sample

Groundwater: Not encountered

Logged: AL **Checked:** WL

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Window Sampler

Borehole No. WS610 Sheet 1 of 1

Project Name:	Fort Halstead		**Co-ords:**	550273E, 159856N	**Hole Type:** WS
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Ground Level:**	180.50m OD	**Scale:** 1:25
Client:	Merseyside Pension Fund		**Date(s):**	23/11/18	**Hole Diameter:**

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m OD)	Legend	Stratum Description
		0.15	ES		0.25	180.25		Soft dark brown slightly gravelly CLAY. Gravel with fine to medium angular flint. (MADE GROUND)
					0.50	180.00		Yellow brown sandy fine to medium sub-rounded to sub-angular Gravel of flint. (MADE GROUND)
					0.70	179.80		Soft dark brown gravelly CLAY. Gravel of fine to coarse angular flint. (CLAY WITH FLINTS)
		0.80	ES					At 2.45-2.55m black staining. Firm orange brown gravelly CLAY. Gravel of fine to coarse angular flint. (CLAY WITH FLINTS)
		0.90	B					
		2.50	ES		2.55	177.95		Orange brown fine SAND. (CLAY WITH FLINTS)
					2.70	177.80		Firm orange brown sandy gravelly CLAY. Gravel with fine to coarse angular flint. (CLAY WITH FLINTS)
					3.00	177.50		Firm dark brown gravelly organic CLAY. Gravel with fine to coarse angular flint. (CLAY WITH FLINTS)
		3.50-4.00	B					
					5.00	175.50		End of Borehole at 5.00m

1.0 2.0 3.0 4.0 5.0

Remarks: No visual or olfactory evidence of contamination.

B = Bulk Sample
D = Disturbed Sample
U = Undisturbed Sample
UT = Undisturbed Sample (Thin Wall)
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
SPT = Standard Penetration Test
AB = Asbestos Bulk Sample

Groundwater: Not encountered

Logged: AL **Checked:** WL

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Trial Pit

Trial Pit No: TP601 Sheet 1 of 1

Project Name:	Fort Halstead		**Dimensions:**	0.60m x 2.50m	**Hole Type:** TP
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Co-ords:** 549637E, 158922N **Ground Level:** 212.46m OD		**Scale:** 1:25
Client:	Merseyside Pension Fund		**Date(s):**	26/11/18	**Plant Used:** JCB 3CX

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m OD)	Legend	Stratum Description
	Depth (m)	Type	Results				
	0.10	ES					Soft brown sandy gravelly CLAY with abundant roots and rootlets. Gravel with fine to coarse angular to sub-rounded flint, brick and glass. (CLAY WITH FLINTS)
				0.35	212.11		
	0.55	B					Soft orange brown friable sandy gravelly CLAY. Gravel with fine to coarse angular to sub-rounded flint with some roots, and rootlets and flint cobbles. (CLAY WITH FLINTS)
	0.80	B		0.75	211.71		Firm orange mottled yellow brown and orange brown sandy gravelly CLAY. Gravel with medium angular to sub-rounded flint cobbles with some roots and rootlets with occasional pockets of sandy CLAY. (CLAY WITH FLINTS) *High cobble content from 1.25m*
				1.85	210.61		Structureless CHALK composed of white sandy slightly gravelly SILT. Clasts are low density, white with black speckles. Matrix is white with orange veins. (LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMARTION, NEWHAVEN CHALK FORMATION - UNDIFFERENTIATED)
	2.20	B		2.10	210.36		
				2.50	209.96		Structureless CHALK composed of silty sandy GRAVEL with cobbles . Clasts are weak, low to medium density, white with black speckles. Matrix is beige with orange veins. (LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMARTION, NEWHAVEN CHALK FORMATION - UNDIFFERENTIATED)
							End of Trial Pit at 2.50m

1.0 2.0 3.0 4.0 5.0

Remarks: Backfilled with arisings. No visual or olfactory evidence of contamination. Backfilled with arisings. No visual or olfactory evidence of contamination.

Stability: Stable

Groundwater: Not encountered

B = Bulk Sample
D = Disturbed Sample
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
CBR = In Situ California Bearing Ratio (%)
HSV = Hand Shear Vane (kPa)
HP = Hand Penetrometer (kPa)
AB = Asbestos Bulk Sample

Logged: RP **Checked:** WL

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Trial Pit

Trial Pit No: TP602

Sheet 1 of 1

Project Name:	Fort Halstead		**Dimensions:**	0.60m x 2.50m	**Hole Type:** TP
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Co-ords:** **Ground Level:**	- -	**Scale:** 1:25
Client:	Merseyside Pension Fund		**Date(s):**	26/11/18	**Plant Used:** JCB 3CX

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m OD)	Legend	Stratum Description
	Depth (m)	Type	Results				
	0.20	ES		0.25			Grass over soft dark brown sandy gravelly CLAY, with frequent roots and rootlets. Gravel with fine to coarse angular to sub-rounded flint with occasional whole bricks. (CLAY WITH FLINTS)
				0.80			Soft brown mottled orange brown sandy gravelly CLAY. Gravel with fine to coarse angular to sub-rounded flint with occasional metal, metal reinforcements, and metal strips (reworked) (CLAY WITH FLINTS)
	1.20	B					Firm to soft red brown slightly sandy gravelly CLAY with cobbles. Gravel with fine to coarse angular to sub-rounded flint and flint cobbles, with some roots and rootlets. (CLAY WITH FLINTS)
	2.30	B					
				2.80			End of Trial Pit at 2.80m

1.0
2.0
3.0
4.0
5.0

Remarks:	Backfilled with arisings. No visual or olfactory evidence of contamination.
Stability:	Stable
Groundwater:	Not encountered

B = Bulk Sample
D = Disturbed Sample
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
CBR = In Situ California Bearing Ratio (%)
HSV = Hand Shear Vane (kPa)
HP = Hand Penetrometer (kPa)
AB = Asbestos Bulk Sample

Logged: RP **Checked:** WL

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Trial Pit

Trial Pit No: TP603

Sheet 1 of 1

Project Name:	Fort Halstead		**Dimensions:**	0.55m x 2.15m	**Hole Type:** TP
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Co-ords:** 549601E, 159183N **Ground Level:** 213.58m OD		**Scale:** 1:25
Client:	Merseyside Pension Fund		**Date(s):**	27/11/18	**Plant Used:** JCB 3CX

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m OD)	Legend	Stratum Description
	Depth (m)	Type	Results				
	0.10	ES					Soft dark brown slightly gravelly CLAY with abundant rootlets. Gravel with fine to medium angular flint. (MADE GROUND)
				0.25	213.33		
	0.40	ES					Soft white structureless CHALK with large clasts. (MADE GROUND)
	0.50	B					
				0.80	212.78		Light grey slightly clayey fine to coarse sub-angular GRAVEL with chalk and brock with occasional metal fragments. (MADE GROUND)
	1.20	ES					
	1.30	B					
				2.25	211.33		Soft orange brown slightly sandy gravelly CLAY. Gravel with medium to coarse angular brick, flint, and sandstone. (MADE GROUND)
	3.70	B					
				4.10	209.48		End of Trial Pit at 4.10m

1.0
2.0
3.0
4.0
5.0

Remarks: Terminated ta 4.10m due to limit of excavation reach. Spalling between 0.80 -2.00m. Backfilled with arisings. No visual or olfactory evidence of contamination.

Stability: Stable

Groundwater: Groundwater not encountered

B = Bulk Sample
D = Disturbed Sample
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
CBR = In Situ California Bearing Ratio (%)
HSV = Hand Shear Vane (kPa)
HP = Hand Penetrometer (kPa)
AB = Asbestos Bulk Sample

Logged: AL **Checked:** WL

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Trial Pit

Trial Pit No: TP605

Sheet 1 of 1

Project Name:	Fort Halstead		**Dimensions:**	0.60m x 2.50m	**Hole Type:** TP
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Co-ords:**	549834E, 159319N	**Scale:** 1:25
			Ground Level:	210.05m OD	
Client:	Merseyside Pension Fund		**Date(s):**	26/11/18	**Plant Used:** JCB 3CX

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m OD)	Legend	Stratum Description
	Depth (m)	Type	Results				
				0.30	209.75		Soft dark brown sandy slightly gravelly CLAY. Gravel with fine to coarse angular to sub-rounded flint and chalk. (CLAY WITH FLINTS)
	1.00	B					Soft to firm orange brown mottled slightly sandy gravelly friable CLAY. Gravel with fine to coarse angular to sub-rounded flint with occasional flint cobbles. (CLAY WITH FLINTS) *At 1m pocket in centre of pit. Black gravelly SAND of ash. Gravel with fine to coarse angular clinker, concrete, slag, asbestos sheeting (5*2cm, 1*6cm, 2*2cm), concrete cobbles and metal pipes.*
				1.40	208.65		
	1.50	B					Firm, red orange mottled orange brown and beige very sandy CLAY. (CLAY WITH FLINTS)
				1.80	208.25		
	1.90	B					Soft light orange brown mottled beige very sandy CLAY. (CLAY WITH FLINTS)
				2.00	208.05		End of Trial Pit at 2.00m

1.0
2.0
3.0
4.0
5.0

Remarks: Service at 1.0m. Backfilled with arisings. No visual or olfactory evidence of contamination.

Stability: Stable

Groundwater: Not encountered

B = Bulk Sample
D = Disturbed Sample
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
CBR = In Situ California Bearing Ratio (%)
HSV = Hand Shear Vane (kPa)
HP = Hand Penetrometer (kPa)
AB = Asbestos Bulk Sample

Logged: RP **Checked:** WL

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Trial Pit

Trial Pit No: TP606

Sheet 1 of 1

Project Name:	Fort Halstead		**Dimensions:**	0.60m x 2.50m	**Hole Type:** TP
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Co-ords:**	549827E, 158907N	**Scale:** 1:25
			Ground Level:	200.08m OD	
Client:	Merseyside Pension Fund		**Date(s):**	29/11/18	**Plant Used:** JCB 3CX

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m OD)	Legend	Stratum Description
	Depth (m)	Type	Results				
	0.10	ES					Soft dark brown slightly sandy CLAY with abundant roots. (CLAY WITH FLINTS)
				0.35	199.73		
	0.60	ES					Medium density white locally yellow structureless chalk (CIRIA GRADE DC). (LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMARTION, NEWHAVEN CHALK FORMATION - UNDIFFERENTIATED)
				0.70	199.38		
	1.00	B					High density white structured CHALK, with wide aperture narrow discontinuity (assumed CIRIA GRADE C5). (LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMARTION, NEWHAVEN CHALK FORMATION - UNDIFFERENTIATED)
				1.70	198.38		End of Trial Pit at 1.70m

1.0 2.0 3.0 4.0 5.0

Remarks: Terminated at 1.70m due density being too high for excavation. Backfilled with arisings. No visual or olfactory evidence of contamination.

Stability: Stable

Groundwater: Not encountered

B = Bulk Sample
D = Disturbed Sample
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
CBR = In Situ California Bearing Ratio (%)
HSV = Hand Shear Vane (kPa)
HP = Hand Penetrometer (kPa)
AB = Asbestos Bulk Sample

Logged: AL **Checked:** WL

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Trial Pit

Trial Pit No: TP607

Sheet 1 of 1

Project Name:	Fort Halstead		**Dimensions:**	0.60m x 2.50m	**Hole Type:** TP
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Co-ords:**	549180E, 159094N	**Scale:** 1:25
			Ground Level:	216.93m OD	
Client:	Merseyside Pension Fund		**Date(s):**	29/11/18	**Plant Used:** JCB 3CX

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m OD)	Legend	Stratum Description
	Depth (m)	Type	Results				
	0.20	ES		0.15	216.78		Soft dark brown slightly organic CLAY with abundant roots. (MADE GROUND)
				0.30	216.63		Soft dark brown slightly gravelly CLAY. Gravel with fine to medium angular flint. (CLAY WITH FLINTS)
	0.80	ES					Firm red brown slightly gravelly CLAY. Gravel with fine to coarse angular flint. (CLAY WITH FLINTS)
	1.00	D					
				1.20	215.73		Medium density white structureless chalk with frequent chalk clasts and iron staining (CIRIA GRADE DC). (LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMARTION, NEWHAVEN CHALK FORMATION - UNDIFFERENTIATED)
	1.50	B					
				2.70	214.23		End of Trial Pit at 2.70m

1.0 2.0 3.0 4.0 5.0

Remarks: Terminted at 2.70m. Backfilled with arisings. No visual or olfactory evidence of contamination.

Stability: Stable

Groundwater: Not encountered

B = Bulk Sample
D = Disturbed Sample
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
CBR = In Situ California Bearing Ratio (%)
HSV = Hand Shear Vane (kPa)
HP = Hand Penetrometer (kPa)
AB = Asbestos Bulk Sample

Logged: AL **Checked:** WL

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Trial Pit

Trial Pit No: TP608

Sheet 1 of 1

Project Name:	Fort Halstead		**Dimensions:**	0.55m x 2.40m	**Hole Type:** TP
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Co-ords:**	549426E, 158883N	**Scale:** 1:25
			Ground Level:	213.90m OD	
Client:	Merseyside Pension Fund		**Date(s):**	29/11/18	**Plant Used:** JCB 3CX

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m OD)	Legend	Stratum Description
	Depth (m)	Type	Results				
				0.20	213.70		Soft dark brown slightly organic CLAY. Imported topsoil. (MADE GROUND)
							Chicken wire at base.
							Dark grey sandy fine to medium sub-rounded to sub-angular GRAVEL with brick, flint, and chalk. (MADE GROUND)
				0.70	213.20		Soft to firm light brown gravelly CLAY. Gravel with fine to coarse angular chalk. (MADE GROUND)
	1.20	ES					
	1.50	D					
				2.00	211.90		Firm orange brown and red brown gravelly CLAY. Gravel with fine to coarse angular flint. (CLAY WITH FLINTS)
	2.20	D					
				3.00	210.90		End of Trial Pit at 3.00m

1.0 2.0 3.0 4.0 5.0

Remarks: Terminated at 3.00m. Backfilled with arisings. No visual or olfactory evidence of contamination.

Stability: Stable

Groundwater: Not encountered

B = Bulk Sample
D = Disturbed Sample
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
CBR = In Situ California Bearing Ratio (%)
HSV = Hand Shear Vane (kPa)
HP = Hand Penetrometer (kPa)
AB = Asbestos Bulk Sample

Logged: AL **Checked:** WL

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Trial Pit

Trial Pit No: TP609

Sheet 1 of 1

Project Name:	Fort Halstead		**Dimensions:**	0.60m x 2.50m	**Hole Type:** TP
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Co-ords:**	549396E, 159076N	**Scale:** 1:25
			Ground Level:	218.02m OD	
Client:	Merseyside Pension Fund		**Date(s):**	27/11/18	**Plant Used:** JCB 3CX

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m OD)	Legend	Stratum Description
	Depth (m)	Type	Results				
	0.20	ES					Soft black gravelly CLAY with abundant roots. Gravel with fine to medium sub-angular flint (CLAY WITH FLINTS)
				0.40	217.62		
	0.50	ES					Cobble sized flint from 1.40m. Firm orange brown gravelly CLAY. Gravel with fine to coarse angular flint. (CLAY WITH FLINTS)
	0.60	B					
	1.40	B					
				2.10	215.92		End of Trial Pit at 2.10m

1.0
2.0
3.0
4.0
5.0

Remarks: Terminated at 2.10m due to difficult excavation and infiltration test. Backfilled with arisings. No visual or olfactory evidence of contamination.

Stability: Stable

Groundwater: Groundwater not encountered

B = Bulk Sample
D = Disturbed Sample
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
CBR = In Situ California Bearing Ratio (%)
HSV = Hand Shear Vane (kPa)
HP = Hand Penetrometer (kPa)
AB = Asbestos Bulk Sample

Logged: AL **Checked:** WL

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Trial Pit

Trial Pit No: TP610 Sheet 1 of 1

Project Name:	Fort Halstead		**Dimensions:**	0.60m x 2.50m	**Hole Type:** TP
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Co-ords:** 549456E, 159326N **Ground Level:** 208.57m OD		**Scale:** 1:25
Client:	Merseyside Pension Fund		**Date(s):**	27/11/18	**Plant Used:** JCB 3CX

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m OD)	Legend	Stratum Description
	Depth (m)	Type	Results				
	0.35	ES		0.30	208.27		Soft light brown gravelly CLAY. Gravel of fine to coarse angular flint and red brick with occasional wire pieces. (MADE GROUND)
	0.60	ES		0.55	208.02		Black gravelly coarse SAND. Gravel with fine to coarse sub-angular brick with abundant ash. (MADE GROUND)
	0.90	B		0.80	207.77		Soft light green brown slightly gravelly CLAY. Gravel of fine to coarse angular flint. (CLAY WITH FLINTS)
	2.30	B		2.40	206.17		Firm orange brown and light brown gravelly CLAY. Gravel with fine to coarse angular flint. (CLAY WITH FLINTS) *Cobble sized flint from 1.60m* End of Trial Pit at 2.40m

1.0 2.0 3.0 4.0 5.0

Remarks: Terminated at 2.40m due to infiltration test. Backfilled with arisings. No visual or olfactory evidence of contamination.

Stability: Stable

Groundwater: Groundwater not encountered

B = Bulk Sample
D = Disturbed Sample
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
CBR = In Situ California Bearing Ratio (%)
HSV = Hand Shear Vane (kPa)
HP = Hand Penetrometer (kPa)
AB = Asbestos Bulk Sample

Logged: AL **Checked:** WL

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Trial Pit

Trial Pit No: TP611

Sheet 1 of 1

Project Name:	Fort Halstead		**Dimensions:**	0.55m x 2.30m	**Hole Type:** TP
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Co-ords:**	549674E, 159640N	**Scale:** 1:25
			Ground Level:	194.10m OD	
Client:	Merseyside Pension Fund		**Date(s):**	28/11/18	**Plant Used:** JCB 3CX

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m OD)	Legend	Stratum Description
	Depth (m)	Type	Results				
	0.10	ES					Soft light brown gravelly CLAY. Gravel with fine to medium angular flint and sandstone. (MADE GROUND)
				0.40	193.70		
	0.60	ES					Soft dark grey gravelly CLAY. Gravel with fine to coarse angular brick and flint with frequent coal and ash. (MADE GROUND)
				0.80	193.30		
	1.00	B					Soft dark brown gravelly CLAY. Gravel with fine to coarse angular flint (Relic Topsoil). (CLAY WITH FLINTS)
				1.10	193.00		Firm orange brown gravelly CLAY. Gravel with fine to coarse angular flint. (CLAY WITH FLINTS)
				2.10	192.00		End of Trial Pit at 2.10m

1.0 2.0 3.0 4.0 5.0

Remarks: Terminated at 2.10m due to infiltration test. Backfilled with arisings. No visual or olfactory evidence of contamination.

Stability: Stable

Groundwater: Groundwater not encountered

B = Bulk Sample
D = Disturbed Sample
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
CBR = In Situ California Bearing Ratio (%)
HSV = Hand Shear Vane (kPa)
HP = Hand Penetrometer (kPa)
AB = Asbestos Bulk Sample

Logged: AL **Checked:** WL

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Trial Pit

Trial Pit No: TP612

Sheet 1 of 1

Project Name:	Fort Halstead		**Dimensions:**	0.55m x 2.30m	**Hole Type:** TP
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Co-ords:**	549624E, 159497N	**Scale:** 1:25
			Ground Level:	199.60m OD	
Client:	Merseyside Pension Fund		**Date(s):**	28/11/18	**Plant Used:** JCB 3CX

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m OD)	Legend	Stratum Description
	Depth (m)	Type	Results				
	0.20	ES		0.10	199.50		Soft dark brown slightly organic CLAY with abundant roots. (MADE GROUND)
				0.50	199.10		Soft orange brown gravelly CLAY. Gravel with fine to coarse angular brick and flint. (MADE GROUND)
	0.60	ES					Soft dark brown slightly gravelly CLAY. Gravel of red brick and flint. (MADE GROUND)
				1.00	198.60		Firm red brown mottled yellow brown slightly gravelly CLAY. Gravel with fine to coarse angular flint. (CLAY WITH FLINTS)
	1.50	B					
				3.00	196.60		End of Trial Pit at 3.00m

1.0 2.0 3.0 4.0 5.0

Remarks: Terminated at 3.00m. Backfilled with arisings. No visual or olfactory evidence of contamination.

Stability: Stable

Groundwater: Not encountered

B = Bulk Sample
D = Disturbed Sample
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
CBR = In Situ California Bearing Ratio (%)
HSV = Hand Shear Vane (kPa)
HP = Hand Penetrometer (kPa)
AB = Asbestos Bulk Sample

Logged: AL **Checked:** WL

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Trial Pit

Trial Pit No: TP613

Sheet 1 of 1

Project Name:	Fort Halstead		**Dimensions:**	0.55m x 2.30m	**Hole Type:** TP
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Co-ords:** 549776E, 159543N **Ground Level:** 197.57m OD		**Scale:** 1:25
Client:	Merseyside Pension Fund		**Date(s):**	28/11/18	**Plant Used:** JCB 3CX

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m OD)	Legend	Stratum Description
	Depth (m)	Type	Results				
				0.20	197.37		Soft dark brown slightly organic CLAY with abundant roots. (CLAY WITH FLINTS)
	0.30	ES					Cobble sized flint present from 1.00m. Soft dark brown and orange brown gravelly CLAY. Gravel of fine to coarse angular flint. (CLAY WITH FLINTS)
				0.70	196.87		
	0.80	B					Firm red brown gravelly CLAY. Gravel of fine to coarse angular flint. (CLAY WITH FLINTS)
	2.00	B					
	3.50	B		3.50	194.07		End of Trial Pit at 3.50m

1.0
2.0
3.0
4.0
5.0

Remarks: Terminated at 3.50m. Backfilled with arisings. No visual or olfactory evidence of contamination.

Stability: Stable

Groundwater: Not encountered

B = Bulk Sample
D = Disturbed Sample
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
CBR = In Situ California Bearing Ratio (%)
HSV = Hand Shear Vane (kPa)
HP = Hand Penetrometer (kPa)
AB = Asbestos Bulk Sample

Logged: AL **Checked:** WL

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Trial Pit

Trial Pit No: TP614 Sheet 1 of 1

Project Name:	Fort Halstead		**Dimensions:**	0.55m x 2.10m	**Hole Type:** TP
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Co-ords:** 549921E, 159503N **Ground Level:** 199.29m OD		**Scale:** 1:25
Client:	Merseyside Pension Fund		**Date(s):**	29/11/18	**Plant Used:** JCB 3CX

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m OD)	Legend	Stratum Description
	Depth (m)	Type	Results				
	0.20	ES		0.20	199.09		Soft dark brown slightly sandy slightly gravelly CLAY. Gravel with fine angular flint with frequent roots. (CLAY WITH FLINTS)
	1.00	D		1.20	198.09		Soft firm light brown gravelly CLAY. Gravel with fine to coarse angular flint. (CLAY WITH FLINTS)
				1.90	197.39		Firm red brown cobbly CLAY. Cobbles with angular flint nodules. (CLAY WITH FLINTS)
							End of Trial Pit at 1.90m

1.0
2.0
3.0
4.0
5.0

Remarks: Terminated excavation at 1.90m due to difficulty in excavating. Backfilled with arisings. No visual or olfactory evidence of contamination.

Stability: Stable

Groundwater: Not encountered

B = Bulk Sample
D = Disturbed Sample
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
CBR = In Situ California Bearing Ratio (%)
HSV = Hand Shear Vane (kPa)
HP = Hand Penetrometer (kPa)
AB = Asbestos Bulk Sample

Logged: AL **Checked:** WL

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Trial Pit

Trial Pit No: TP615 Sheet 1 of 1

Project Name:	Fort Halstead		**Dimensions:**	0.60m x 2.50m	**Hole Type:** TP
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Co-ords:** 550073E, 159630N **Ground Level:** 193.68m OD		**Scale:** 1:25
Client:	Merseyside Pension Fund		**Date(s):**	28/11/18	**Plant Used:** JCB 3CX

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m OD)	Legend	Stratum Description
	Depth (m)	Type	Results				
				0.10	193.58		Soft dark brown slightly gravelly CLAY. Gravel with fine to medium angular flint. (MADE GROUND)
							Soft brown slightly sandy gravelly CLAY. Gravel with fine to coarse angular brick and flint with frequent roots. (MADE GROUND)
				0.70	192.98		Yellow brown sandy fine to coarse angular GRAVEL with flint and occasional flint cobbles. (MADE GROUND)
	0.90	ES					
	1.50	B					
				1.80	191.88		Firm orange brown gravelly CLAY. Gravel with fine to coarse angular flint. (CLAY WITH FLINTS)
	2.00	B					
				2.30	191.38		End of Trial Pit at 2.30m

1.0 2.0 3.0 4.0 5.0

Remarks: Terminated at 2.30m due to infiltration test. Backfilled with arisings. No visual or olfactory evidence of contamination.

Stability: Stable

Groundwater: Groundwater not encountered

B = Bulk Sample
D = Disturbed Sample
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
CBR = In Situ California Bearing Ratio (%)
HSV = Hand Shear Vane (kPa)
HP = Hand Penetrometer (kPa)
AB = Asbestos Bulk Sample

Logged: AL **Checked:** WL

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Trial Pit

Trial Pit No: TP616

Sheet 1 of 1

Project Name:	Fort Halstead		**Dimensions:**	0.60m x 2.50m	**Hole Type:** TP
Location:	Fort Halstead, Kent	**Project No:** C-10730-C	**Co-ords:** 550254E, 159816N **Ground Level:** 182.20m OD		**Scale:** 1:25
Client:	Merseyside Pension Fund		**Date(s):**	28/11/18	**Plant Used:** JCB 3CX

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m OD)	Legend	Stratum Description
	Depth (m)	Type	Results				
	0.20	ES		0.25	181.95		Black grey sandy fine angular GRAVEL with ash and flint. (MADE GROUND)
	0.40	ES					Soft orange brown mottled red brown slightly gravelly sandy CLAY. Gravel with fine to coarse angular flint. (CLAY WITH FLINTS)
	0.50	B		0.60	181.60		Firm red brown locally mottled orange brown gravelly CLAY. Gravel with fine to coarse angular flint. (CLAY WITH FLINTS)
	2.00	B		2.05	180.15		End of Trial Pit at 2.05m

1.0
2.0
3.0
4.0
5.0

Remarks: Backfilled with arisings. No visual or olfactory evidence of contamination.

Stability: Stable

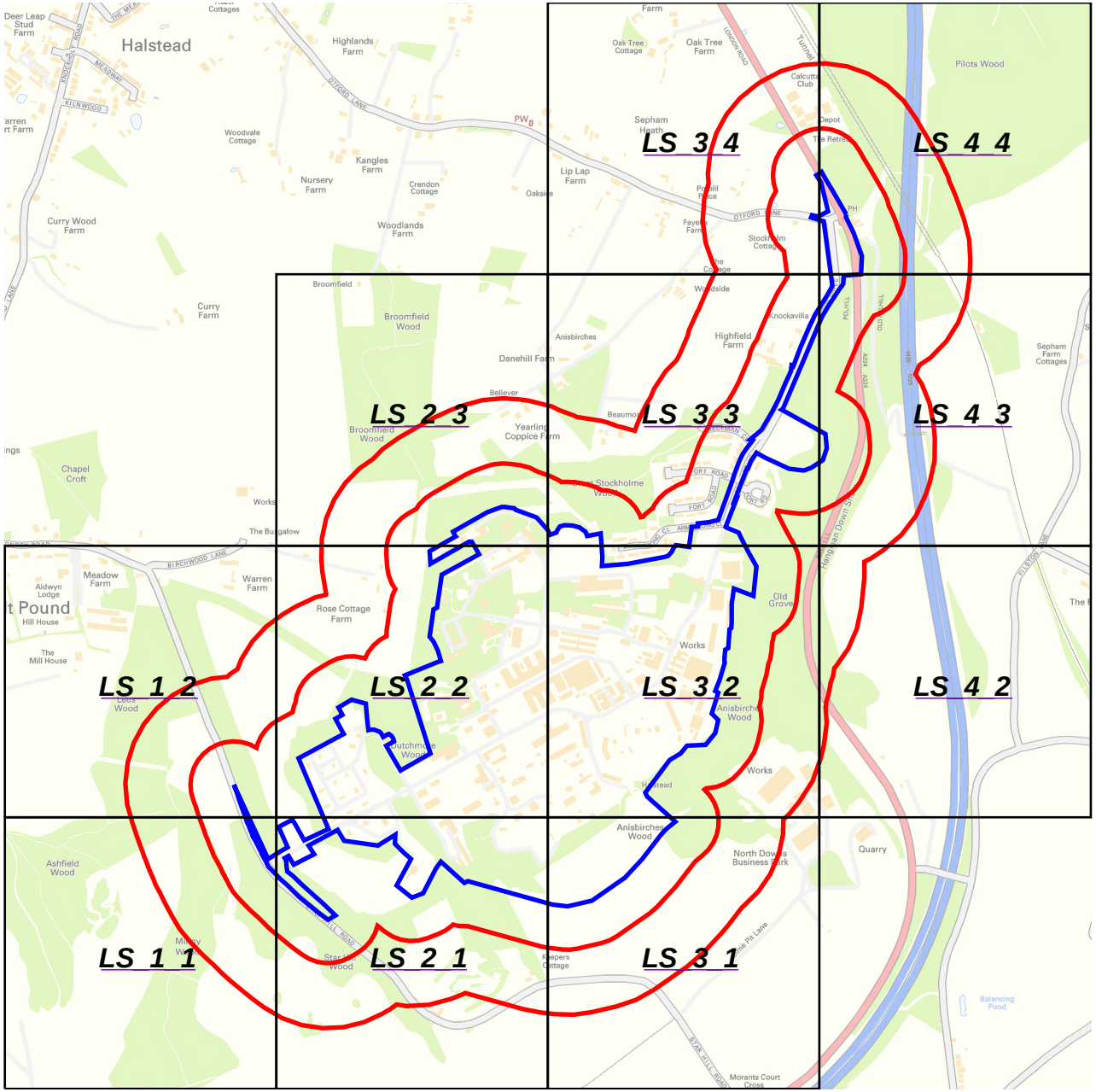
Groundwater: Groundwater not encountered

B = Bulk Sample
D = Disturbed Sample
ES = Environmental Sample
W = Water Sample
PID = Photoionization Detector (ppm)
CBR = In Situ California Bearing Ratio (%)
HSV = Hand Shear Vane (kPa)
HP = Hand Penetrometer (kPa)
AB = Asbestos Bulk Sample

Logged: AL **Checked:** WL

Appendix C

Historical Ordnance Survey Maps


LS 3 4
LS 4 4
LS 2 3
LS 3 3
LS 4 3
LS 1 2
LS 2 2
LS 3 2
LS 4 2
LS 1 1
LS 2 1
LS 3 1
Halstead
Groundsure
INSIGHTS
N
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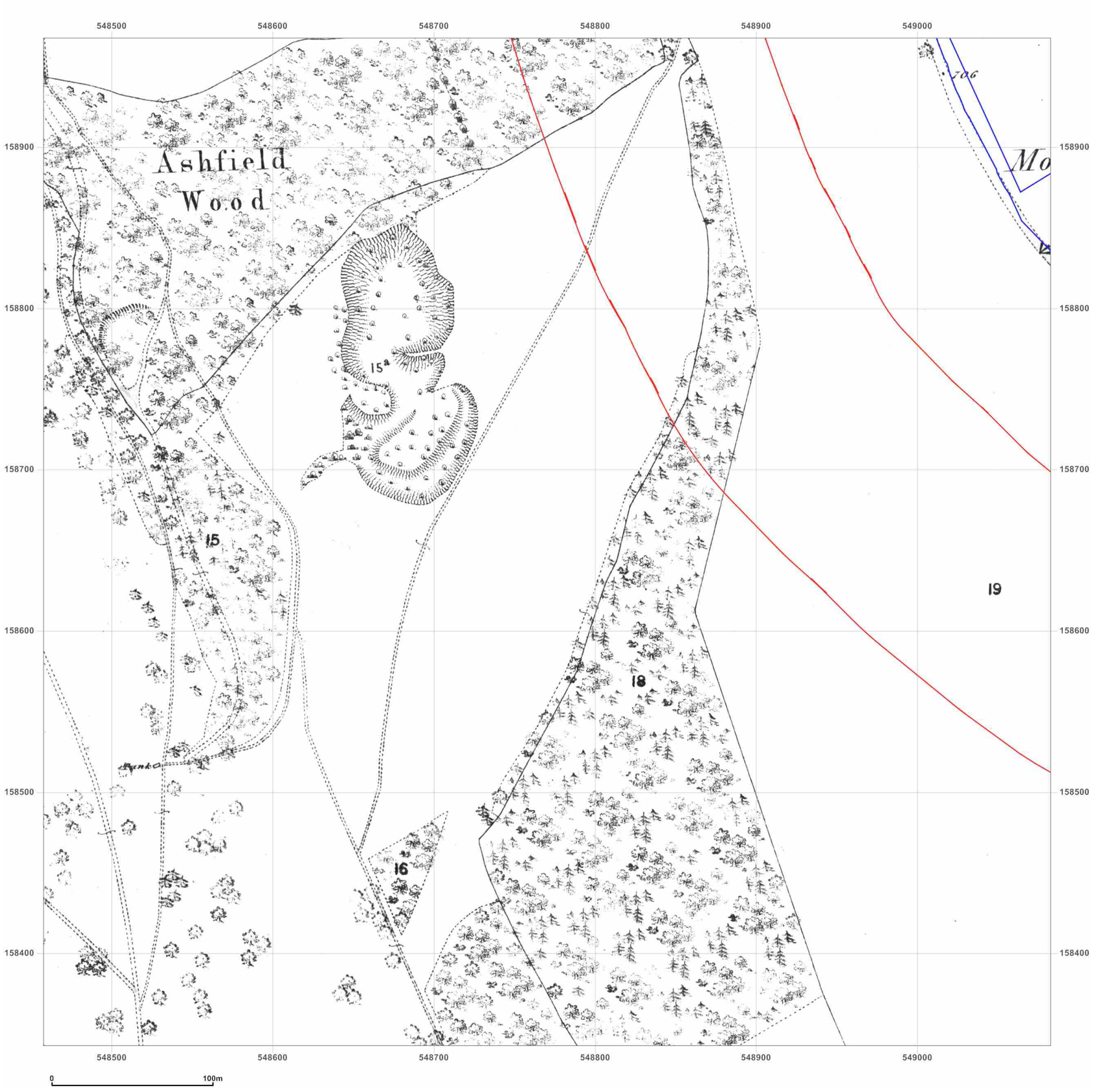
E
S
1:2500 Scale Grid Index



Groundsure INSIGHTS

Site Details:

LAND WEST OF 41, FORT ROAD, HALSTEAD, SEVENOAKS, TN14 7BS

Client Ref: C-10730-C_Fort_Halstead_PO_P028025
Report Ref: GS-5746913_LS_1_1
Grid Ref: 548770, 158655

Map Name: County Series

Map date: **1869**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1869
Revised 1869
Edition N/A
Copyright N/A
Levelled N/A

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Produced by
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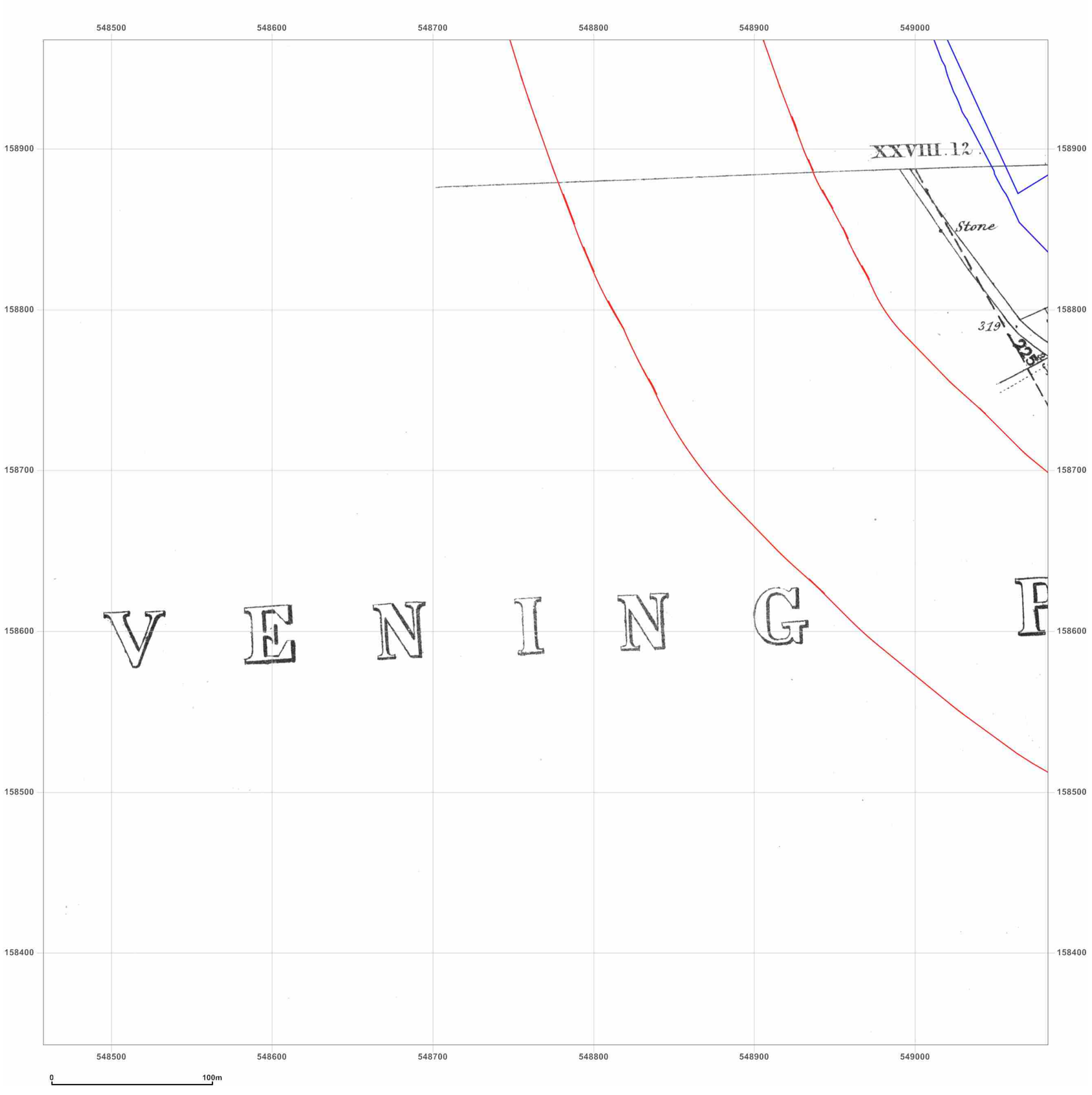
W: www.groundsure.com

Production date: 14 January 2019

Map legend available at:
www.groundsure.com/sites/default/files/groundsure_legend.pdf



Groundsure INSIGHTS

Site Details:

LAND WEST OF 41, FORT ROAD, HALSTEAD, SEVENOAKS, TN14 7BS

Client Ref: C-10730-C_Fort_Halstead_PO_P028025
Report Ref: GS-5746913_LS_1_1
Grid Ref: 548770, 158655

Map Name: County Series
Map date: **1869**
Scale: 1:2,500
Printed at: 1:2,500

N
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Surveyed 1869
Revised 1869
Edition N/A
Copyright N/A
Levelled N/A

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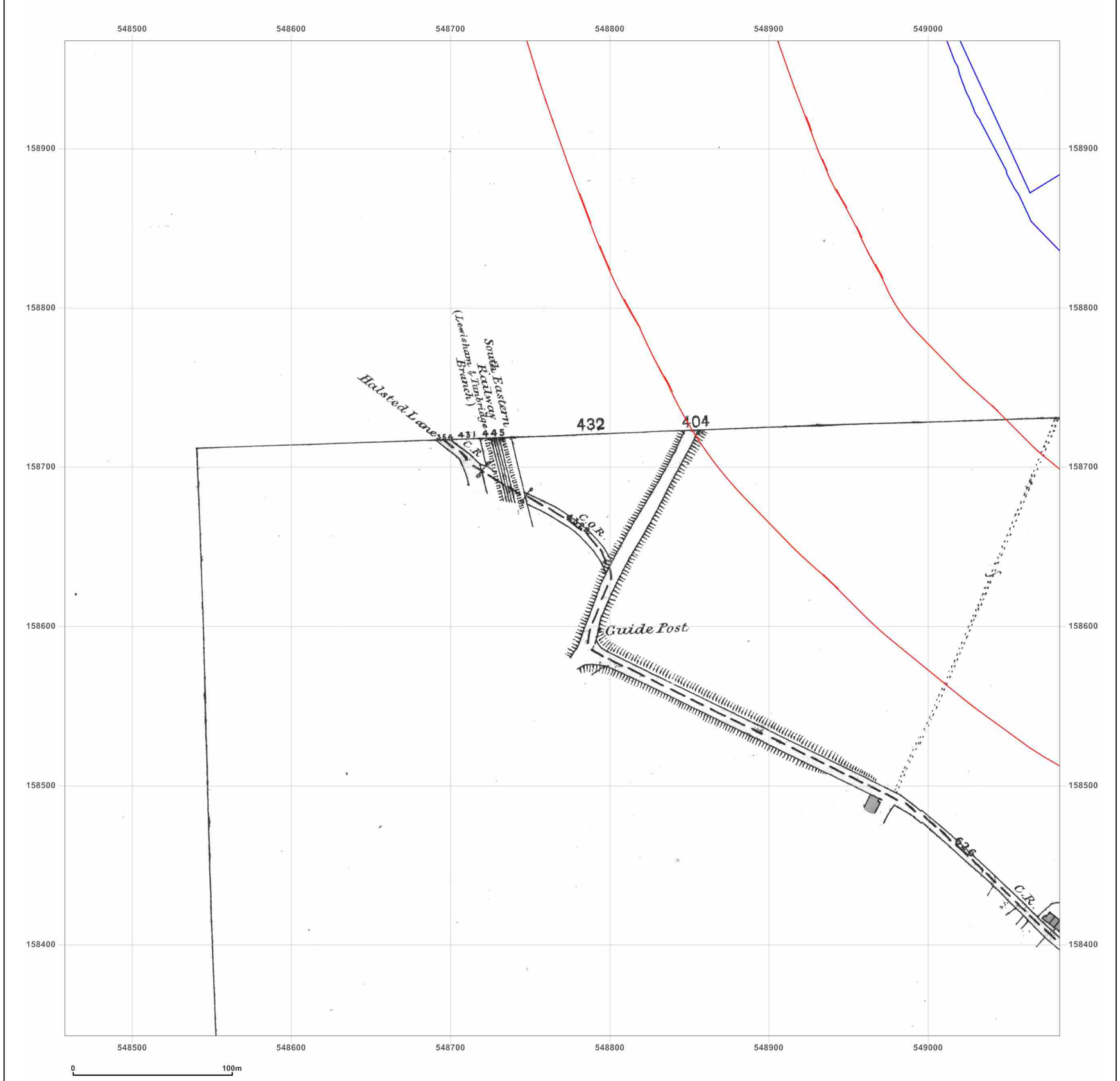

Groundsure INSIGHTS

Site Details:

LAND WEST OF 41, FORT ROAD, HALSTEAD, SEVENOAKS, TN14 7BS

Client Ref: C-10730-C_Fort_Halstead_PO_P028025
Report Ref: GS-5746913_LS_1_1
Grid Ref: 548770, 158655

Map Name: County Series

Map date: **1869**

Scale: 1:2,500

Printed at: 1:2,500

N
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Surveyed 1869
Revised 1869
Edition N/A
Copyright N/A
Levelled N/A

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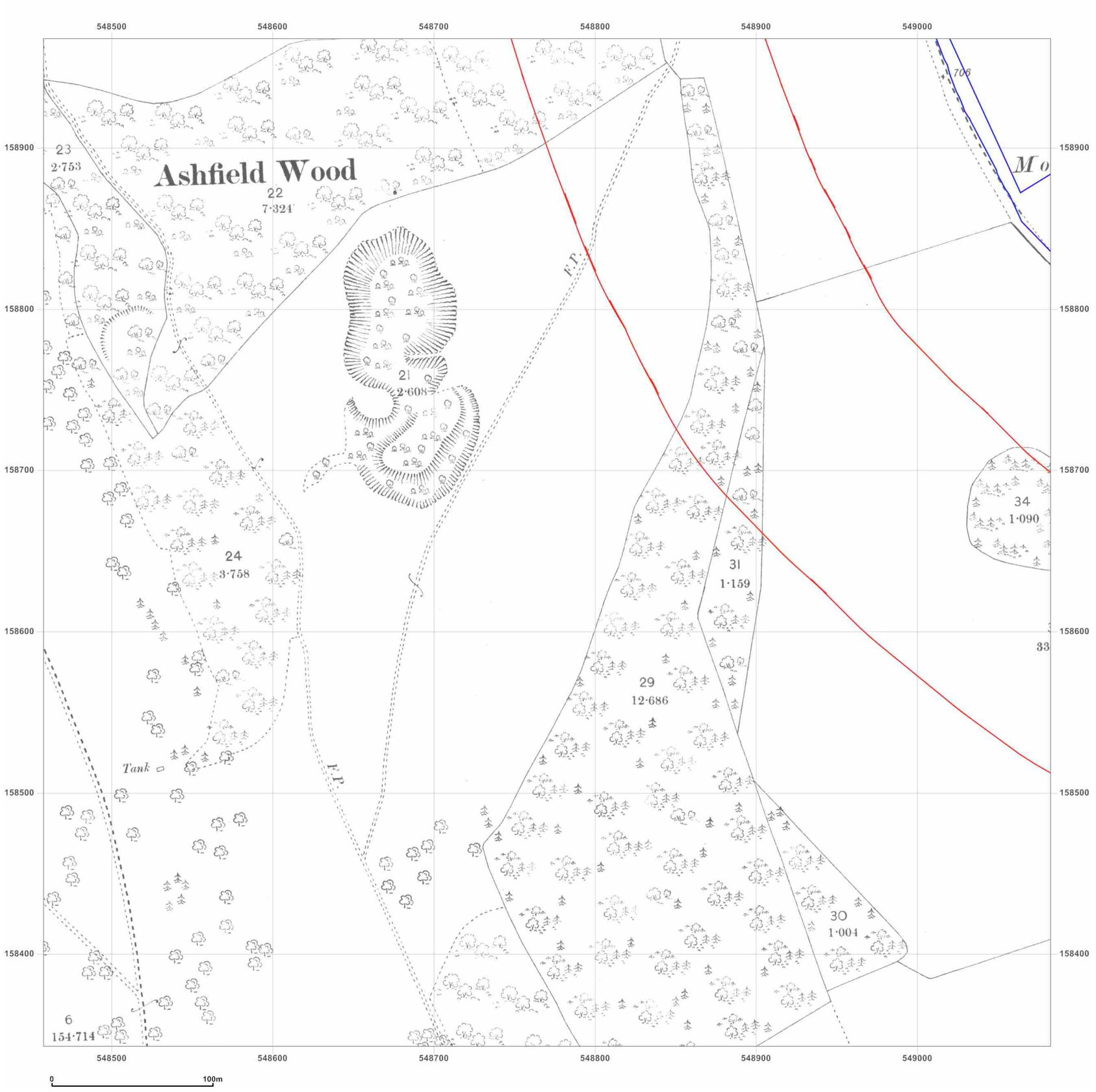

Groundsure INSIGHTS

Site Details:

LAND WEST OF 41, FORT ROAD, HALSTEAD, SEVENOAKS, TN14 7BS

Client Ref: C-10730-C_Fort_Halstead_PO_P028025
Report Ref: GS-5746913_LS_1_1
Grid Ref: 548770, 158655

Map Name: County Series

Map date: **1896**

Scale: 1:2,500

Printed at: 1:2,500

N
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Surveyed 1896
Revised 1896
Edition N/A
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Levelled N/A

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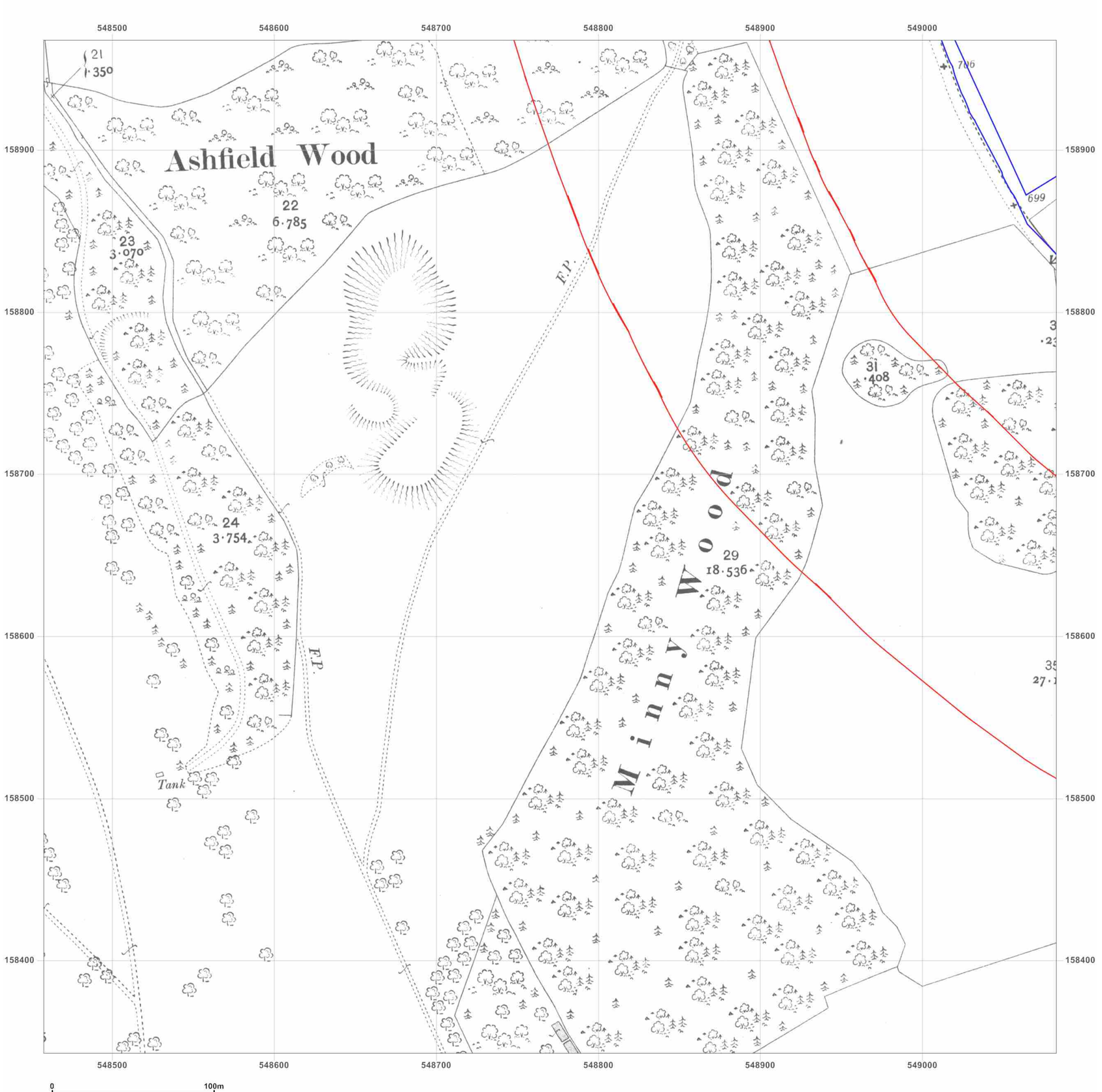

Groundsure INSIGHTS

Site Details:

LAND WEST OF 41, FORT ROAD, HALSTEAD, SEVENOAKS, TN14 7BS

Client Ref: C-10730-C_Fort_Halstead_PO_P028025
Report Ref: GS-5746913_LS_1_1
Grid Ref: 548770, 158655

Map Name: County Series

Map date: **1909**

Scale: 1:2,500

Printed at: 1:2,500

N
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Surveyed 1909
Revised 1909
Edition N/A
Copyright N/A
Levelled N/A

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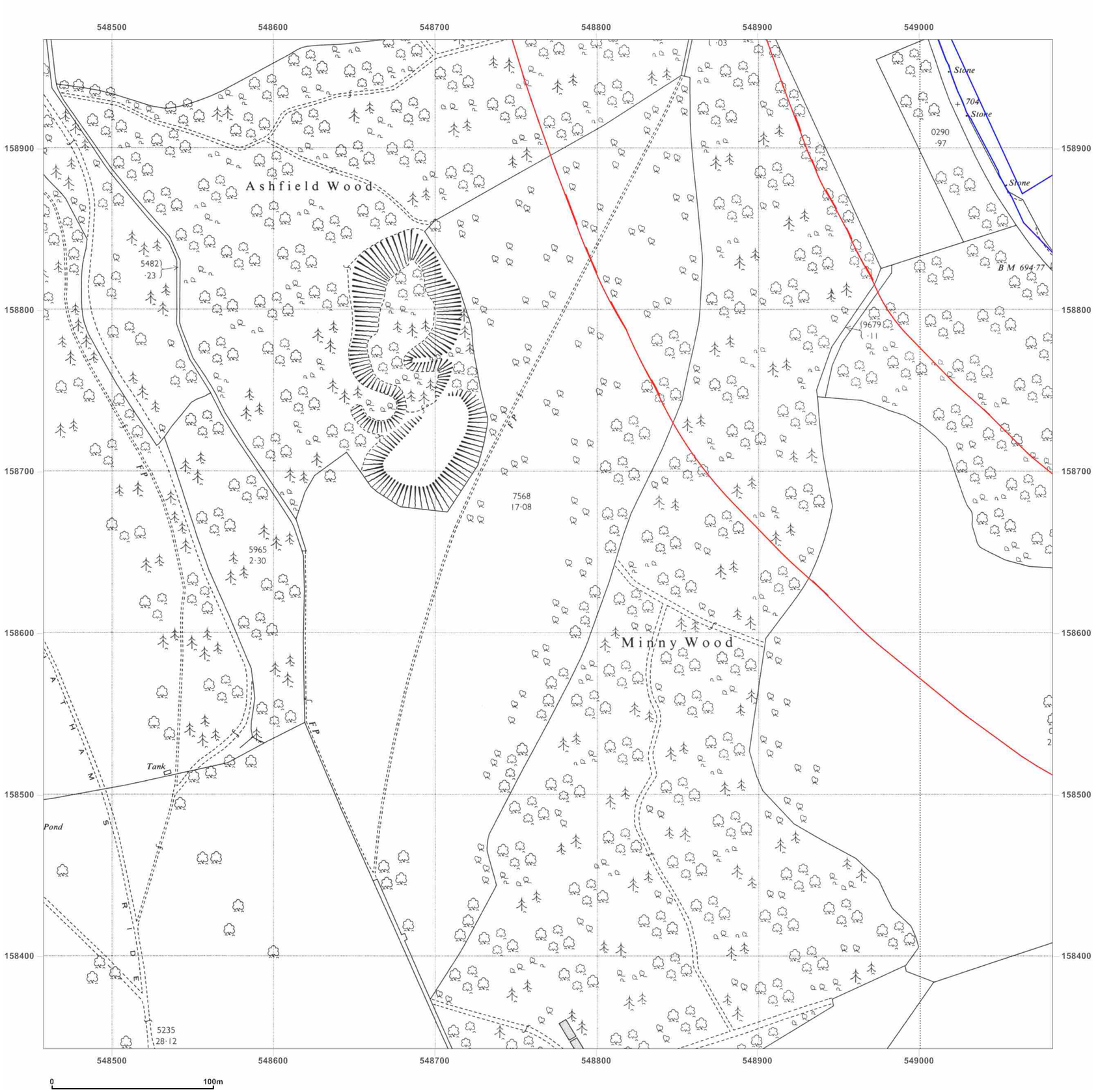

Groundsure INSIGHTS

Site Details:

LAND WEST OF 41, FORT ROAD, HALSTEAD, SEVENOAKS, TN14 7BS

Client Ref: C-10730-C_Fort_Halstead_PO_P028025
Report Ref: GS-5746913_LS_1_1
Grid Ref: 548770, 158655

Map Name: National Grid

Map date: **1961**

Scale: 1:2,500

Printed at: 1:2,500

N
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Surveyed 1961
Revised 1961
Edition N/A
Copyright 1963
Levelled 1952

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Production date: 14 January 2019

Map legend available at:
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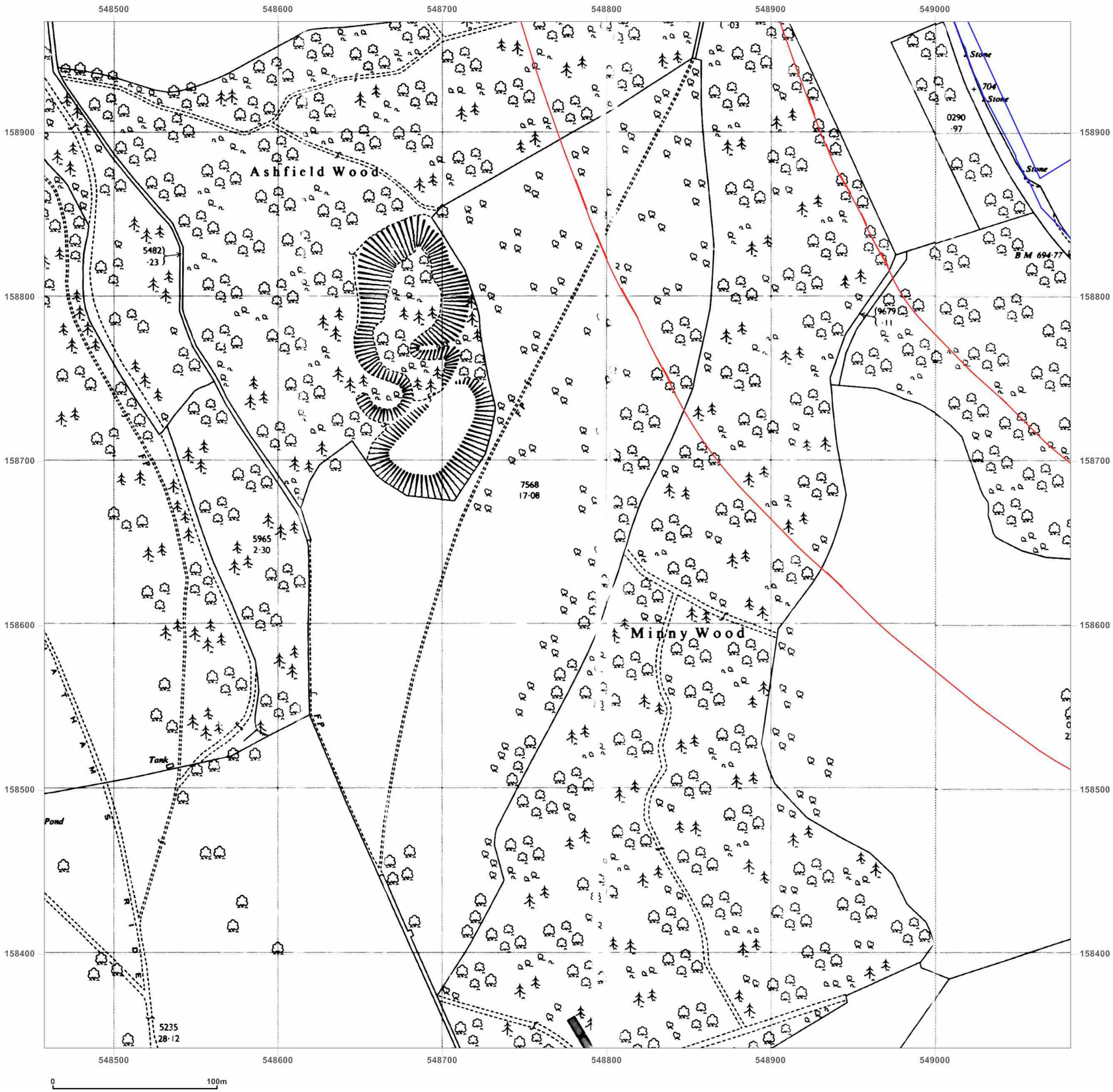

Groundsure INSIGHTS

Site Details:

LAND WEST OF 41, FORT ROAD, HALSTEAD, SEVENOAKS, TN14 7BS

Client Ref: C-10730-C_Fort_Halstead_PO_P028025
Report Ref: GS-5746913_LS_1_1
Grid Ref: 548770, 158655

Map Name: National Grid

Map date: **1963**

Scale: 1:2,500

Printed at: 1:2,500

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Surveyed N/A
Revised N/A
Edition N/A
Copyright N/A
Levelled N/A

Surveyed N/A
Revised N/A
Edition N/A
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Map legend available at:
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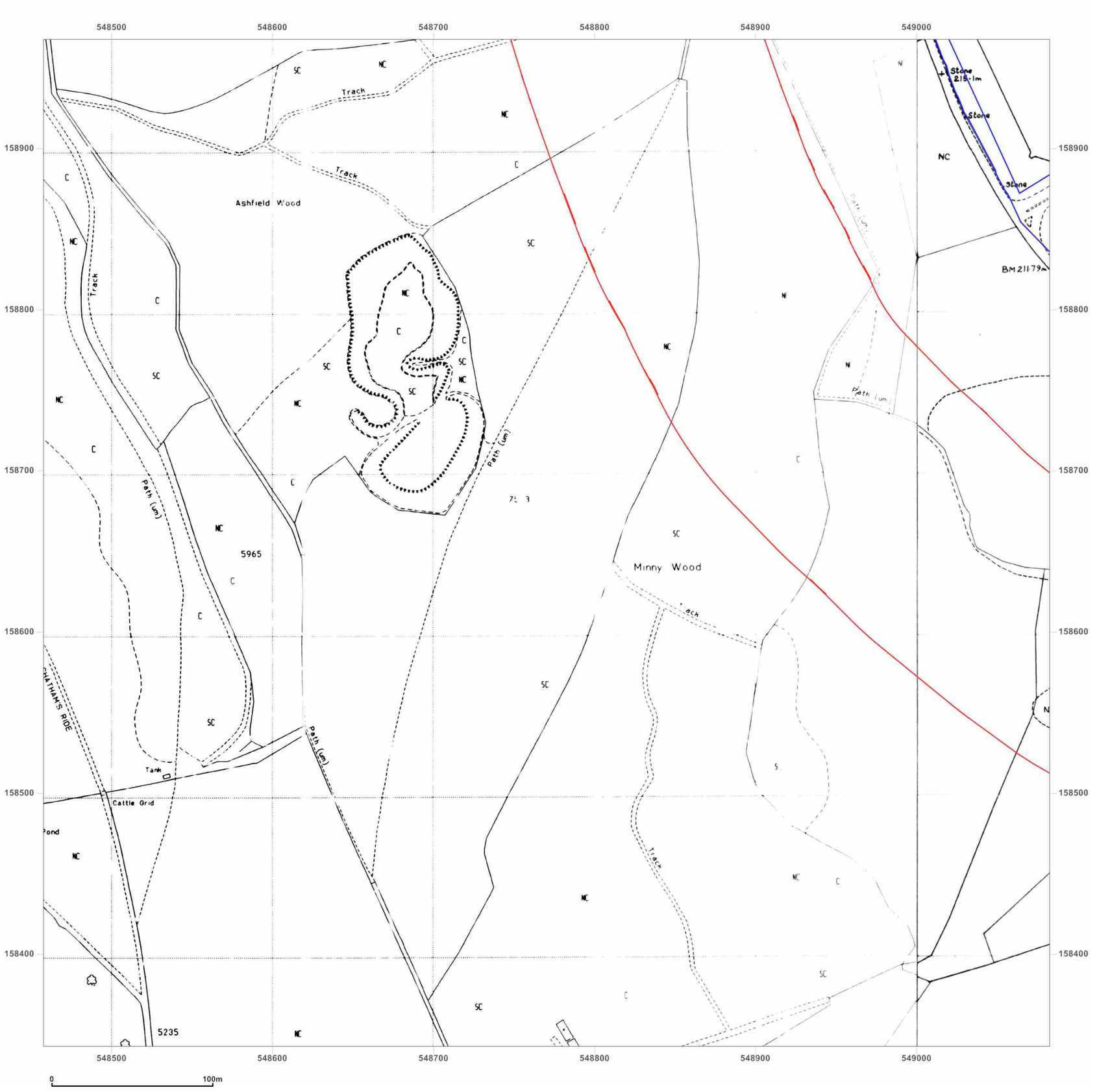

Groundsure INSIGHTS

Site Details:

LAND WEST OF 41, FORT ROAD, HALSTEAD, SEVENOAKS, TN14 7BS

Client Ref: C-10730-C_Fort_Halstead_PO_P028025
Report Ref: GS-5746913_LS_1_1
Grid Ref: 548770, 158655

Map Name: National Grid

Map date: **1988-1992**

Scale: 1:2,500

Printed at: 1:2,500

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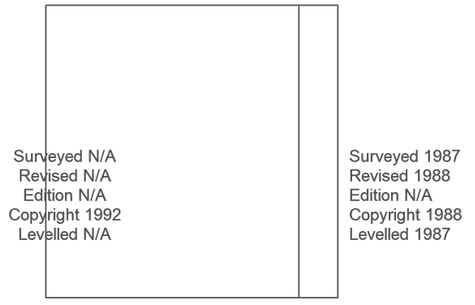

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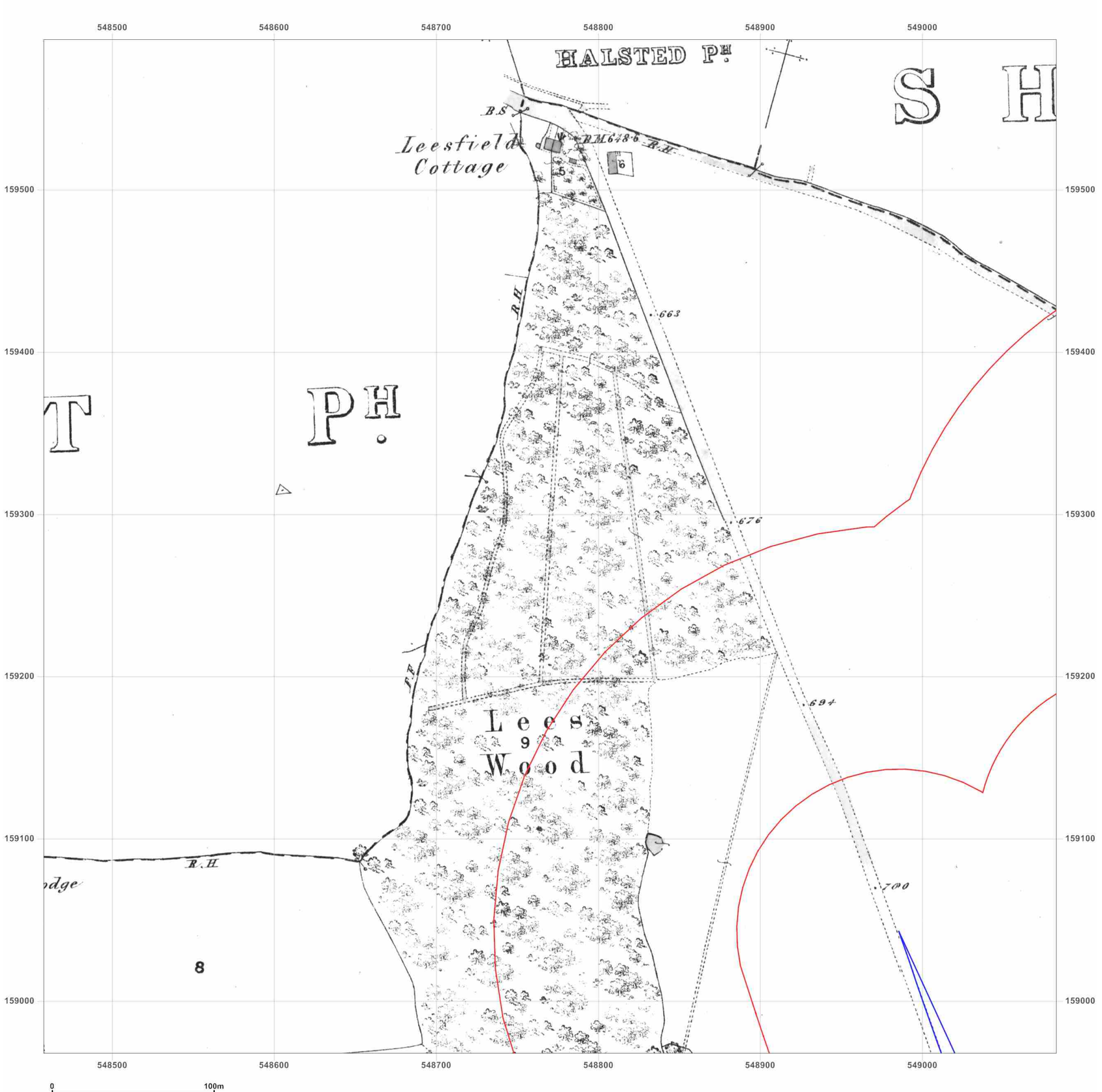

Groundsure INSIGHTS

Site Details:

LAND WEST OF 41, FORT ROAD, HALSTEAD, SEVENOAKS, TN14 7BS

Client Ref: C-10730-C_Fort_Halstead_PO_P028025
Report Ref: GS-5746913_LS_1_2
Grid Ref: 548770, 159280

Map Name: County Series
Map date: **1869**
Scale: 1:2,500
Printed at: 1:2,500

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Surveyed 1869
Revised 1869
Edition N/A
Copyright N/A
Levelled N/A

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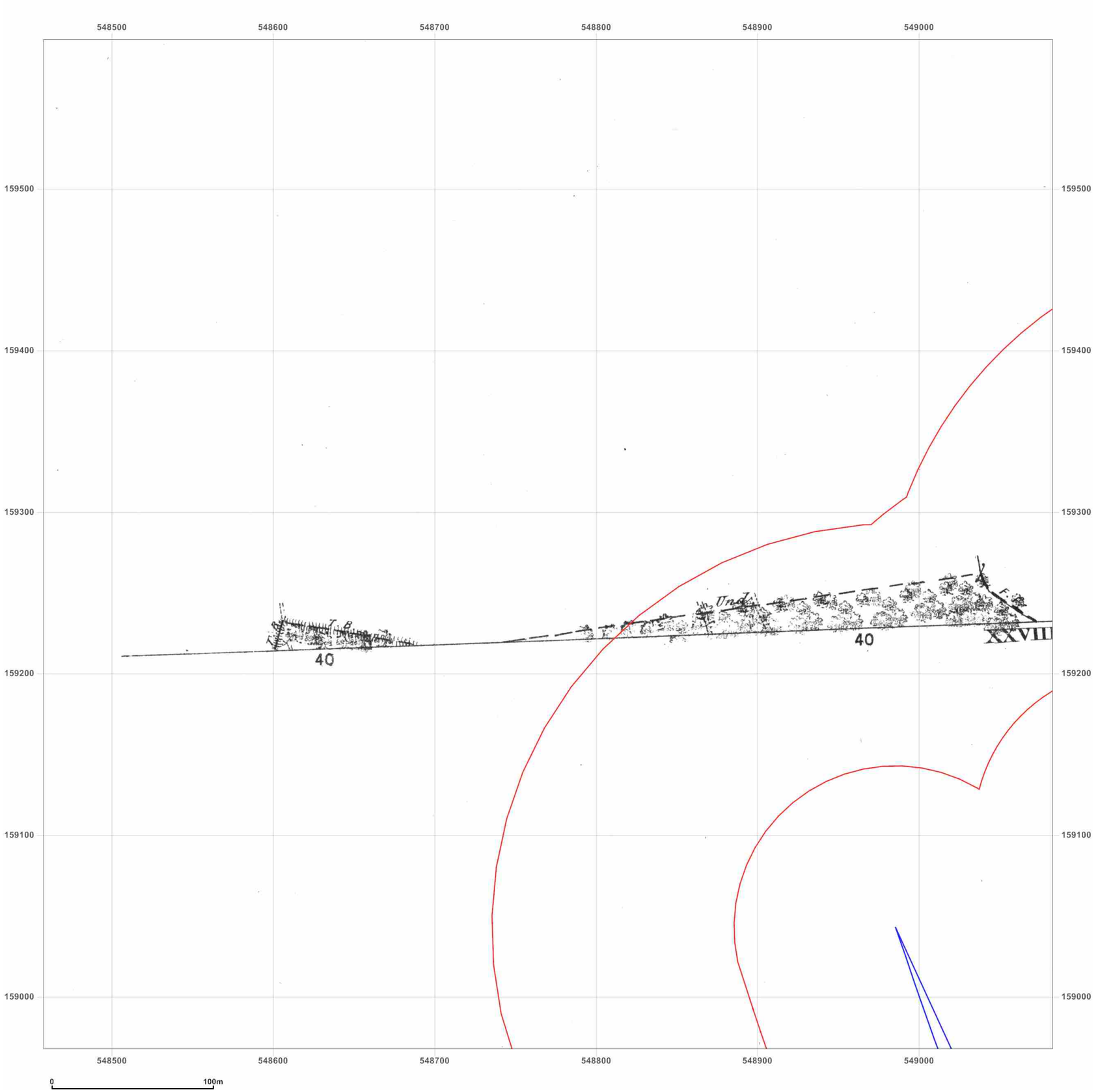

Groundsure INSIGHTS

Site Details:

LAND WEST OF 41, FORT ROAD, HALSTEAD, SEVENOAKS, TN14 7BS

Client Ref: C-10730-C_Fort_Halstead_PO_P028025
Report Ref: GS-5746913_LS_1_2
Grid Ref: 548770, 159280

Map Name: County Series
Map date: **1869**
Scale: 1:2,500
Printed at: 1:2,500

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Surveyed 1869
Revised 1869
Edition N/A
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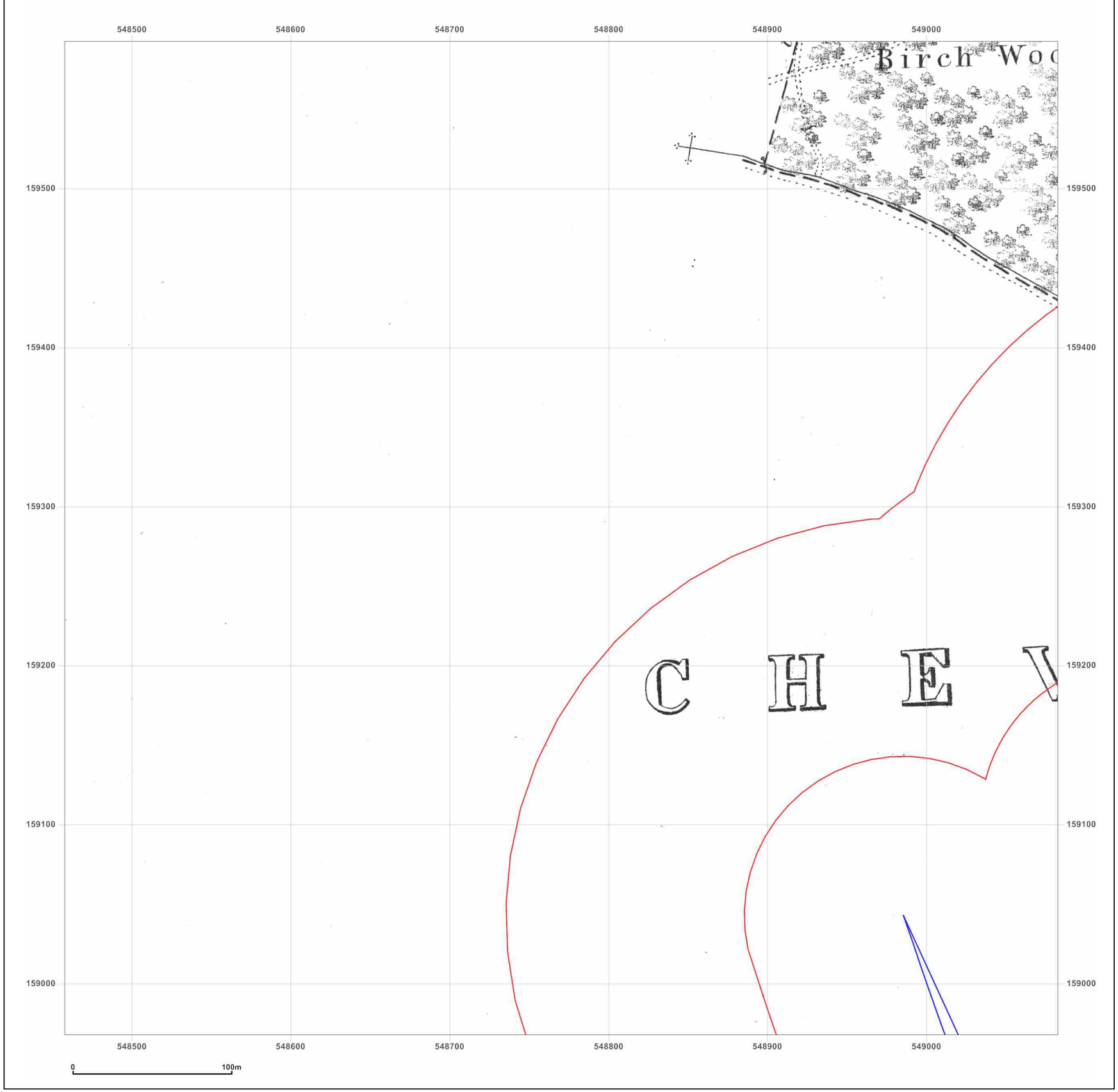

Groundsure INSIGHTS

Site Details:

LAND WEST OF 41, FORT ROAD, HALSTEAD, SEVENOAKS, TN14 7BS

Client Ref: C-10730-C_Fort_Halstead_PO_P028025
Report Ref: GS-5746913_LS_1_2
Grid Ref: 548770, 159280

Map Name: County Series
Map date: **1869**
Scale: 1:2,500
Printed at: 1:2,500

N
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Surveyed 1869
Revised 1869
Edition N/A
Copyright N/A
Levelled N/A

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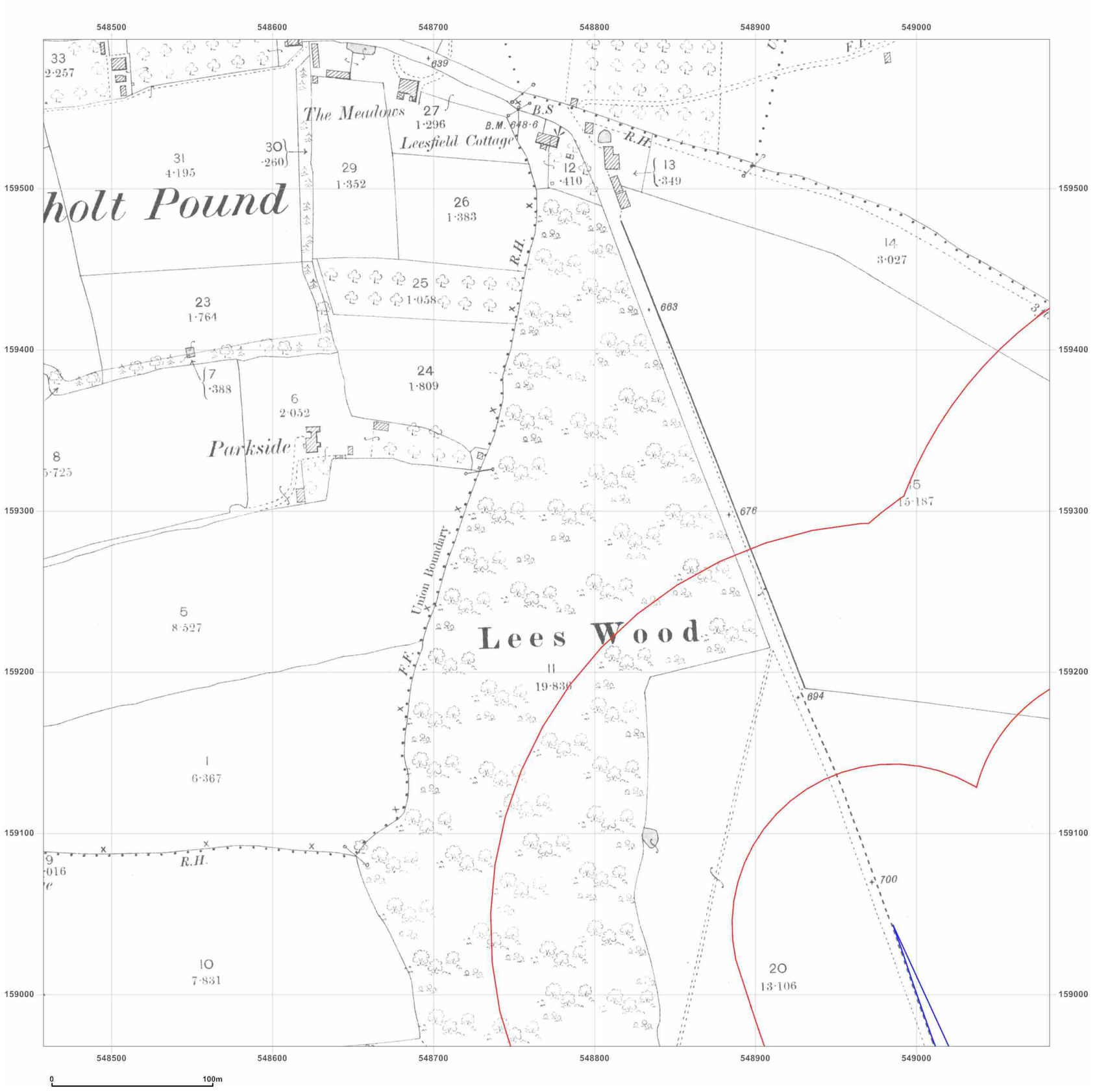

Groundsure INSIGHTS

Site Details:

LAND WEST OF 41, FORT ROAD, HALSTEAD, SEVENOAKS, TN14 7BS

Client Ref: C-10730-C_Fort_Halstead_PO_P028025
Report Ref: GS-5746913_LS_1_2
Grid Ref: 548770, 159280

Map Name: County Series

Map date: **1896**

Scale: 1:2,500

Printed at: 1:2,500

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Surveyed 1896
Revised 1896
Edition N/A
Copyright N/A
Levelled N/A

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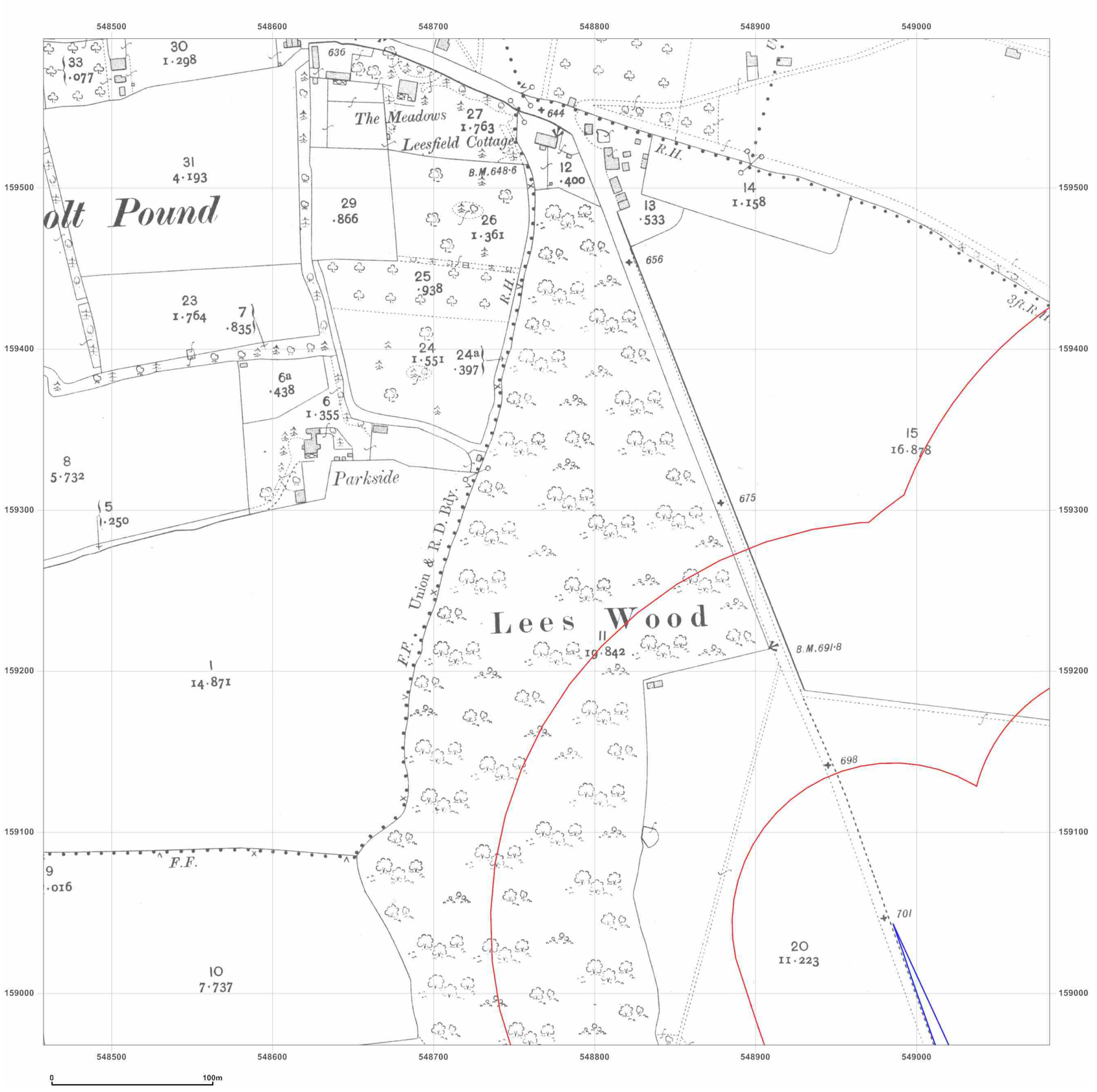

Groundsure INSIGHTS

Site Details:

LAND WEST OF 41, FORT ROAD, HALSTEAD, SEVENOAKS, TN14 7BS

Client Ref: C-10730-C_Fort_Halstead_PO_P028025
Report Ref: GS-5746913_LS_1_2
Grid Ref: 548770, 159280

Map Name: County Series

Map date: **1909**

Scale: 1:2,500

Printed at: 1:2,500

N
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Surveyed 1909
Revised 1909
Edition N/A
Copyright N/A
Levelled N/A

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Groundsure INSIGHTS

Site Details:

LAND WEST OF 41, FORT ROAD, HALSTEAD, SEVENOAKS, TN14 7BS

Client Ref: C-10730-C_Fort_Halstead_PO_P028025
Report Ref: GS-5746913_LS_1_2
Grid Ref: 548770, 159280

Map Name: National Grid

Map date: **1961**

Scale: 1:2,500

Printed at: 1:2,500

N
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Surveyed 1961
Revised 1961
Edition N/A
Copyright 1963
Levelled 1952

Surveyed 1961
Revised 1961
Edition N/A
Copyright 1963
Levelled 1952

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Groundsure INSIGHTS

Site Details:

LAND WEST OF 41, FORT ROAD, HALSTEAD, SEVENOAKS, TN14 7BS

Client Ref: C-10730-C_Fort_Halstead_PO_P028025
Report Ref: GS-5746913_LS_1_2
Grid Ref: 548770, 159280

Map Name: National Grid

Map date: **1961**

Scale: 1:2,500

Printed at: 1:2,500

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W E
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Surveyed 1961
Revised 1961
Edition N/A
Copyright 1963
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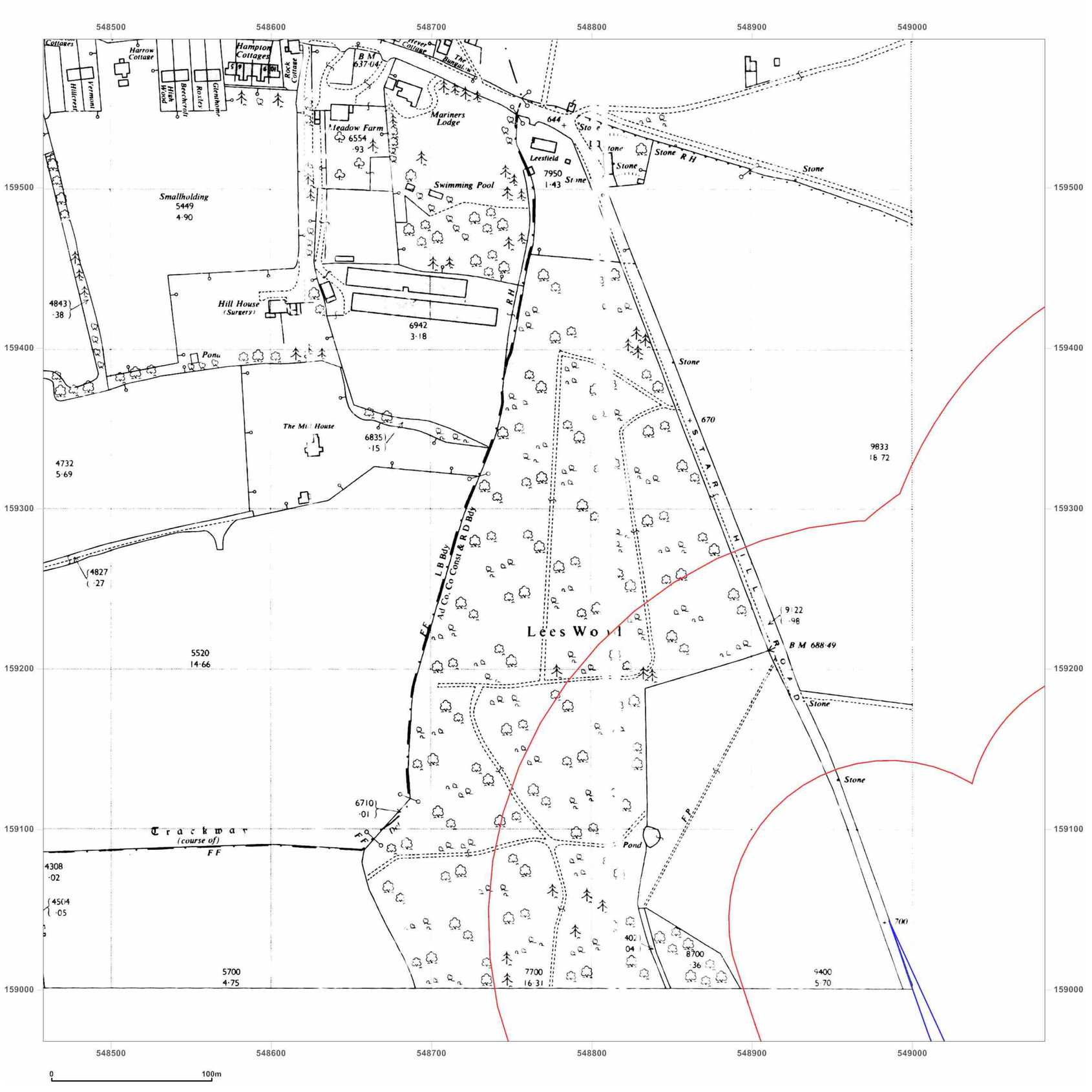
Map legend available at:
www.groundsure.com/sites/default/files/groundsure_legend.pdf



Groundsure INSIGHTS

Site Details:

LAND WEST OF 41, FORT ROAD, HALSTEAD, SEVENOAKS, TN14 7BS

Client Ref: C-10730-C_Fort_Halstead_PO_P028025
Report Ref: GS-5746913_LS_1_2
Grid Ref: 548770, 159280

Map Name: National Grid

Map date: **1963**

Scale: 1:2,500

Printed at: 1:2,500

N
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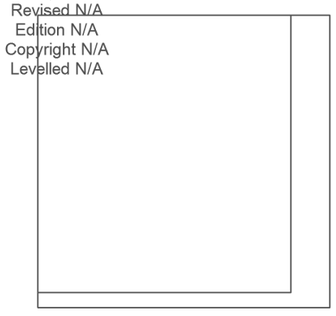
Surveyed N/A
Revised N/A
Edition N/A
Copyright N/A
Levelled N/A



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Production date: 14 January 2019

Map legend available at:
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Groundsure INSIGHTS

Site Details:

LAND WEST OF 41, FORT ROAD, HALSTEAD, SEVENOAKS, TN14 7BS

Client Ref: C-10730-C_Fort_Halstead_PO_P028025
Report Ref: GS-5746913_LS_1_2
Grid Ref: 548770, 159280

Map Name: National Grid

Map date: **1961-1963**

Scale: 1:2,500

Printed at: 1:2,500

N
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Surveyed 1961
Revised 1961
Edition N/A
Copyright 1963
Levelled 1952

Surveyed N/A
Revised N/A
Edition N/A
Copyright N/A
Levelled N/A

Surveyed N/A
Revised N/A
Edition N/A
Copyright N/A
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