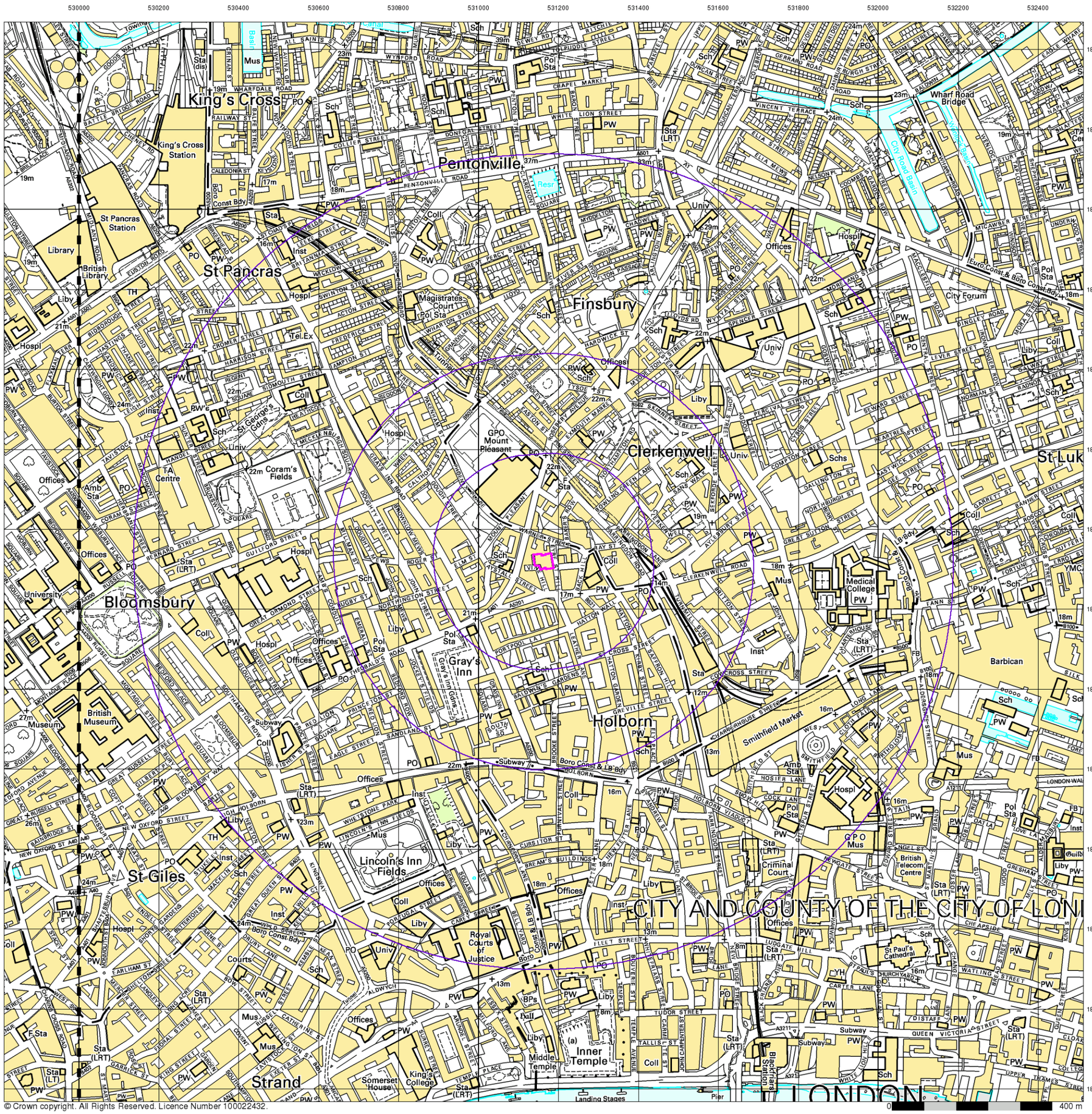


GEA

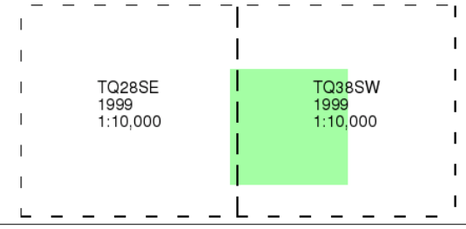
10k Raster Mapping

Published 1999

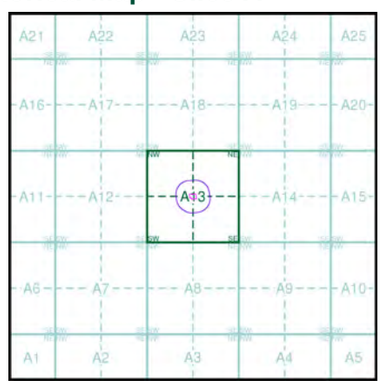
Source map scale - 1:10,000

The historical maps shown were produced from the Ordnance Survey`s 1:10,000 colour raster mapping. These maps are derived from Landplan which replaced the old 1:10,000 maps originally published in 1970. The data is highly detailed showing buildings, fences and field boundaries as well as all roads, tracks and paths. Road names are also included together with the relevant road number and classification. Boundary information depiction includes county, unitary authority, district, civil parish and constituency.

Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

Order Number:	158480127_1_1
Customer Ref:	J18042
National Grid Reference:	531160, 182120
Slice:	A
Site Area (Ha):	0.16
Search Buffer (m):	1000

Site Details

Flint Corporate & Marketing Communication, 18, Vine Hill, LONDON, EC1R 5DZ

Landmark INFORMATION GROUP
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

10k Raster Mapping

Published 2006

Source map scale - 1:10,000

The historical maps shown were produced from the Ordnance Survey`s 1:10,000 colour raster mapping. These maps are derived from Landplan which replaced the old 1:10,000 maps originally published in 1970. The data is highly detailed showing buildings, fences and field boundaries as well as all roads, tracks and paths. Road names are also included together with the relevant road number and classification. Boundary information depiction includes county, unitary authority, district, civil parish and constituency.

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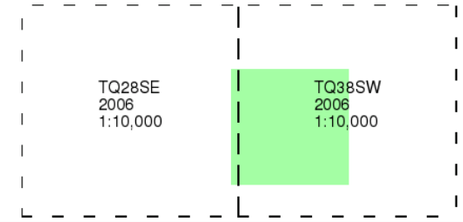

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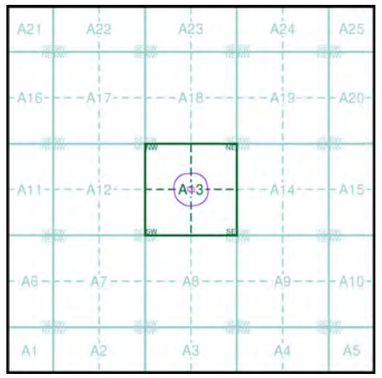

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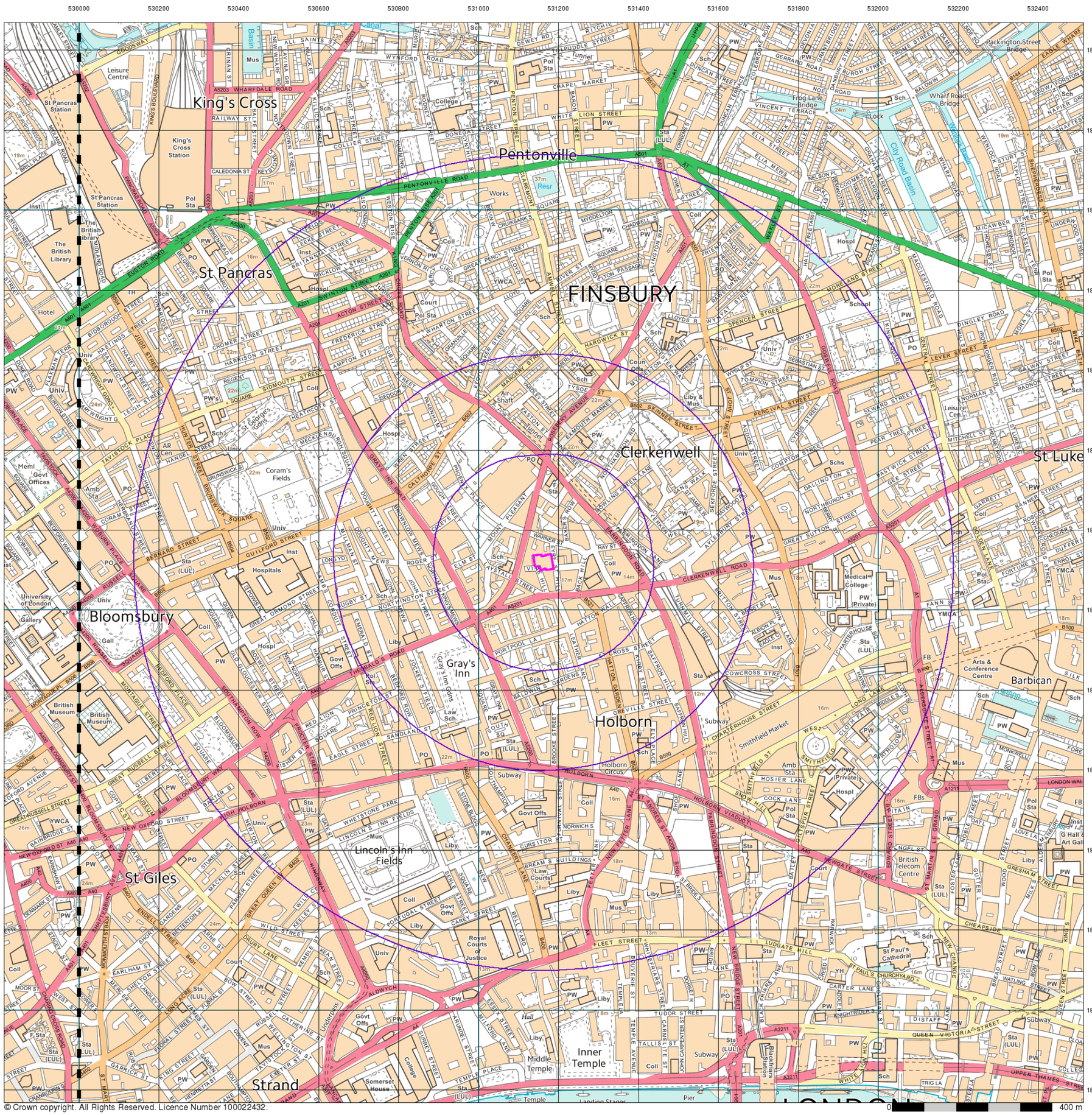


0 400 m

GEA

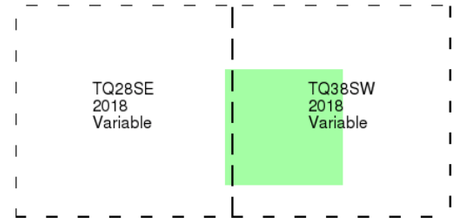
VectorMap Local

Published 2018

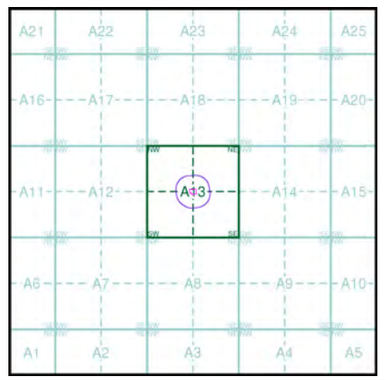
Source map scale - 1:10,000

VectorMap Local (Raster) is Ordnance Survey's highest detailed 'backdrop' mapping product. These maps are produced from OS's VectorMap Local, a simple vector dataset at a nominal scale of 1:10,000, covering the whole of Great Britain, that has been designed for creating graphical mapping. OS VectorMap Local is derived from large-scale information surveyed at 1:1250 scale (covering major towns and cities),1:2500 scale (smaller towns, villages and developed rural areas), and 1:10 000 scale (mountain, moorland and river estuary areas).

Map Name(s) and Date(s)



Historical Map - Slice A



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Detailed Unexploded Ordnance (UXO) Risk Assessment

Project Name	Ragged School
Client	GEA Ltd
Site Address	Ragged School, 18 Vine Hill & 15-29 Eyre St Hill
Report Reference	DA6188-00
Date	26th March 2018
Originator	AT

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Company No: 7717863 VAT No: 128 8833 79

www.1stlinedefence.co.uk

1st Line Defence Limited

Unit 3, Maple Park, Essex Road, Hoddesdon, Herts. EN11 0EX

Tel: +44 (0)1992 245 020 info@1stlinedefence.co.uk

Executive Summary

Site Location and Description

The site is currently located in the area of Holburn, in the London Borough of Camden, between the roads of Vine Hill to the west and Eyre Street Hill to the east. Warner Street and Clerkenwell Road are the two closest streets to the north and south respectively.

The site is currently occupied by a mix of multi-storey buildings, mostly in the west of the site, and hard-standing land in use as car parking in the east of the site.

The site is approximately centred on the OS grid reference: **TQ 3117282122**

Proposed Works

It is proposed to refurbish the existing Former Ragged School building (18 Vine Hill) and to construct a new hotel with a single or two-storey basement in the car park / garage area (15-29 Eyre St Hill). Ground investigation works are believed to be taking place on site prior to any construction.

Geology and Bomb Penetration Depth

The British Geological Survey (BGS) map shows the bedrock geology of the site to be underlain by the London Clay Formation – clay, silt and sand, of the Palaeogene Period. The superficial deposits are comprised of Sand and Gravel of the Quaternary Period.

Site specific geotechnical information was not available to 1st Line Defence at the time of the production of this report. An assessment of maximum bomb penetration depth can be made once such data becomes available, or by a UXO specialist during on-site support.

It should be noted that the maximum depth that a bomb could reach may vary across a site and will be largely dependent on the specific underlying geological strata and its density.

UXO Risk Assessment

1st Line Defence has assessed that there is a **Medium Risk** from items of unexploded German aerial delivered and Allied ordnance across the site. This assessment is based on the following factors:

- The site was situated in the Metropolitan Borough of Holborn during WWII. According to Home Office statistics, this borough received 921.2 items per 1,000 acres, the highest bomb density within London and the country.
- London bomb census mapping, both consolidated and weekly, record one bomb strike on the site's south-western border. The Holborn Record Of Air Raid Incidents, obtained from Camden Archives, records this strike in roughly the same place in May 1941.
- LCC Bomb damage mapping records 'damage requiring demolition' to the structures immediately west of the site during the war. The area in the east of the site is marked as 'cleared by the War Debris & Disposal Service'. This means that this area was likely cleared before any damage could be attributed to it, meaning that it was either damaged by bombing or in such a poor condition that it was cleared regardless.
- The western part of the site, which was occupied by a large multi-storey structure, was likely accessed frequently throughout the war. The eastern part of the site was likely accessed less frequently, as it does not appear to have been occupied with structures throughout the war and was cleared by 1942. This section appears on 1945 photography to be undeveloped hard-standing land, post-clearance. While the groundcover in the west of the site, which was occupied by a large multi-storey building, would have been conductive to the evidence of UXO, this would not have been the case in the east of the site.
- Evidence from bomb mapping, damage mapping and incident records suggests that at least one strike occurred within the site's immediate proximity, to the west of the site. This caused significant damage. The eastern area of the site was marked as cleared on damage mapping. It is not know what caused this clearance. It is possible that this part of the site was in such a poor condition that it was cleared during the destruction of damaged properties. The combination of both this area and the bombing and damage recorded to the west of the site, means that no area of the site can be considered as 'low risk', due to the 'J-curve effect'. A buffer zone has been placed around the damaged/cleared areas to account for the possibility that a UXB can end its trajectory at a lateral offset from point of entry – sometimes ending up beneath structures which survived the war intact.

UXO Risk Assessment

- There is no evidence that the site formerly had any military occupation or usage that could have led to contamination with items of Allied ordnance, such as LSA and SAA. The conditions in which HAA or LAA projectiles may have fallen unnoticed within the site boundary are however analogous to those regarding aerial delivered ordnance.
- The site does not appear to have been significantly developed post-war. The building in the west of the site does not appear to have changed, while the east of the site is occupied by hard-standing land. The risk from deep-buried unexploded bombs is only considered mitigated at locations where post war piling or deep foundations have taken place. Any smaller developments may have mitigated the risk from shallow-buried items somewhat.

Recommended Risk Mitigation Measures

The following risk mitigation measures are recommended to support the proposed works at the Ragged School site:

All Works

- Site Specific UXO Awareness Briefings to all personnel conducting intrusive works.

Open Intrusive Works (trial pits, service pits, open excavations, shallow foundations etc.)

- UXO Specialist On-site Support

Boreholes and Piled Foundations

- Intrusive Magnetometer Survey of all borehole and pile locations/clusters down to maximum bomb penetration depth.

Glossary

Abbreviation	Definition
AA	Anti-Aircraft
AFS	Auxiliary Fire Service
AP	Anti-Personnel
ARP	Air Raid Precautions
AWAS	Air Warfare Analysis Section
DA	Delay-action
EOC	Explosive Ordnance Clearance
EOD	Explosive Ordnance Disposal
FP	Fire Pot
GM	G Mine (Parachute mine)
HAA	Heavy Anti-Aircraft
HE	High Explosive
IB	Incendiary Bomb
LAA	Light Anti-Aircraft
LCC	London County Council
LRRB	Long Range Rocket Bomb (V-2)
LSA	Land Service Ammunition
MOL	Molotov (Incendiary Bomb)
OB	Oil Bomb
PAC	Pilotless Aircraft (V-1)
PB	Phosphorous Bomb
PM	Parachute Mine
POW	Prisoner Of War
RAF	Royal Air Force
RCAF	Royal Canadian Air Force
RFC	Royal Flying Corps
RNAS	Royal Naval Air Service
ROF	Royal Ordnance Factory
SA	Small Arms
SAA	Small Arms Ammunition
SD1000	1,000kg high explosive bomb
SD2	Anti-personnel “Butterfly Bomb”
SIP	Self-Igniting Phosphorous
U/C	Unclassified bomb
UP	Unrotated Projectile (rocket)
USAAF	United States Army Air Force
UX	Unexploded
UXAA	Unexploded Anti-Aircraft
UXB	Unexploded Bomb
UXO	Unexploded Ordnance
V-1	Flying Bomb (Doodlebug)
V-2	Long Range Rocket
WAAF	Women’s Auxiliary Air Force
X	Exploded

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Annex B	Recent Aerial Photography
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Annex F	Historical Aerial Photographs of the Site
Annex G	The 'J-curve' Effect Principle
Annex H	Examples of German Air Delivered Ordnance
Annex I	Examples of UXO Incidents
Annex J	London WWI Bomb Plot Map
Annex K	London WWII Bomb Density Map
Annex L	London Civil Defence Region ARP Bomb Census Mapping
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1st Line Defence Limited
Detailed Unexploded Ordnance (UXO) Risk Assessment

Site: Ragged School
Client: GEA Ltd

1. Introduction

1.1. Background

1st Line Defence has been commissioned by GEA Ltd to conduct a Detailed Unexploded Ordnance (UXO) Risk Assessment for the proposed works at the Ragged School site.

Buried UXO can present a significant risk to construction works and development projects. The discovery of a suspect device during works can cause considerable disruption to operations as well as cause unwanted delays and expense.

UXO in the UK can originate from three principal sources:

1. Munitions resulting from wartime activities including German bombing in WWI and WWII, long range shelling, and defensive activities.
2. Munitions deposited as a result of military training and exercises.
3. Munitions lost, burnt, buried or otherwise discarded either deliberately, accidentally, or ineffectively.

This report will assess the potential factors that may contribute to the risk of UXO contamination. If an elevated risk is identified at the site, this report will recommend appropriate mitigation measures, in order to reduce the risk to as low as is reasonably practicable. Detailed analysis and evidence will be provided to ensure an understanding of the basis for the assessed risk level and any recommendations.

This report complies with the guidelines outlined in *CIRIA C681*, 'Unexploded Ordnance (UXO) A Guide for the Construction Industry'.

2. Method Statement

2.1. Report Objectives

The aim of this report is to conduct a comprehensive assessment of the potential risk from UXO at the Ragged School site. The report will also recommend appropriate site and work-specific risk mitigation measures to reduce the risk from explosive ordnance during the envisaged works to a level that is as low as reasonably practicable.

2.2. Risk Assessment Process

1st Line Defence has undertaken a five-step process for assessing the risk of UXO contamination:

1. The risk that the site was contaminated with UXO.
2. The risk that UXO remains on the site.
3. The risk that UXO may be encountered during the proposed works.
4. The risk that UXO may be initiated.
5. The consequences of initiating or encountering UXO.

In order to address the above, 1st Line Defence has taken into consideration the following factors:

- Evidence of WWI and WWII German aerial delivered bombing as well as the legacy of Allied occupation.
- The nature and conditions of the site during WWII.
- The extent of post-war development and UXO clearance operations on site.
- The scope and nature of the proposed works and the maximum assessed bomb penetration depth.
- The nature of ordnance that may have contaminated the proposed site area.

2.3. Sources of Information

Every reasonable effort has been made to ensure that relevant evidence has been consulted and presented in order to produce a thorough and comprehensible report for the client. To achieve this the following, which includes military records and archive material held in the public domain, have been accessed:

- The National Archives, Kew
- Historical mapping datasets.
- Historic England National Monuments Record.
- Relevant information supplied by GEA Ltd.
- Available material from 33 Engineer Regiment (EOD) Archive.
- 1st Line Defence's extensive historical archives, library and UXO geo-datasets.
- Open sources such as published books and internet resources.

Research involved a visit to The National Archives.

2.4. General Considerations of Historical Research

This desktop assessment is based largely upon analysis of historical evidence. Every reasonable effort has been made to locate and present significant and pertinent information. 1st Line Defence cannot be held accountable for any changes to the assessed risk level or risk mitigation measures, based on documentation or other data that may come to light at a later date, or which was not available to 1st Line Defence during the production of this report.

It is often problematic and sometimes impossible to verify the completeness and accuracy of WWII-era records. As a consequence, conclusions as to the exact location and nature of a UXO risk can rarely be quantified and are to a degree subjective. To counter this, a range of sources have been consulted and analysed. The same methodology is applied to each report during the risk assessment process. 1st Line Defence cannot be held responsible for any inaccuracies or the incompleteness in available historical information.

3. Background to Bombing Records

During WWII bombing records were gathered by the police, Air Raid Precaution (ARP) wardens and military personnel. Records were maintained in the form of local and regional written records, maps depicting the locations of individual strikes, and maps indicating the levels of damage sustained by structures. Records typically documented when, where and what types of bombs had fallen during an air raid. Records of bomb strikes were made either through direct observation or by post-raid surveys. The immediate priority was focused on assisting casualties and minimising damage. As a result some records were incomplete and contradictory.

The quality, detail and nature of record keeping could vary considerably between boroughs and towns. No two areas identically collated or recorded data. While some local authorities maintained records with a methodical approach, sources in certain areas can be considerably more vague, dispersed, and narrower in scope. Many records were even damaged or destroyed in subsequent bombing raids. Records of raids that took place on sparsely or uninhabited areas were often based upon third party or hearsay information and are therefore not always reliable. Furthermore, records of attacks on military or strategic targets were often maintained separately from the general records and have not always survived.

4. Background to Allied Records

During WWII considerable areas of land were requisitioned by the army for the purpose of defence, training, and the construction of airfields and facilities for munitions production. Records relating to military features vary and some may remain censored. Within urban environments datasets will be consulted detailing the location of munition production as well as air and land defences. In rural locations it may be possible to obtain plans of airfields and military establishments, as well as operational training logs, plans and personal memoirs.

5. UK Regulatory Environment

5.1. General

There is no formal obligation requiring a UXO risk assessment to be undertaken for construction projects in the UK, nor is there any specific legislation stipulating the management or mitigation of UXO risk. However, it is implicit in the legislation outlined below that those responsible for intrusive works (archaeology, site investigation, drilling, piling, excavation etc.) should undertake a comprehensive and robust assessment of the potential risks to employees and that mitigation measures are implemented to address any identified hazards.

5.2. CDM Regulations 2015

The Construction (Design and Management) Regulations 2015 (CDM 2015) define the responsibilities of parties involved in the construction of temporary or permanent structures.

The CDM 2015 establishes a duty of care extending from clients, principle co-ordinators, designers, and contractors to those working on, or affected by, a project. Those responsible for construction projects may therefore be accountable for the personal or proprietary loss of third parties, if correct health and safety procedure has not been applied.

Although the CDM does not specifically reference UXO, the risk presented by such items is both within the scope and purpose of the legislation. It is therefore implied that there is an obligation on parties to:

- Provide an appropriate assessment of potential UXO risks at the site (or ensure such an assessment is completed by others).
- Put in place appropriate risk mitigation measures if necessary.
- Supply all parties with information relevant to the risks presented by the project.
- Ensure the preparation of a suitably robust emergency response plan.

5.3. The 1974 Health and Safety at Work etc. Act

All employers have a responsibility under the Health and Safety at Work etc. Act 1974 and the Management of Health and Safety at Work Regulations 1999, to ensure the health and safety of their employees and third parties, so far as is reasonably practicable and conduct suitable and sufficient risk assessments.

5.4. Additional Legislation

In the event of a casualty resulting from the failure of an employer/client to address the risks relating to UXO, the organisation may be criminally liable under the Corporate Manslaughter and Corporate Homicide Act 2007.

6. Role of Commercial UXO Contractors and The Authorities

6.1. Commercial UXO Contractors

In the event that a risk of UXO contamination is detected at the proposed site, the support of a UXO specialist may be recommended. A UXO specialist may be able to avoid unnecessary call-outs to the authorities through the disposal or removal of low risk items. In addition a specialist will assist in the swift recognition of high risk items, and will thereafter co-ordinate with the local authority with the objective of causing minimal levels of disruption to site operations, whilst putting in place safe and appropriate measures.

For more information on the role of commercial UXO specialists, see *CIRIA C681*.

6.2. The Authorities

The police have a responsibility to co-ordinate the emergency services in the event of an ordnance-related incident at a construction site. Upon inspection they may impose a safety cordon, order an evacuation, and call the military authorities Joint Services Explosive Ordnance Disposal (JSEOD) to arrange for investigation and/or disposal. In the absence of a UXO specialist, police officers will usually employ such precautionary safety measures, thereby causing works to cease, and possibly requiring the evacuation of neighbouring businesses and properties.

The priority given to the police request will depend on JSEOD's judgement of the nature of the UXO risk, the location, people and assets at risk, as well as the availability of resources. The speed of response varies; authorities may respond immediately or in some cases it may take several days for the item of ordnance to be dealt with.

Depending on the on-site risk assessment the item of ordnance may be removed from the site and/or destroyed by a controlled explosion. The latter process is lengthy and may necessitate the establishment of addition cordons and evacuations.

Following the removal of an item of UXO, the military authorities will only undertake further investigations or clearances in high risk situations. If there are regular UXO finds on a site the JSEOD may not treat each occurrence as an emergency and will recommend the construction company puts in place alternative procedures, such as the appointment of a commercial contractor to manage the situation.

7. The Site

7.1. Site Location

The site is currently located in the area of Holburn, in the London Borough of Camden, between the roads of Vine Hill to the west and Eyre Street Hill to the east. Warner Street and Clerkenwell Road are the two closest streets to the north and south respectively.

The site is approximately centred on the OS grid reference: **TQ 3117282122**

Site location maps are presented in **Annex A**.

7.2. Site Description

The site is currently occupied by a mix of multi-storey buildings, mostly in the west of the site, and hard-standing land in use as car parking in the east of the site.

A recent aerial photograph and site plan are presented in **Annex B** and **Annex C** respectively.

8. Scope of the Proposed Works

8.1. General

It is proposed to refurbish the existing Former Ragged School building (18 Vine Hill) and to construct a new hotel with a single or two-storey basement in the car park / garage area (15-29 Eyre St Hill). Ground investigation works are believed to be taking place on site prior to any construction.

9. Ground Conditions

9.1. General Geology

The British Geological Survey (BGS) map shows the bedrock geology of the site to be underlain by the London Clay Formation – clay, silt and sand, of the Palaeogene Period. The superficial deposits are comprised of Sand and Gravel of the Quaternary Period.

9.2. Site Specific Geology

Site specific geotechnical data was not available during the production of this report.

10. Site History

10.1. Introduction

The purpose of this section is to identify the composition of the site pre and post-WWII. It is important to establish the historical use of the site, as this may indicate the site's relation to potential sources of UXO as well as help with determining factors such as the land use, groundcover, likely frequency of access and signs of bomb damage.

10.2. Ordnance Survey Historical Maps

Relevant historical maps were obtained for this report and are presented in **Annex D.** See below for a summary of the site history shown on acquired mapping.

WWI Period		
Date	**Scale**	**Description**
1916	1:2,500	This map shows that an institute occupied the western part of the site, while the eastern part of the site was occupied with structures and part of a road.

Post-WWII		
Date	**Scale**	**Description**
1952 – 1953	1:1,250	This map shows that while the western part of the site was still occupied with structures, the eastern part of the site looks to have been cleared, apart from three new buildings in the south of the site. The road has moved eastwards, and now does not appear as part of the site.
1965 – 1968	1;2,500	The site does not appear to have significantly changed since the previous map edition. Some construction may have occurred in the eastern part of the site.
1976	1:1,250	The site does not appear to have significantly changed since the previous map edition. Some construction appears to have occurred in the eastern part of the site.

10.3. Goad Fire Insurance Mapping

Available pre and post-WWII fire insurance plans for the site were obtained by 1st Line Defence. These are comprehensive street plans detailing the structure and uses of individual buildings. The plans were originally designed to assist the fire insurance industry. See **Annex E** for the mapping with the site boundary outlined accordingly.

During WWII	
Date	**Description**
1942	The western part of the site is occupied by buildings, while the eastern part of the site is currently vacant. This map does not appear to show wartime damage.

Post-WWII	
Date	**Description**
1951	The buildings within the west of the site do not appear to have significantly changed since the previous map edition. Three new temporary structures have been constructed in the east of the site. The area immediately west of the site is labelled as 'cleared due to enemy action'.
1967	The majority of structures within the site do not appear to have changed since the previous map edition.

10.4. Historical Aerial Photographs of the Site

Historical aerial photographs have been consulted from the Aerofilms collection available from Britain From Above. These photographs provide a view of the site in 1934 & 1947 (see **Annex F**). See below for a description of each photograph.

Title of Photograph	**Comments**
General Post Office Mount Pleasant complex and environs, Clerkenwell, 1934	This oblique aerial image shows the site to appear similar to the 1916 historic OS mapping edition. The large building in the west of the site can be seen, along with the majority of the smaller structures in the east of the site. These structures do not appear to be in a good condition.
The Bourne Estate and environs, Holborn, 1947	This oblique image shows the site post-war. The structures in the east of the site have been fully cleared, matching up with the 1942 Goad Mapping. Clearance also appears to have taken place to the west of the site, along with a large area of clearance to the north-east of the site, on the other side of Eyre Street Hill.

11. Aerial Bombing Introduction

11.1. General

During WWI and WWII, many towns and cities across the UK were subjected to bombing which often resulted in extensive damage to city centres, docks, rail infrastructure and industrial areas. The poor accuracy of WWII targeting technology and the nature of bombing techniques often resulted in neighbouring areas to targets sustaining collateral damage.

In addition to raids which concentrated on specific targets, indiscriminate bombing of large areas also took place, this occurred most prominently in the London 'Blitz', though affected many other towns and cities. As discussed in the following sections, a proportion of the bombs dropped on the UK did not detonate as designed. Although extensive efforts were made to locate and deal with these UXBs at the time, many still remain buried and can present a potential risk to construction projects.

The main focus of research for this report will concern German aerial delivered weapons dropped during WWII, although WWI bombing will also be considered.

11.2. Generic Types of WWII German Aerial-delivered Ordnance

An understanding of the type and characteristics of the ordnance used by the Luftwaffe during WWII allows an informed assessment of the hazards posed by any unexploded items that may remain in situ on a site.

Generic Types of WWII German Aerial Delivered Ordnance		
Type	**Frequency**	**Likelihood of detection**
High Explosive (HE) bombs	In terms of weight of ordnance dropped, HE bombs were the most frequently deployed by the Luftwaffe during WWII.	Although efforts were made to identify the presence of unexploded ordnance following an air raid, often the damage and destruction caused by detonated bombs made observation of UXB entry holes impossible. The entry hole of an unexploded bomb can be as little as 20cm in diameter and was easily overlooked in certain ground conditions (see **Annex H**). Furthermore, ARP documents describe the danger of assuming that damage, actually caused by a large UXB, was due to an exploded 50kg bomb. UXBs therefore present the greatest risk to present–day intrusive works.
Aerial or Parachute mines (PM)	There were deployed less frequently than HE and IBs due to size, cost and the difficulty of deployment.	If functioning correctly, PMs generally would have had a slow rate of descent and were very unlikely to have penetrated the ground. Where the parachute failed, mines would have simply shattered on impact if the main charge failed to explode. There have been extreme cases when these items have been found unexploded. However, in these scenarios, the ground was either extremely soft or the munition fell into water.
1kg Incendiary bombs (IB)	In terms of the number of weapons dropped, small IBs were the most numerous. Millions of these were dropped throughout WWII.	IBs had very limited penetration capability and in urban areas would often have been located in post-raid surveys. If they failed to initiate and fell in water, on soft vegetated ground, or bombed rubble, they could have gone unnoticed.
Large Incendiary bombs (IB)	These were not as common as the 1kg IBs, although they were more frequently deployed than PMs and AP bomblets.	If large IBs did penetrate the ground, complete combustion did not always occur and in such cases they could remain a risk to intrusive works.
Anti-personnel (AP) bomblets	These were not commonly used and are generally considered to pose a low risk to most works in the UK.	SD2 bomblets were packed into containers holding between 6 and 108 submunitions. They had little ground penetration ability and should have been located by the post-raid survey unless they fell into water, dense vegetation or bomb rubble.

Images and brief summaries of the characteristics of the above listed German aerial delivered ordnance are presented in **Annex G**.

11.3. Failure Rate of German Aerial-delivered Ordnance

It has been estimated that 10% of WWII German aerial delivered HE bombs failed to explode as designed. Reasons for why such weapons might have failed to function as designed include:

- Malfunction of the fuze or gain mechanism (manufacturing fault, sabotage by forced labour or faulty installation).
- Many were fitted with a clockwork mechanism that could become immobilised on impact.
- Failure of the bomber aircraft to arm the bombs due to human error or an equipment defect.
- Jettisoning the bomb before it was armed or from a very low altitude. This most likely occurred if the bomber aircraft was under attack or crashing.

From 1940 to 1945 bomb disposal teams dealt with a total of 50,000 explosive items of 50kg, over, 7,000 anti-aircraft projectiles and 300,000 beach mines. Unexploded ordnance is still regularly encountered across the UK, see press articles in **Annex I**.

11.4. V-Weapons

Hitler's 'V-weapon' campaign began from mid-1944. It used newly developed unmanned cruise missiles and rockets. The V-1 known as the *flying bomb* or *pilotless aircraft* and the V-2, a long range rocket, were launched from bases in Germany and occupied Europe. A total of 2,419 V-1s and 517 V-2s were recorded in the London Civil Defence region alone.

Although these weapons caused considerable damage their relatively low numbers allowed accurate records of strikes to be maintained. These records have mostly survived. There is a negligible risk from unexploded V-weapons on land today since even if the 1,000kg warhead failed to explode, the weapons are so large that they would have been observed and the risk dealt with at the time. Therefore, V-weapons are referenced in this report not as a viable risk factor, but primarily in order to help account for evidence of damage and clearance reported.

12. UXB Ground Penetration

12.1. General

An important consideration when assessing the risk from a UXB is the likely maximum depth of burial. There are several factors which determine the depth that an unexploded bomb will penetrate:

- Mass and shape of bomb.
- Height of release.
- Velocity and angle of bomb.
- Nature of the ground cover.
- Underlying geology.

Geology is perhaps the most important variable. If the ground is soft, there is a greater potential of deeper penetration. For example, peat and alluvium are easier to penetrate than gravel and sand, whereas layers of hard strata will significantly retard and may stop the trajectory of a UXB.

12.2. The J-Curve Effect

J-curve is the term used to describe the characteristic curve commonly followed by an aerial delivered bomb dropped from height after it penetrates the ground. Typically, as the bomb is slowed by its passage through underlying soils, its trajectory curves towards the surface. Many UXBs are found with their nose cone pointing upwards as a result of this effect. More importantly however is the resulting horizontal offset from the point of entry. This is typically a distance of about one third of the bomb's penetration depth, but can be up to 15m.

12.3. WWII UXB Penetration Studies

During WWII the Ministry of Home Security undertook a major study on actual bomb penetration depths, carrying out statistical analysis on the measured depths of 1,328 bombs as reported by bomb disposal (BD) teams. Conclusions were made as to the likely average and maximum depths of penetration of different sized bombs in different geological strata.

For example, the largest common German bomb (500kg) had a likely concluded penetration depth of 6m in sand or gravel but 11m in clay. The maximum observed depth for a 500kg bomb was 11.4m and for a 1,000kg bomb 12.8m. Theoretical calculations suggested that significantly greater penetration depths were probable.

12.4. Site Specific Bomb Penetration Considerations

When considering an assessment of the bomb penetration at the site of proposed works the following parameters have been used:

- WWII geology – London Clay Formation.
- Impact angle and velocity – 10-15° from vertical and 270 metres per second.
- Bomb mass and configuration – The 500kg SC HE bomb, without retarder units or armour piercing nose (this was the largest of the common bombs used against Britain).

It has not been possible to determine maximum bomb penetration capabilities at this stage due to the lack or limitations of site specific borehole geotechnical information. An assessment can be made once such information becomes available or by an UXO Specialist on-site.

13. Initiation of Unexploded Ordnance

13.1. General

Unexploded ordnance does not spontaneously explode. All high explosive filling requires significant energy to create the conditions for detonation to occur. In the case of unexploded German bombs discovered within the construction site environment, there are a number of potential initiation mechanisms.

13.2. UXB Initiation Mechanisms

UXB Initiation	
Direct Impact	Unless the fuze or fuze pocket is struck, there needs to be a significant impact e.g. from piling or large and violent mechanical excavation, onto the main body of the weapon to initiate a buried iron bomb. Such violent action can cause the bomb to detonate.
Re- starting the Clockwork Fuze	A small proportion of German WWII bombs employed clockwork fuzes. It is probable that significant corrosion would have taken place within the fuze mechanism over the last 70+ years that would prevent clockwork mechanisms from functioning. Nevertheless, it was reported that the clockwork fuze in a UXB dealt with by 33 EOD Regiment in Surrey in 2002 did re-start.
Friction Impact	The most likely scenario resulting in the detonation of a UXB is friction impact initiating the shock-sensitive fuze explosive. The combined effects of seasonal changes in temperature and general degradation over time can cause explosive compounds to crystallise and extrude out from the main body of the bomb. It may only require a limited amount of energy to initiate the extruded explosive which could detonate the main charge.

Annex I details incidents where intrusive works have caused items of UXO to detonate, resulting in death or injury and damage to plant.

13.3. Effects of Detonation

When considering the potential consequences of a detonation, it is necessary to identify the significant receptors that may be affected. The receptors that may potentially be at risk from a UXO detonation on a construction site will vary depending on the site specific conditions but can be summarised as follows:

- People – site workers, local residents and general public.
- Plant and equipment – construction plant on site.
- Services – subsurface gas, electricity, telecommunications.
- Structures – not only visible damage to above ground buildings, but potentially damage to foundations and the weakening of support structures.
- Environment – introduction of potentially contaminating materials.

14. The Risk from German Air Delivered UXBs

14.1. World War I

During WWI London was targeted and bombed by Zeppelin Airships as well as Gotha and Giant fixed-wing aircraft. An estimated 250 tons of ordnance (high explosive and incendiary bombs) was dropped on Greater London, more than half of which fell on the City of London (see **Annex J** for a WWI bomb plot map of London).

Two significant WWI raids are shown to affect areas close to the site. A Zeppelin raid on the 8th/9th September 1915 dropped bombs over an area of central London, including Bedford Row to the north of the site. Another Zeppelin raid, on the 13th/14th October 1915 involved bombing incidents close to the site, at Gray's Inn. Whilst this shows bombing in areas close to the site, no WWI bombing is shown to have taken place within the site area or in an immediate proximity.

WWI bombs were generally smaller than those used in WWII and were dropped from a lower altitude. This resulted in limited UXB penetration depths. Aerial bombing was often such a novelty at the time that it attracted public interest and even spectators to watch the raids in progress. For these reasons there is a limited risk that UXBs passed undiscovered in the urban environment. When combined with the relative infrequency of attacks and an overall low bombing density the risk from WWI UXBs is considered low and will not be further addressed in this report.

14.2. World War II Bombing of Holborn

The Luftwaffe's main objective for the attacks on London was to inhibit the capital's commercial output. To achieve this they targeted the docks, warehouses, wharves, railway lines, factories and power stations. As the war progressed this strategy gradually changed to the indiscriminate bombing of civilian areas in an attempt to subvert public morale.

During WWII the site was located within the Metropolitan Borough of Holborn, which sustained a very high density of bombing as represented by bomb density data figures and maps, see **Annex K**. The density of bombing in Holborn can be attributed largely to its position in central London meaning that it was at the centre of the Luftwaffe's targeted campaign against the capital. Holborn is home to many historic buildings and commercial institutions that made obvious targets.

Records of bombing incidents in the civilian areas of London/the region were collected by the Air Raid Precautions wardens and collated by the Civil Defence Office. Some other organisations, such as the London Port Authority and railways, maintained separate records. Records would be in the form of typed or hand written incident notes, maps and statistics. Bombing data was carefully analysed, not only due to the requirement to identify those parts of the country most needing assistance, but also in an attempt to find patterns in the Germans' bombing strategy in order to predict where future raids might take place.

Records of bombing incidents for Holburn are presented in the following sections.

14.3. WWII Home Office Bombing Statistics

The following table summarises the quantity of German bombs (excluding 1kg incendiaries and anti-personnel bombs) falling on the Metropolitan Borough of Holborn between 1940 and 1945.

Record of German Ordnance Dropped on the Metropolitan Borough of Holborn		
Area Acreage		**406**
Weapons	High Explosive Bombs (all types)	354
	Parachute Mines	7
	Oil Bombs	8
	Phosphorus Bombs	0
	Fire Pot	0
	Pilotless Aircraft (V1)	4
	Long Range Rockets (V2)	1
Total		**374**
Number of Items per 1,000 acres		**921.2**

Source: Home Office Statistics
This table does not include UXO found during or after WWII.

Detailed records of the quantity and locations of the 1kg incendiary and anti-personnel bombs were not routinely maintained by the authorities as they were frequently too numerous to record. Although the risk relating to IBs is lesser than that relating to larger HE bombs, they were designed to inflict damage and injury and should therefore not be dismissed. Therefore, they should not be overlooked in assessing the general risk to personnel and equipment. Anti-personnel bombs were used in much smaller quantities and are rarely found today but are potentially more dangerous.

14.4. London Civil Defence Region ARP Bomb Census Maps

During WWII, the ARP Department within the Research and Experiments Branch of the Ministry of Home Security produced consolidated, weekly and V-1 pilotless aircraft bomb census maps for the London Civil Defence Region. These maps collectively shows the approximate locations of bombs, mines and rockets. The site area was checked on each available map sheet, those showing bomb incidents on and in the immediate vicinity of the site are discussed below and are presented in **Annexes L** & M.

London Consolidated Bomb Census Maps	
Date Range	**Comments**
Night Bombing up to 7th October 1940	No bomb strikes are recorded within the site and the immediate proximity of the site.
7th October 1940 to 6th June 1941	One bomb is recorded on the site's south-western border.

London Weekly Bomb Census Maps	
Date Range	**Comments**
7th to 14th October 1940	An Incendiary bomb 'shower' can be seen to the south-west of the site, along with a HE bomb to the south-east.
21st to 28th October 1940	One bomb strike can be seen to the north-east and south-east of the site respectively.
4th to 11th November 1940	One UXB and several bomb strikes can be seen to the south of the site.
30th December 1940 to 6th January 1941	An incendiary bomb shower can be seen to the north of the site.
5th to 12th May 1941	One bomb is recorded on the site's south-western border. Two further strikes are recorded to the north of the site.

V-1 Pilotless Aircraft Bomb Census Map	
Date Range	**Comments**
1944-45	No V1 strikes can be seen to be affecting the site and the site's proximity.

14.5. Holborn Record of Air Raid Incidents

Bomb incident records were obtained from the Camden Local Studies And Archives Centre. A transcript of the associated written records for bombs which fell in the site area is presented in the table below.

Holborn Record Of Air Raid Incidents	
Date Range	**Comments**
8th September 1940	One Incendiary bomb on Rosebery Avenue, in the roadway. Extinguished by wardens. A 50kg HE bomb fell on waste ground on Summer Street between Eyre Street Hill & Back Hill. No apparent damage.
16th September 1940	Incendiary bombing on Rosebery Avenue. No damage recorded.
27th September 1940	Incident recorded on Eyre Street Hill, but later recorded as 'nil'. The 'bomb strike' was found to be machine gun bullets.
11th October 1940	Incendiary bombing on Rosebery Square, Rosebery Avenue, Vine Hill & Eyre Street Hill. All bombs put out.
15th October 1940	Incendiary bombing on Rosebery Avenue, Vine Hill & Eyre Street Hill. Fire Brigade reported as dealing with the incidents. No casualties reported.
5th January 1941	Incendiary bombing on Rosebery Avenue & Eyre Street Hill. Fires put out.
8th March 1941	Incendiary bombing on Rosebery Square buildings, Rosebery Avenue. Fire put out.
10th May 1941	**One 250kg bomb on Vine Hill Buildings near Rosebery Square / Avenue. Severe damage to rear of buildings and adjoining premises. Incendiary bombs & fire recorded in the front of the buildings. Two recorded as dead.**
22nd March 1944	Damage was recorded as having been sustained from two HE bombs on Rosebery Square, Rosebery Avenue & Vine Hill. A large number of properties were registered as damaged in this incident. It is plausible that the cause of this was a parachute mine that exploded in the air.
6th July 1944	A V1 Flying bomb was recorded as having damaged number 37 Eyre Street Hill. The flying bomb actually landed in the Metropolitan Borough of Finsbury.

14.6. London County Council Bomb Damage Map

A map created by London County Council (LCC) showing the extent of bomb damage in the city was compiled during/after WWII. The section showing the area of the site is described in the table below and presented in **Annex N**.

LCC Bomb Damage Map	
Date Range	**Comments**
1940-1945	This mapping records damage requiring demolition' to the structures immediately west of the site during the war. The area in the east of the site is marked as 'cleared by the War Debris & Disposal Service'. This means that this area was likely cleared before any damage could be attributed to it, meaning that it was either damaged by bombing or in such a poor condition that it was cleared regardless.

14.7. WWII-Era Aerial Photography

A high resolution scan of WWII-era aerial photography for the site area was obtained from the National Monuments Record Office (Historic England). This photograph provides a record of the potential composition of the site during the war, as well as its condition immediately following the war (**see Annex O**).

WWII-Era Aerial Photography	
Date	**Description**
12th August 1945	This photography shows the site in 1945, immediately after the end of the war. The main building in the western part of the site can be seen. The eastern part of the site appears to be cleared. What appears to damage can be seen to the west of the site boundary. A large area of clearance can be seen on the eastern side of Eyre Street Hill.

14.8. Abandoned Bombs

A post air-raid survey of buildings, facilities, and installations would have included a search for evidence of bomb entry holes. If evidence of an entry hole was encountered, Bomb Disposal Officer Teams would normally have been requested to attempt to locate, render safe, and dispose of the bomb. Occasionally, evidence of UXBs was discovered but due to a relatively benign position, access problems, or a shortage of resources the UXB could not be exposed and rendered safe. Such an incident may have been recorded and noted as an 'abandoned bomb'.

Given the inaccuracy of WWII records and the fact that these bombs were 'abandoned', their locations cannot be considered definitive or the lists exhaustive. The MoD states that 'action to make the devices safe would be taken only if it was thought they were unstable'. It should be noted that other than the 'officially' abandoned bombs, there will inevitably be UXBs that were never recorded.

1st Line Defence holds no records of officially registered abandoned bombs at or near the site of the proposed works.

14.9. Bomb Disposal Tasks

The information service from the Explosive Ordnance Disposal (EOD) Archive Information Office at 33 Engineer Regiment (EOD) is currently facing considerable delay. It has therefore not been possible to include any updated official information regarding bomb disposal/clearance tasks with regards to this site. A database of known disposal/clearance tasks has been referred to which does not make reference to such instances occurring within the site of proposed works. If any relevant information is received at a later date GEA Ltd will be advised.

14.10. Evaluation of German Air Delivered UXB Risk

Factors	Conclusion
Density of Bombing *It is important to consider the bombing density when assessing the possibility that UXBs remain in an area. High levels of bombing density could allow for error in record keeping due to extreme damage caused to the area.*	The site was situated in the Metropolitan Borough of Holborn during WWII. According to Home Office statistics, this borough received 921.2 items per 1,000 acres, the highest bomb density within London and the country. London bomb census mapping, both consolidated and weekly, record one bomb strike on the site's south-western border. The Holborn Record Of Air Raid Incidents, obtained from Camden Archives, records this strike in roughly the same place in May 1941.
Damage *If buildings or structures on a site sustained bomb or fire damage any resulting rubble and debris could have obscured the entry holes of unexploded bombs dropped during the same, or later, raids. Similarly, a High Explosive bomb strike in an area of open agricultural land will have caused soil disturbance, increasing the risk that a UXB entry hole would be overlooked.*	LCC Bomb damage mapping records 'damage requiring demolition' to the structures immediately west of the site during the war. The area in the east of the site is marked as 'cleared by the War Debris & Disposal Service'. This means that this area was likely cleared before any damage could be attributed to it, meaning that it was either damaged by bombing or in such a poor condition that it was cleared regardless.
Access Frequency *UXO in locations where access was irregular would have a greater chance of passing unnoticed than at those that were regularly occupied. The importance of a site to the war effort is also an important consideration as such sites are likely to have been both frequently visited and subject to post-raid checks for evidence of UXO.*	The western part of the site, which was occupied by a large multi-storey structure, was likely accessed frequently throughout the war. The eastern part of the site was likely accessed less frequently, as it does not appear to have been occupied with structures throughout the war and was cleared at some point.
Ground Cover *The nature of the ground cover present during WWII would have a substantial influence on any visual indication that may indicate UXO being present.*	The western part of the site was occupied by buildings during the war. The eastern part of the site appears to have been cleared by 1942, and appears on 1945 photography to be undeveloped hard-standing land, post-clearance. While the groundcover in the west of the site would have been conductive to the evidence of UXO, this would not have been the case in the east of the site.
Bomb Failure Rate	There is no evidence to suggest that the bomb failure rate in the locality of the site would have been dissimilar to the 10% normally used.
Abandoned Bombs	1st Line Defence holds no records of abandoned bombs at or within the site vicinity.
Bombing Decoy sites	1st Line Defence could find no evidence of bombing decoy sites within the site vicinity.
Bomb Disposal Tasks	1st Line Defence could find no evidence of bomb disposal tasks within the site boundary and immediate area.

15. The Risk from Allied Ordnance

15.1. General

The potential risk of encountering Allied ordnance on construction sites is particularly elevated in areas previously associated with military activity. This includes munitions deposited by military training exercises, dumped as a result of poor working practices, or deliberately placed to prevent adversary occupation and from other home defence activities. For example, contamination from items of Land Service (LSA) and Small Arms Ammunition (SAA) may result from historical occupation of an area or its use for military training.

It should be highlighted that there is no evidence that the site formerly had any military occupation or usage that could have led to contamination with such items of Allied ordnance. Despite this, urban areas such as the location of the site, can however be at risk from buried unexploded Anti-Aircraft projectiles fired during WWII – as addressed below.

15.2. Defending the UK From Aerial Attack

During WWII the Ministry of Defence employed a number of defence tactics against the Luftwaffe from bombing major towns, cities, manufacturing areas, ports and airfields. These can be divided into passive and active defences (examples are provided in the table below).

Active Defences	Passive Defences
• Anti-aircraft gun emplacements to engage enemy aircraft. • Fighter aircraft to act as interceptors. • Rockets and missiles were used later during WWII.	• Blackouts and camouflaging to hinder the identification of Luftwaffe targets. • Decoy sites were located away from targets and used dummy buildings and lighting to replicate urban, military, or industrial areas. • Barrage balloons forced enemy aircraft to greater altitudes. • Searchlights were often used to track and divert adversary bomber crews during night raids.

Active defences such as anti-aircraft artillery present a greater risk of UXO contamination than passive defences. Unexploded ordnance resulting from dogfights and fighter interceptors is rarely encountered and difficult to accurately qualify.

15.3. Anti-Aircraft Artillery (AAA)

During WWII three main types of gun sites existed: heavy anti-aircraft (HAA), light anti-aircraft (LAA) and 'Z' batteries (ZAA). If the projectiles and rockets fired from these guns failed to explode or strike an aircraft they would descend back to land. The table below provides further information on the operation and ordnance associated with these type of weapons.

Anti-Aircraft Artillery				
Item	**Description**			
HAA	These large calibre guns such as the 3.7" QF (Quick Firing) were used to engage high flying enemy bombers., They often fired large HE projectiles, which were usually initiated by integral fuzes triggered by impact, area, time delay or a combination of aforementioned mechanisms The closest HAA was located approximately 3.7km south-west of the site, however the range of a projectile can be up to 15km.			
LAA	These mobile guns were intended to engage fast, low flying aircraft. They were typically rotated between locations on the perimeters of towns and strategically important industrial works. As they could be moved to new positions with relative ease when required, records of their locations are limited. The most numerous of these were the 40mm Bofors gun which could fire up to 120 x 40mm HE projectiles per minute to over 1,800m.			
Variations in HAA and LSA Ammunition	**Gun type**	**Calibre**	**Shell Weight**	**Shell Dimensions**
	3.0 Inch	76mm	7.3kg	76mm x 356mm
	3.7 Inch	94mm	12.7kg	94mm x 438mm
	4.5 Inch	114mm	24.7kg	114mm x 578mm
	40mm	40mm	0.9kg	40mm x 311mm
Z-AA	The three inch unrotated rocket/projectile known as the UP-3 had initially been developed for the Royal Navy. The UP-3 was also used in ground-based single and 128-round launchers known as ''Z'' batteries. The rocket, containing a high explosive warhead was often propelled by cordite.			
29mm Spigot Mortars (Blacker Bombards)	This was an infantry anti-tank weapon. A heavy steel rod (spigot) would be driven into the hollow tail of a projectile to ignite the explosive charge located in the rear of the projectile, and lead to it being propelled toward a target. It was not an effective method of air defence and was mainly used in defensive positons at key locations. If encountered, a spigot mortar projectile will resemble a mortar round, but with an elongated metal tail rod.			
Quick Firing (QF) 1 and 2 Pounder	QF 1 and 2 Pounders, or 'pom poms' were a light battery most often used by the navy. During the beginning of WWII they were used to defend targets in the absence of more effective LAA or HAA.			
Machine Gun Posts	These were established at some significant military and industrial positions. Machine guns were a largely ineffective form of AAA. Machine guns usually fired the .303 Round.			

The conditions in which an HAA or LAA projectiles may have fallen unnoticed within a site area are analogous to those regarding aerial delivered ordnance. For detailed analysis on the ground conditions and access frequency within the proposed site, see the evaluation of German Bombing Records in, **Section 14.10**

Unexploded HAA ammunition is likely to be found close to WWII ground level. If encountered, the high explosive fill and fragmentation hazard of these items could present a significant risk to workers and equipment.

40mm projectiles are similar in appearance and effect to SAA. However, they remain dangerous as they were fitted with an impact initiated explosive fuse that may cause harm if detonated.

Spigot mortar rounds do not lose their efficacy over time. If encountered they are likely to be unstable and easily initiated. If initiated a spigot mortar may result in harm and damage to persons and plant.

Z-battery rounds do not lose their effectiveness with age. Z-battery rockets were filled with a TNT based compound. If initiated the projectile may result in harm and damage to persons and plant.

If encountered, a QF pom pom round is comparable to a 40mm projectile.

Illustrations of Anti-Aircraft artillery, projectiles and rockets are presented at **Annex P**.

15.4. Evaluation of Allied Ordnance Risk

1st Line Defence has considered the following potential sources of Allied ordnance contamination:

Sources of Contamination	Conclusion
Military Camps *Military camps present an elevated risk from ordnance simply due to the large military presence and likelihood of associated live ordnance training.*	1st Line Defence could find no evidence of a military camp within the site.
Anti-Aircraft Defences *Anti-Aircraft defences were employed across the country. Proximity to anti-aircraft defences increases the chance of encountering AA projectiles.*	1st Line Defence could find no evidence of Anti-Aircraft defences such as a HAA or LAA gun emplacement occupying or bordering the site. The closest HAA was located approximately X.Xkm north-east of the site, however the range of a projectile can be up to 15km. The conditions in which HAA or LAA projectiles may have fallen unnoticed within a site footprint are analogous to those regarding German aerial delivered ordnance.
Home Guard Activity *The Home Guard regularly undertook training and ordnance practice in open areas, as well as burying ordnance as part of anti-invasion defences.*	Evidence of Home Guard training areas and activities is difficult to obtain. 1st Line Defence has no evidence of any Home Guard activities on the site.
Defensive Positions *Defensive positions suggest the presence of military activity, which is often indicative of ordnance storage, usage or disposal.*	There is no evidence of any defensive features formerly located on or bordering the site footprint.
Training or firing ranges *Areas of ordnance training saw historical ordnance usage in large numbers, often with inadequate disposal of expended and live items. The presence of these ranges significantly impact on the risk of encountering items of ordnance in their vicinity.*	There is no evidence of such features affecting the site.

Defensive Minefields *Minefields were placed in strategic areas to defend the country in the event of a German invasion. Minefields were not always cleared with an appropriate level of vigilance.*	There is no evidence of defensive minefields affecting the site.
Ordnance Manufacture *Ordnance manufacture indicates an increased chance that items of ordnance were stored, or disposed of, within a location.*	No information of ordnance being stored, produced, or disposed of within the proposed site could be found.
Military Related Airfields *Military airfields present an elevated risk from ordnance simply due to the large military presence and likelihood of associated live ordnance training or bombing practice.*	The site was not situated within the perimeters or vicinity of a military airfield.

16. Ordnance Clearance and Post-WWII Ground Works

16.1. General

It is important to consider the extent to which any explosive ordnance clearance (EOC) activities or extensive ground works have occurred on site. This may indicate previous ordnance contamination or reduce the risk that ordnance remains undiscovered.

16.2. UXO Clearance

1st Line Defence has no evidence that any official ordnance clearance operations have taken place on site. Note however that we have not received confirmation of this fact from 33 EOD Regiment.

16.3. Post-war Redevelopment

The site does not appear to have been significantly developed post-war. The building in the west of the site does not appear to have changed, while the east of the site is occupied by hard-standing land. The risk from deep-buried unexploded bombs is only considered mitigated at locations where post war piling or deep foundations have taken place. Any smaller developments may have mitigated the risk from shallow-buried items somewhat.

17. 1st Line Defence Risk Assessment

17.1. Risk Assessment Stages

Taking into account the quality of the historical evidence, the assessment of the overall risk from unexploded ordnance is based on the following five considerations:

1. That the site was contaminated with unexploded ordnance.
2. That unexploded ordnance remains on site.
3. That such items will be encountered during the proposed works.
4. That ordnance may be initiated by the works operations.
5. The consequences of encountering or initiating ordnance.

UXO Risk Assessment	
Quality of the Historical Record	The research has located and evaluated pre- and post-WWII Ordnance Survey maps, London WWII ARP bomb plots from 1940 to 1945, Holborn written records, bomb damage mapping, in-house data and pre- and post-WWII aerial imagery of the site. In general, the presence of recorded bombing incidents is consistent with evidence of damage.
The Risk that the Site was Contaminated with UXO	After considering the following facts, 1st Line Defence has assessed that there is a **Medium Risk** that items of unexploded German aerial delivered and anti-aircraft ordnance could have fallen unrecorded within the site boundary. • The site was situated in the Metropolitan Borough of Holborn during WWII. According to Home Office statistics, this borough received 921.2 items per 1,000 acres, the highest bomb density within London and the country. • London bomb census mapping, both consolidated and weekly, record one bomb strike on the site's south-western border. The Holborn Record Of Air Raid Incidents, obtained from Camden Archives, records this strike in roughly the same place in May 1941. • LCC Bomb damage mapping records 'damage requiring demolition' to the structures immediately west of the site during the war. The area in the east of the site is marked as 'cleared by the War Debris & Disposal Service'. This means that this area was likely cleared before any damage could be attributed to it, meaning that it was either damaged by bombing or in such a poor condition that it was cleared regardless. • The western part of the site, which was occupied by a large multi-storey structure, was likely accessed frequently throughout the war. The eastern part of the site was likely accessed less frequently, as it does not appear to have been occupied with structures throughout the war and was cleared by 1942. This section appears on 1945 photography to be undeveloped hard-standing land, post-clearance. While the groundcover in the west of the site, which was occupied by a large multi-storey building, would have been conductive to the evidence of UXO, this would not have been the case in the east of the site. • Evidence from bomb mapping, damage mapping and incident records suggests that at least one strike occurred within the site's immediate proximity, to the west of the site. This caused significant damage. The eastern area of the site was marked as cleared on damage mapping. It is not know what caused this clearance. It is possible that this part of the site was in such a poor condition that it was cleared during the destruction of damaged properties. The combination of both this area and the bombing and damage recorded to the west of the site, means that no area of the site can be considered as 'low risk', due to the 'J-curve effect'. A buffer zone

	has been placed around the damaged/cleared areas to account for the possibility that a UXB can end its trajectory at a lateral offset from point of entry – sometimes ending up beneath structures which survived the war intact. • There is no evidence that the site formerly had any military occupation or usage that could have led to contamination with items of Allied ordnance, such as LSA and SAA. The conditions in which HAA or LAA projectiles may have fallen unnoticed within the site boundary are however analogous to those regarding aerial delivered ordnance.
The Risk that UXO Remains on Site	The site does not appear to have been significantly developed post-war. The building in the west of the site does not appear to have changed, while the east of the site is occupied by hard-standing land. The risk from deep-buried unexploded bombs is only considered mitigated at locations where post war piling or deep foundations have taken place. Any smaller developments may have mitigated the risk from shallow-buried items somewhat.
The Risk that UXO may be Encountered during the Works	The most likely scenarios under which items of UXO could be encountered during construction works is during piling, drilling operations or bulk excavations for basement levels. The risk of encountering will depend on the extent of the works, such as the numbers of boreholes/piles (if required) and the volume of the excavations. An aerial delivered bombs may come to rest at any depth between just below ground level and its maximum penetration depth. Consequently there is also a possibility that UXBs could be encountered during shallow excavations (for services or site investigations) into the original WWII ground level. There is not considered to be any significant risk of encountering UXO during works planned within the footprint and down to the depth of any post-war buildings/excavations. Beyond these depths and away from these areas, a risk of encounter could remain.
The Risk that UXO may be Initiated	The risk that UXO could be initiated if encountered will depend on its condition, how it is found, and the energy with which it is struck. Certain construction activities such as piling and percussive drilling pose a greater risk of initiating UXO in comparison to machine excavation, where the force of impact is generally lower and the item is more likely to be observed. If a UXB is struck by piling or percussive drilling equipment, the force of the impact can be sufficient to detonate the main high explosive charge irrespective of the condition of the fuze or other components. Violent vibration might also impart enough energy to a chemical detonator for it to function, and there is a potential risk that clockwork fuzes could restart. If piling works are planned at the Ragged School site, there is a potential risk that a UXB, if present, could be initiated. The risk of initiation is assessed to be lower for any shallow intrusive works planned.
The Consequences of Encountering or Initiating Ordnance	The repercussions of the inadvertent detonation of items of UXO during intrusive ground works are potentially severe, both in terms of human and financial cost. A serious risk to life and limb, damage to plant and total site shutdown during follow-up investigations are potential outcomes. If appropriate risk mitigation measures are undertaken, the chances of initiating an item of UXO during ground works is comparatively low. The primary consequence of encounter of UXO will therefore be economic. This would be particularly notable in the case of sites with a high-profile or where it is necessary to evacuate the public from the surrounding area. A site may be closed from a few hours to a week with potentially significant cost in lost time. It should be noted that even the discovery of suspected or possible items of UXO during intrusive works (if handled solely through the authorities), may also involve loss of

	production. Generally, the first action of the police in most cases will be to isolate the locale whilst awaiting military assistance, even if this becomes unnecessary.

17.2. Assessed Risk Level

Taking into consideration the findings of this study, 1st Line Defence has assessed that there is a **Medium Risk** from German and anti-aircraft unexploded ordnance at the site of proposed works.

Medium Risk

Ordnance Type	Risk Level			
	Negligible	Low	Medium	High
German Unexploded HE Bombs			✓	
German 1kg Incendiary Bombs			✓	
Anti-Aircraft Artillery Projectiles			✓	
Allied Military Land Service Ammunition (Grenades, Mortars etc.)	✓			

18. Proposed Risk Mitigation Methodology

18.1. General

The following risk mitigation measures are recommended to support the proposed works at the Ragged School site:

Type of Work	Recommended Mitigation Measure
All Works	• **Site Specific UXO Awareness Briefings to all personnel conducting intrusive works.** As a minimum precaution, all personnel working on the site should be briefed on the basic identification of UXO and what to do in the event of encountering a suspect item. This should in the first instance be undertaken by a UXO Specialist. Posters and information on the risk of UXO can be held in the site office for reference.
Shallow Intrusive Works/Open Excavations	• **Unexploded Ordnance (UXO) Specialist Presence on Site to support shallow intrusive works** When on site the role of the UXO Specialist would include: • Monitoring works using visual recognition and instrumentation, including immediate response to reports of suspicious objects or suspected items of ordnance that have been recovered by the ground workers on site. • Providing UXO awareness briefings to any uninformed staff and advise staff of the need to modify working practices to take account of the ordnance risk. • To aid incident management which would involve liaison with the local authorities and police should ordnance be identified and present an explosive hazard.
Borehole/Piles	• **Intrusive Magnetometer Survey of all borehole and pile locations down to a maximum bomb penetration depth:** 1st Line Defence can deploy a range of intrusive magnetometer techniques to clear pile locations. The appropriate technique is influenced by a number of factors, but most importantly the site's ground conditions. The appropriate survey methodology would be confirmed once the enabling works have been completed.

In making this assessment and recommending these risk mitigation measures, if known, the works outlined in the 'Scope of the Proposed Works' section were considered. Should the planned works be modified or additional intrusive engineering works be considered, 1st Line Defence should be consulted to see if a re-assessment of the risk or mitigation recommendations is necessary.

1st Line Defence Limited **26th March 2018**

This Report has been produced in compliance with the Construction Industry Research and Information Association (CIRIA) C681 guidelines for the writing of Detailed UXO Risk Assessments.

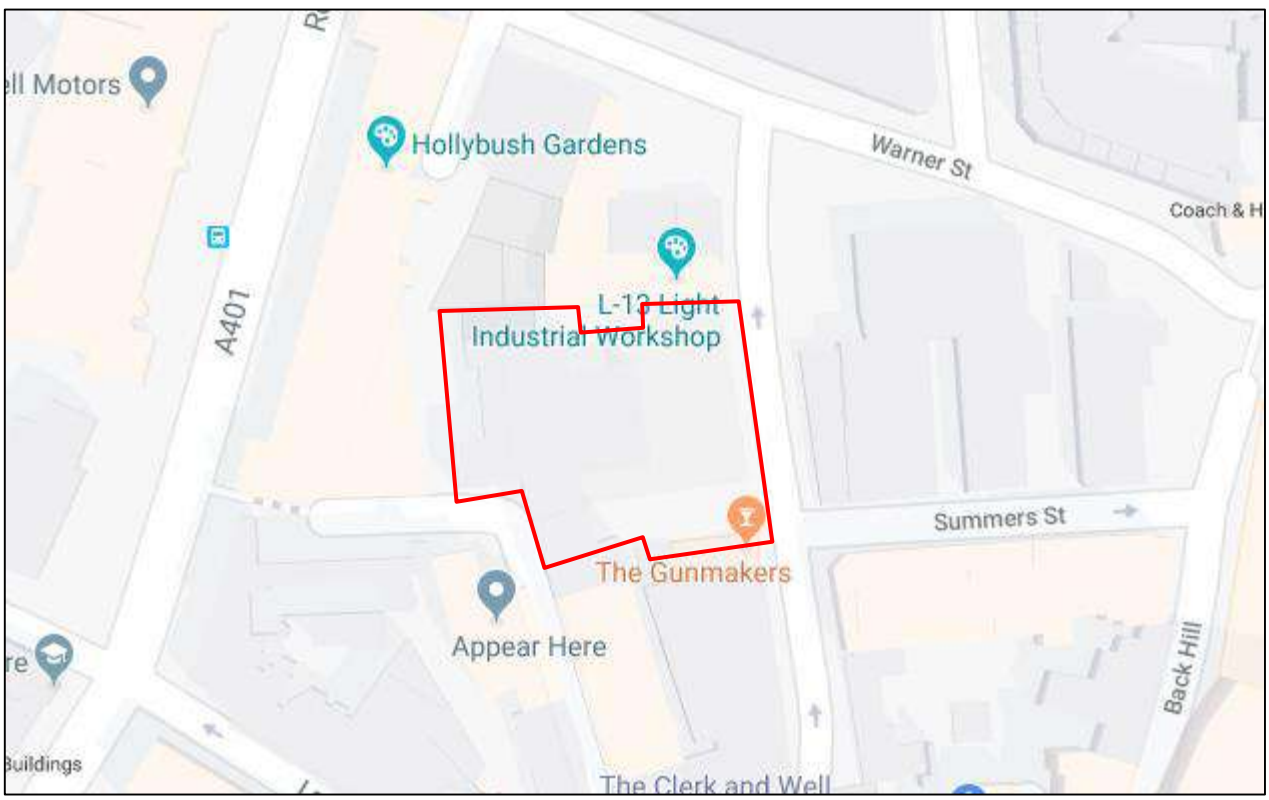
Bibliography

- Bates, H. E., *Flying Bombs over England*, Frogletts Publications Ltd., 1994
- Castle, I., *London 1914-17: The Zeppelin Menace*, Osprey Publications Ltd., 2008
- Castle, I., *London 1917-18: The Bomber Blitz*, Osprey Publications Ltd., 2010
- Dobinson, C., *AA Command: Britain's Anti-Aircraft Defences of the Second World War*, Methuen., 2001
- Fegan, T., *The 'Baby Killers': German Air raids on Britain in the First World War*, Leo Cooper Ltd., 2002
- Fleischer, W., *German Air-Dropped Weapons to 1945,* Midland Publishing., 2004
- Jappy, M. J., *Danger UXB: The Remarkable Story of the Disposal of Unexploded Bombs during the Second World War*, Channel 4 Books., 2001
- Morris, J., *German Air Raids on Britain: 1914 – 1918*, The Naval & Military Press., 1993
- Price, A., *Blitz on Britain, The Bomber Attacks on the United Kingdom 1939 – 1945*, Purnell Book Services Ltd., 1977
- Ramsey, W., *The Blitz Then and Now, Volume 1*, Battle of Britain Prints International Ltd., 1987
- Ramsey, W., *The Blitz Then and Now, Volume 2*, Battle of Britain Prints International Ltd., 1988
- Ramsey, W., *The Blitz Then and Now, Volume 3*, Battle of Britain Prints International Ltd., 1990
- Scofield, J., *Modern Military Matters*., Council for British Archaeology., 2004
- Stone, K., et al., *Unexploded Ordnance (UXO) A Guide For The Construction Industry (C681)*., CIRIA, 2009
- Ward, L., *The London County Council: Bomb Damage Maps: 1939 – 1945,* Thames and Hudson., 2015
- Whiting, C., *Britain Under Fire: The Bombing of Britain's Cities 1940-1945*, Pen & Sword Books Ltd., 1999

This report has been prepared by 1st Line Defence Limited with all reasonable care and skill. The report contains historical data and information from third party sources. 1st Line Defence Limited has sought to verify the accuracy and comprehensiveness of this information where possible but cannot be held accountable for any inherent errors. Furthermore, whilst every reasonable effort has been made to locate and access all relevant historical information, 1st Line Defence cannot be held responsible for any changes to risk level or mitigation recommendations resulting from documentation or other information which may come to light at a later date.

Site Location Maps

Annex: **A**



1ST LINE DEFENCE

Unit 3, Maple Park
Essex Road, Hoddesdon,
Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
Tel: +44 (0)1992 245 020

Client: **GEA Ltd**

Approximate site boundary

N

Project: **Ragged School**

Ref: **DA6188-00**

Source: Google Maps

Recent Aerial Photography

Annex: **B**

1ST LINE DEFENCE

Unit 3, Maple Park
Essex Road, Hoddesdon,
Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
Tel: +44 (0)1992 245 020

Client: **GEA Ltd**

Approximate site boundary

N

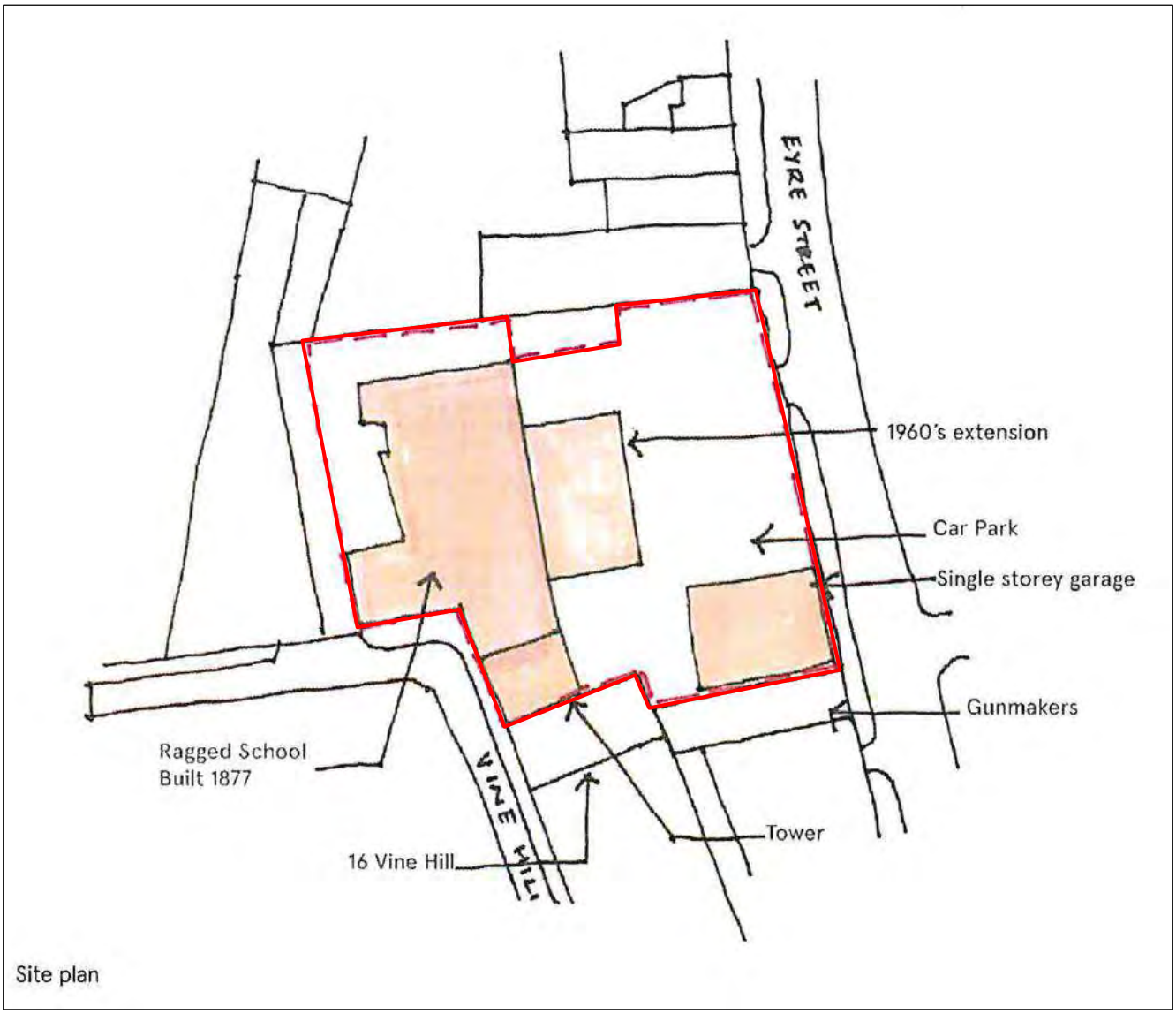
Project: **Ragged School**

Ref: **DA6188-00**

Source: Google Earth ™ Mapping Services

Client Provided Site Plan

Annex: **C**



Site plan

1ST LINE DEFENCE

Unit 3, Maple Park
Essex Road, Hoddesdon,
Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
Tel: +44 (0)1992 245 020

Client: **GEA Ltd**

Project: **Ragged School**

Ref: **DA6188-00**

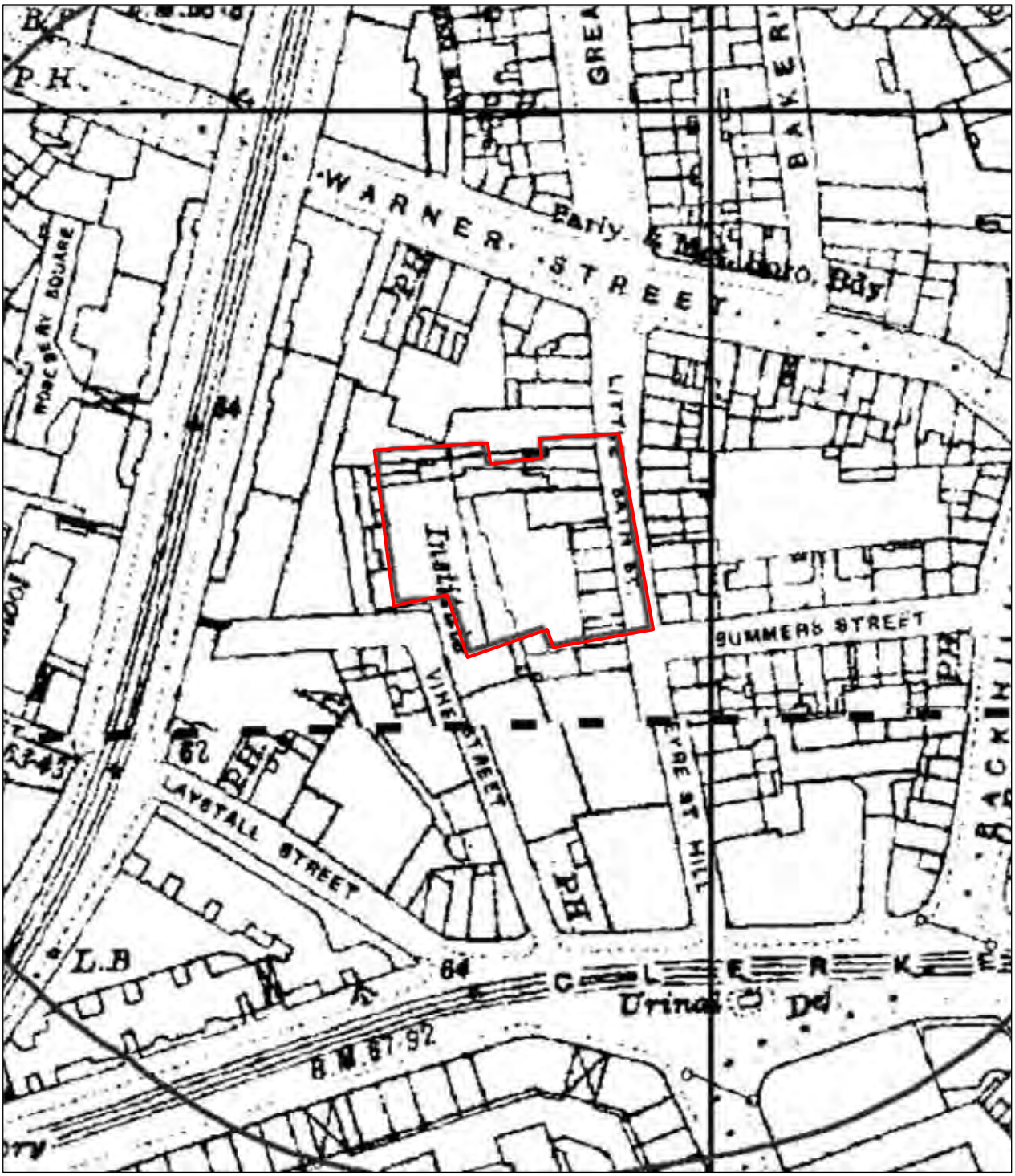
Source: GEA Ltd

Approximate site boundary

N

1916 Historical Map

Annex: **D1**



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Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
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Client: **GEA Ltd**

Project: **Ragged School**

Ref: **DA6188-00**

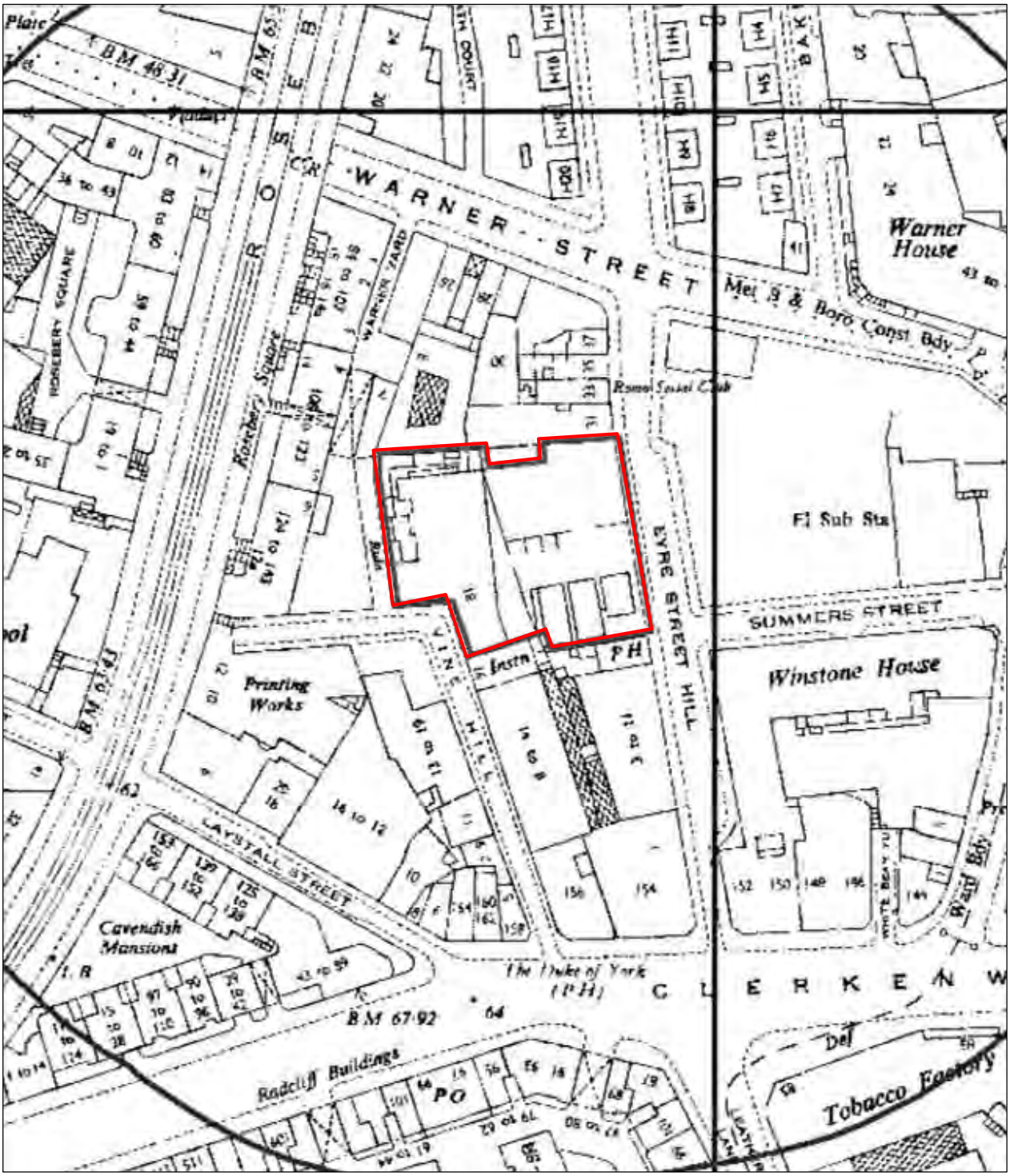
Source: Landmark Maps

Approximate site boundary

N

1952-53 Historical Map

Annex: **D2**



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Unit 3, Maple Park
Essex Road, Hoddesdon,
Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
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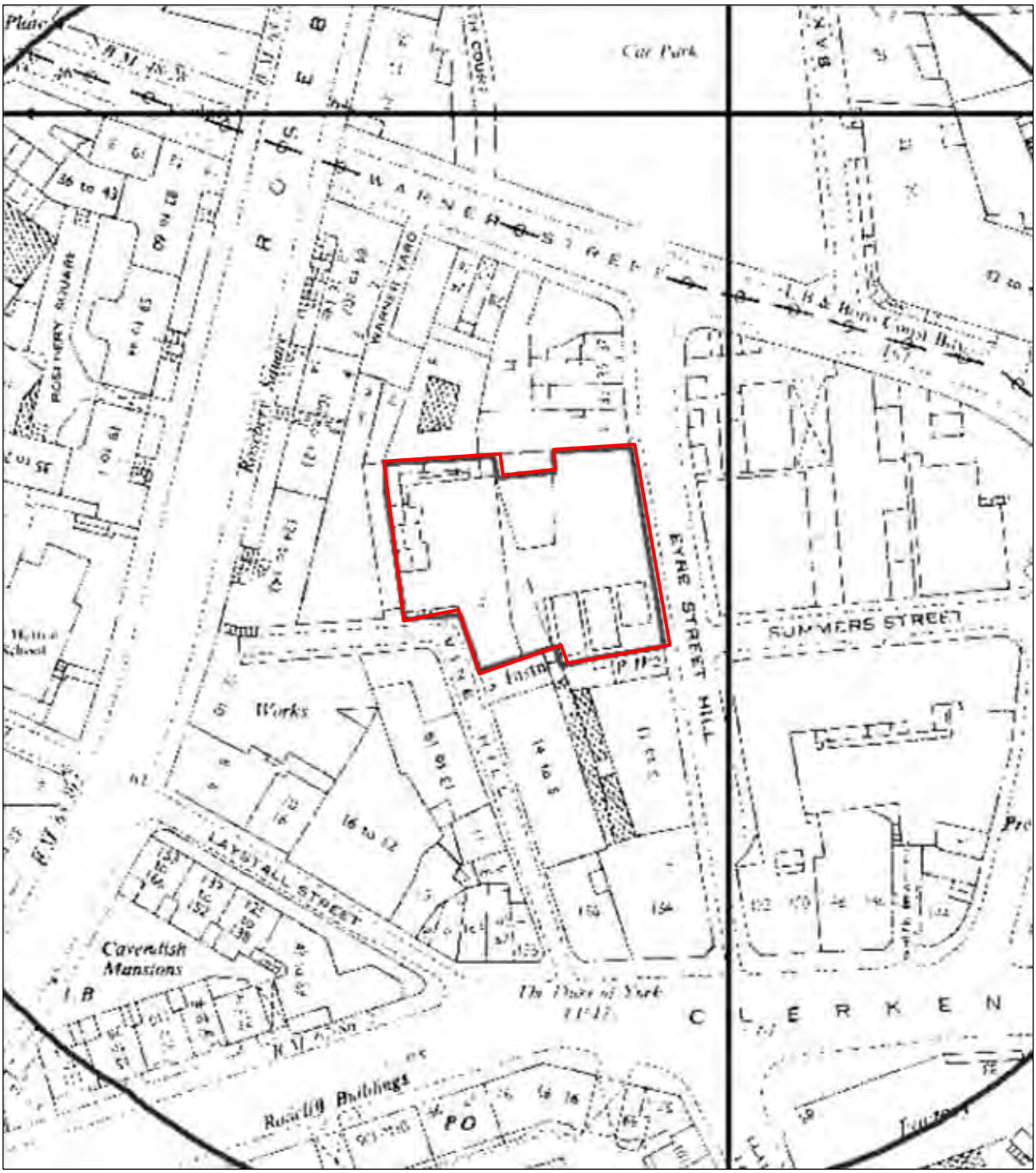
Client: **GEA Ltd**		**Approximate site boundary**	N
Project: **Ragged School**			
Ref: **DA6188-00**	Source: Landmark Maps		

1965-68 Historical Map

Annex: D3



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Essex Road, Hoddesdon,
Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
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Client: **GEA Ltd**

Project: **Ragged School**

Ref: **DA6188-00**

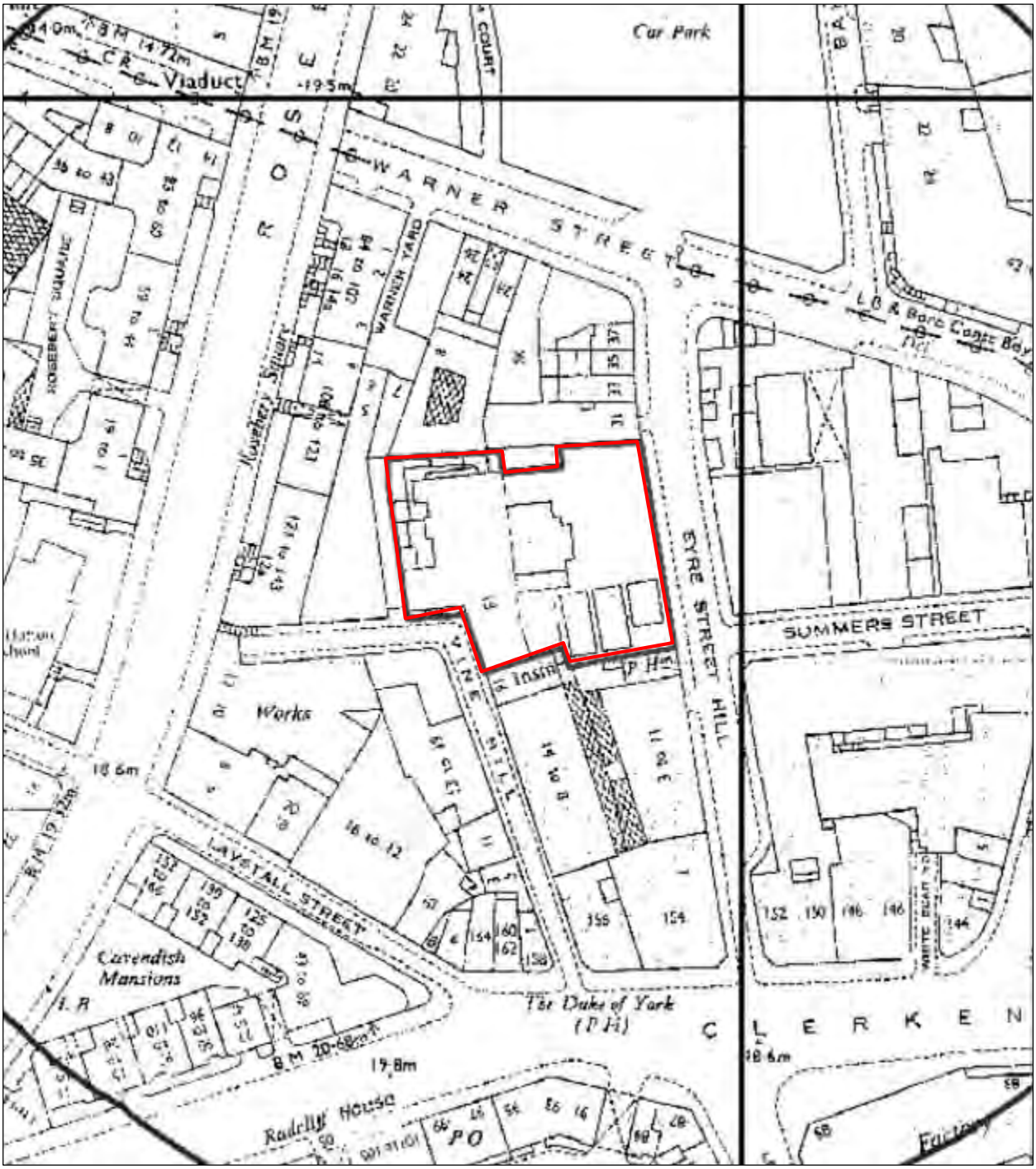
Source: Landmark Maps

Approximate site boundary

N

1976 Historical Map

Annex: D4



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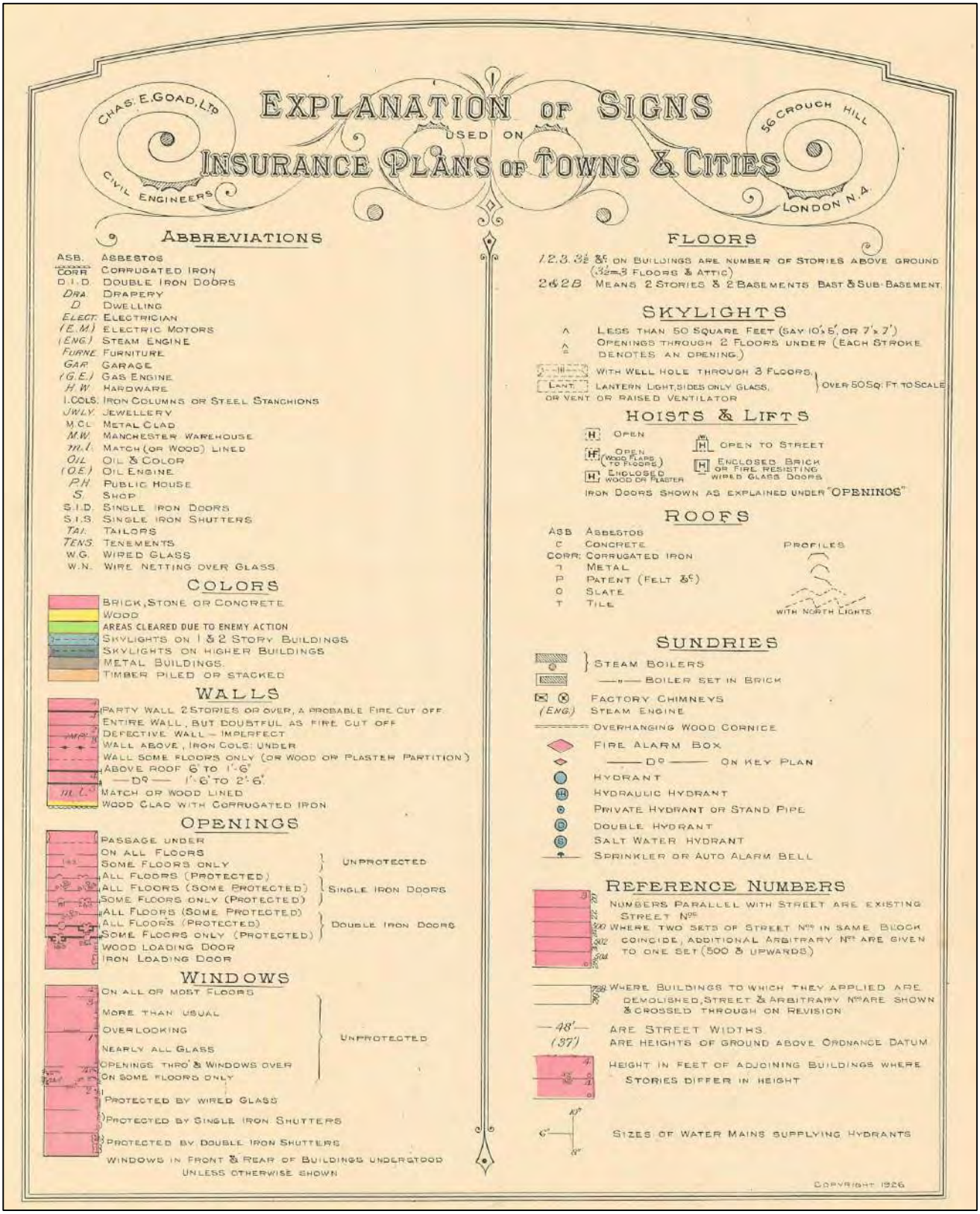
Unit 3, Maple Park
Essex Road, Hoddesdon,
Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
Tel: +44 (0)1992 245 020

Client:	**GEA Ltd**	**Approximate site boundary**	N
Project:	**Ragged School**		
Ref:	**DA6188-00**	Source: Landmark Maps	



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Email: info@1stlinedefence.co.uk
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Client: **GEA Ltd**

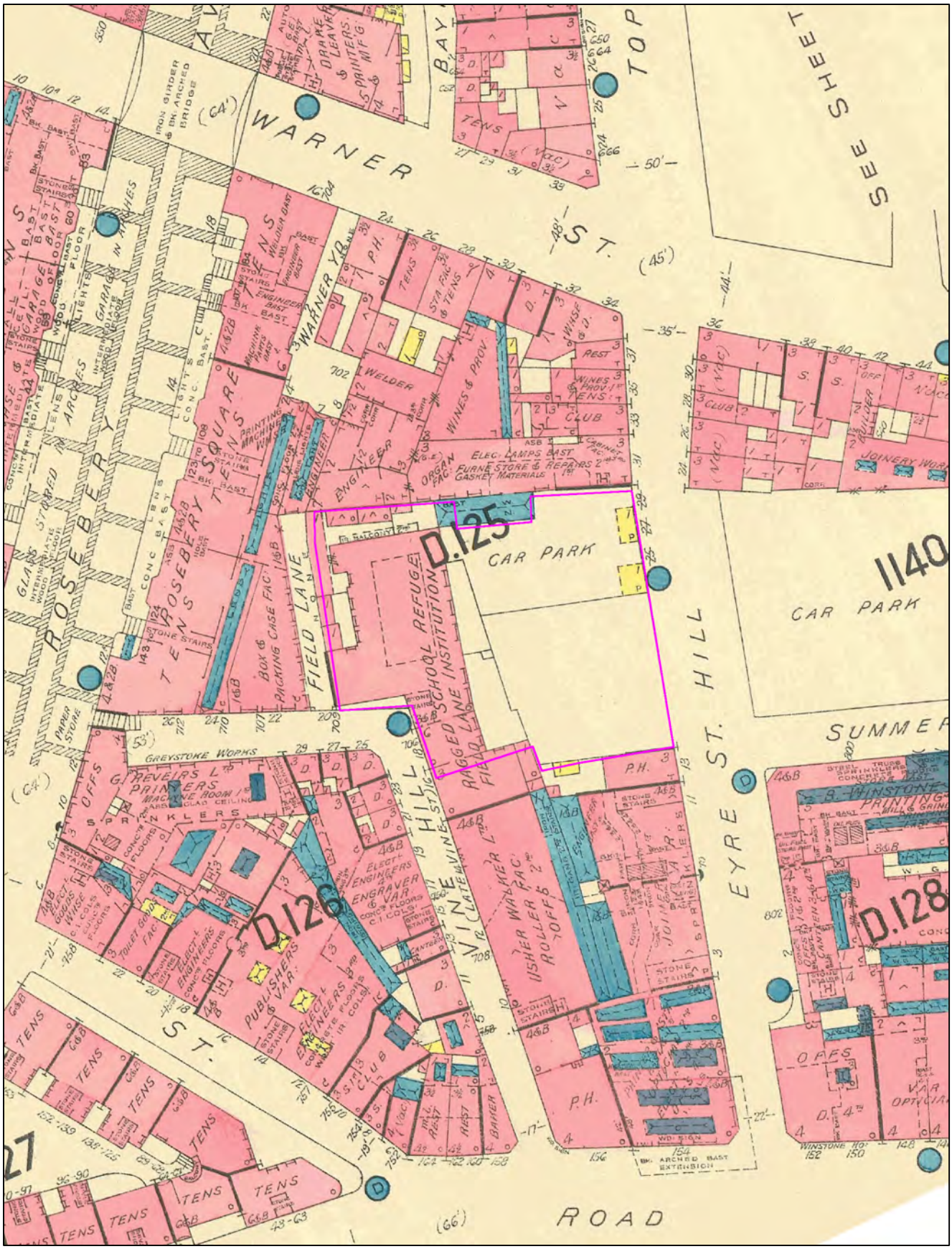
Project: **Ragged School**

Ref: **DA6188-00**

Source: Landmark Maps

Goad Mapping – 1942

Annex: **E2**



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Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
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Project: **Ragged School**

Ref: **DA6188-00**

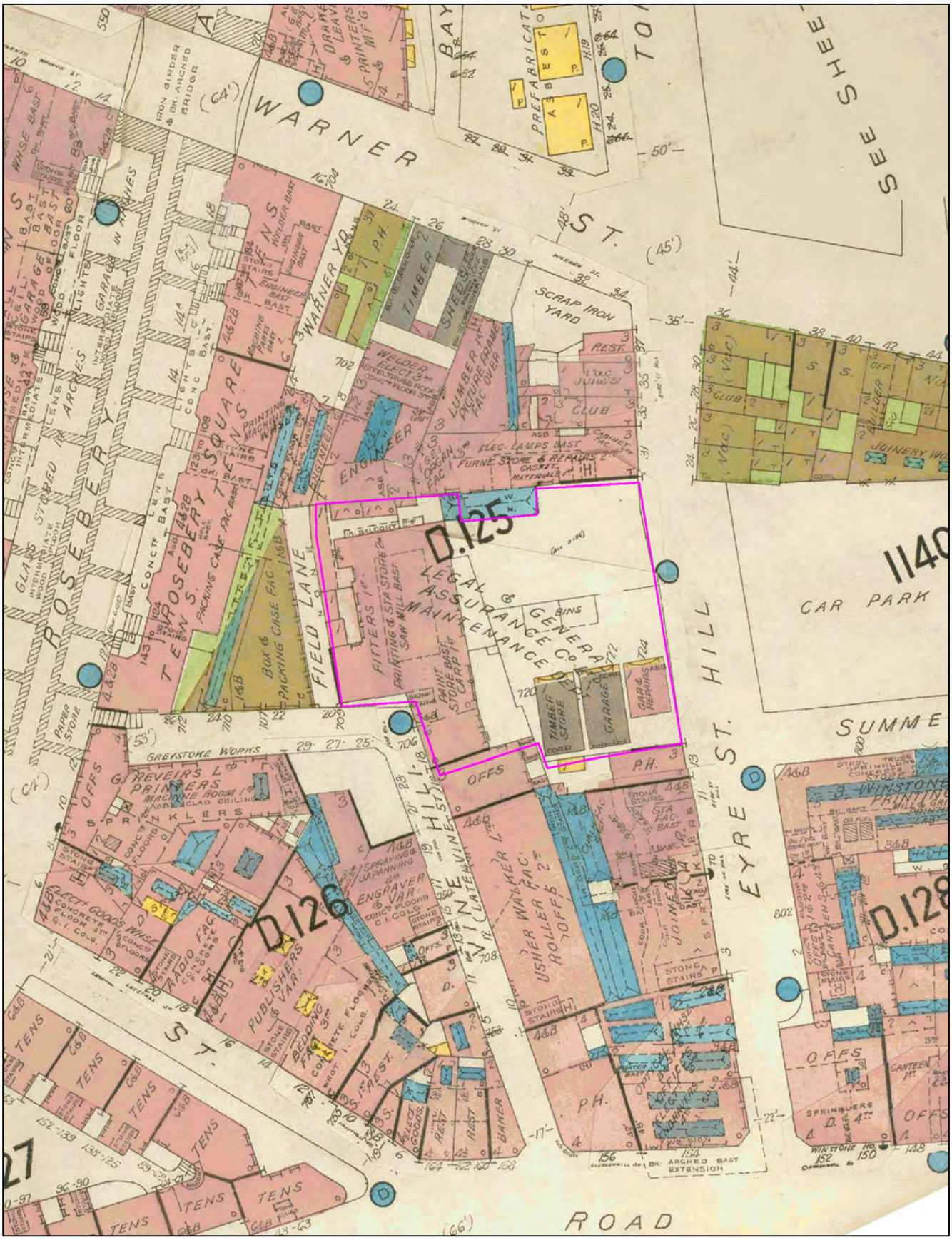
Source: Landmark Maps

Approximate site boundary

N

Goad Mapping – 1951

Annex: E3



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Unit 3, Maple Park
Essex Road, Hoddesdon,
Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
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Client: **GEA Ltd**

Project: **Ragged School**

Ref: **DA6188-00**

Source: Landmark Maps

Approximate site boundary

N

Goad Mapping – 1967

Annex: **E4**

1ST LINE DEFENCE

Unit 3, Maple Park
Essex Road, Hoddesdon,
Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
Tel: +44 (0)1992 245 020

Client: **GEA Ltd**

Project: **Ragged School**

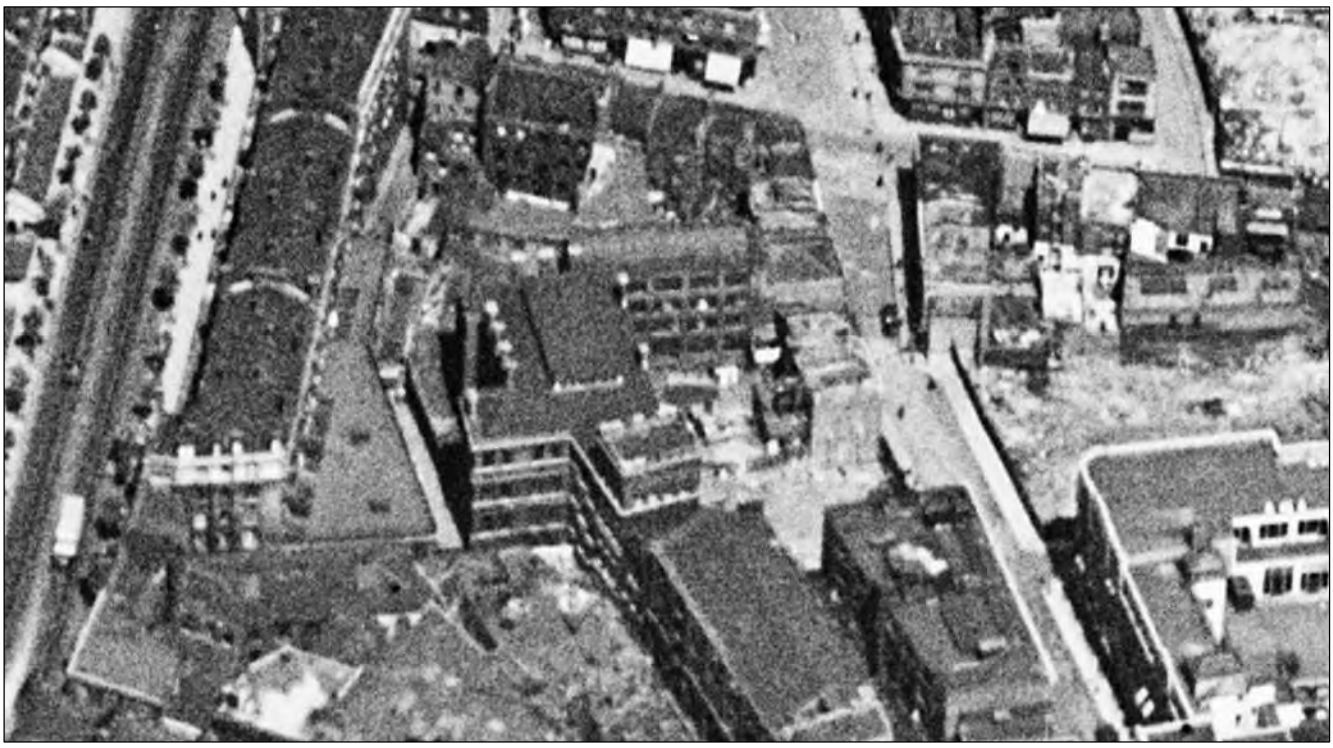
Ref: **DA6188-00**

Source: Landmark Maps

Approximate site boundary

N

1934 Aerial Oblique



1947 Aerial Oblique

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Unit 3, Maple Park
Essex Road, Hoddesdon,
Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
Tel: +44 (0)1992 245 020

Client: **GEA Ltd**

Project: **Ragged School**

Ref: **DA6188-00**

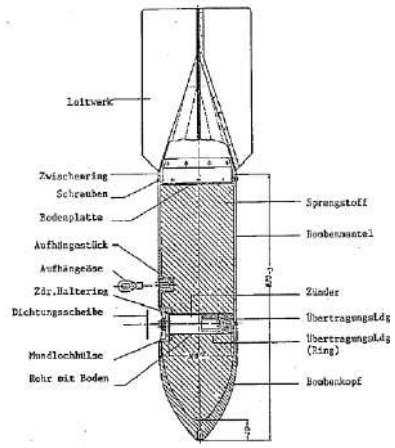
Source: Britain From Above

N

Examples of German Air-Delivered Ordnance

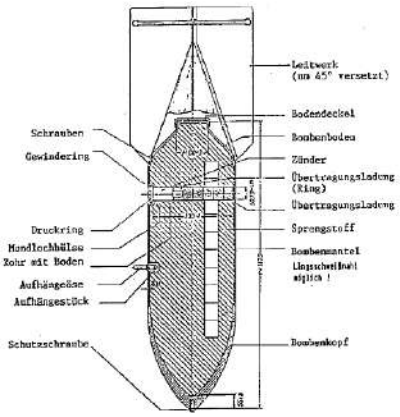
SC 50kg High Explosive Bomb

Bomb Weight	40-54kg (88-119lb)
Explosive Weight	c25kg (55lb)
Fuze Type	Impact fuze/electro-mechanical time delay fuze
Bomb Dimensions	1,090 x 280mm (42.9 x 11.0in)
Body Diameter	200mm (7.87in)
Use	Against lightly damageable materials, hangars, railway rolling stock, ammunition depots, light bridges and buildings up to three stories.
Remarks	The smallest and most common conventional German bomb. Nearly 70% of bombs dropped on the UK were 50kg.



SC 250kg High Explosive Bomb

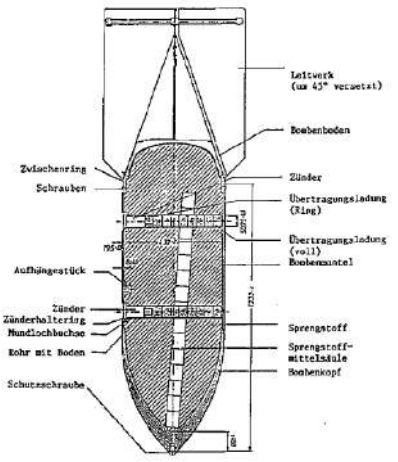
Bomb Weight	245-256kg (540-564lb)
Explosive Weight	125-130kg (276-287lb)
Fuze Type	Electrical impact/mechanical time delay fuze.
Bomb Dimensions	1640 x 512mm (64.57 x 20.16in)
Body Diameter	368mm (14.5in)
Use	Against railway installations, embankments, flyovers, underpasses, large buildings and below-ground installations.
Remarks	It could be carried by almost all German bomber aircraft, and was used to notable effect by the Junkers Ju-87 Stuka (Sturzkampfflugzeug or dive-bomber).



SC250 bomb being loaded onto German bomber

SC 500kg High Explosive Bomb

Bomb Weight	480-520kg (1,058-1,146lb)
Explosive Weight	250-260kg (551-573lb)
Fuze Type	Electrical impact/mechanical time delay fuze.
Bomb Dimensions	1957 x 640mm (77 x 25.2in)
Body Diameter	470mm (18.5in)
Use	Against fixed airfield installations, hangars, assembly halls, flyovers, underpasses, high-rise buildings and below-ground installations.
Remarks	40/60 or 50/50 Amatol TNT, trialene. Bombs recovered with Trialen filling have cylindrical paper wrapped pellets 1-15/16 in. in length and diameter forming



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Project: **Ragged School**

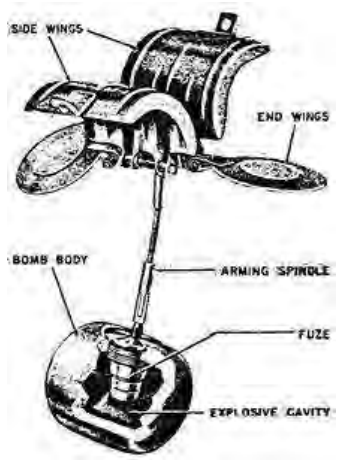
Ref: **DA6188-00**

Source: Various sources

Examples of German Air-Delivered Ordnance

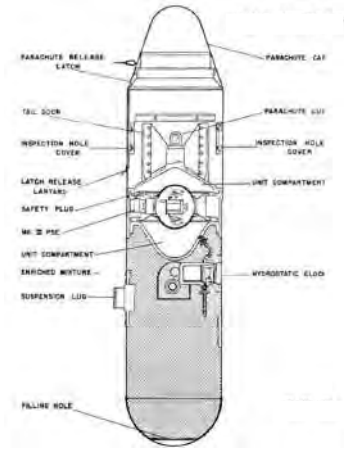
SD2 Anti-Personnel 'Butterfly Bomb'

Bomb Weight	2kg (4.41lb)
Explosive Weight	7.5oz (225 grams) of Amatol surrounded by a layer of bituminous composition.
Fuze Type	41 fuze (time) , 67 fuze (clockwork time delay) or 70 fuze (anti-handling device)
Body Diameter	3in (7.62 cm) diameter, 3.1in (7.874) long
Use	Designed as an anti-personnel/ fragmentation weapon. They were delivered by air, being dropped in containers of 23-144 sub-munitions that opened at a predetermined height, thus scattering the bombs.
Remarks	Very rare. First used against Ipswich in 1940, but were also dropped on Kingston upon Hull, Grimsby and Cleethorpes in June 1943, amongst various other targets in UK. As the bombs fell the outer case flicked open by springs which caused four light metal drogues with a protruding 5 inch steel cable to deploy in the form of a parachute & wind vane which armed the device as it span.



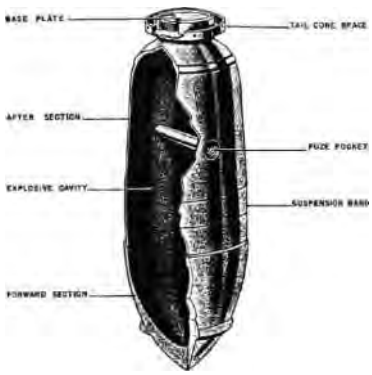
Parachute Mine (Luftmine B / LMB)

Bomb Weight	Approx. 990kg (2176lb)
Explosive Weight	Approx. 705kg (1,554lb)
Fuze Type	Impact/ Time delay / hydrostatic pressure fuze
Dimensions	2.64m x 0.64m (3.04m with parachute housing)
Use	Against civilian, military and industrial targets. Used as blast bombs and designed to detonate above ground level to maximise damage to a wider area.
Remarks	Deployed a parachute when dropped in order to control its descent. Had the potential to destroy a whole street of housing in a 100m radius.



SC 1000kg

Bomb Weight	993-1027kg (2,189-2,264lb)
Explosive Weight	530-620kg (1168-1367lb)
Fuze Type	Electrical impact/mechanical time delay fuze.
Filling	Mixture of 40% amatol and 60% TNT, but when used as an anti-shipping bomb it was filled with Trialen 105, a mixture of 15% RDX, 70% TNT and 15% aluminium powder.
Bomb Dimensions	2800 x 654mm (110 x 25.8in)
Body Diameter	654mm (18.5in)
Use	SC type bombs are General Purpose Bombs used primarily for general demolition work. Constructed of parallel walls with comparatively heavy noses. They are usually of three piece welded construction



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Unit 3, Maple Park
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Client: **GEA Ltd**

Project: **Ragged School**

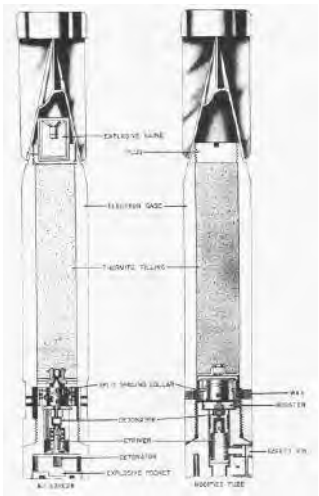
Ref: **DA6188-00**

Source: Various sources

German Incendiary Bombs

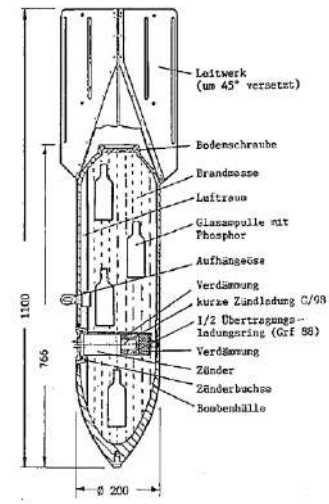
1kg Incendiary Bomb

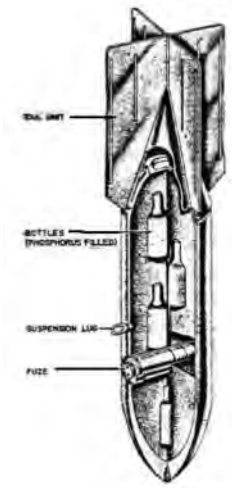
Bomb Weight	1.0 and 1.3kg (2.2 and 2.9lb)
Explosive Weight	680g (1.3lb) Thermite 8-15gm Explosive Nitropenta
Fuze Type	Impact fuze
Bomb Dimensions	350 x 50mm (13.8 x 1.97in)
Body Diameter	50mm (1.97in)
Use	As incendiary – dropped in clusters against towns and industrial complexes
Remarks	Magnesium alloy case. Sometimes fitted with high explosive charge. The body is a cylindrical alloy casting threaded internally at the nose to receive the fuze holder and fuze.



C50 A Incendiary Bomb

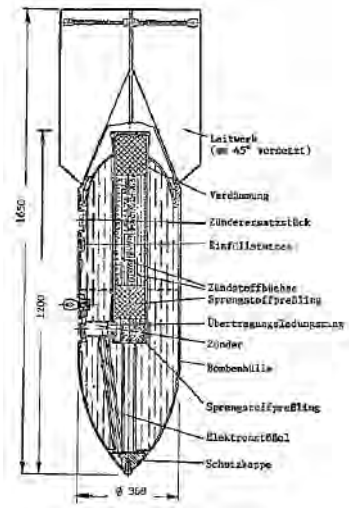
Bomb Weight	c41kg (90.4lb)
Explosive Weight	0.03kg (0.066lb)
Incendiary Filling	12kg (25.5lb) liquid filling with phosphor igniters in glass phials. Benzine 85%; Phosphorus 4%; Pure Rubber 10%
Fuze Type	Electrical impact fuze
Bomb Dimensions	1,100 x 280mm (43.2 x 8in)
Use	Against all targets where an incendiary effect is required
Remarks	Early fill was a phosphorous/carbon disulphide incendiary mixture





Flam C-250 Oil Bomb

Bomb Weight	125kg (276lb)
Explosive Weight	1kg (2.2lb)
Fuze Type	Super-fast electrical impact fuze
Filling	Mixture of 30% petrol and 70% crude oil
Bomb Dimensions	1,650 x 512.2mm (65 x 20.2in)
Body Diameter	368mm (14.5in)
Use	Often used for surprise attacks on ground troops, against troop barracks and industrial installations. Thin casing – not designed for ground penetration



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Unit 3, Maple Park
Essex Road, Hoddesdon,
Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
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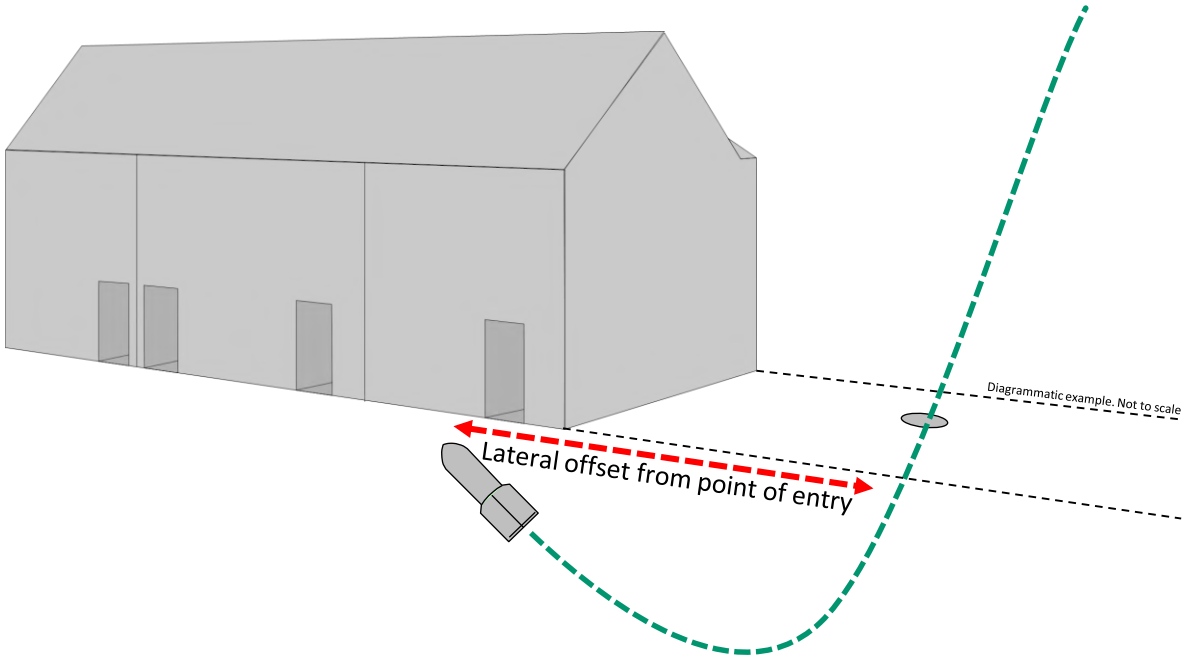
Project: **Ragged School**

Ref: **DA6188-00**

Source: Various sources



Top: J-curve Effect - Due to angle of entry, unexploded bombs would often end their trajectory at a lateral offset from point of entry, often ending up beneath adjacent extant structures/sites.

One of the most common scenarios for the above occurring was where a UXB fell into a ‘bomb site’ (such as the area shown **Top Left**), the entry hole of the bomb obscured by debris and rubble present. Note that the entry hole of a 50kg UXB could be as little as 20cm in diameter (**Left**).

Photograph **above** shows 250kg bomb found in Bermondsey pointing upwards, demonstrating ‘J-curve’

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Source: Various sources

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Bermondsey bomb: World War Two device safely removed

24 March 2015 London Share

The bomb measured about 5ft (1.5m) in length

An unexploded World War Two bomb found in south London has been driven away safely under police and Army escort.

The 500lb (250kg) device was found on a building site in Grange Walk, Bermondsey on Monday

250kg HE bomb found in Bermondsey March 2015

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Bethnal Green WW2 bomb: Experts remove unexploded device

11 August 2016 London Share

The MoD said the German WW2 air delivered bomb could have caused "mass destruction" if it had detonated

An unexploded World War Two bomb that prompted the evacuation of 700 people in east London has been made safe and removed by the military.

Families spent the night in a school hall after the 500lb bomb was found in the basement of a building site on Temple Street, in Bethnal Green, on Monday afternoon.

250kg HE bomb found in Bethnal Green, Aug 2016

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England Regions Somerset

Bath WW2 bomb scare: Device defused, police say

13 May 2016 Somerset Share

The bomb was found on the site of a former school on Thursday

A 500lb World War Two bomb found on the site of a former school in Bath has been defused and made safe.

250kg HE bomb found in Bath, May 2016

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Wembley WW2 live bomb posed 'risk to life'

22 May 2015 London Share

A blast wall was put up around the bomb to minimise damage if it exploded

An unexploded World War Two bomb uncovered by builders near Wembley Stadium posed "a genuine risk to life", the Army has said.

50kg HE bomb found in Wembley, May 2015

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Unit 3, Maple Park
Essex Road, Hoddesdon,
Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
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Project: **Ragged School**

Ref: **DA6188-00**

Source: BBC News

BASF has confirmed that an explosive device, most likely a World War II-era bomb, caused the blast that left one person injured Tuesday at a plant construction site in Germany.

The explosion was reported at BASF's Ludwigshafen toluene diisocyanate (TDI) plant, which recently broke ground for a 300,000 metric tons per year TDI production plant and other construction to expand its facilities.

1st March 2013

BASF is expanding their its Ludwigshafen location by expanding several plants and building a TDI plant, which was the site of an explosion on Tuesday (Feb. 26). One person was injured in the blast, which BASF believes was caused when excavation work detonated a bomb.

Early reports had speculated that excavation work had detonated a bomb from World War II. While the age of the bomb has not been confirmed, BASF has said that an explosive device was detonated.

BASF Provides Some Details

Responding to a request from *PaintSquare News* for more information on Wednesday (Feb. 27), BASF's manager of media relations and corporate communications Europe, Ursula von Stetten, wrote in an email, "So here [are] the facts: The detonation took place at 10:00 a.m. One person was injured; the injury is not serious. He will be kept in the hospital for some days.

"Cause of the detonation was an explosive device, presumably a bomb deriving from the Second World War. The device detonated when grounding work was done. No details on [a] delay [are] available. At the moment, the exact circumstances of the incident are [being] evaluated."

19th September 2013

WWII bomb injures 17 at Hattingen construction site

Published: 19 Sep 08 16:53 CET

Share +1 0 Tweet 0

Seventeen people were injured on Friday when a construction crew unwittingly detonated a buried World War II-era bomb in Hattingen.

- Liberals grit teeth ahead of May state election (17 Mar 12)
- Nazi death camp guard Demjanjuk dies (17 Mar 12)
- Stupid stunt causes bomb scare chaos (16 Mar 12)

An excavator apparently drove over a 250-kilogramme (550 pound) American bomb, damaging surrounding buildings. Most of the injured suffered auditory trauma from the blast, and the excavator operator suffered injuries to his hands, police in the German state of North Rhine-Westphalia said.

"The hole was astoundingly small for such a large bomb full of so many explosives," Armin Gebhard, head of the Arnsberg department for military ordnance removal, told The Local. "But of course it damaged all the surrounding buildings too. We are really happy it wasn't worse."

World War II Bomb Explodes on German Motorway

A highway construction worker in Germany accidentally struck an unexploded World War II bomb, causing an explosion which killed him and wrecked several passing cars.

Tweet 0 Recommend 1

23rd October 2006

AP

A cutting machine lies wrecked by the side of the A3 motorway next to a small crater left by the explosion.

A World War II bomb has exploded during construction work on a German highway, killing one worker and injuring several motorists who were driving past, police said.

The worker had been cutting through the road surface near the south-western town of Aschaffenburg when his machine struck the bomb and triggered it. Police said they weren't sure yet what type of bomb it was. "The explosion seems to have been too small for it to have been an aircraft bomb," a police spokesman said.

The A3 Autobahn linking the cities of Frankfurt and Würzburg has been blocked in both directions.

More than 60 years since the end of World War II, construction workers still frequently unearth unexploded bombs and it is not uncommon for whole city districts to be cordoned off and even evacuated while bomb disposal experts defuse them.

Indeed, just last week, some 22,000 people were evacuated from their homes in Hanover when three World War II bombs were discovered.

Allied pilots rained nearly 2 million tons of explosives on Germany during the war. Landmines, hand grenades, mortar bombs and anti-tank devices from the fighting on German soil at the end of the war are also found, and authorities say it will take decades before the country is cleared of duds.

Between 400 and 600 bombs are discovered a year in the state of North Rhine-Westphalia alone, where the heavily industrialized Ruhr region was a major target for Allied bombers.

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Africa | Asia | Europe | Latin America | Middle East | US & Canada

2 June 2010 Last updated at 15:37

Share

World War II bomb kills three in Germany

Three people have been killed and six injured trying to defuse a World War II bomb in central Germany.

2nd June 2010

All the victims were involved in an operation to defuse the bomb

Workers building a sports stadium had earlier unearthed the bomb in the town of Goettingen.

It was not immediately clear why the bomb, reportedly weighing 500kg (1,100lb), had detonated.

Unexploded WWII bombs dropped by Allied planes are frequently found in Germany, though it is unusual for them to explode unexpectedly.

A special commission is investigating the causes of the explosion, while prosecutors are considering whether the team leader should face charges of manslaughter through culpable negligence, the BBC's Oana Lungescu reports from Berlin.

The blast happened an hour before the defusing operation was due to start.

Officials said the three men who died were experienced sappers, or combat engineers, who over 20 years had defused up to 700 bombs.

More than 7,000 people were immediately evacuated when the 500kg bomb was found. Several schools, a kindergarten and local companies remain closed.

June 2006

1ST LINE DEFENCE

Unit 3, Maple Park
Essex Road, Hoddesdon,
Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
Tel: +44 (0)1992 245 020

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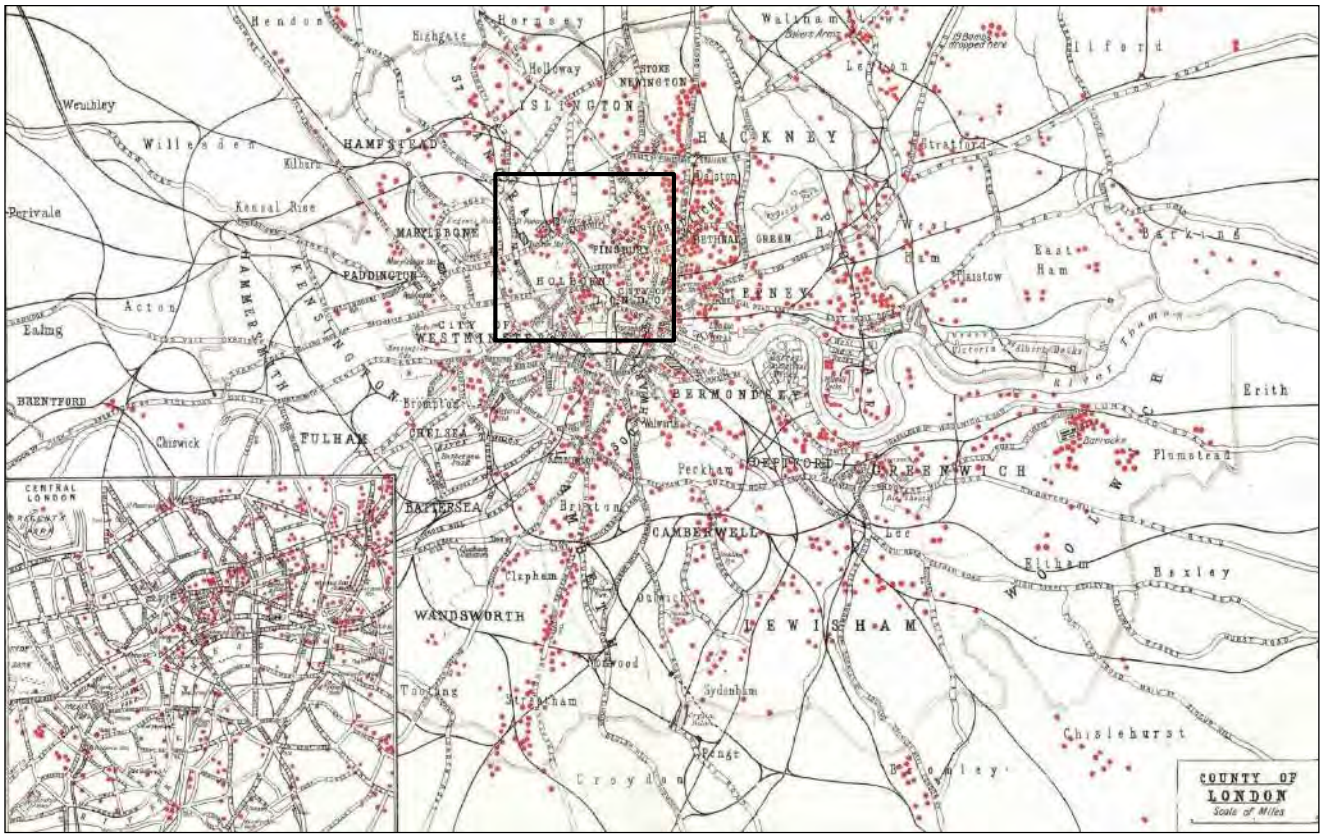
Project: **Ragged School**

Ref: **DA6188-00**

Source: Various news sources

WWI Bomb Plot Map, London

Annex: J



Examples of 50 and 100kg German WWI bombs

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Essex Road, Hoddesdon,
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Email: info@1stlinedefence.co.uk
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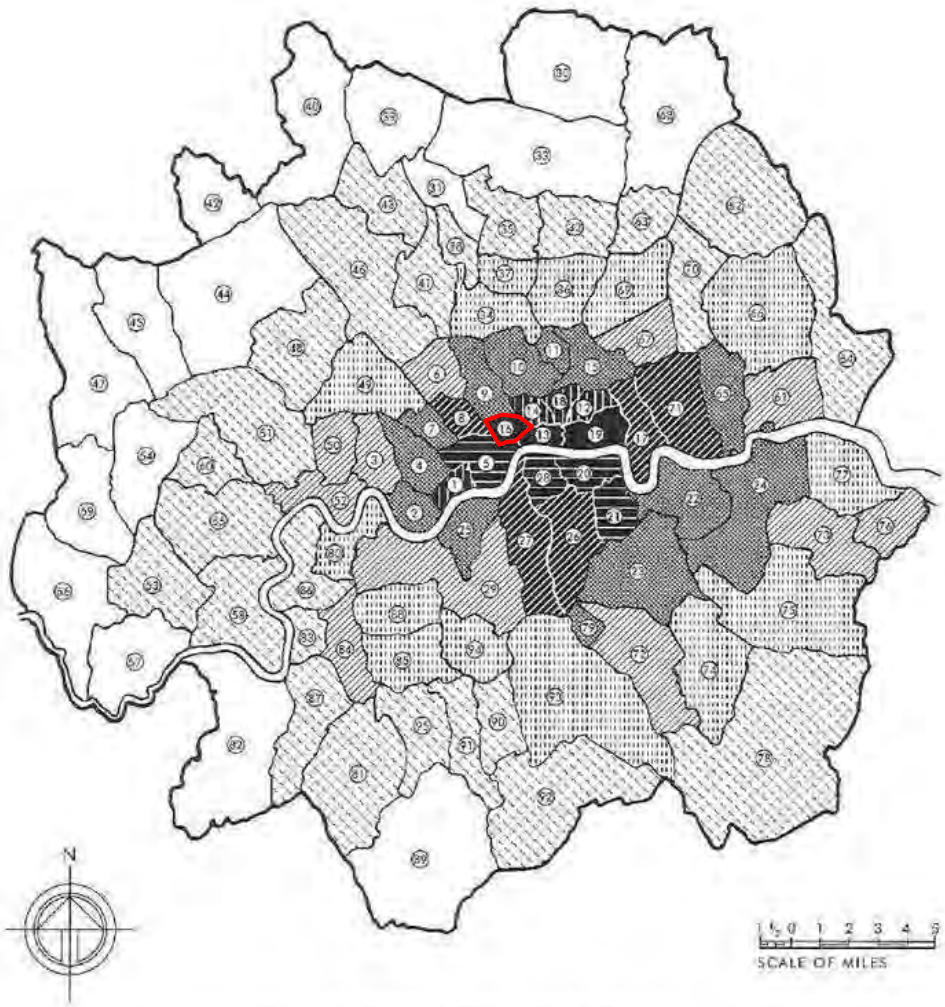
Source: The National Archives, Kew

N

London WWII Bomb Density Map

Annex: K



No. OF BOMBS PER 1,000 ACRES

OVER 600		300 - 299		100 - 149	
500 - 599		200 - 299		50 - 99	
400 - 499		150 - 199		UNDER 50	

1	Chelsea	25	Battersea	49	Willesden	72	Beckenham
2	Fulham	26	Camberwell	50	Acton	73	Bexley
3	Hammersmith	27	Lambeth	51	Ealing	74	Bromley
4	Kensington	28	Southwark	52	Brentford and Chiswick	75	Chislehurst and Sidcup
5	Westminster	29	Wandsworth	53	Feltham	76	Crayford
6	Hampstead	30	Chesnunt	54	Hayes and Harlington	77	Erith
7	Paddington	31	East Barnet	55	Heston and Isleworth	78	Orpington
8	St. Marylebone	32	Edmonton	56	Staines	79	Penge
9	St. Pancras	33	Enfield	57	Sunbury	80	Barnes
10	Islington	34	Hornsey	58	Twickenham	81	Epsom and Ewell
11	Stoke Newington	35	Southgate	59	Yiewsley and West Drayton	82	Esher
12	Bethnal Green	36	Tottenham			83	Kingston on Thames
13	City of London	37	Wood Green	60	Southall and Norwood	84	Malden and Coombe
14	Finsbury	38	Friern Barnet	61	Barking	85	Merton and Morden
15	Hackney	39	Potters Bar	62	Chigwell	86	Richmond
16	Holborn	40	Elstree	63	Chingford	87	Surbiton
17	Poplar	41	Finchley	64	Dagenham	88	Wimbledon
18	Shoreditch	42	Busney	65	East Ham	89	Banstead
19	Stepney	43	Barnet U.D.	66	Ilford	90	Beddington and Wallington
20	Bermondsey	44	Harrow	67	Leyton	91	Carshalton
21	Deptford	45	Ruislip and Northwood	68	Waltham Holy Cross	92	Coulsdon and Purley
22	Greenwich	46	Hendon	69	Walthamstow	93	Croydon
23	Lewisham	47	Uxbridge	70	Wanstead and Woodford	94	Mitcham
24	Woolwich	48	Wembley	71	West Ham	95	Sutton and Cheam

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Unit 3, Maple Park
Essex Road, Hoddesdon,
Hertfordshire. EN11 0EX
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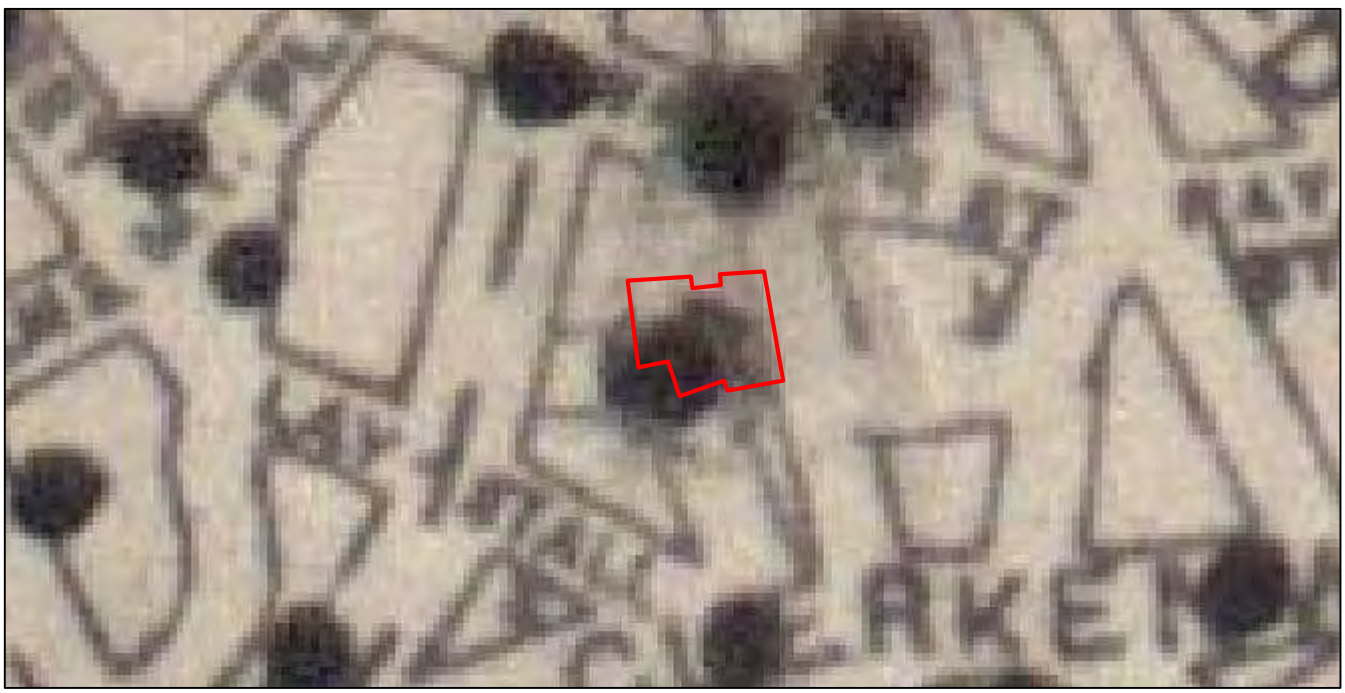
Source: The London Metropolitan Archives

Consolidated London Bomb Census Mapping

Annex: L1

Night Bombing up to 7th October 1940

Night Bombing 7th October to 6th June 1941



Recorded HE bomb strike

Recorded UXB strike

Recorded incendiary bomb shower

Recorded oil bomb strike

Colour refers to day of the week.

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Essex Road, Hoddesdon,
Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
Tel: +44 (0)1992 245 020

Client: **GEA Ltd**

Approximate site boundary

N

Project: **Ragged School**

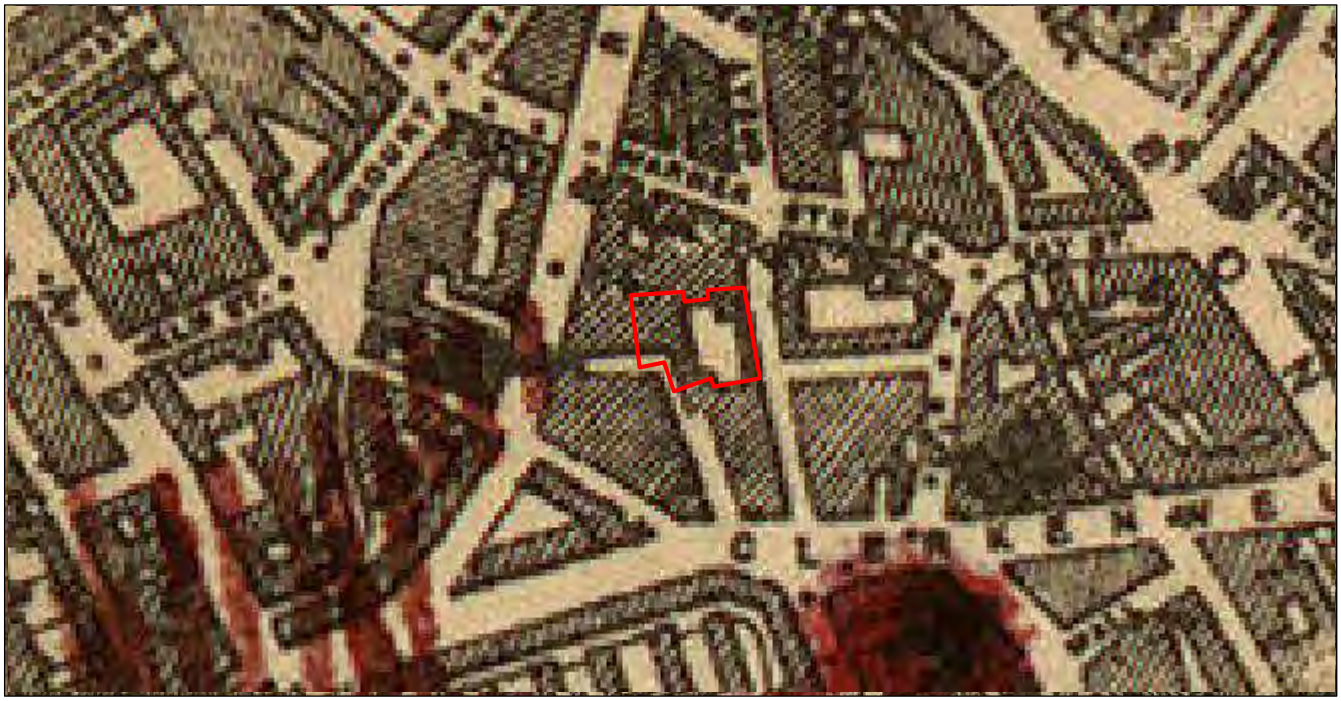
Ref: **DA6188-00**

Source: The National Archives

Weekly London Bomb Census Mapping

Annex: **L2**

7th to 14th October 1940



21st to 28th October 1940

Recorded HE bomb strike

Recorded UXB strike

Recorded incendiary bomb shower

Recorded oil bomb strike

Colour refers to day of the week.

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Tel: +44 (0)1992 245 020

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Approximate site boundary

N

Project: **Ragged School**

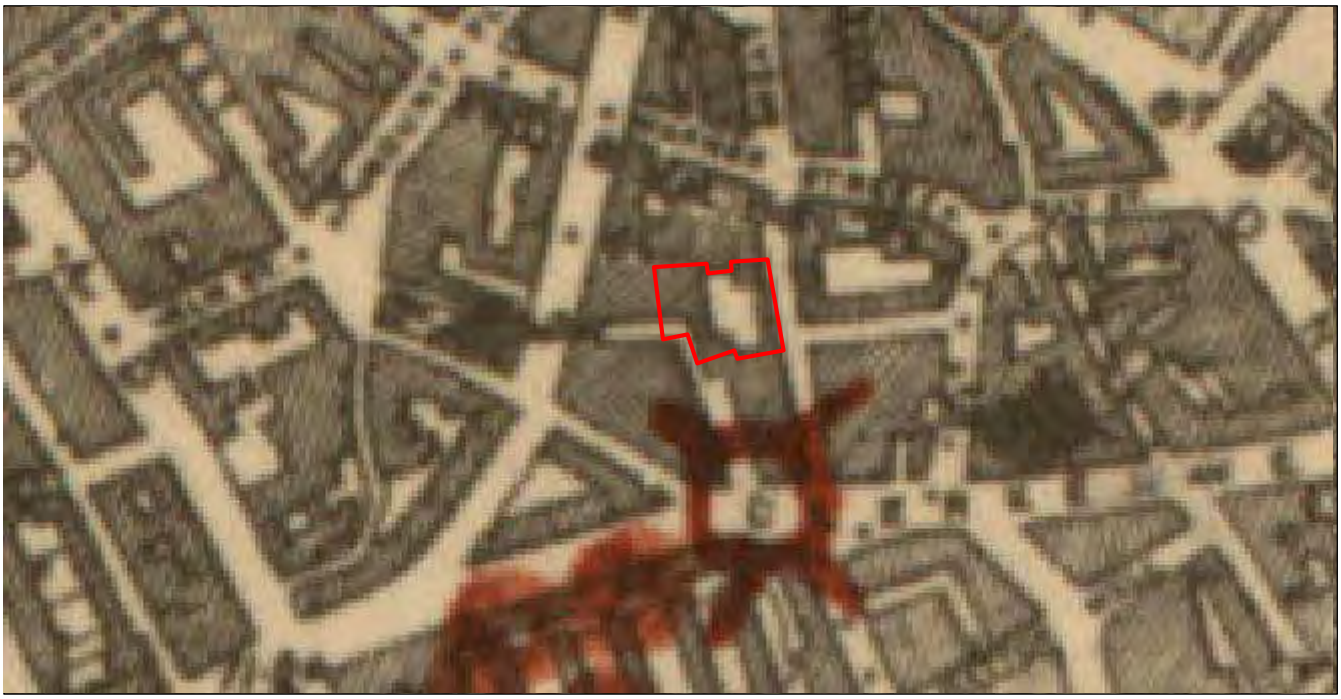
Ref: **DA6188-00**

Source: The National Archives

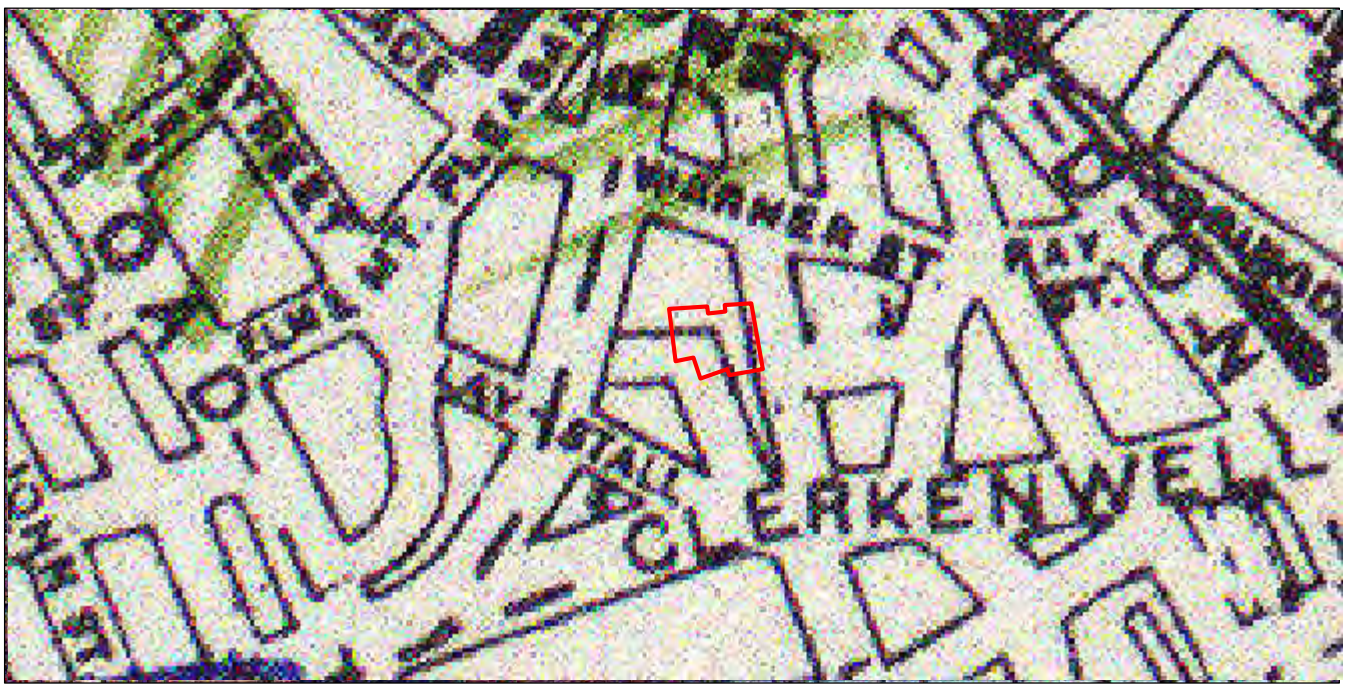
Weekly London Bomb Census Mapping

Annex: **L3**

4th to 11th November 1940



30th December 1940 to 6th January 1941



Recorded HE bomb strike

Recorded UXB strike

Recorded incendiary bomb shower

Recorded oil bomb strike

Colour refers to day of the week.

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Email: info@1stlinedefence.co.uk
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Project: **Ragged School**

Ref: **DA6188-00**

Source: The National Archives

Approximate site boundary

N

Weekly London Bomb Census Mapping

Annex: **L4**

5th to 12th May 1941

Recorded HE bomb strike

Recorded UXB strike

Recorded incendiary bomb shower

Recorded oil bomb strike

Colour refers to day of the week.

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Essex Road, Hoddesdon,
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Source: The National Archives

Approximate site boundary

N

London V-1 Flying Bomb Map

Annex: **M**

V-1 Flying Bomb

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Unit 3, Maple Park
Essex Road, Hoddesdon,
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Project: **Ragged School**

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Ref: **DA6188-00**

Source: The National Archives, Kew

London County Council Bomb Damage Map

Annex: N

Black	Total destruction	Orange	General blast damage; not structural
Purple	Damage beyond repair	Yellow	Blast damage, minor in nature
Dark Red	Seriously damaged; doubtful if repairable	Light Green	Clearance areas
Light Red	Seriously damaged, but repairable at cost		

V-1 Flying Bomb

V-2 Long Range Rocket

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Unit 3, Maple Park
Essex Road, Hoddesdon,
Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
Tel: +44 (0)1992 245 020

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Source: London Metropolitan Archives

RAF Aerial Photography 12th August 1945

Annex: **O1**

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Unit 3, Maple Park
Essex Road, Hoddesdon,
Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
Tel: +44 (0)1992 245 020

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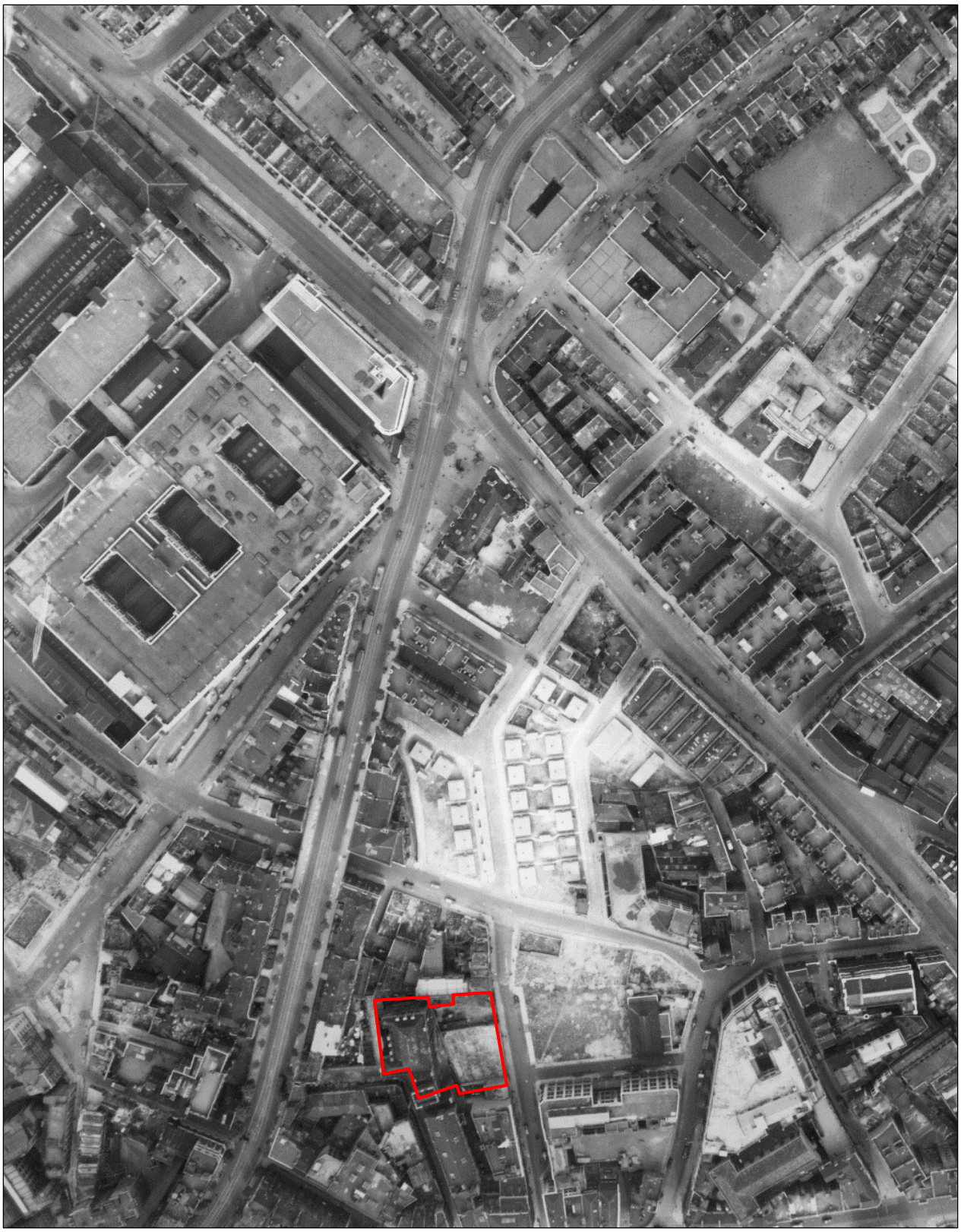
Ref: **DA6188-00**

Source: National Monuments Record Office (Historic England)

RAF Aerial Photography 12th August 1945

Annex: **O2**



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Approximate site boundary

N

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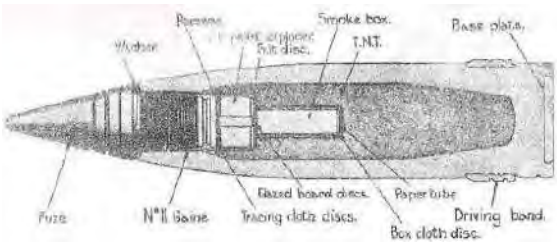
Ref: **DA6188-00**

Source: National Monuments Record Office (Historic England)

Examples of Anti-Aircraft Projectiles

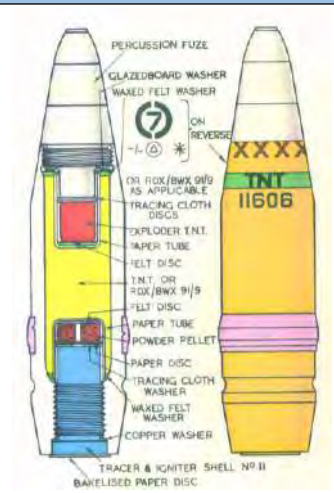
3.7 Inch QF Anti-Aircraft Projectile

Projectile Weight	28lb (12.6 kg)
Explosive Weight	2.52lbs
Fuze Type	Mechanical Time Fuze
Dimensions	3.7in x 14.7in (94mm x 360mm)
Rate of Fire	10 to 20 rounds per minute
Use	The 3.7in AA Mks 1-3 were the standard Heavy Anti-Aircraft guns of the British Army.
Ceiling	30,000ft to 59,000ft



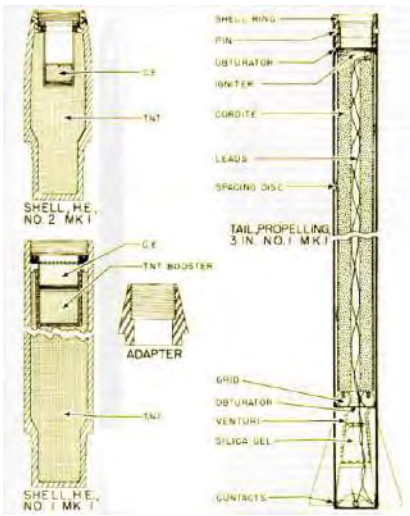
40mm Bofors Projectile

Projectile Weight	1.96lb (0.86kg)
Explosive Weight	300g (0.6lb)
Fuze Type	Impact Fuze
Rate of Fire	120 rounds per minute
Projectile Dimensions	40 x 180mm
Ceiling	23,000ft (7000m)
Remarks	Light quick fire high explosive anti-aircraft projectile. Each projectile fitted with small tracer element. If no target hit, shell would explode when tracer burnt out. Designed to engage aircraft flying below 2,000ft



3in Unrotated Projectile (UP) Anti-Aircraft Rocket ("Z" Battery)

HE Projectile Weight	3.4kg (7.6lb)
Explosive Weight	0.96kg (2.13lb)
Filling	High Explosive – TNT. Fitted with aerial burst fuzing
Dimensions of projectile	236 x 83mm (9.29 x 3.25in)
Remarks	As a short range rocket-firing anti-aircraft weapon developed for the Royal Navy. It was used extensively by British ships during the early days of World War II. The UP was also used in ground-based single and 128-round launchers known as Z Batteries. Shell consists of a steel cylinder reduced in diameter at the base and threaded externally to screw into the shell ring of the rocket motor



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Ref: **DA6188-00**

Source: Various sources

1ST LINE DEFENCE
Unit 3, Maple Park
Essex Road
Hoddesdon
Hertfordshire
EN11 0EX
Tel: 01992 245020

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1ST LINE DEFENCE

APPENDIX – PART 1B

Ground Investigation

Borehole Records

Trial Pit Records

SPT/Cohesion vs Depth plot

Geotechnical Laboratory Test Results

Chemical Analyses (Soil)

Generic Risk Based Screening Values

Discovery Strategy

Site Plan

GEA Geotechnical & Environmental Associates Widbury Barn | Widbury Hill | Ware | SG12 7QE	Site The Former Ragged School, 15-29 Eyre Street Hill, London EC1R 5DZ	Borehole Number **BH1**

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	200mm cased to 17.00m 150mm cased to 25.00m	13.62	Clerkenwell Lifestyle (UK) Ltd	J18042
	Location	**Dates** 21/05/2018- 23/05/2018	**Engineer** Heyne Tillett Steel	**Sheet** 1/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.20	D1						Made ground (concrete screed over dark grey brown sandy silt with fragments of ash, concrete, chalk, pottery, coal and brick)		
0.50	D2								
0.80	D3								
1.00	D4								
1.20-1.65 1.20-1.65	SPT(C) N60=5 D5	1.00	DRY	1,0/1,1,1,1					
1.75	D6					(3.50)			
2.00-2.45 2.00-2.50	SPT(C) N60=5 D7	2.00	DRY	1,0/1,1,1,1					
2.75	D8								
3.00-3.45 3.00-3.50	SPT N60=9 D9	3.00	DRY	1,1/2,1,2,2					
					10.12	3.50	Soft greyish brown mottled dark grey very silty CLAY with occasional gravel of flint and rare pockets of organic material		
						(0.50)			
4.00-4.45	U10			20 blows	9.62	4.00	Soft becoming firm brown mottled dark grey slightly fissured very silty CLAY with abundant selenite crystals and occasional partings of fine sand.		
4.50	D11								
						(1.50)			
5.00-5.45	SPT N60=18	4.00	DRY	1,2/3,3,3,5					
5.50	D12				8.12	5.50	Firm becoming stiff fissured dark blueish grey very silty CLAY with with abundant selenite crystals and occasional partings of fine sand. Sand partings becoming more frequent from a depth of 9.0 m.		
6.00	D13								
6.50-6.95	U14			25 blows					
7.00	D15								
7.50	D16					(4.20)			
8.00-8.45 8.00-8.45	SPT N60=32 D17	6.00	DRY	3,4/5,6,6,7					
9.00	D18								
9.50-9.95	U19			30 blows					
					3.92	9.70	Stiff becoming very stiff brown mottled grey and red slightly silty CLAY. Becoming multicoloured at a depth of 13.5 m.		

Remarks
Service pit excvated to a depth of 1.2 m: 1 hour 30 minutes standing
Borehole terminated at a depth of 27.5 m on hard strata
1 hour 30 minutes standing for occupants to move cars
Standpipe installed to a depth of 7.0 m

Scale (approx)	Logged By
1:50	JD

Figure No.
J18042.BH1

GEA Geotechnical & Environmental Associates Widbury Barn | Widbury Hill | Ware | SG12 7QE	Site The Former Ragged School, 15-29 Eyre Street Hill, London EC1R 5DZ	Borehole Number BH1
Boring Method Cable Percussion	**Casing Diameter** 200mm cased to 17.00m 150mm cased to 25.00m	**Ground Level (mOD)** 13.62	**Client** Clerkenwell Lifestyle (UK) Ltd	**Job Number** J18042
	Location	**Dates** 21/05/2018- 23/05/2018	**Engineer** Heyne Tillett Steel	**Sheet** 2/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
10.00	D20						Occasionally thinly laminated partings of fine sand from a depth of 16.0 m.		
10.50	D21								
11.00-11.45	SPT N60=40	6.00	DRY	3,5/7,7,8,8					
11.00-11.50	D22								
11.50	D23								
12.00	D24								
12.50-12.95	U25			21/05/2018:DRY					
				22/05/2018:DRY					
12.50-12.95	U26			50 blows					
						(7.00)			
13.50	D27								
14.00-14.45	SPT N60=67	6.00	DRY	4,7/10,12,13,16					
14.00-14.50	D28								
15.00	D29								
15.00-15.50	U29			80 blows					
16.00	D30								
16.50	D31								
					-3.08	16.70	Very dense cemented brown SAND with fine gravel sized fragments of cemented sand		
17.00-17.05	SPT(C) 25*/30 50/15	17.00		25/50		(0.80)			
17.00-17.50	D32								
					-3.88	17.50	Very dense dark grey mottled brown very clayey very silty fine to medium SAND with abundant partings of greyish brown clay. Becoming fine to medium sand with rare fine gravel of lignite and cemented sand fragments from a depth of 20.0 m.		
18.00	D34								
18.00-18.45	D33								
18.50-18.95	SPT N60=59	17.00		5,7/9,10,10,16					
19.50	D35								
20.00-20.45	SPT N60=82	17.00		6,8/11,14,17,20					

Remarks
Service pit excvated to a depth of 1.2 m: 1 hour 30 minutes standing
Borehole terminated at a depth of 27.5 m on hard strata
1 hour 30 minutes standing for occupants to move cars
Standpipe installed to a depth of 7.0 m
Chiselling from 16.80m to 17.40m for 2 hours. Water added from 17.00m.

Scale (approx)	Logged By
1:50	JD

Figure No.
J18042.BH1

GEA Geotechnical & Environmental Associates Widbury Barn | Widbury Hill | Ware | SG12 7QE	Site The Former Ragged School, 15-29 Eyre Street Hill, London EC1R 5DZ	Borehole Number **BH1**

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	200mm cased to 17.00m 150mm cased to 25.00m	13.62	Clerkenwell Lifestyle (UK) Ltd	J18042
	Location	**Dates** 21/05/2018- 23/05/2018	**Engineer** Heyne Tillett Steel	**Sheet** 3/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
20.00-20.45	D36					(5.20)			
21.00	D37								
21.50-21.95	SPT N60=125	17.00		8,12/17,21,27,30					
21.50-21.95	D38								
22.50	D39				-9.08	22.70	Very stiff occasionally friable brownish mottled grey silty CLAY with occasional bands of siltstone		
23.00-23.45	SPT(C) N60=76	22.00		1,10/12,14,15,17		(1.20)			
23.00-23.45	B40								
24.00	D41				-10.28	23.90	Very dense cemented very clayey medium SAND with abundant fine to coarse rounded gravel of mottled red claystone		
24.50	D42			22/05/2018:					
24.50-24.58	SPT(C) 25*/45	23.00		23/05/2018: 25/50					
	50/30								
25.50	D43					(3.60)			
26.00-26.27	SPT(C) 50/120	23.00		10,15/50					
26.00	D44								
27.00-27.21	SPT(C) 50/60	23.00		5,20/50					
27.00-27.45	D45								
				23/05/2018:	-13.88	27.50	Complete at 27.50m		

Remarks
Service pit excvated to a depth of 1.2 m: 1 hour 30 minutes standing
Borehole terminated at a depth of 27.5 m on hard strata
1 hour 30 minutes standing for occupants to move cars
Standpipe installed to a depth of 7.0 m
Chiselling from 24.20m to 24.50m for 1 hour. Chiselling from 26.00m to 27.50m for 6 hours. Water added from 23.90m. Water added from 24.50m. Water added from 27.50m.

Scale (approx)	Logged By
1:50	JD

Figure No.
J18042.BH1

GEA Geotechnical & Environmental Associates Widbury Barn | Widbury Hill | Ware | SG12 7QE	Site The Former Ragged School, 15-29 Eyre Street Hill, London EC1R 5DZ	Borehole Number **BH2**

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm cased to 7.60m	13.44	Clerkenwell Lifestyle (UK) Ltd	J18042
	Location	**Dates** 22/05/2018	**Engineer** Heyne Tillett Steel	**Sheet** 1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.30	D						Made ground (tarmac over dark brown silty clayey sand with fragments of ash, concrete, coal, masonry and brick)		
1.20-1.65 1.20	SPT(C) N60=9 B			2,1/3,2,2,1					
1.75	D								
2.00-2.45 2.00	SPT(C) N60=6 D	2.00		1,0/1,1,2,1					
						(5.00)			
2.75	D								
3.00-3.45 3.00-3.45	SPT(C) N60=1 D	3.00		1,0/0,1,0,0					
3.75 3.75	D D								
4.00-4.45 4.00-4.45	SPT(C) N60=1 D	4.00		1,0/0,0,0,1					
4.75	D								
5.00-5.45 5.00-5.45 5.00-5.95	SPT(C) N60=4 D D	5.00		1,1/1,0,2,1	8.44	5.00	Soft to firm dark brownish grey very sandy very clayey slightly gravelly SILT with fragments of brick, flint, bone and pottery and rare pockets of organic content.		
6.00	D								
						(2.50)			
6.50-6.95	D								
7.50	D				5.94	7.50	Firm grey mottled brown very silty CLAY with abundant layers of fine sand and rare angular flint gravel.		
						(0.50)			
8.00-8.45	U			30 blows	5.44	8.00	Firm becoming stiff slightly fissured greyish brown silty slightly sandy CLAY with abundant selenite crystals and occasional pockets of fine to medium sand.		
9.00	D								
						(2.10)			
9.50-9.95 9.50-9.95	SPT N60=31 D	7.60		3,5/6,7,7,8					

Remarks
Service pit excavated to a depth of 1.2 m: 1 hour 30 minutes standing time
Groundwater not encountered
1 hour standing for UXO testing
Standpipe installed to a depth of 7.5 m

Scale (approx)	Logged By
1:50	JD

Figure No.
J18042.BH2

GEA Geotechnical & Environmental Associates Widbury Barn | Widbury Hill | Ware | SG12 7QE	Site The Former Ragged School, 15-29 Eyre Street Hill, London EC1R 5DZ	Borehole Number **BH2**

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm cased to 7.60m	13.44	Clerkenwell Lifestyle (UK) Ltd	J18042
	Location	**Dates** 22/05/2018	**Engineer** Heyne Tillett Steel	**Sheet** 2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					3.34	10.10	Firm becoming stiff brown mottled grey and red slightly silty CLAY. Becoming multicoloured and stiff at a depth of 14.5 m.		
10.50	D								
11.00-11.45	U			60 blows					
12.00	D								
12.50-12.95 12.50-12.95	SPT N60=33 D	7.60		1,5/7,7,7,9		(4.90)			
13.50	D								
14.55-15.00 14.55-15.00	SPT N60=40 D	7.60		4,6/7,8,10,11					
				22/05/2018:DRY	-1.56	15.00	Complete at 15.00m		

Remarks	Scale (approx)	Logged By
	1:50	JD
	Figure No.	J18042.BH2

GEA

Geotechnical & Environmental Associates
Widbury Barn | Widbury Hill | Ware | SG12 7QE

Site
The Former Ragged School, 15-29 Eyre Street Hill, London EC1R 5DZ

Borehole Number
BH3

Boring Method
Cable Percussion

Casing Diameter
250mm cased to 18.00m
200mm cased to 27.00m
150mm cased to 35.00m

Ground Level (mOD)
13.41

Client
Clerkenwell Lifestyle (UK) Ltd

Job Number
J18042

Location

Dates
29/05/2018-01/06/2018

Engineer
Heyne Tillett Steel

Sheet
1/4

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
							Made ground (tarmac over grey silty sand clay with fragments of brick, coal, ash and concrete).		
1.20-1.65 1.20-1.60	SPT(C) N60=5 B		DRY	1,0/1,1,1,1					
1.75	D								
2.00-2.45 2.00-2.45	SPT(C) N60=7 B		DRY	1,0/1,1,1,2		(4.00)			
2.75	D								
3.00-3.45 3.00-3.45	SPT(C) N60=9 B	3.00	DRY	1,1/1,2,2,2					
3.75	D								
4.00-4.45	SPT(C) N60=13	4.00	DRY	1,1/2,2,3,3	9.41	4.00	Soft greyish brown mottled dark grey very silty sandy CLAY with occasional flint gravel and rare pockets of organic content and brick fragments		
4.45	B					(1.00)			
4.75	D								
5.00-5.45	U			20 blows	8.41	5.00	Firm grey mottled orange-brown slightly fissured very silty CLAY with abundant selenite crystals and occasional partings of fine sand <10 mm in thickness. Sand partings become more frequent and >20 mm thickness from a depth of 8.0 m.		
5.50	D								
6.00	D								
6.50-6.95 6.50-6.95 6.50-6.95	SPT N60=21 D U	6.00	DRY	1,2/3,3,4,6 25 blows					
7.50	D					(4.90)			
8.00-8.45	U								
8.50	D								
9.00	D								
9.50-9.95 9.50-9.95	SPT N60=33 D	6.00	DRY	3,4/5,6,7,7					
					3.51	9.90			

Remarks
Service pit excavated to a depth of 1.2 m: 1 hour 30 minutes standing time
Groundwater not encountered
5 hours standing to clear car park of spoil
1 hours standing to wait for tenant car to be cleared

Scale (approx)
1:50

Logged By
JD

Figure No.
J18042.BH3

GEA Geotechnical & Environmental Associates Widbury Barn | Widbury Hill | Ware | SG12 7QE	Site The Former Ragged School, 15-29 Eyre Street Hill, London EC1R 5DZ	Borehole Number BH3

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	250mm cased to 18.00m 200mm cased to 27.00m 150mm cased to 35.00m	13.41	Clerkenwell Lifestyle (UK) Ltd	J18042
	Location	**Dates** 29/05/2018- 01/06/2018	**Engineer** Heyne Tillett Steel	**Sheet** 2/4

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
							Stiff becoming very stiff slightly fissured pale blueish grey mottled brown silty CLAY. Becoming multicoloured from a depth of 12.0 m.		
10.50	D								
11.00-11.45	U			30 blows					
11.50	D								
12.00	D								
						(5.10)			
12.50-12.95	SPT N60=40	6.00	DRY	3,4/6,7,8,9					
12.50-12.95	D								
14.50	D								
15.00	D				-1.59	15.00	Very stiff pale grey very silty sandy CLAY with occasional partings of sand		
15.50-15.95	D								
						(1.50)			
				29/05/2018:DRY					
				30/05/2018:15.90m					
16.50	D				-3.09	16.50	Very dense pale grey very silty very clayey fine to medium SAND		
17.00-17.45	SPT N60=86	6.00	DAMP	5,10/12,15,17,21					
17.00-17.45	D								
						(1.50)			
18.00	D				-4.59	18.00	Very dense dark grey mottled brown very clayey very silty fine to medium SAND		
18.00-18.95	B								
18.50-18.95	SPT N60=53	18.00	ADD	4,6/8,10,11,11					
						(2.50)			
19.50	D								
20.00-20.45	SPT N60=57	20.00	ADD	5,7/10,11,10,12					

Remarks

Scale (approx)	Logged By
1:50	JD

Figure No.
J18042.BH3

GEA Geotechnical & Environmental Associates Widbury Barn | Widbury Hill | Ware | SG12 7QE	Site The Former Ragged School, 15-29 Eyre Street Hill, London EC1R 5DZ	Borehole Number BH3
Boring Method Cable Percussion	**Casing Diameter** 250mm cased to 18.00m 200mm cased to 27.00m 150mm cased to 35.00m	**Ground Level (mOD)** 13.41	**Client** Clerkenwell Lifestyle (UK) Ltd	**Job Number** J18042
	Location	**Dates** 29/05/2018-01/06/2018	**Engineer** Heyne Tillett Steel	**Sheet** 3/4

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
20.00-20.45	D								
					-7.09	20.50	Very stiff occasionally fissured multicoloured silty sandy CLAY with occasional claystone fragments		
21.00	D								
21.50-21.95	SPT(C) N60=65	20.00	ADD	6,9/10,12,13,14		(2.00)			
21.50-21.95	B								
					-9.09	22.50	Very dense cemented multicoloured clayey sandy GRAVEL		
22.50	D								
23.00-23.45	B					(1.50)			
24.00	D				-10.59	24.00	Very stiff slightly fissured multicoloured very silty very sandy gravelly CLAY with abundant partings of fine to medium sand. Gravel is of claystone.		
24.00-24.95	B								
24.50-24.95	SPT(C) N60=99	23.00	ADD	8,11/14,17,20,24					
25.00	D					(2.00)			
26.00-26.50	D			30/05/2018:25.90m 31/05/2018:25.90m	-12.59	26.00	Very stiff greenish grey very sandy very gravelly CLAY. Gravel is rounded and of flint.		
26.00-26.45	SPT(C) N60=76	26.00	ADD	5,8/11,13,15,19					
27.00	D					(1.50)			
27.45-27.95	D				-14.09	27.50	Very dense slightly cemented grey fine to medium silty SAND		
27.50-27.95	SPT(C) N60=84	26.00	DAMP	5,10/12,15,17,20					
28.50	D								
29.00-29.45	SPT N60=79	27.00	ADD	5,10/15,45					
29.00-29.50	D								

Remarks
Chiselling from 23.00m to 23.50m for 1 hr 30 min hour. Chiselling from 26.50m to 27.00m for 2 hours. Water added from 23.00m to 26.00m. Water added from 26.00m to 35.00m.

Scale (approx)	Logged By
1:50	JD

Figure No.
J18042.BH3

GEA

Geotechnical & Environmental Associates

Widbury Barn | Widbury Hill | Ware | SG12 7QE

Site	Borehole Number
The Former Ragged School, 15-29 Eyre Street Hill, London EC1R 5DZ	BH3

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	250mm cased to 18.00m 200mm cased to 27.00m 150mm cased to 35.00m	13.41	Clerkenwell Lifestyle (UK) Ltd	J18042
	Location	**Dates** 29/05/2018-01/06/2018	**Engineer** Heyne Tillett Steel	**Sheet** 4/4

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
30.00	D								
30.50-30.71	SPT(C) 25*/120 50/90	27.50	ADD	25/50					
30.50-30.95	D								
						(7.50)			
32.00-32.23	SPT(C) 50/75	27.50	ADD	25/50					
32.00-32.50	D								
32.50	D								
33.00	D								
33.50-33.65	SPT(C) 25*/75 50/75	27.50	ADD	25/50					
33.50-33.95	D								
34.50	D								
35.00-35.45	D			31/05/2018:34.99m	-21.59	35.00	Complete at 35.00m		
35.00-35.35	SPT(C) 25*/120 50/225	34.00	ADD	25/50					

Remarks

Scale (approx)	Logged By
1:50	JD

Figure No. J18042.BH3

GEA	Geotechnical & Environmental Associates Widbury Barn | Widbury Hill | Ware | SG12 7QE	**Site** The Former Ragged School, 15-29 Eyre Street Hill, London EC1R 5DZ	**Number** **BH4**
Excavation Method Drive-in Window Sampler	**Dimensions**	**Ground Level (mOD)**	**Client** Clerkenwell Lifestyle (UK) Ltd	**Job Number** J18042
	Location	**Dates** 12/05/2018	**Engineer** Heyne Tillett Steel	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(2.80)	Made ground (Concrete screed over dark brown silty sandy gravelly clay with fragments of brick, flint, coal, ash, shell, glass, chalk, charcoal and clinker)		
					2.80 (0.60)	Soft to firm orange-brown mottled grey very silty sandy CLAY with rare gravel of flint		
					3.40 (2.00)	Soft to firm grey occasionally fissured very silty sandy CLAY with occasional selenite crystals and rare partings of fine sand		
					5.40	Complete at 5.40m		

Remarks
Borehole advanced through base of Trial Pit No 10
Groundwater not encountered

Scale (approx)	**Logged By**
1:50	JD

Figure No.
j18042.BH4

GEA	Geotechnical & Environmental Associates Widbury Barn | Widbury Hill | Ware | SG12 7QE	Site The Former Ragged School, 15-29 Eyre Street Hill, London EC1R 5DZ	Number **BH5**
Excavation Method Window Sampler	**Dimensions**	**Ground Level (mOD)**	**Client** Clerkenwell Lifestyle (UK) Ltd	**Job Number** J18042
	Location As per separate plan	**Dates** 12/05/2018	**Engineer** Heyne Tillett Steel	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.13)	MADE GROUND (concrete screed over rough concrete between 100 mm and 130 mm thick. No reinforcement)		
					0.13 (0.27)			
					0.40	MADE GROUND (brown and light grey sand and gravel of compacted concrete and brick fill)		
0.90	D1					MADE GROUND (dark brown sandy gravelly clay with flint gravel and fragments of coal and ash, frequent fragments of brick and occasional concrete. Clayey with fragments of slate and burnt brick from 2.5 m to 2.7 m. Becoming silty from 4.4 m)		
2.60	D2				(4.10)			
					4.50	Dark brown and black silty CLAY with occasional fine sand and medium subangular gravel		
					(0.90)			
					5.40	Soft dark grey slightly silty CLAY. Rare medium subangular gravel at 5.5 m. Becoming brown mottled grey from 5.7 m		
					(0.60)			
					6.00	Complete at 6.00m		

Remarks	Scale (approx)	Logged By
	1:50	KM
	Figure No. J18042.BH8	

GEA

Geotechnical & Environmental Associates

Widbury Barn | Widbury Hill | Ware | SG12 7QE

Site	Number
The Former Ragged School, 15-29 Eyre Street Hill, London EC1R 5DZ	BH6

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Window Sampler			Clerkenwell Lifestyle (UK) Ltd	J18042
	Location	**Dates**	**Engineer**	**Sheet**
	As per separate plan	12/05/2018	Heyne Tillett Steel	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	MADE GROUND (70 mm smooth concrete over 130 mm rough concrete)		
					(0.17) 0.37	MADE GROUND (brown and light grey sand and gravel of compacted concrete and brick fill)		
					(2.63)	MADE GROUND (dark brown sandy gravelly clay with flint gravel and fragments of coal and ash, frequent fragments of brick including half bricks and occasional slate and concrete. Becoming grey mottled brown from 1.0 m. Poor sample recovery)		
					3.00			
					(2.10)	MADE GROUND (brown silty sand and gravel with frequent fragments of brick, occasional grey clay and rare fragments of glass and ceramic. Damp with fine to medium rounded flint gravel from approximately 4.0 m. Poor sample recovery)		
					5.10	Complete at 5.10m		

Remarks

Borehole terminated on refusal. Collapsed on withdrawal of rods to 3.50 m. Backfilled with arisings on completion.
Borehole driven through base of Trial Pit No 9. Refer also to trial pit log.

Scale (approx)	Logged By
1:50	KM

Figure No. J18042.BH9

GEA Geotechnical & Environmental Associates Widbury Barn | Widbury Hill | Ware | SG12 7QE	Site The Former Ragged School, 15-29 Eyre Street Hill, London EC1R 5DZ	Number **BH8**

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Window Sampler			Clerkenwell Lifestyle (UK) Ltd	J18042
	Location As per separate plan	**Dates** 12/05/2018	**Engineer** Heyne Tillett Steel	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.13) 0.13	MADE GROUND (concrete screed over rough concrete between 100 mm and 130 mm thick. No reinforcement)		
					(0.27) 0.40	MADE GROUND (brown and light grey sand and gravel of compacted concrete and brick fill)		
0.90	D1					MADE GROUND (dark brown sandy gravelly clay with flint gravel and fragments of coal and ash, frequent fragments of brick and occasional concrete. Clayey with fragments of slate and burnt brick from 2.5 m to 2.7 m. Becoming silty from 4.4 m)		
2.60	D2				(4.10)			
					4.50	Dark brown and black silty CLAY with occasional fine sand and medium subangular gravel		
					(0.90)			
					5.40	Soft dark grey slightly silty CLAY. Rare medium subangular gravel at 5.5 m. Becoming brown mottled grey from 5.7 m		
					(0.60)			
					6.00	Complete at 6.00m		

Remarks	Scale (approx)	Logged By
	1:50	KM
	Figure No. J18042.BH8	

GEA Geotechnical & Environmental Associates Widbury Barn | Widbury Hill | Ware | SG12 7QE	Site The Former Ragged School, 15-29 Eyre Street Hill, London EC1R 5DZ	Number **BH9**

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Window Sampler			Clerkenwell Lifestyle (UK) Ltd	J18042
	Location As per separate plan	**Dates** 12/05/2018	**Engineer** Heyne Tillett Steel	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20)	MADE GROUND (70 mm smooth concrete over 130 mm rough concrete)		
					0.20 (0.17)			
					0.37	MADE GROUND (brown and light grey sand and gravel of compacted concrete and brick fill)		
						MADE GROUND (dark brown sandy gravelly clay with flint gravel and fragments of coal and ash, frequent fragments of brick including half bricks and occasional slate and concrete. Becoming grey mottled brown from 1.0 m. Poor sample recovery)		
					(2.63)			
					3.00	MADE GROUND (brown silty sand and gravel with frequent fragments of brick, occasional grey clay and rare fragments of glass and ceramic. Damp with fine to medium rounded flint gravel from approximately 4.0 m. Poor sample recovery)		
					(2.10)			
					5.10	Complete at 5.10m		

Remarks
Borehole terminated on refusal. Collapsed on withdrawal of rods to 3.50 m. Backfilled with arisings on completion.
Borehole driven through base of Trial Pit No 9. Refer also to trial pit log.

Scale (approx)	Logged By
1:50	KM

Figure No.
J18042.BH9

GEA

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Herts | 01727 824666 Notts | 01509 674888

Trial Pit No

1

Site Former Ragged School, 15-29 Eyre Street Hill, London, EC1R 5DZ

Client Clerkenwell Lifestyle (UK) Ltd

Engineer HTS

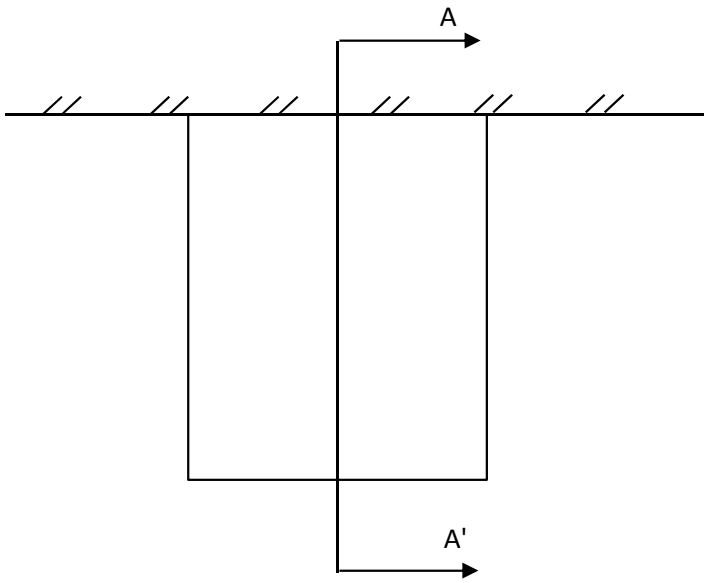
Job Number J18042

Sheet

Dates 11/05/2018

Excavation Method	Dimensions	Ground Level (mOD)	Location
Machine excavated	750 x 1000 x 2500	13.38	

Plan:



Remarks:

All dimensions in millimetres

Sides of trial pit collapsing towards the base due to brick content

Basement wall appeared extremely worn and friable toward GL

Scale: 1:20

Logged by: JD

GEA

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Herts | 01727 824666 Notts | 01509 674888

Trial Pit No 1

Site Former Ragged School, 15-29 Eyre Street Hill, London, EC1R 5DZ

Client Clerkenwell Lifestyle (UK) Ltd

Engineer CTP Consulting Engineers

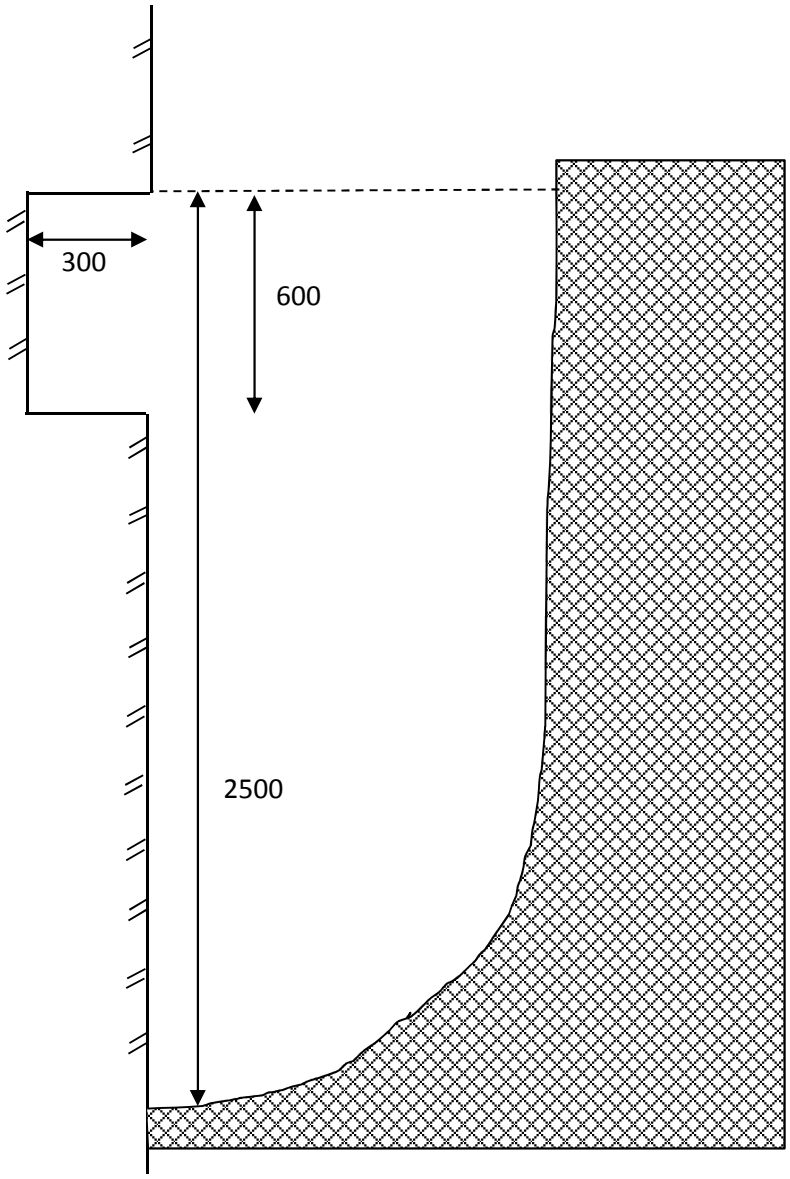
Job Number J18042

Sheet

Dates 08/01/2018

Excavation Method	Dimensions	Ground Level (mOD)	Location
Machine excavated	750 x 1000 x 2500		

Section A-A'



GL to 2.5 m Dark brown with black staining sandy silty clay with fragments of brick, concrete, coal, tarmac, flint, glass, ash and slate

Remarks:

All dimensions in millimetres

Sides of trial pit collapsing towards the base due to water ingress during excavation

Groundwater encountered at 0.9 m and rose to approximately 0.3 m

Scale: 1:20

Logged by: JS

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Trial Pit No 2

Site Former Ragged School, 15-29 Eyre Street Hill, London, EC1R 5DZ

Client Clerkenwell Lifestyle (UK) Ltd

Engineer HTS

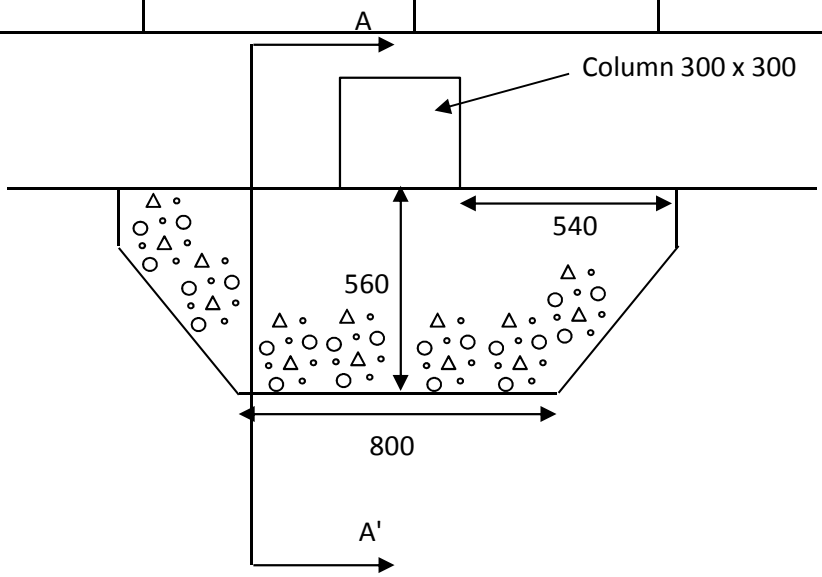
Job Number J18042

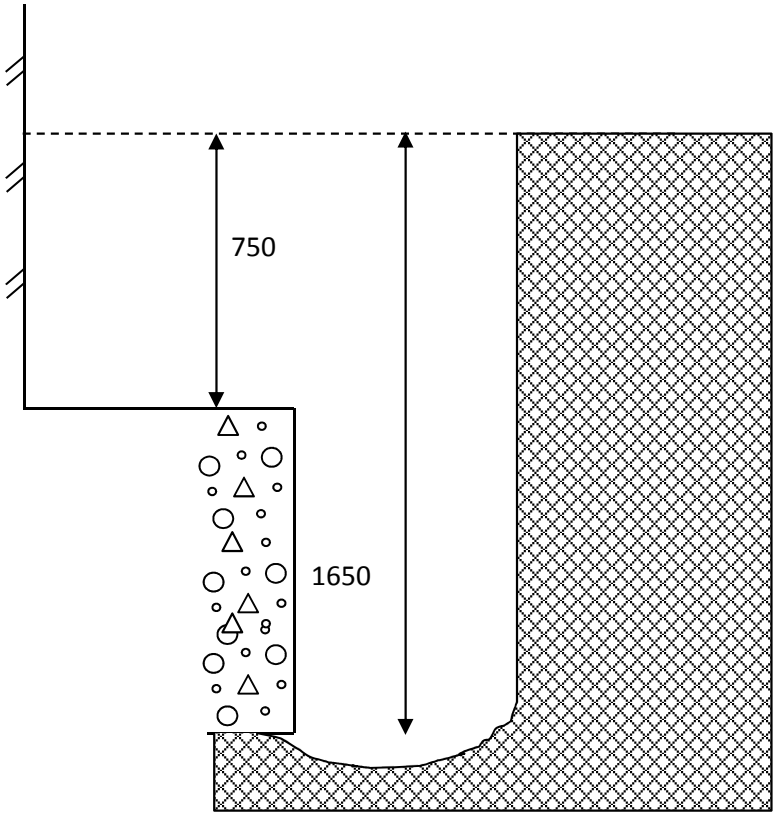
Sheet

Dates 11/05/2018

Excavation Method	Dimensions	Ground Level (mOD)	Location
Machine excavated	1000 x 1000 x 1700	13.23	

Plan:





GL to 1.0 m Dark brown sandy silty clay with fragments of brick, concrete, coal, tarmac, flint, glass, ash and slate.

1.0 m to 1.7 m Whitish grey mottled orange-brown slightly silty clay with fragments of brick, flint and coal.

Remarks:

All dimensions in millimetres

Sides of trial pit remained stable

Pad foundation appeared to be irregularly shaped and of mass concrete.

Scale: 1:20

Logged by: JD

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Trial Pit No 3

Site Former Ragged School, 15-29 Eyre Street Hill, London, EC1R 5DZ

Client Clerkenwell Lifestyle (UK) Ltd

Engineer HTS

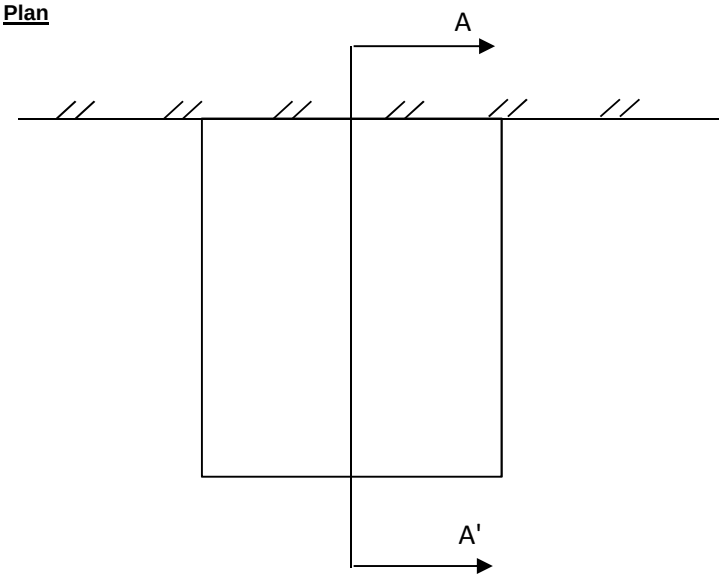
Job Number J18042

Sheet

Dates 11/05/2018

Excavation Method	Dimensions	Ground Level (mOD)	Location
Machine excavated	1000 x 750 x 1500		

Plan



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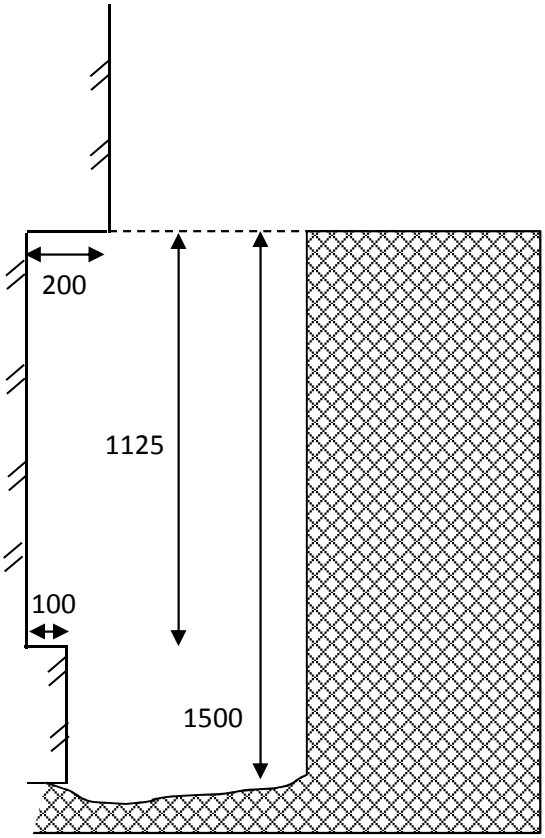

GL to 1.5 m Dark brown clayey silty sand with fragments of brick, concrete, slate, yark stone, tarmac and glass.

Remarks:

All dimensions in millimetres

Sides of trial pit remained stable

Base of footing proven with hand tool

Scale: 1:20

Logged by: JD

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Trial Pit No 4

Site Former Ragged School, 15-29 Eyre Street Hill, London, EC1R 5DZ

Client Clerkenwell Lifestyle (UK) Ltd

Engineer HTS

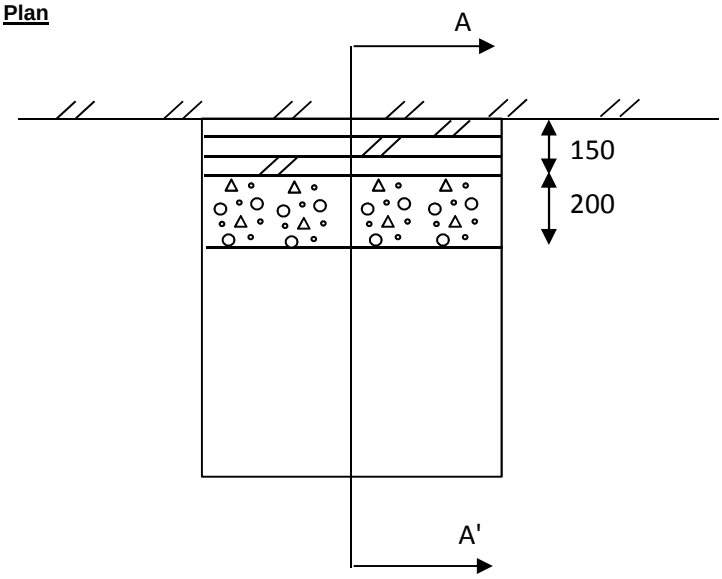
Job Number J18042

Sheet

Dates 11/05/2018

Excavation Method	Dimensions	Ground Level (mOD)	Location
Machine excavated	1000 x 750 x 1700		

Plan



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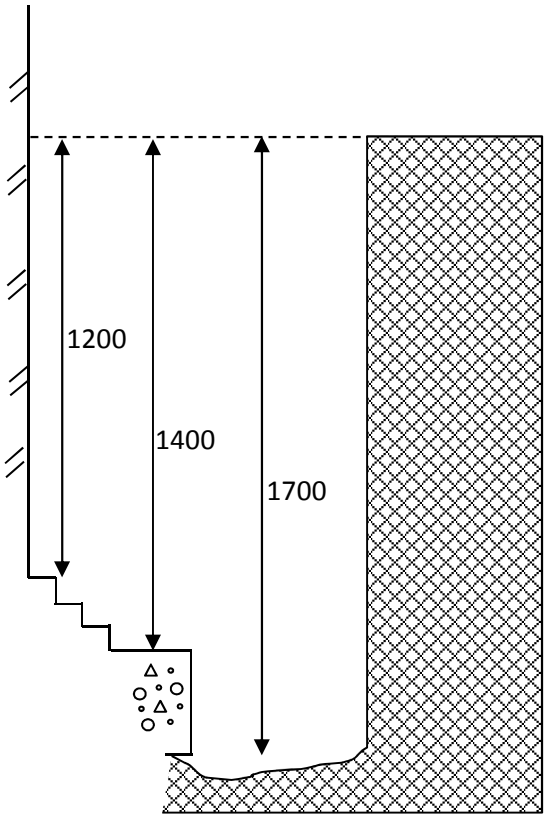

GL to 1.8 m Dark brown silty sand with fragments of brick, concrete, coal, tarmac, flint, glass, ash and slate

Remarks:

All dimensions in millimetres

Sides of trial pit remained stable

Base of footing proven with hand tool

Slow water seepage at 1.7 m depth

Scale: 1:20

Logged by: JD

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Trial Pit No 5

Site Former Ragged School, 15-29 Eyre Street Hill, London, EC1R 5DZ

Client Clerkenwell Lifestyle (UK) Ltd

Engineer HTS

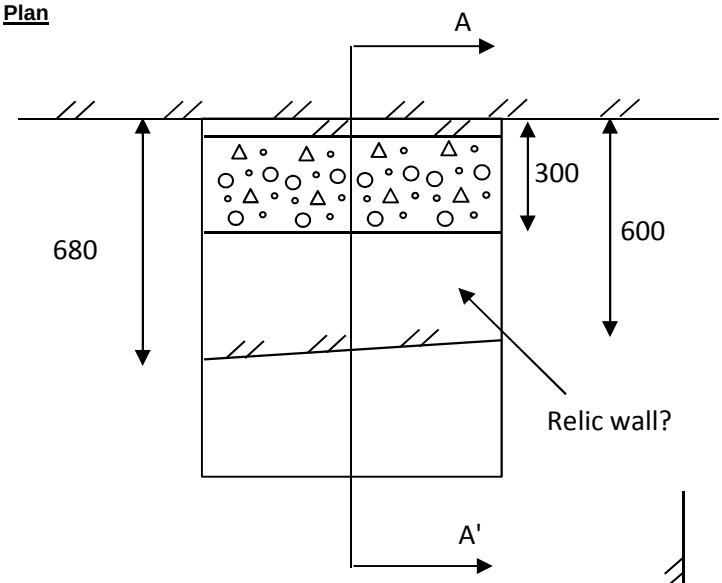
Job Number J18042

Sheet

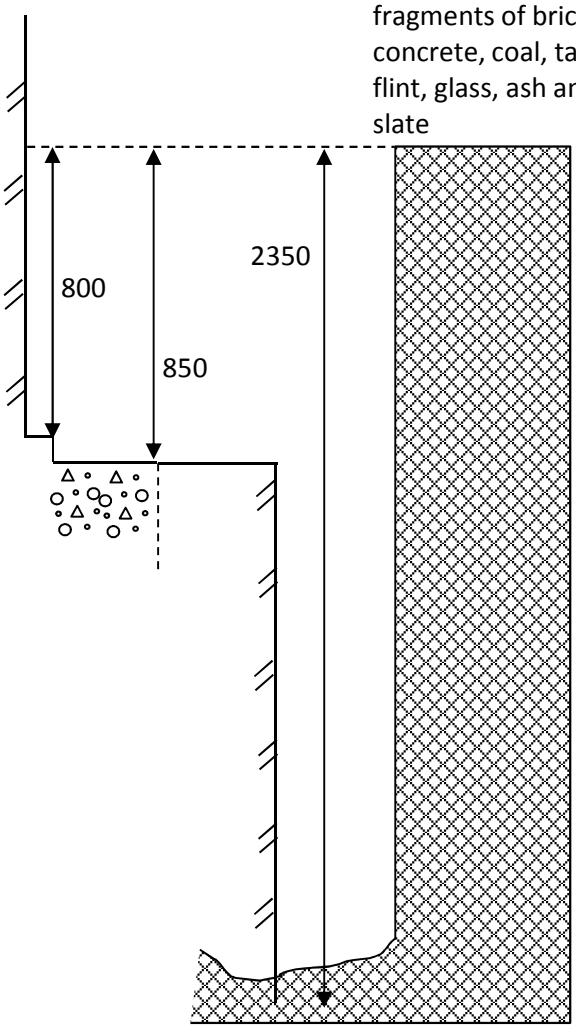
Dates 12/05/2018

Excavation Method	Dimensions	Ground Level (mOD)	Location
Machine excavated	1000 x 750 x 2350		

Plan



GL to 2.35 m Dark brown silty sand with fragments of brick, concrete, coal, tarmac, flint, glass, ash and slate



Remarks:

All dimensions in millimetres

Sides of trial pit unstable toward base of pit

Base of footing not encountered

Suspected Relic Wall infront of footing

Scale: 1:20

Logged by: JD

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Trial Pit No 6

Site Former Ragged School, 15-29 Eyre Street Hill, London, EC1R 5DZ

Client Clerkenwell Lifestyle (UK) Ltd

Engineer HTS

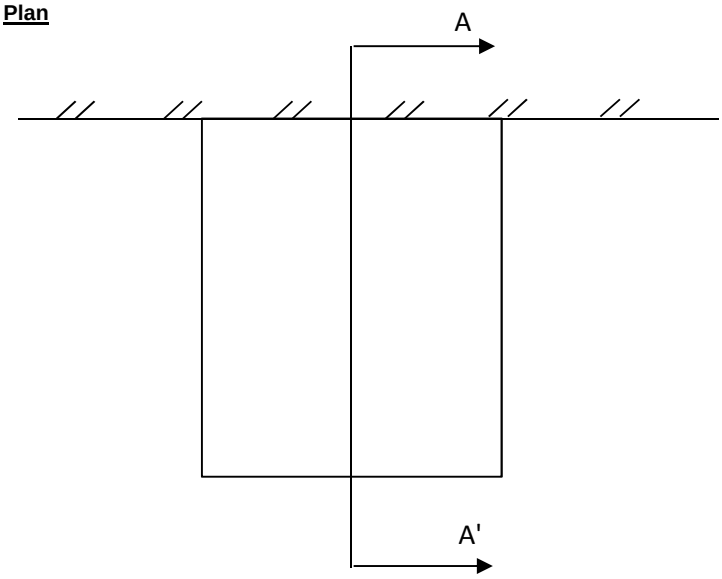
Job Number J18042

Sheet

Dates 12/05/2018

Excavation Method	Dimensions	Ground Level (mOD)	Location
Hand excavated	1000 x 750 x 1700		

Plan



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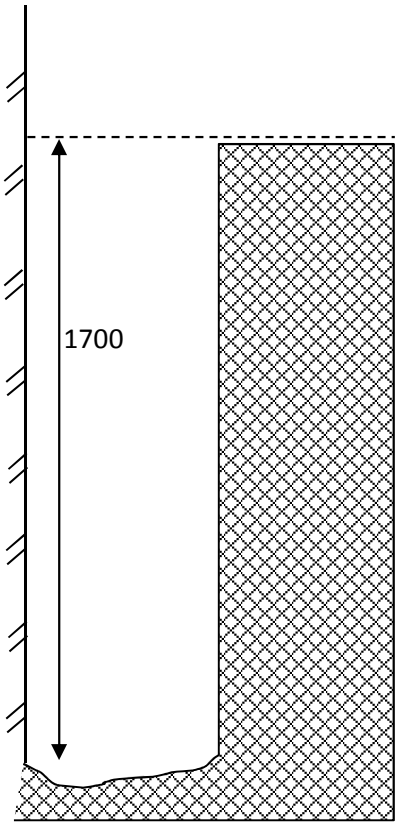

GL to 1.7 m Dark brown silty sand with fragments of brick, concrete, coal, tarmac, flint, glass, ash and slate

Remarks:

All dimensions in millimetres

Sides of trial pit remained stable

Base of footing proven with hand tool

Scale: 1:20

Logged by: JD

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Trial Pit No 7

Site Former Ragged School, 15-29 Eyre Street Hill, London, EC1R 5DZ

Client Clerkenwell Lifestyle (UK) Ltd

Engineer HTS

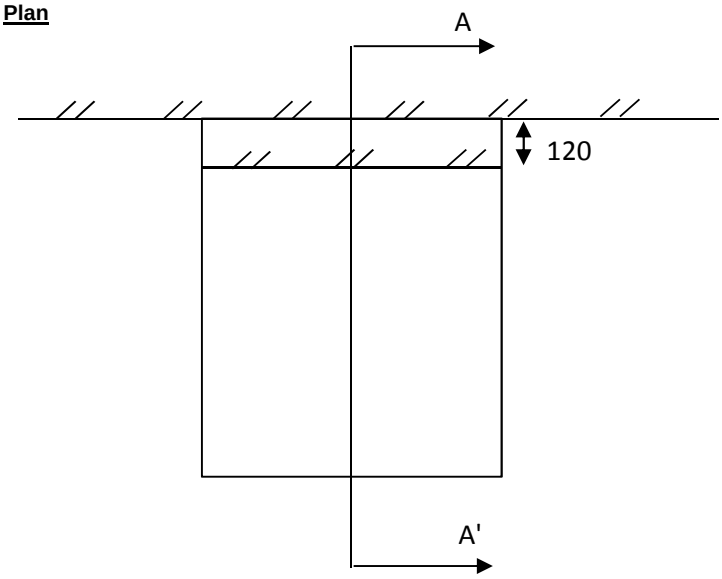
Job Number J18042

Sheet

Dates 12/05/2018

Excavation Method	Dimensions	Ground Level (mOD)	Location
Hand excavated	1000 x 750 x 1500		

Plan



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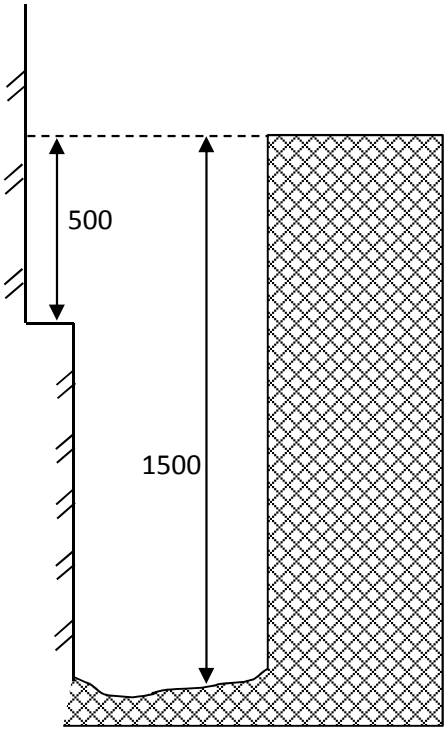


GL to 1.5 m Dark brown silty sand with fragments of brick, concrete, coal, tarmac, flint, glass, ash and slate

Remarks:

All dimensions in millimetres

Sides of trial pit remained stable

Base of footing proven with hand tool

Scale: 1:20

Logged by: JD

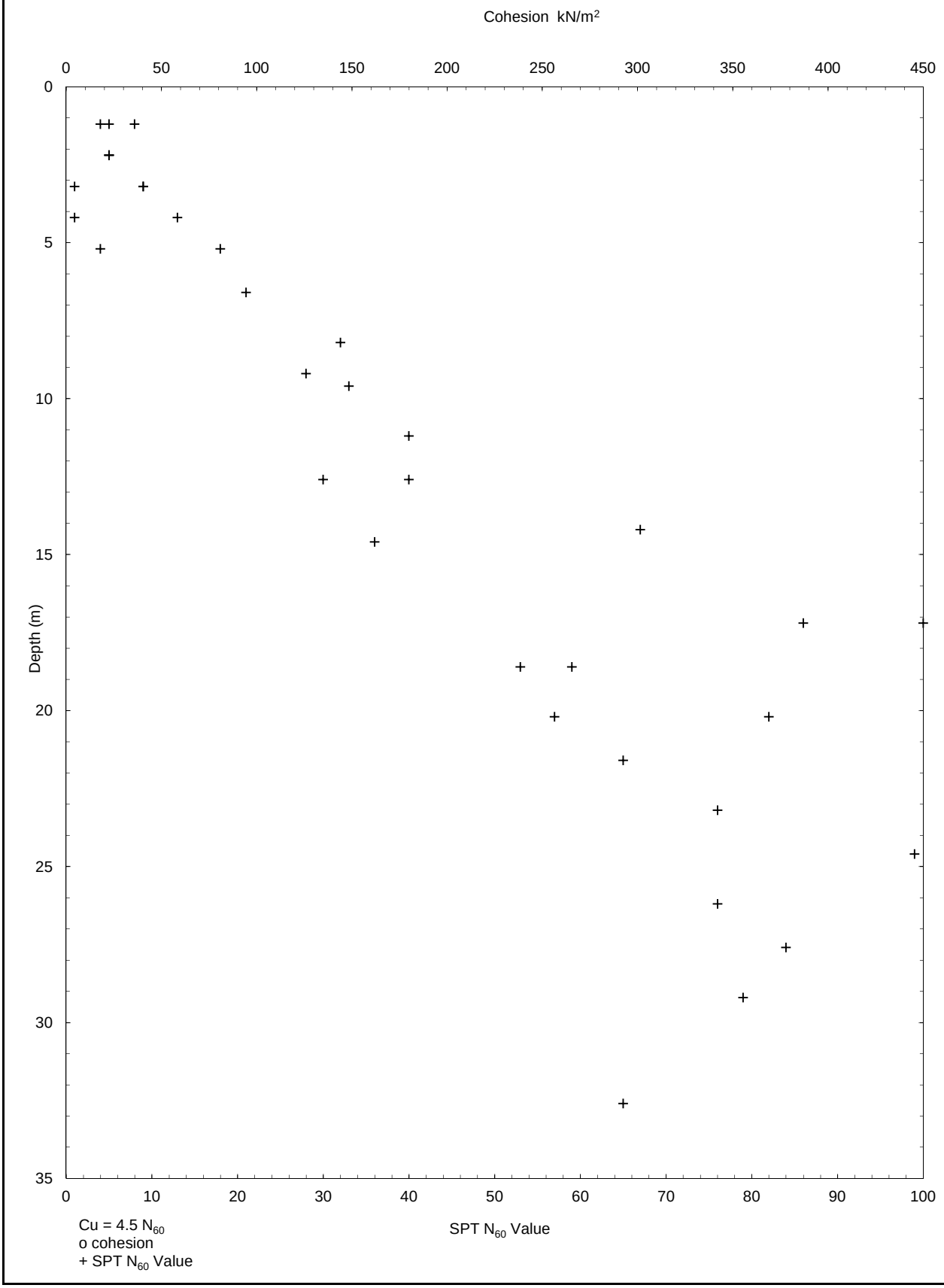
GEA
www.gea-ltd.co.uk
Herts | 01727 824666 Notts | 01509 674888

SPT & Cohesion / Depth Graph

Site	The Former Ragged School, 15-29 Eyre Street Hill, London, EC1R 5DZ
Client	Clerkenwell Lifestyle (UK) Ltd
Engineer	HTS

Job Number J17017A

Sheet 1 / 1



SUMMARY OF GEOTECHNICAL TESTING

Sample details					Classification Tests					Density Tests		Undrained Triaxial Compression				Chemical Tests			Other tests and comments
Borehole / Trial Pit	Sample Ref	Depth (m)	Type	Description	WC (%)	LL (%)	PL (%)	PI (%)	<425 µm (%)	Bulk Mg/m³	Dry Mg/m³	Condition	Cell Pressure kPa	Deviator Stress kPa	Shear Stress kPa	pH	2:1 W/S SO4 (g/L)	W/S Mg (mg/L)	
BH1		2.00	D													7.9	0.04		
BH1		4.00	U	Stiff fissured multicoloured silty CLAY.	38.4	59	24	35	99	1.91	1.38	Undisturbed	80	105	53				
BH1		6.50	U	Firm dark grey CLAY.	32.6					1.94	1.46	Undisturbed	130	138	69				
BH1		9.50	U	Very stiff fissured dark brown silty CLAY.	23.8	58	21	37	98	2.04	1.65	Undisturbed	190	250	125	8.4	0.30		
BH1		12.50	U	Very stiff fissured brown mottled grey CLAY.	23.1	69	27	42	100	2.11	1.71	Undisturbed	250	381	191				
BH1		18.00	D	Brownish grey clayey silty SAND.															Particle Size Distribution
BH1		23.00	B	Yellowish brown mottled dark brown and light grey CLAY with rare fine gravel.	26.0	51	20	31	98										
BH1		25.50	D	Greenish grey clayey sandy GRAVEL.															Particle Size Distribution
BH2		3.75	D													8.5	0.01		
BH2		8.00	U	Very stiff fissured dark brown silty CLAY.	22.5	59	22	37	99	2.01	1.64	Undisturbed	160	215	107				

Sample type: B (Bulk disturb.) BLK (Block) C (Core) D (Disturbed) LB (Large Bulk dist.) U (Undisturbed)

Checked and Approved by

S Burke

S Burke - Senior Technician
29/06/2018

Project Number:

GEO / 27587

Project Name:

EYRE STREET, RAGGED SCHOOL
J18042

GEOLABS

SUMMARY OF GEOTECHNICAL TESTING

Sample details					Classification Tests					Density Tests		Undrained Triaxial Compression				Chemical Tests			Other tests and comments
Borehole / Trial Pit	Sample Ref	Depth (m)	Type	Description	WC (%)	LL (%)	PL (%)	PI (%)	<425 µm (%)	Bulk Mg/m³	Dry Mg/m³	Condition	Cell Pressure kPa	Deviator Stress kPa	Shear Stress kPa	pH	2:1 W/S SO4 (g/L)	W/S Mg (mg/L)	
BH2		11.00	U	Very stiff fissured brown mottled grey CLAY.	21.8	60	24	36	100	2.10	1.73	Undisturbed	220	241	120				
BH3		5.00	U	Soft dark grey mottled brown CLAY.	37.0					1.86	1.36	Undisturbed	100	69	34				
BH3		8.00	U	Firm dark brown mottled dark grey CLAY.	30.0					1.99	1.53	Undisturbed	160	191	96				
BH3		11.00	U	Firm brown mottled grey CLAY.	29.2					2.00	1.55	Undisturbed	220	132	66				
BH3		14.00	U	Firm brown mottled grey CLAY.	20.5					2.13	1.77	Undisturbed	130	491	245				
BH3		15.50	D	Light brownish grey clayey silty SAND.															Particle Size Distribution
BH3		21.00	D	Yellowish brown and light grey CLAY.	17.2	49	21	28	100										
BH3		24.00	D	Multicoloured clayey silty SAND and GRAVEL.															Particle Size Distribution
BH3		27.00	D	Dark bluish grey slightly gravelly sandy CLAY.															Particle Size Distribution
BH3		30.50	D	Grey silty SAND.															Particle Size Distribution

Sample type: B (Bulk disturb.) BLK (Block) C (Core) D (Disturbed) LB (Large Bulk dist.) U (Undisturbed)

Checked and Approved by

S Burke

S Burke - Senior Technician
29/06/2018

Project Number:

GEO / 27587

Project Name:

EYRE STREET, RAGGED SCHOOL
J18042

GEOLABS

SUMMARY OF GEOTECHNICAL TESTING

Sample details					Classification Tests					Density Tests		Undrained Triaxial Compression				Chemical Tests			Other tests and comments
Borehole / Trial Pit	Sample Ref	Depth (m)	Type	Description	WC (%)	LL (%)	PL (%)	PI (%)	<425 µm (%)	Bulk Mg/m³	Dry Mg/m³	Condition	Cell Pressure kPa	Deviator Stress kPa	Shear Stress kPa	pH	2:1 W/S SO4 (g/L)	W/S Mg (mg/L)	
BH3		35.00	D	Dark grey clayey SAND.															Particle Size Distribution

Sample type: B (Bulk disturb.) BLK (Block) C (Core) D (Disturbed) LB (Large Bulk dist.) U (Undisturbed)

Checked and Approved by

S Burke

S Burke - Senior Technician
29/06/2018

Project Number:

GEO / 27587

Project Name:

EYRE STREET, RAGGED SCHOOL
J18042

GEOLABS

BS EN ISO 17892-4 : 2016

PARTICLE SIZE DISTRIBUTION

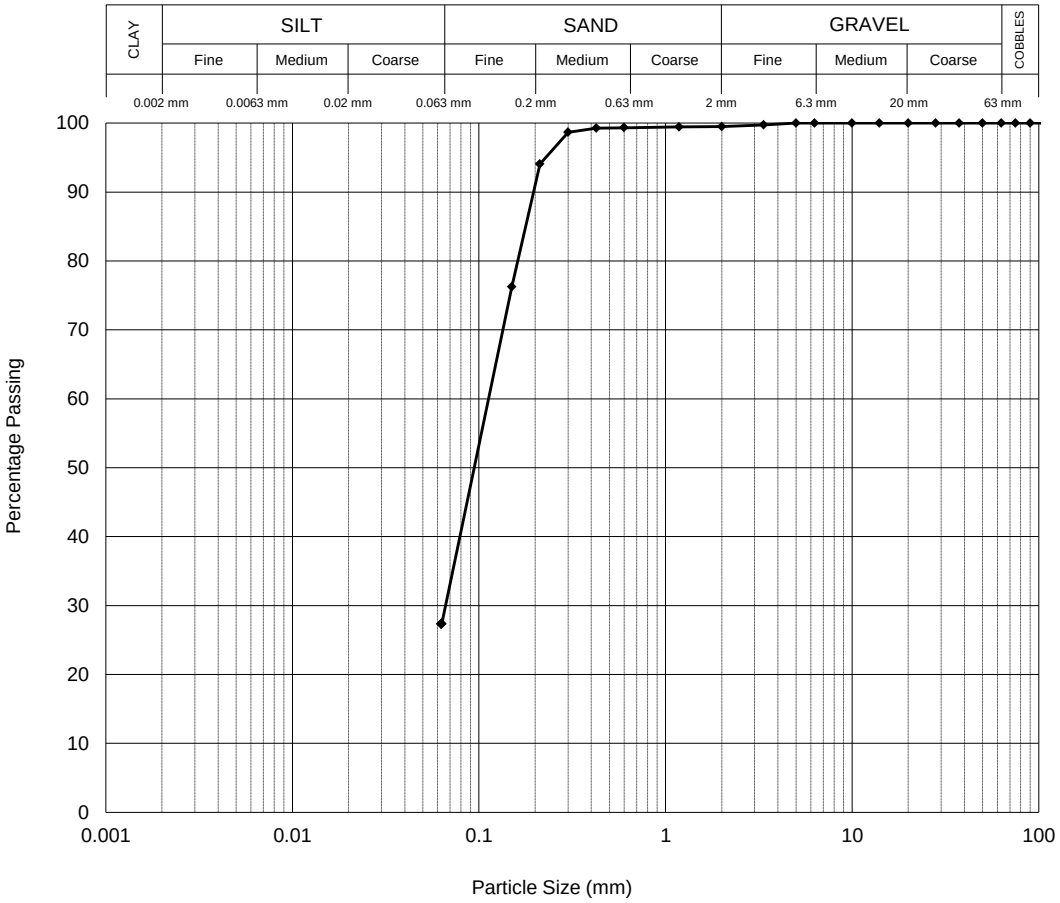
BH / TP No.	BH1
Depth (m)	18.00
Sample Type	D

Description

Brownish grey clayey silty SAND.

BS EN ISO 17892-4 : 2016 : Clause 5.2 - Wet Sieve

Sieve	
Size	% Pass
200.0 mm	100
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	100
20.0 mm	100
14.0 mm	100
10.0 mm	100
6.30 mm	100
5.00 mm	100
3.35 mm	100
2.00 mm	100
1.18 mm	99
600 µm	99
425 µm	99
300 µm	99
212 µm	94
150 µm	76
63 µm	27



Particle Proportions	
Cobbles	0
Gravel	0
Sand	72
Silt & Clay	28

Checked and Approved by

S Burke

S Burke - Senior Technician
29/06/2018

Project Number:

GEO / 27587

Project Name:

EYRE STREET, RAGGED SCHOOL
J18042

GEOLABS

UKAS TESTING 1962

BS EN ISO 17892-4 : 2016

PARTICLE SIZE DISTRIBUTION

BH / TP No.	BH1
Depth (m)	25.50
Sample Type	D

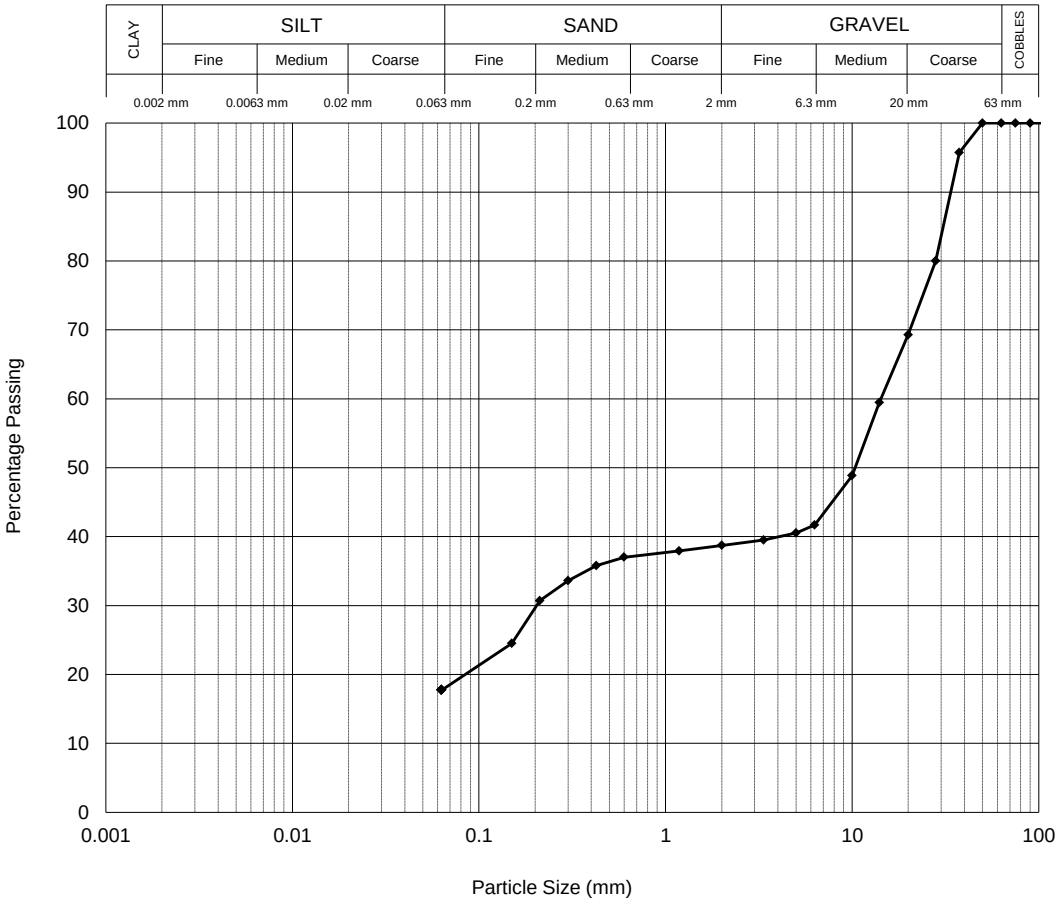
Description

Greenish grey clayey sandy GRAVEL.

Remarks Insuffcient sample supplied to comply with BS EN ISO 17892-4 : 2016 minimum mass requirements

BS EN ISO 17892-4 : 2016 : Clause 5.2 - Wet Sieve

Sieve	
Size	% Pass
200.0 mm	100
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	100
37.5 mm	96
28.0 mm	80
20.0 mm	69
14.0 mm	59
10.0 mm	49
6.30 mm	42
5.00 mm	41
3.35 mm	40
2.00 mm	39
1.18 mm	38
600 µm	37
425 µm	36
300 µm	34
212 µm	31
150 µm	24
63 µm	18



Particle Proportions	
Cobbles	0
Gravel	61
Sand	21
Silt & Clay	18

Checked and Approved by

S Burke

S Burke - Senior Technician
29/06/2018

Project Number:

GEO / 27587

Project Name:

EYRE STREET, RAGGED SCHOOL

J18042

GEOLABS

UKAS TESTING 1982

BS EN ISO 17892-4 : 2016

PARTICLE SIZE DISTRIBUTION

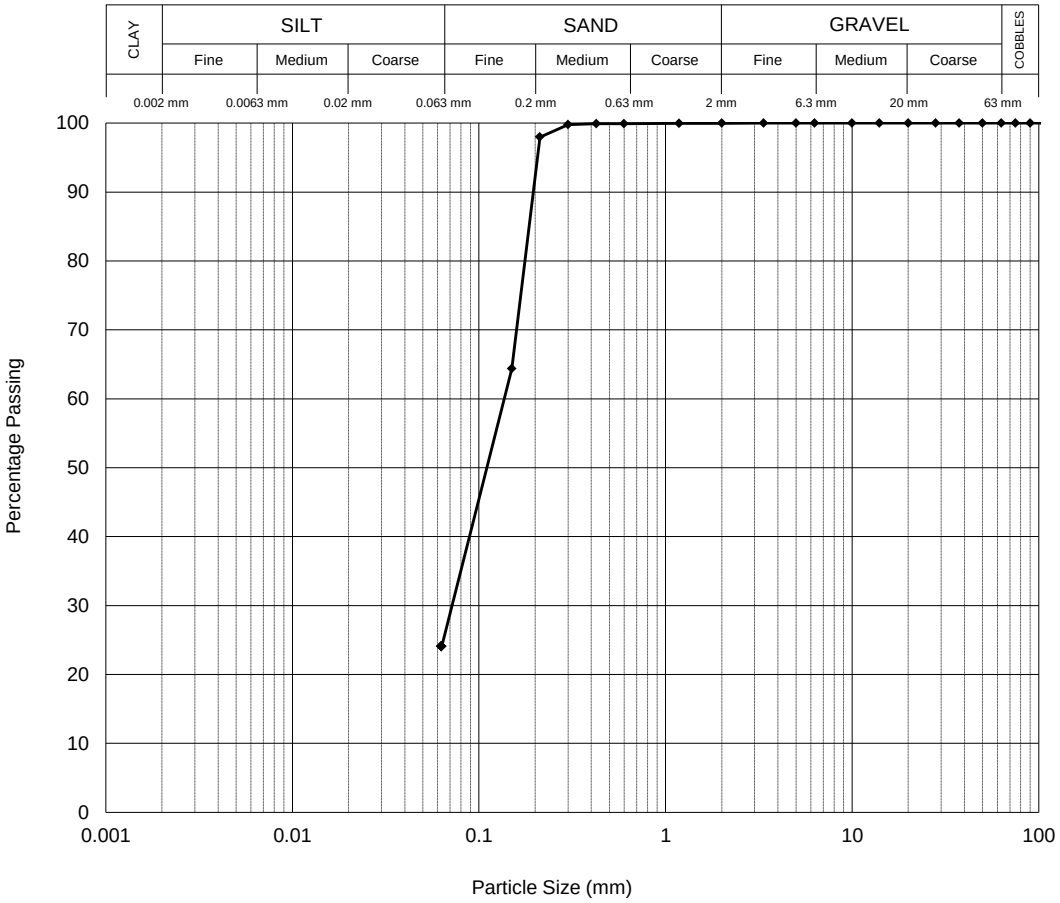
BH / TP No.	BH3
Depth (m)	15.50
Sample Type	D

Description

Light brownish grey clayey silty SAND.

BS EN ISO 17892-4 : 2016 : Clause 5.2 - Wet Sieve

Sieve	
Size	% Pass
200.0 mm	100
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	100
20.0 mm	100
14.0 mm	100
10.0 mm	100
6.30 mm	100
5.00 mm	100
3.35 mm	100
2.00 mm	100
1.18 mm	100
600 µm	100
425 µm	100
300 µm	100
212 µm	98
150 µm	64
63 µm	24



Particle Proportions	
Cobbles	0
Gravel	0
Sand	76
Silt & Clay	24

Checked and Approved by

S Burke

S Burke - Senior Technician
29/06/2018

Project Number:

GEO / 27587

Project Name:

EYRE STREET, RAGGED SCHOOL
J18042

GEOLABS

UKAS TESTING 1982

BS EN ISO 17892-4 : 2016

PARTICLE SIZE DISTRIBUTION

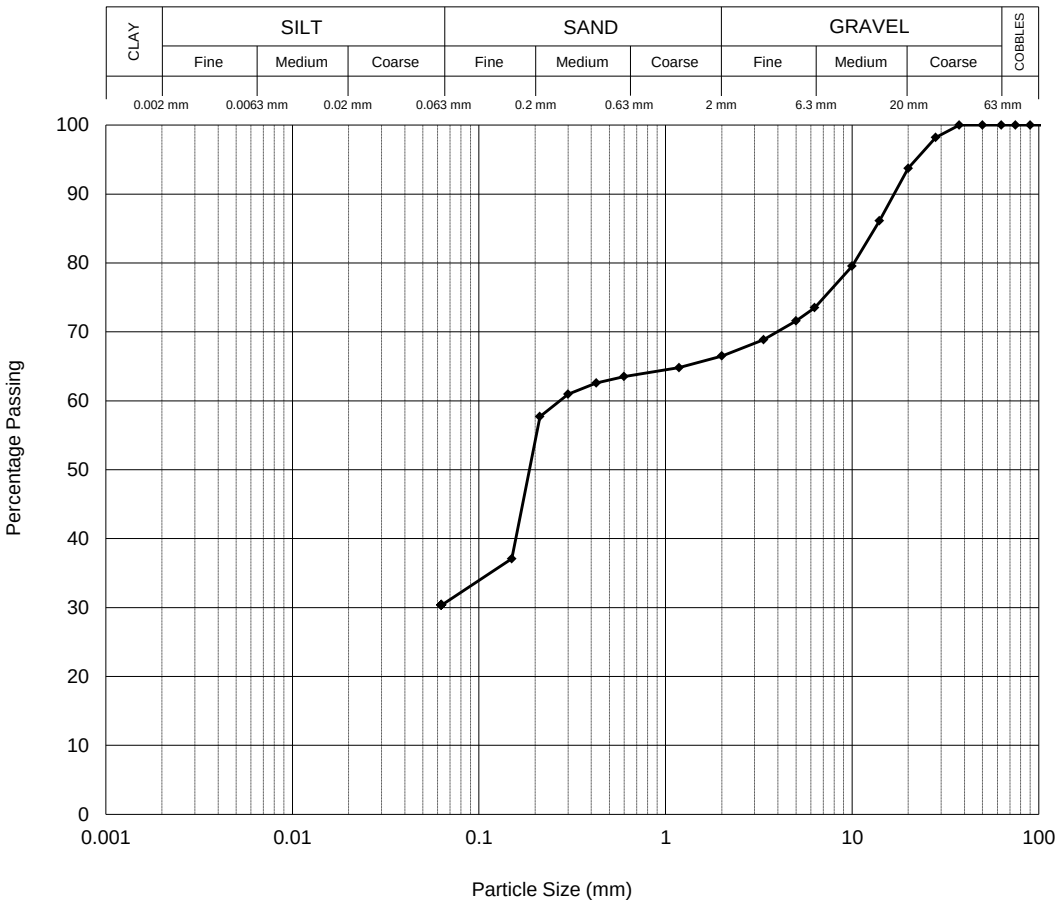
BH / TP No.	BH3
Depth (m)	24.00
Sample Type	D

Description

Multicoloured clayey silty SAND and GRAVEL.

BS EN ISO 17892-4 : 2016 : Clause 5.2 - Wet Sieve

Sieve	
Size	% Pass
200.0 mm	100
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	98
20.0 mm	94
14.0 mm	86
10.0 mm	80
6.30 mm	73
5.00 mm	72
3.35 mm	69
2.00 mm	66
1.18 mm	65
600 µm	63
425 µm	63
300 µm	61
212 µm	58
150 µm	37
63 µm	30



Particle Proportions	
Cobbles	0
Gravel	34
Sand	36
Silt & Clay	30

Checked and Approved by

S Burke

S Burke - Senior Technician
29/06/2018

Project Number:

GEO / 27587

Project Name:

EYRE STREET, RAGGED SCHOOL
J18042

GEOLABS

UKAS TESTING 1982

BS EN ISO 17892-4 : 2016

PARTICLE SIZE DISTRIBUTION

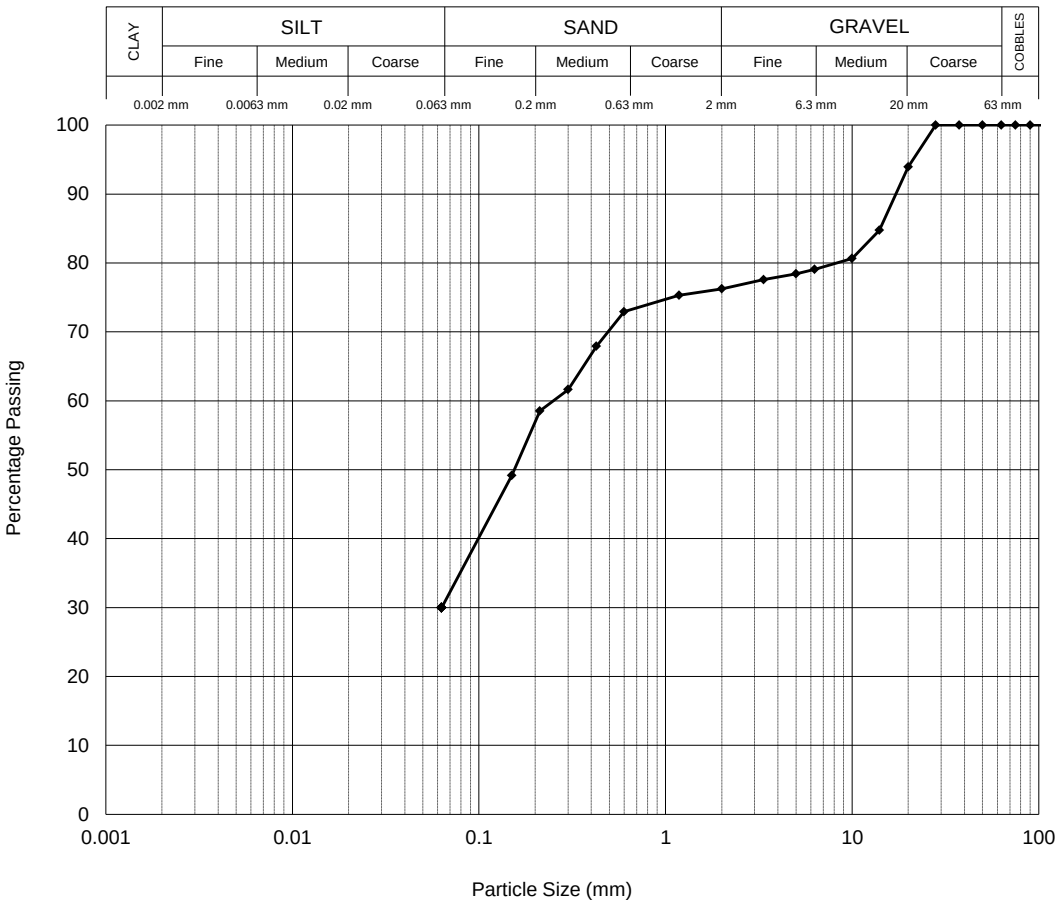
BH / TP No.	BH3
Depth (m)	27.00
Sample Type	D

Description

Dark bluish grey slightly gravelly sandy CLAY.

BS EN ISO 17892-4 : 2016 : Clause 5.2 - Wet Sieve

Sieve	
Size	% Pass
200.0 mm	100
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	100
20.0 mm	94
14.0 mm	85
10.0 mm	81
6.30 mm	79
5.00 mm	78
3.35 mm	78
2.00 mm	76
1.18 mm	75
600 µm	73
425 µm	68
300 µm	62
212 µm	59
150 µm	49
63 µm	30



Particle Proportions	
Cobbles	0
Gravel	24
Sand	46
Silt & Clay	30

Checked and Approved by

S Burke

S Burke - Senior Technician
29/06/2018

Project Number:

GEO / 27587

Project Name:

EYRE STREET, RAGGED SCHOOL
J18042

GEOLABS

UKAS TESTING 1982

BS EN ISO 17892-4 : 2016

PARTICLE SIZE DISTRIBUTION

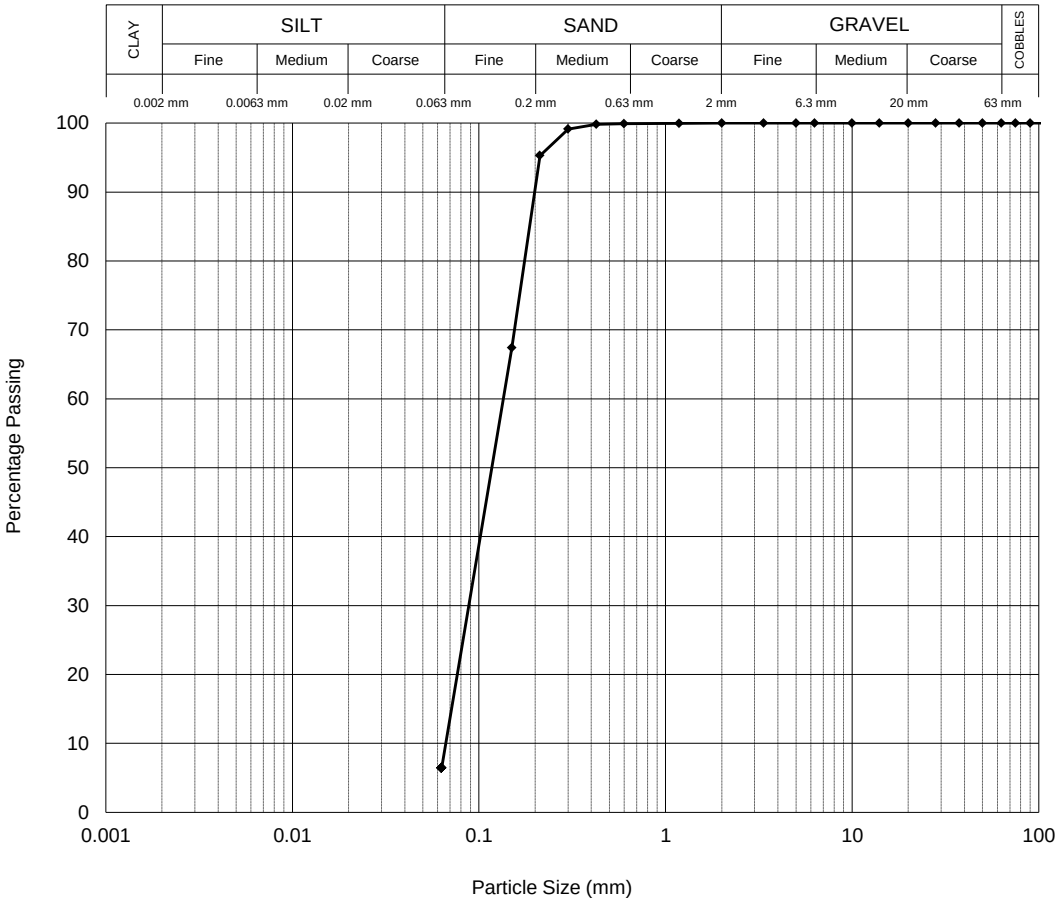
BH / TP No.	BH3
Depth (m)	30.50
Sample Type	D

Description

Grey silty SAND.

BS EN ISO 17892-4 : 2016 : Clause 5.2 - Dry Sieve

Sieve	
Size	% Pass
200.0 mm	100
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	100
20.0 mm	100
14.0 mm	100
10.0 mm	100
6.30 mm	100
5.00 mm	100
3.35 mm	100
2.00 mm	100
1.18 mm	100
600 µm	100
425 µm	100
300 µm	99
212 µm	95
150 µm	67
63 µm	6



Particle Proportions	
Cobbles	0
Gravel	0
Sand	94
Silt & Clay	6

Checked and Approved by

S Burke

S Burke - Senior Technician
29/06/2018

Project Number:

GEO / 27587

Project Name:

EYRE STREET, RAGGED SCHOOL
J18042

GEOLABS

UKAS TESTING 1982

BS EN ISO 17892-4 : 2016

PARTICLE SIZE DISTRIBUTION

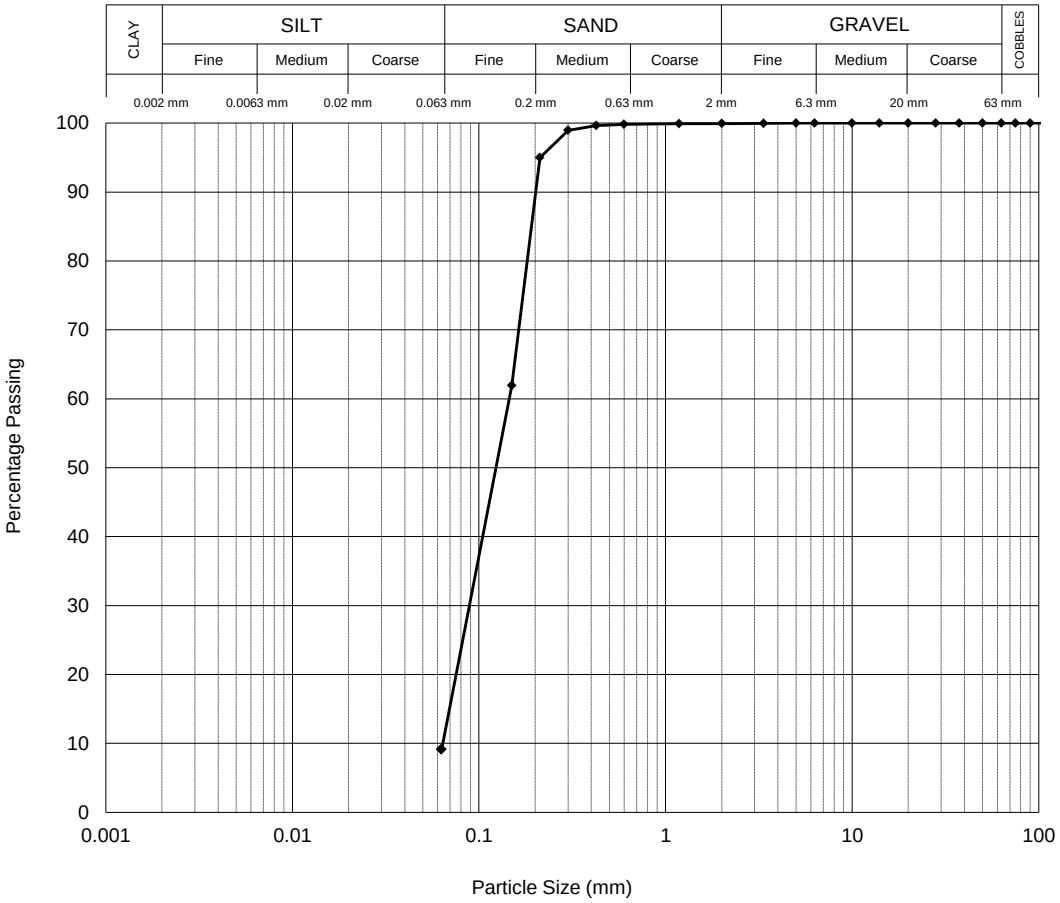
BH / TP No.	BH3
Depth (m)	35.00
Sample Type	D

Description

Dark grey clayey SAND.

BS EN ISO 17892-4 : 2016 : Clause 5.2 - Wet Sieve

Sieve	
Size	% Pass
200.0 mm	100
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	100
20.0 mm	100
14.0 mm	100
10.0 mm	100
6.30 mm	100
5.00 mm	100
3.35 mm	100
2.00 mm	100
1.18 mm	100
600 µm	100
425 µm	100
300 µm	99
212 µm	95
150 µm	62
63 µm	9



Particle Proportions	
Cobbles	0
Gravel	0
Sand	91
Silt & Clay	9

Checked and Approved by

S Burke

S Burke - Senior Technician
29/06/2018

Project Number:

GEO / 27587

Project Name:

EYRE STREET, RAGGED SCHOOL
J18042

GEOLABS

UKAS TESTING 1982

BS 1377 : Part 7 : 1990 Clause 8

QUICK UNDRAINED TRIAXIAL COMPRESSION TEST

BH/TP No	BH1
Depth (m)	4.00
Sample Type	U

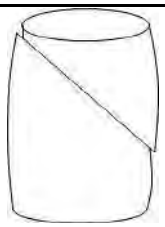
Description:

Stiff fissured multicoloured silty CLAY.

Specimen Details

Specimen conditions		Undisturbed
Length	(mm)	202.0
Diameter	(mm)	103.3
Moisture Content	(%)	38.4
Bulk Density	(Mg/m³)	1.91
Dry Density	(Mg/m³)	1.38
Test Details		
Latex membrane thickness	(mm)	0.3
Membrane correction	(kPa)	1.1
Axial displacement rate	(%/min)	2.0
Cell pressure	(kPa)	80
Strain at failure	(%)	19.8
Maximum Deviator Stress	(kPa)	105
Shear Stress Cu	(kPa)	53

Mode of failure



Orientation of the sample	Vertical
Distance from top of tube mm	45

Checked and Approved by:

S Burke

S Burke - Senior Technician
29/06/2018

Project Number:

GEO / 27587

Project Name:

EYRE STREET, RAGGED SCHOOL

J18042

GEOLABS

UKAS TESTING 1982

BS 1377 : Part 7 : 1990 Clause 8

QUICK UNDRAINED TRIAXIAL COMPRESSION TEST

BH/TP No	BH1
Depth (m)	6.50
Sample Type	U

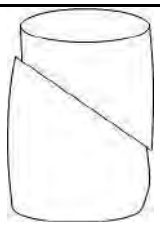
Description:

Firm dark grey CLAY.

Specimen Details

Specimen conditions		Undisturbed
Length	(mm)	203.6
Diameter	(mm)	103.4
Moisture Content	(%)	32.6
Bulk Density	(Mg/m³)	1.94
Dry Density	(Mg/m³)	1.46
Test Details		
Latex membrane thickness	(mm)	0.3
Membrane correction	(kPa)	0.2
Axial displacement rate	(%/min)	2.0
Cell pressure	(kPa)	130
Strain at failure	(%)	2.7
Maximum Deviator Stress	(kPa)	138
Shear Stress Cu	(kPa)	69

Mode of failure



Orientation of the sample	Vertical
Distance from top of tube mm	50

Checked and Approved by:

S Burke

S Burke - Senior Technician
29/06/2018

Project Number:

GEO / 27587

Project Name:

EYRE STREET, RAGGED SCHOOL

J18042

GEOLABS

UKAS TESTING 1982

BS 1377 : Part 7 : 1990 Clause 8

QUICK UNDRAINED TRIAXIAL COMPRESSION TEST

BH/TP No	BH1
Depth (m)	9.50
Sample Type	U

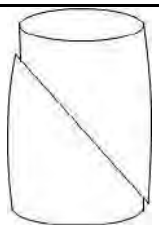
Description:

Very stiff fissured dark brown silty CLAY.

Specimen Details

Specimen conditions		Undisturbed
Length	(mm)	202.2
Diameter	(mm)	102.8
Moisture Content	(%)	23.8
Bulk Density	(Mg/m³)	2.04
Dry Density	(Mg/m³)	1.65
Test Details		
Latex membrane thickness	(mm)	0.3
Membrane correction	(kPa)	0.8
Axial displacement rate	(%/min)	2.0
Cell pressure	(kPa)	190
Strain at failure	(%)	12.9
Maximum Deviator Stress	(kPa)	250
Shear Stress Cu	(kPa)	125

Mode of failure



Orientation of the sample	Vertical
Distance from top of tube mm	

Checked and Approved by:

S Burke

S Burke - Senior Technician
29/06/2018

Project Number:

GEO / 27587

Project Name:

EYRE STREET, RAGGED SCHOOL

J18042

GEOLABS

UKAS TESTING 1982

BS 1377 : Part 7 : 1990 Clause 8

QUICK UNDRAINED TRIAXIAL COMPRESSION TEST

BH/TP No	BH1
Depth (m)	12.50
Sample Type	U

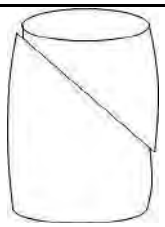
Description:

Very stiff fissured brown mottled grey CLAY.

Specimen Details

Specimen conditions		Undisturbed
Length	(mm)	202.9
Diameter	(mm)	103.1
Moisture Content	(%)	23.1
Bulk Density	(Mg/m³)	2.11
Dry Density	(Mg/m³)	1.71
Test Details		
Latex membrane thickness	(mm)	0.3
Membrane correction	(kPa)	0.7
Axial displacement rate	(%/min)	2.0
Cell pressure	(kPa)	250
Strain at failure	(%)	10.8
Maximum Deviator Stress	(kPa)	381
Shear Stress Cu	(kPa)	191

Mode of failure



Orientation of the sample	Vertical
Distance from top of tube mm	45

Checked and Approved by:

S Burke

S Burke - Senior Technician
29/06/2018

Project Number:

GEO / 27587

Project Name:

EYRE STREET, RAGGED SCHOOL

J18042

GEOLABS

UKAS TESTING 1982

BS 1377 : Part 7 : 1990 Clause 8

QUICK UNDRAINED TRIAXIAL COMPRESSION TEST

BH/TP No	BH2
Depth (m)	8.00
Sample Type	U

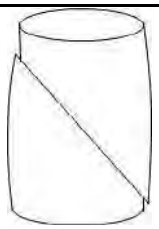
Description:

Very stiff fissured dark brown silty CLAY.

Specimen Details

Specimen conditions		Undisturbed
Length	(mm)	202.3
Diameter	(mm)	102.7
Moisture Content	(%)	22.5
Bulk Density	(Mg/m³)	2.01
Dry Density	(Mg/m³)	1.64
Test Details		
Latex membrane thickness	(mm)	0.3
Membrane correction	(kPa)	1.1
Axial displacement rate	(%/min)	2.0
Cell pressure	(kPa)	160
Strain at failure	(%)	19.8
Maximum Deviator Stress	(kPa)	215
Shear Stress Cu	(kPa)	107

Mode of failure



Orientation of the sample	Vertical
Distance from top of tube mm	30

Checked and Approved by:

S Burke

S Burke - Senior Technician
29/06/2018

Project Number:

GEO / 27587

Project Name:

EYRE STREET, RAGGED SCHOOL

J18042

GEOLABS

UKAS TESTING 1982

BS 1377 : Part 7 : 1990 Clause 8

QUICK UNDRAINED TRIAXIAL COMPRESSION TEST

BH/TP No	BH2
Depth (m)	11.00
Sample Type	U

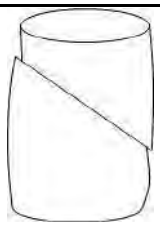
Description:

Very stiff fissured brown mottled grey CLAY.

Specimen Details

Specimen conditions		Undisturbed
Length	(mm)	202.6
Diameter	(mm)	102.7
Moisture Content	(%)	21.8
Bulk Density	(Mg/m³)	2.10
Dry Density	(Mg/m³)	1.73
Test Details		
Latex membrane thickness	(mm)	0.3
Membrane correction	(kPa)	0.3
Axial displacement rate	(%/min)	2.0
Cell pressure	(kPa)	220
Strain at failure	(%)	3.2
Maximum Deviator Stress	(kPa)	241
Shear Stress Cu	(kPa)	120

Mode of failure



Orientation of the sample	Vertical
Distance from top of tube mm	

Checked and Approved by:

S Burke

S Burke - Senior Technician
29/06/2018

Project Number:

GEO / 27587

Project Name:

EYRE STREET, RAGGED SCHOOL

J18042

GEOLABS

UKAS TESTING 1982

BS 1377 : Part 7 : 1990 Clause 8

QUICK UNDRAINED TRIAXIAL COMPRESSION TEST

BH/TP No	BH3
Depth (m)	5.00
Sample Type	U

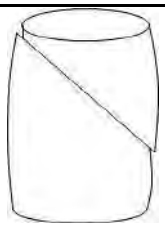
Description:

Soft dark grey mottled brown CLAY.

Specimen Details

Specimen conditions		Undisturbed
Length	(mm)	203.3
Diameter	(mm)	101.9
Moisture Content	(%)	37.0
Bulk Density	(Mg/m³)	1.86
Dry Density	(Mg/m³)	1.36
Test Details		
Latex membrane thickness	(mm)	0.3
Membrane correction	(kPa)	1.1
Axial displacement rate	(%/min)	2.0
Cell pressure	(kPa)	100
Strain at failure	(%)	19.7
Maximum Deviator Stress	(kPa)	69
Shear Stress Cu	(kPa)	34

Mode of failure



Orientation of the sample	Vertical
Distance from top of tube mm	40

Checked and Approved by:

S Burke

S Burke - Senior Technician
29/06/2018

Project Number:

GEO / 27587

Project Name:

EYRE STREET, RAGGED SCHOOL

J18042

GEOLABS

UKAS TESTING 1982

BS 1377 : Part 7 : 1990 Clause 8

QUICK UNDRAINED TRIAXIAL COMPRESSION TEST

BH/TP No	BH3
Depth (m)	8.00
Sample Type	U

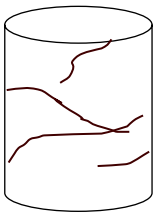
Description:

Firm dark brown mottled dark grey CLAY.

Specimen Details

Specimen conditions		Undisturbed
Length	(mm)	203.0
Diameter	(mm)	103.3
Moisture Content	(%)	30.0
Bulk Density	(Mg/m³)	1.99
Dry Density	(Mg/m³)	1.53
Test Details		
Latex membrane thickness	(mm)	0.3
Membrane correction	(kPa)	1.1
Axial displacement rate	(%/min)	2.0
Cell pressure	(kPa)	160
Strain at failure	(%)	19.7
Maximum Deviator Stress	(kPa)	191
Shear Stress Cu	(kPa)	96

Mode of failure



Orientation of the sample	Vertical
Distance from top of tube mm	25

Checked and Approved by:

S Burke

S Burke - Senior Technician
29/06/2018

Project Number:

GEO / 27587

Project Name:

EYRE STREET, RAGGED SCHOOL

J18042

GEOLABS

UKAS TESTING 1982

BS 1377 : Part 7 : 1990 Clause 8

QUICK UNDRAINED TRIAXIAL COMPRESSION TEST

BH/TP No	BH3
Depth (m)	11.00
Sample Type	U

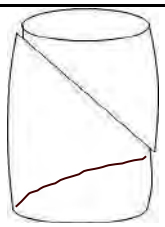
Description:

Firm brown mottled grey CLAY.

Specimen Details

Specimen conditions		Undisturbed
Length	(mm)	203.6
Diameter	(mm)	103.2
Moisture Content	(%)	29.2
Bulk Density	(Mg/m³)	2.00
Dry Density	(Mg/m³)	1.55
Test Details		
Latex membrane thickness	(mm)	0.3
Membrane correction	(kPa)	0.3
Axial displacement rate	(%/min)	2.0
Cell pressure	(kPa)	220
Strain at failure	(%)	4.4
Maximum Deviator Stress	(kPa)	132
Shear Stress Cu	(kPa)	66

Mode of failure



Orientation of the sample	Vertical
Distance from top of tube mm	30

Checked and Approved by:

S Burke

S Burke - Senior Technician
29/06/2018

Project Number:

GEO / 27587

Project Name:

EYRE STREET, RAGGED SCHOOL

J18042

GEOLABS

UKAS TESTING 1982

BS 1377 : Part 7 : 1990 Clause 8

QUICK UNDRAINED TRIAXIAL COMPRESSION TEST

BH/TP No	BH3
Depth (m)	14.00
Sample Type	U

Description:

Firm brown mottled grey CLAY.

Specimen Details

Specimen conditions		Undisturbed
Length	(mm)	203.6
Diameter	(mm)	103.2
Moisture Content	(%)	20.5
Bulk Density	(Mg/m³)	2.13
Dry Density	(Mg/m³)	1.77
Test Details		
Latex membrane thickness	(mm)	0.3
Membrane correction	(kPa)	0.5
Axial displacement rate	(%/min)	2.0
Cell pressure	(kPa)	130
Strain at failure	(%)	7.9
Maximum Deviator Stress	(kPa)	491
Shear Stress Cu	(kPa)	245

Mode of failure

Orientation of the sample	Vertical
Distance from top of tube mm	30

Checked and Approved by:

S Burke

S Burke - Senior Technician
29/06/2018

Project Number:

GEO / 27587

Project Name:

EYRE STREET, RAGGED SCHOOL

J18042

GEOLABS

UKAS TESTING 1982

Jack Deaney
Geotechnical & Environmental Associates
Widbury Barn
Widbury Hill
Ware
Hertfordshire
SG127QE

e: Jack@gea-ltd.co.uk

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

Analytical Report Number : 18-85373

Project / Site name:	Ragged School	**Samples received on:**	14/05/2018
Your job number:	J18042	**Samples instructed on:**	14/05/2018
Your order number:	J18042	**Analysis completed by:**	21/05/2018
Report Issue Number:	1	**Report issued on:**	21/05/2018
Samples Analysed:	2 soil samples		

Signed: _____

Jordan Hill
Reporting Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Analytical Report Number: 18-85373

Project / Site name: Ragged School
Your Order No: J18042

Lab Sample Number				960497	960498			
Sample Reference				BH3	TP9			
Sample Number				None Supplied	None Supplied			
Depth (m)				1.50	0.90			
Date Sampled				10/05/2018	12/05/2018			
Time Taken				None Supplied	None Supplied			
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1			
Moisture Content	%	N/A	NONE	18	17			
Total mass of sample received	kg	0.001	NONE	1.1	1.2			
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected			
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	8.0	8.2			
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1			
Total Sulphate as SO_4	mg/kg	50	MCERTS	1200	2700			
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.16	0.20			
Sulphide	mg/kg	1	MCERTS	< 1.0	1.6			
Water Soluble Chloride (2:1)	mg/kg	1	MCERTS	26	94			
Total Organic Carbon (TOC)	%	0.1	MCERTS	3.2	1.8			
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0			
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	< 0.80			
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	15	21			
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2			
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	17	19			
Copper (aqua regia extractable)	mg/kg	1	MCERTS	180	140			
Lead (aqua regia extractable)	mg/kg	1	MCERTS	1100	880			
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	3.3	4.7			
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	19	17			
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	1.2	1.1			
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	93	110			

Analytical Report Number: 18-85373

Project / Site name: Ragged School
Your Order No: J18042

Lab Sample Number				960497	960498			
Sample Reference				BH3	TP9			
Sample Number				None Supplied	None Supplied			
Depth (m)				1.50	0.90			
Date Sampled				10/05/2018	12/05/2018			
Time Taken				None Supplied	None Supplied			
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Petroleum Hydrocarbons								
TPH C10 - C40	mg/kg	10	MCERTS	37	< 10			
TPH (C8 - C10)	mg/kg	0.1	MCERTS	< 0.1	< 0.1			
TPH (C10 - C12)	mg/kg	2	MCERTS	< 2.0	< 2.0			
TPH (C12 - C16)	mg/kg	4	MCERTS	< 4.0	< 4.0			
TPH (C16 - C21)	mg/kg	1	MCERTS	11	< 1.0			
TPH (C21 - C35)	mg/kg	1	MCERTS	21	< 1.0			

Analytical Report Number : 18-85373

Project / Site name: Ragged School

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
960497	BH3	None Supplied	1.50	Brown clay and sand with rubble and brick.
960498	TP9	None Supplied	0.90	Brown sand with rubble and brick.

Analytical Report Number : 18-85373

Project / Site name: Ragged School

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Chloride, water soluble, in soil	Determination of Chloride colorimetrically by discrete analyser.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests. 2:1 extraction.	L082-PL	D	MCERTS
D.O. for Gravimetric Quant if Screen/ID positive	Dependent option for Gravimetric Quant if Screen/ID positive scheduled.	In house asbestos methods A001 & A006.	A006-PL	D	NONE
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	D	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP-OES.	L038-PL	D	MCERTS
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode.	In-house method	L010-PL	D	MCERTS
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests""	L009-PL	D	MCERTS
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L038-PL	D	MCERTS
TPH Banding in Soil by FID	Determination of hexane extractable hydrocarbons in soil by GC-FID.	In-house method, TPH with carbon banding.	L076-PL	W	MCERTS
TPH in (Soil)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding.	L076-PL	D	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

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Generic Risk-Based Soil Screening Values

Site	The Former Ragged School, 15-29 Eyre Street Hil, London, EC1R 5DZ	**Job Number** J18042
Client	Clerkenwell Lifestyle (UK) Ltd	**Sheet** 1 / 1
Engineer	HTS	

Proposed End Use Residential without plant uptake

Soil pH 8

Soil Organic Matter content % 2.5

Contaminant	Screening Value mg/kg	Data Source
Metals		
Arsenic	40	C4SL
Cadmium	149	C4SL
Chromium (III)	3000	LQM/CIEH
Chromium (VI)	21	C4SL
Copper	2,330	LQM/CIEH
Lead	310	C4SL
Elemental Mercury	1.02	SGV
Inorganic Mercury	235	SGV
Nickel	99	LQM/CIEH
Selenium	595	SGV
Zinc	3,750	LQM/CIEH
Hydrocarbons		
Benzene	1.4	C4SL
Toluene	320	SGV
Ethyl Benzene	180	SGV
Xylene	120	SGV
Aliphatic C5-C6	55	LQM/CIEH
Aliphatic C6-C8	160	LQM/CIEH
Aliphatic C8-C10	46	LQM/CIEH
Aliphatic C10-C12	230	LQM/CIEH
Aliphatic C12-C16	1700	LQM/CIEH
Aliphatic C16-C35	64,000	LQM/CIEH
Aromatic C6-C7	See Benzene	LQM/CIEH
Aromatic C7-C8	See Toluene	LQM/CIEH
Aromatic C8-C10	65	LQM/CIEH
Aromatic C10-C12	160	LQM/CIEH
Aromatic C12-C16	310	LQM/CIEH
Aromatic C16-C21	480	LQM/CIEH
Aromatic C21-C35	1100	LQM/CIEH
PRO (C_5 –C_{10})	647	Calc
DRO (C_{12} –C_{28})	66,490	Calc
Lube Oil (C_{28} –C_{44})	65,100	Calc
TPH	**1000**	Trigger for speciated testing

Contaminant	Screening Value mg/kg	Data Source
Anions		
Soluble Sulphate	500 mg/l	Structures
Sulphide	50	Structures
Chloride	400	Structures
Others		
Organic Carbon (%)	6	Methanogenic potential
Total Cyanide	140	WRAS
Total Mono Phenols	420	SGV
PAH		
Naphthalene	5.60	C4SL exp & LQM/CIEH
Acenaphthylene	3,020	LQM/CIEH
Acenaphthene	3,090	LQM/CIEH
Fluorene	2,480	LQM/CIEH
Phenanthrene	928	LQM/CIEH
Anthracene	22,200	LQM/CIEH
Fluoranthene	993	LQM/CIEH
Pyrene	2,380	LQM/CIEH
Benzo(a) Anthracene	7.8	C4SL exp & LQM/CIEH
Chrysene	15	C4SL exp & LQM/CIEH
Benzo(b) Fluoranthene	11.0	C4SL exp & LQM/CIEH
Benzo(k) Fluoranthene	15.6	C4SL exp & LQM/CIEH
Benzo(a) pyrene	4.70	C4SL
Indeno(1 2 3 cd) Pyrene	6.6	C4SL exp & LQM/CIEH
Dibenzo(a h) Anthracene	1.38	C4SL exp & LQM/CIEH
Benzo (g h i) Perylene	72	C4SL exp & LQM/CIEH
Screening value for PAH	**67.1**	B(a)P / 0.15
Chlorinated Solvents		
1,1,1 trichloroethane (TCA)	29.8	LQM/CIEH
tetrachloroethane (PCA)	8.05	LQM/CIEH
tetrachloroethene (PCE)	3.39	LQM/CIEH
trichloroethene (TCE)	0.346	LQM/CIEH
1,2-dichloroethane (DCA)	0.00931	LQM/CIEH
vinyl chloride (Chloroethene)	0.00248	LQM/CIEH
tetrachloromethane (Carbon tetra	0.0793	LQM/CIEH
trichloromethane (Chloroform)	3.91	LQM/CIEH

Notes

Concentrations measured below the above values may be considered to represent 'uncontaminated conditions' which pose 'LOW' risk to human health. Concentrations measured in excess of these values indicate a potential risk which require further, site specific risk assessment.

SGV - Soil Guideline Value, derived from the CLEA model and published by Environment Agency 2009

LQM/CIEH - Generic Assessment Criteria for Human Health Risk Assessment 2nd edition (2009)derived using CLEA 1.04 model 2009

C4SL - Defra Category 4 Screening value based on Low Level of Toxicological Risk

C4SL exp & LQM/CIEH calculated using C4SL revisions to exposure assessment but LQM/CIEH health criteria values

Calc - sum of nearest available carbon range specified including BTEX for PRO fraction

B(a)P / 0.15 - GEA experience indicates that Benzo(a) pyrene (one of the most common and most carcinogenic of the PAHs) rarely exceeds 15% of the total PAH concentration, hence this Total PAH threshold is regarded as being conservative

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Generic Risk-Based Soil Screening Values

Site	The Former Ragged School, 15-29 Eyre Street Hil, London, EC1R 5DZ
Client	Clerkenwell Lifestyle (UK) Ltd
Engineer	HTS

Job Number J18042

Sheet 2 / 2

Proposed End Use **Residential without plant uptake**

The key generic assumptions for this end use are as follows;

- ❑ that groundwater will not be a critical risk receptor;
- ❑ that the critical receptor for human health will be a young female aged 0 to 6 years old;
- ❑ that the exposure duration will be six years;
- ❑ that the building type equates to a terraced house.
- ❑ that the critical exposure pathways will be direct soil and indoor dust ingestion, skin contact with soils and dust, and inhalation of dust and vapours;

Where contaminant concentrations are measured at concentrations below the generic screening value it is considered that they pose an acceptable level of risk and thus further consideration of these contaminant concentrations is not required. However, where concentrations are measured in excess of the generic screening value there is considered to be a potential that they could pose an unacceptable risk and thus further action will be required which could include:

- ❑ additional testing to zone the extent of the contaminated material and thus reduce the uncertainty with regard to its potential risk;
- ❑ site specific risk assessment to refine the assessment criteria and allow an assessment to be made as to whether the concentration present would pose an unacceptable risk at this site; or
- ❑ soil remediation or risk management to mitigate the risk posed by the contaminant to a degree that it poses an acceptable risk.

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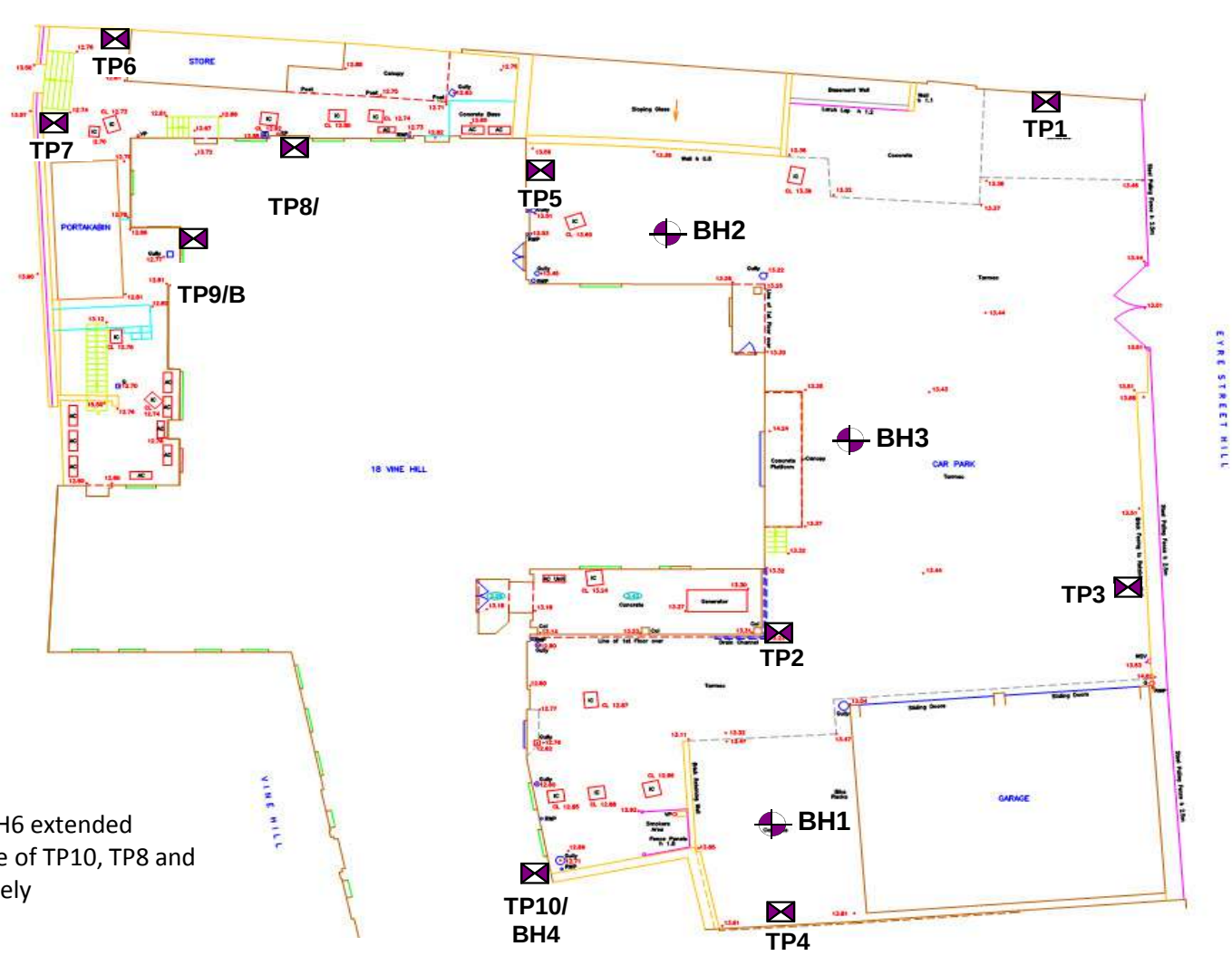
Notts | 01509 674888

Site Plan

Site	The Former Ragged School
Client	Clerkenwell Lifestyle (UK) Ltd
Engineer	Heyne Tillett Steel

Job Number J18042

Sheet 1 / 1



BH4, BH5, BH6 extended through base of TP10, TP8 and TP9 repectively

DISCOVERY STRATEGY- CONSTRUCTION PHASE
CONTAMINATED MATERIALS

SITE ADDRESS: **THE FORMER RAGGED SCHOOL, 18 VINE STREET AND 15-29 EYRE STREET HILL, LONDON EC1R 5DZ**

SITE REFERENCE: **J18042**

INTRODUCTION

The site is proposed for redevelopment for a mix of commercial and residential purposes and a Discovery Strategy is to be implemented during the construction phase of the programme. Its purpose is to define the process to be undertaken on site in the event that previously unidentified pockets of contamination or suspicious objects are discovered during the redevelopment of the site. It is intended to be understood and followed by all on-site workers and for all new site workers to be made aware of the procedure.

HOW TO IDENTIFY POTENTIAL CONTAMINATED MATERIAL

- Looks oily and has an odour similar to that of oil, petrol or deisel
- Solvent or organic type of odour
- Man made materials in fill such as paint cans, car parts, glass fragments
- Fragments of asbestos containing cement sheeting, coal/coke clinker or ash
- Subsurface concrete / metal structures

(Examples only – this list is not exhaustive. If in any doubt ask)

PROCEDURE

On the discovery of any suspicious pockets of material during the redevelopment the following procedure should be followed:

- Site personnel to immediately inform Contractor's Site Manager. Do not investigate it yourself.
- The Site Manager will initially decide if the material is potentially contaminated and will inform GEA. The area will be cordoned off and work will cease in the vicinity.
- GEA will attend site to sample material for laboratory testing and will attempt to quantify the volume. The Local Authority Environmental Health Officer will then be notified that potentially contaminated material has been discovered and will be forwarded laboratory data and a remedial strategy for their approval in the event that the material is to be classified as contaminated.

GEA CONTACT DETAILS

Alex Taylor
Senior Geotechnical Engineer
01727 824 666
AlexTaylor@gea-ltd.co.uk

GEA

Geotechnical & Environmental Associates (GEA) is an engineer-led and client-focused independent specialist providing a complete range of geotechnical and contaminated land investigation, analytical and consultancy services to the property and construction industries.

We have offices at

Widbury Barn
Widbury Hill
Ware
Hertfordshire
SG12 7QE
tel 01727 824666
mail@gea-ltd.co.uk

Church Farm
Gotham Road
Kingston on Soar
Notts
NG11 0DE
tel 01509 674888
midlands@gea-ltd.co.uk

Enquiries can also be made on-line at

www.gea-ltd.co.uk

where information can be found
on all of the services that we offer.

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