

**Hillingdon Young Person's Hub
Falling Lane
Yiewsley
West Drayton
Middlesex**

**Preliminary Ground Contamination
Risk Assessment Report**



Report No. R17-12386/ds

September 2017

Report prepared for the benefit of:

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The risk assessment presented in this report follows 'source-pathway-receptor' techniques for the determination of whether a site is contaminated. This is standard practice in the UK, being intrinsic to Part 2A of the Environmental Protection Act 1990 as amended.

The report considers the proposed end users as the most sensitive human health receptors. If significant risks to construction workers are identified by the preliminary assessment attention is drawn to this, although it is noted that no assessment of risk from acute exposure has been undertaken in this connection.

This report is not intended to be either an ecological, archaeological or flood risk assessment. An appropriate specialist should be consulted about any concerns that may arise in this regard.

EXECUTIVE SUMMARY

The following presents a summary of the main findings of the preliminary ground contamination risk assessment. It is emphasised that no reliance should be placed on any individual point until the whole of the report has been read as other sections of the report may put into context the information contained herein.

It is proposed to develop the Young Person's Academy located at Falling Lane, Yiewsley, West Drayton, Middlesex. The proposed development is understood to comprise the demolition of the existing school buildings and the construction of a new special needs secondary school for approximately 160 students.

The site currently comprises an existing school, with a main school building located centrally on the site, and several pre-fabricated classrooms. A large playing field is located in the northern part of the site, whilst a garden area is located to the east and a car park to the south west. A 1m high mound separates the playing field from the main school building

The site comprised an open field at the time of the earliest historical map referenced in 1868, with the south west of the site comprising part of a garden area for residential housing in the 1960s. The school is shown as developed by the time of the 1971 mapping revision, with several small outbuildings (pre-fabricated class rooms) shown as added, and an extension to the eastern main school building.

Reference to geological datasets indicates that the site is expected to be underlain by the Langley Silt Member overlying the London Clay Formation, which are both classed as Unproductive Strata.

Historical mineral sites (gravel pits and brick works) are identified to be present to the east and south east of the site and backfilled at the turn of the 20th century; geological maps indicate worked ground to be present in these areas.

The site does not lie within an Environment Agency Source Protection Zone with regard to the protection of the quality of groundwater that is abstracted for potable supply.

The preliminary contamination risk assessment identified a low risk associated with potential pollutant linkages linking end users of the site to potential contaminants within the mound present adjacent to the playing fields as well as to land gases that may emanate from the backfilled off-site mineral workings.

An intrusive ground investigation has been undertaken and a factual report on the findings produced under separate cover to allow the undertaking of a quantitative assessment of risks that may be posed by the potential contamination sources that have been identified by this report.

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Exploded Ordnance Desk Top Study

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1. INTRODUCTION

It is proposed to develop the Young Person's Academy located at Falling Lane, Yiewsley, West Drayton, Middlesex. No specific development proposals were available at the time of drafting of this report, though it is understood that the development is to comprise the demolition of the existing school buildings and the construction of a new special needs secondary school for approximately 160 students.

Ashdown Site Investigation Limited was requested to provide an estimate for carrying out a preliminary ground contamination risk assessment of the site by Mr. G. Madelin of Mace, 155 Moorgate, London, EC2M 6XB. The scope of the works allowed for and the terms and conditions under which the works were to be undertaken were set out within the offer letter Q17-5686/Rev 1, dated 21st July 2017.

The works were commissioned under a contract dated 10th August 2017.

The objectives of the works were to:

- a) Establish the expected geology, hydrogeology and hydrology at the site;
- b) Ascertain the development history and current site use; and
- c) Develop a preliminary conceptual model of the site identifying potential complete pollutant linkages relating to end users of the proposed development works, to controlled waters beneath and in the vicinity of the site, or to other off-site sensitive receptors, if identified.

The preliminary conceptual model has been based on the findings of a walkover survey and reference to historical Ordnance Survey maps and published geological and environmental information obtained from various sources.

Copies of the historical maps and geo-environmental data referred to in this report are included in a separate volume¹.

An Exploded Ordnance Desk Top Study² was undertaken for the site and is included as Appendix A.

¹ Geo-Environmental Data and Historical Maps, Ashdown Site Investigation Limited, Report Number R17-12386/map, dated August 2017.

² Exploded Ordnance Desk Stop Study, EOC Contracts Limited, Reference EOD/17/17367/DTS, dated 22nd August 2017

2. WALKOVER SURVEY

The site comprises an irregular shaped plot of land located at Falling Lane, Yiewsley, West Drayton, Middlesex and is centred on the approximate Ordnance Survey national grid reference TQ 0613 8099. A site location plan and site plan are presented as Figure 1 and Figure 2, respectively. Photographs taken during the walkover survey are included in Appendix B.

The site is bounded by residential properties to the south and east, Rabbsfarm School to the west and open land to the north, with access to the site off Falling Lane to south.

The site is currently used as a school and comprises a single storey school building located centrally on the site, with five pre-fabricated classroom buildings located to the west and south west of the main school building. A modern extension is present on the east of the main school building. An asphalt surfaced car park separates the school building from the pre-fabricated classroom to the south west.

A garden area (including a wooden structure used as a classroom) was present to the east of the main school building, with a multi-use games area (MUGA) present to the north east.

The northern part of the site is comprised of a grassed playing field, with an approximately 1m high mound separating the playing field from the school building and the MUGA to the south.

Mature trees are present along the boundaries of the site.

3. ENVIRONMENTAL AND GEO-ENVIRONMENTAL DATA REVIEW

3.1 Geological and Hydrogeological Information

3.1.1 Expected Geology, Aquifer Designation & Groundwater Vulnerability

The stratigraphic succession that may be expected to underlie the site is presented in the following table.

Table 1. Expected Strata, Aquifer Designation and Description

Type	Stratum	Aquifer Designation	Source Protection Zone
Superficial	Langley Silt Member	Unproductive Stratum	The site does not lie within an Environment Agency Source Protection Zone with regard to the protection of the quality of groundwater that is abstracted for potable supply.
Bedrock	London Clay Formation	Unproductive Stratum	

The Langley Silt Member generally comprises soft structureless sandy clay and silt with variable gravel content. The material may have been reworked by water flow to produce some lateral variability in the grain size of the soil. Where it has not been reworked by river action, it may be subject to significant collapse in volume where it is affected by water flow.

The eastern boundary of the site is inferred to be on a boundary between the Langley Silt Member and Lynch Hill Gravel Member. The Lynch Hill Gravel Member forms part of the river terrace gravel associated with the Thames. It typically comprises sand, derived mainly from the Tertiary beds, together with gravel of sub angular flint, chert and Lower Greensand Formation rock types.

Nearby British Geological Survey (BGS) boreholes suggest that the superficial Langley Silt Member extends to depths in the order of 2.5m to 5.0m below ground level, with a similar depth recorded for the Lynch Hill Gravel Member.

However, the Geology Maps also show that in the area to the east and south east of the site the Lynch Hill Gravel Member is shown as "worked ground". A review of the historical maps (1878) indicates the presence of a number of gravel pits approximately 100m to the east of the site and a brick field 100m to the north east. A further gravel pit is shown approximately 200m to the south east of the site. A BGS borehole approximately 200m to the south east of the site and potentially within the former gravel pit, identified the depth of made ground to be approximately 4.0m below ground level, indicating that the gravel pit had been historically backfilled. No BGS boreholes are located within the former gravel pit or the brick field to the east and north east of the site.

The London Clay Formation, that underlies both the Langley Silt Member and the Lynch Hill Gravel Member, comprises a blue grey silty clay, which tends to weather to brown near to the upper surface. With depth, the clay becomes very stiff/hard, is frequently fissured and can contain some inclusions and beds of weak mudstone and siltstone.

Nearby BGS boreholes suggest that the London Clay formation extends to depths of between 25.0m and 30.0m below ground level, approximately.

3.1.2 Groundwater and Surface Water Abstraction Licences

The surface water features and groundwater and surface water abstraction licences closest to the site are presented in the following table.

Table 2. Groundwater and Surface Water

Section	Discussion
Groundwater Abstraction	No groundwater abstraction licences are indicated within 1km of the site.
Groundwater Vulnerability	The site is located within an area where the groundwater vulnerability is classed as a "Major Aquifer (Highly Permeable)". This is considered to be representative of the Lambeth Group or Chalk deposits likely to be present at significant depth (in excess of 25.0m) beneath the site.
Surface Water Features	The nearest recorded surface water feature is the River Pinn, located 152m to the north west of the site, which flows from north to south. The General Quality Assessment (GQA) Grade for the River Pinn is Grade E - Poor.
Surface Water Abstractions	The closest surface water abstraction licence is recorded to lie 400m to the south west of the site from an abstraction/stream. The abstraction is for cooling.

3.1.3 Flooding

The site lies within an Environment Agency Flood Zone 1.

The site lies within an area where the British Geological Survey report "Potential for Groundwater Flooding to Occur at Surface", but only in the north easternmost part of the site.

The GeoSmart Groundwater Flood Risk (GW5) Map (GeoSmart, 2017)³ states that the risk of groundwater flooding at the site is primarily 'negligible'. The risk along the eastern boundary of the site is considered to be 'moderate' or 'low'.

3.1.4 Mining and Natural Ground Subsidence

Table 3. Natural Ground Subsidence Hazards

Section	Risk Assessment
BGS Recorded Mineral Site	A number of mineral sites are recorded to be present within 250m to the north east and the south east of the site. These refer to Yiewlsey Gravel Pit identified as being located 237m to the north east and 269m to the south east of the site, and Yiewlsey Brickfields identified to be located 239m north east and 244m to the south east of the site.
Coal Mining Affected Areas	In an area that might not be affected by coal mining
Non-Coal Mining Areas of Great Britain	No Hazard
Potential for Collapsible Ground Stability Hazards	Very Low
Potential for Compressible Ground Stability Hazards	No Hazard Identified
Potential for Ground Dissolution Stability Hazards	No Hazard Identified
Potential for Landslide Ground Stability Hazards	Very Low
Potential for Running Sand Ground Stability Hazards	Very Low
Potential for Shrinking or Swelling Clay Ground Stability Hazards	Very Low

Although a "Very Low" risk of soil volume change potential has been highlighted by the Landmark data, it is noted that the Langley Silt Member and London Clay Formation expected beneath the site comprise shrinkable soils and therefore the actual risk may be higher.

It should be noted that the assessment provided within the data represents a generic assessment only. A site specific assessment would require the undertaking of an intrusive ground investigation.

³ GeoSmart Information Limited, 2017. National Groundwater Flood Risk Map (GW5)

3.1.5 Radon

Table 4. Radon

Section	Risk Assessment
Radon Affected Areas	The site is reported to be within an area where less than 1% of properties are at or above the action level requiring radon gas protection measures to be installed in new buildings.
Radon Protection Measures	No radon protection measures are reported by the British Geological Survey to be necessary in the construction of new dwellings or extensions.

3.2 Agency & Hydrological Data

The data has been reviewed and any entries referring to locations on, or in close proximity to, the site that may pose a potential risk are discussed within the following table.

Table 5. Agency & Hydrogeological Data

Section	Discussion
Discharge Consents	None located within 250m of the site.
Prosecutions Relating to Controlled Waters	None located within 250m of the site.
Enforcement and Prohibition Notices	None located within 250m of the site.
Integrated Pollution Controls	None located within 250m of the site.
Integrated Pollution Prevention and Control (including Part A Processes)	None located within 250m of the site.
Local Authority Pollution Prevention and Control (including Part B Processes)	The closest entry refers to a petrol station located 206m south west of the site.
Pollution Incidents to Controlled Waters	None located within 250m of the site.
Prosecutions Relating to Authorised Processes	None located within 250m of the site.
Registered Radioactive Substances	None located within 250m of the site.

3.3 Waste

The data has been reviewed and any entries referring to locations on, or in close proximity to, the site that may pose a potential risk are discussed within the following table.

Table 6. Waste Data

Section	Discussion
BGS Recorded Landfill Sites	None located within 500m of the site.
Historical Landfill Sites	None located within 500m of the site.
Integrated Pollution Control Registered Waste Sites	None located within 500m of the site.
Licensed Waste Management Facilities	None located within 500m of the site.
Registered Landfill Sites	None located within 500m of the site.
Registered Waste Transfer Sites	None located within 500m of the site.
Registered Waste Treatment or Disposal Sites	None located within 500m of the site.

3.4 Hazardous Substance

The data has been reviewed and any entries referring to locations on, or in close proximity to, the site that may pose a potential risk are discussed within the following table.

Table 7. Hazardous Substances Data

Section	Discussion
Control of Major Accident Hazards Site (COMAH)	None located within 500m of the site.
Explosive Sites	None located within 500m of the site.
Notification of Installations Handling Hazardous Substances (NIHHS)	None located within 500m of the site.
Planning Hazardous Substance Consents	None located within 500m of the site.
Planning Hazardous Substance Enforcements	None located within 500m of the site.

3.5 Industrial Land Use

The data has been reviewed and any entries referring to locations on, or in close proximity to, the site that may pose a potential risk are discussed within the following table.

Table 8. Agency & Hydrogeological Data

Section	Discussion
Contemporary Trade Directory Entries	Eight entries are identified within 250m of the site: Ironing and home laundry service: 98m to the south west of the site. Scrap metal merchants: 123m to the north east of the site. Used car dealers: 179m south west of the site. Petrol filling station: 206m south west of the site. Swimming pool contractors/Rubber/plastic products: 237m south of the site. Electronic Engineers: 244m east of the site.

Section	Discussion
Fuel Station Entries	An obsolete entry is identified for "Falling Lane Filling Station" located 296m to the south west of the site.
Gas Pipelines / Underground Electrical Cables	No entries are identified within 250m of the site.

3.6 Sensitive Land Use

The site is recorded to be within a nitrate vulnerable zone (NVZ). The development proposals are not considered to pose a significant risk to the NVZ.

An area of adopted Green Belt is recorded to lie to the north of the site.

No other sensitive land uses are identified within 1,000m of the site.

4. HISTORICAL MAP REVIEW

Historical Ordnance Survey maps covering the area of the site have been reviewed and are summarised in the following table.

It is noted that each map presents information applicable at the time of the survey (or revision date) and is subject to surveying and cartographic errors and/or advances. Revisions to maps are made at irregular intervals and it is possible that significant developments may have taken place on or within the vicinity of the site that are not shown on the maps.

'In the Vicinity of the Site' generally refers to features of relevance within approximately 250m of the site boundary, but may also include more distant features if considered to be pertinent to the assessment of the development history.

Table 9. Summary of Significant Features Identified on Historical Maps

Map Details	On-Site	In the Vicinity of the Site
1868 1:10,560	The site comprises part of a much larger open field.	A gravel pit is shown 120m to the north east and approximately 200m to the south east of the site. A brick works is shown approximately 150m to the north east of the site.
1878 1:2,500	An embankment forms the eastern boundary of the site.	The brick field is shown to be approximately 100m to the north east of the site. A road is shown 10m to the south east of the site.
1895 1:2,500	The site comprises part of an area of woodland that extends to the south and west of the site.	The gravel pits and brick field are no longer shown.
1965 1:1,250	Residential housing is shown to the south of the site, with the south western most part of the site comprising formal gardens to the houses; a small outbuilding is shown in this part of the site.	Residential housing is shown bounding the site along its southern boundary. Domestic garages associated with residential housing are shown bounding the site to the east.

Map Details	On-Site	In the Vicinity of the Site
1971/73 1:1,250	A rectangular building labelled as "Chantry School" is shown in the central part of the site, with an area of hardstanding to the east. The northern part of the site is labelled as playing field.	"Rabbsfarm Primary School" and associated playing field are shown to the west of the site.
1987 1:1,250	A "Games Court" is shown in the south west of the site.	No significant changes.
1999 1:10,000	A small building is shown to the west of the main school building.	No significant changes.
2017 1:10,000	The site is shown in its current layout, with the extension to the east of the main school building and a number of smaller buildings shown to the west/south west of the main school building.	No significant changes.

5. EXPLOSIVE ORDNANCE DESK STOP STUDY

A copy of the EOD Limited, Explosive Ordnance Desk Top Study is included as Appendix A.

The report concludes that there was no evidence that the site had any military usage in the past and was used as farmland during World War II. In addition, the report concludes that as the site and the area around the site had been subject to major construction works since World War II, the risk level on the site has been deemed as "Low", and no further risk mitigation measures are considered to be necessary.

6. PRELIMINARY CONTAMINATION RISK ASSESSMENT

6.1 Introduction

A preliminary risk assessment considers the potential sources of contamination identified, the receptors that may be present in view of the development proposals and the contaminant pathways by which these may be linked. A complete pollutant linkage is only deemed to exist where all three are present and a site is considered suitable for use where no complete pollutant linkages are identified.

Where a complete pollutant linkage is deemed to be present, an assessment of the level of risk associated with the pollutant linkage has been carried out in line with current guidance⁴.

The level of risk is determined using the risk matrix presented in the following table. Classifications of probability, consequence and risk are presented in Appendix D.

Table 10. Risk Assessment Matrix

		Probability			
		Very Low	Low	Moderate	High
Consequence	Very Minor	Negligible	Very Low	Low	Low/Moderate
	Minor	Very Low	Low	Low/Moderate	Moderate
	Moderate	Low	Low/Moderate	Moderate	High
	Severe	Low/Moderate	Moderate	High	Very High

6.2 Basis of Assessment

The assessment of risk has been undertaken on the basis that the proposed development for the site will include the provision of new educational buildings along with areas of soft landscaping where direct soil contact may occur.

Should the proposed development plans be altered, a revised risk assessment may be required.

It is noted that an asbestos survey of existing structures and infrastructure⁵ was beyond the brief of this report. The risk assessment has been undertaken on the basis that should asbestos be identified within buildings or infrastructure, these materials will be removed appropriately by licensed contractors and asbestos materials disposed of in accordance with legal requirements prior to demolition or other works in order to avoid contaminating soils at the site.

6.3 Potential Contamination Sources Identified

The following potential sources of contamination have been identified by the preliminary contamination risk assessment:

⁴ Contaminated Land Risk Assessment: A guide to good practice, CIRIA C552, 2001.

⁵ As defined under Section 5(a) of the Control of Asbestos Regulations, 2012.

- Mound adjacent to school playing fields.
- Backfilled mineral sites in the vicinity of the site.

The petrol station and industrial land uses, identified in Section 3, are too distant from the site to be considered a potential source of contamination that would pose an unacceptable risk to the site.

6.4 Preliminary Conceptual Model

The preliminary conceptual model for the proposed development is presented in Appendix C. The conceptual model concludes there is a low risk posed to the end users of the site by the potential sources discussed above.

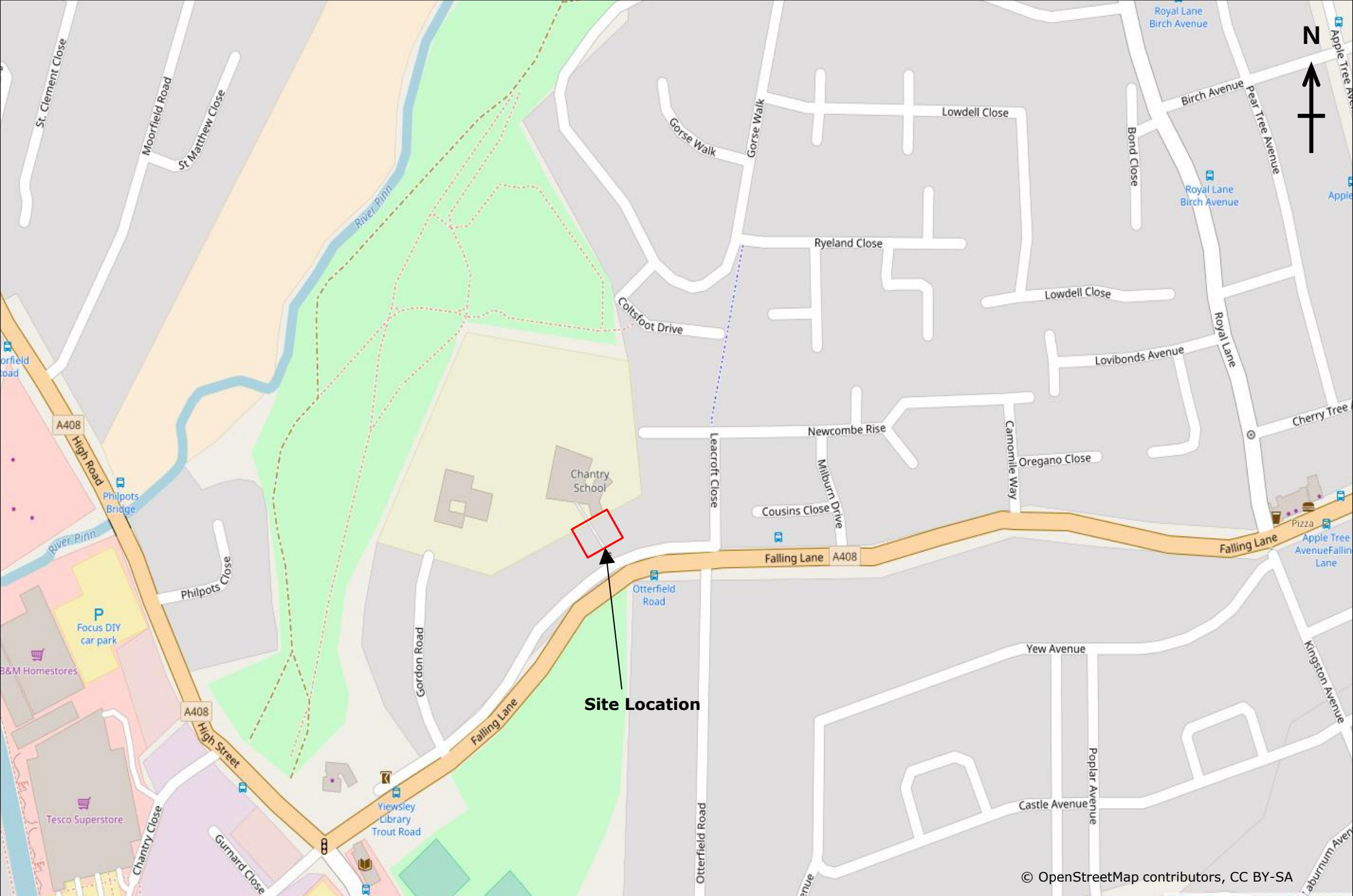
6.5 Recommendations

The findings of the preliminary contamination assessment have been used to inform the intrusive ground investigation.

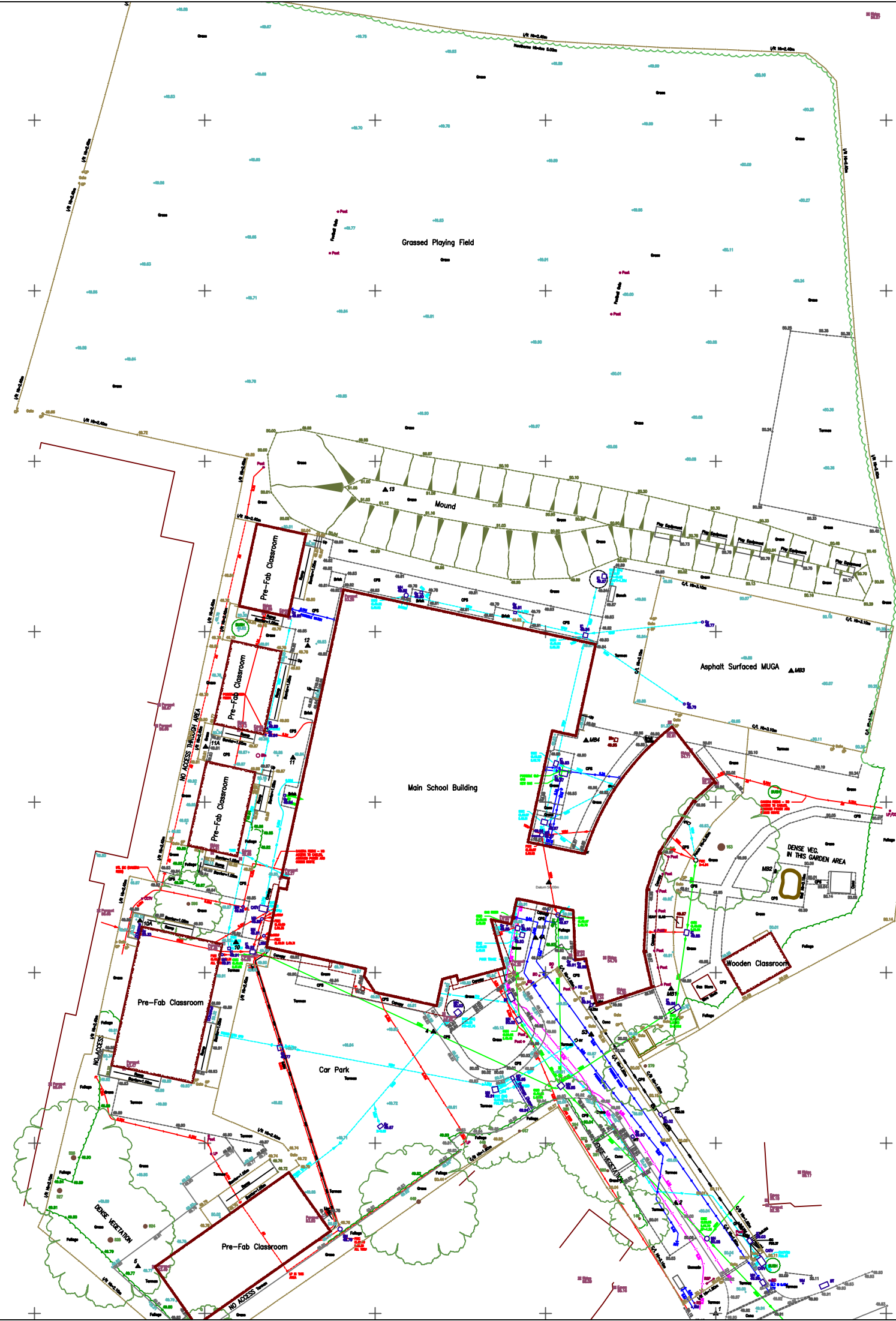
Ashdown Site Investigation Ltd.
September 2017

FIGURES

- Figure 1 Site Location Plan
- Figure 2 Site Walkover Plan



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ASHDOWN SITE INVESTIGATION

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Yiewsley, West Drayton
Middlesex

REPORT REF.:	FIGURE NO.:
R17-12386/ds	2

DRAWING TITLE:
Site Walkover Plan

APPENDIX A

Exploded Ordnance Desk Top Study



International Unexploded Ordnance Risk Mitigation

Many People...
...One Aim

**EXPLOSIVE ORDNANCE
DESK TOP STUDY
FOR:**

PROJECT 17367

**HILLINGDON YOUNG PEOPLES HUB
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EXPLOSIVE ORDNANCE DESK TOP STUDY

Of

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On behalf of

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TERMS AND DEFINITIONS

Anti Aircraft Shells (AA)

Small High Explosive Shells (HE) shells ranging up to 100mm in diameter.

Battlefield Area Clearance (BAC)

The systematic clearance of munitions from military property or old battle sites e.g. ranges, airfields etc.

Borehole Search

The placing of boreholes in a set pattern, then using a magnetometer to take readings at specific depths along each borehole. When used with a geophysical survey system this will give a magnetic signature of the area. The depth of the borehole and the pattern will depend upon the type of Unexploded Bombs (UXB) and the geology of the ground.

Doodle Bug (See Pilotless Aircraft)

Explosive Ordnance (EO)

All munitions containing explosives, nuclear fission/fusion materials and or biological and chemical agents. This includes bombs and warheads; guided and ballistic missiles; artillery, mortar, rocket and Small Arms Ammunition (SAA); all mines, torpedoes and depth charges; pyrotechnics; clusters and dispensers; cartridge and propellant actuated devices; electro-explosive devices; clandestine and improvised explosive devices (IED); and all similar or related items or components explosive in nature.

Explosive Ordnance Clearance (EOC)

See BAC.

Explosive Ordnance Disposal (EOD)

The detection, identification, field evaluation, render safe, recovery and disposal of **UXO**.

Geophysical Survey

The survey of an area using a Magnetometer and geophysical gathering device, after interpretation, this will produce a geophysical map and an object list for any metallic anomalies.

High Explosive (HE)

High explosives burn/detonate at rates of up to 9,000 m/per second.

Incendiary Bomb (IB)

Incendiary bombs ranged from 1kg in size to 500kg the larger sizes were sometimes called Oil Bombs. Fills range from thermite mixtures, phosphorus to kerosene.

Intrusive Survey

The use of a cone penetrometer (MagCone) or drilled boreholes (MagDrill) to take magnetometer test in a set pattern (see borehole search), or to prove pile positions.

Land Service Ammunition (LSA)

LSA is defined as “All items containing explosives or pyrotechnic compounds which are placed, thrown or projected so as to cause damage to men and equipment during land warfare.

Long Range Rocket (LRR)

The long range rocket sometimes codenamed Big Ben is the V2 rocket designed to deliver an approximate payload of 1000 kg.

Oil Bomb (OB)

A bomb containing a flammable liquid, normally the KC 250 Flam or the C 500 flam.

Pilot less Aircraft (PAC)

A flying bomb (Fly) or doodlebug is the V1 rocket or predecessors designed to deliver an explosive payload of approximately 500kg - 800kg.

Parachute Mine (PM)

Air dropped mine may have been used as a blast effect bomb maximum explosive content 1600lb always fitted with anti-handling and anti-stripping equipment.

Unexploded Bomb (UXB)

Any air dropped bomb that has failed to operate.

Unexploded Ordnance (UXO)

Explosive ordnance that has been primed, fused, armed or otherwise prepared for use or used. It may have been fired, dropped, launched or projected yet remains unexploded either through malfunction or design or for any other cause.

Vengeance Weapons (V)

V1 see Pilot less Aircraft.

V2 see Long Range Rocket.

WWI

First World War 1 (1914 – 1918)

WWII

Second World War 2 (1939 – 1945)

EXECUTIVE SUMMARY

1 INSTRUCTION

EOD Contracts Ltd, have been commissioned by ASHDOWN (hereafter, “the Client”) to undertake a desktop study for potential historic Unexploded Ordnance (UXO) contamination for the future works at Hillingdon Young Persons Hub, West Drayton, London, UB7 8AB.

2 SCOPE OF WORK

The scope of this EO Risk Assessment/Desk Study is to assess the likelihood of buried EO/UXO within the environs of Hillingdon Young Persons Hub, West Drayton, London, UB7 8AB (See Photo 2.1), in view of further development. A further aim was to evaluate the implication from UXO contamination during any future intrusive land use.

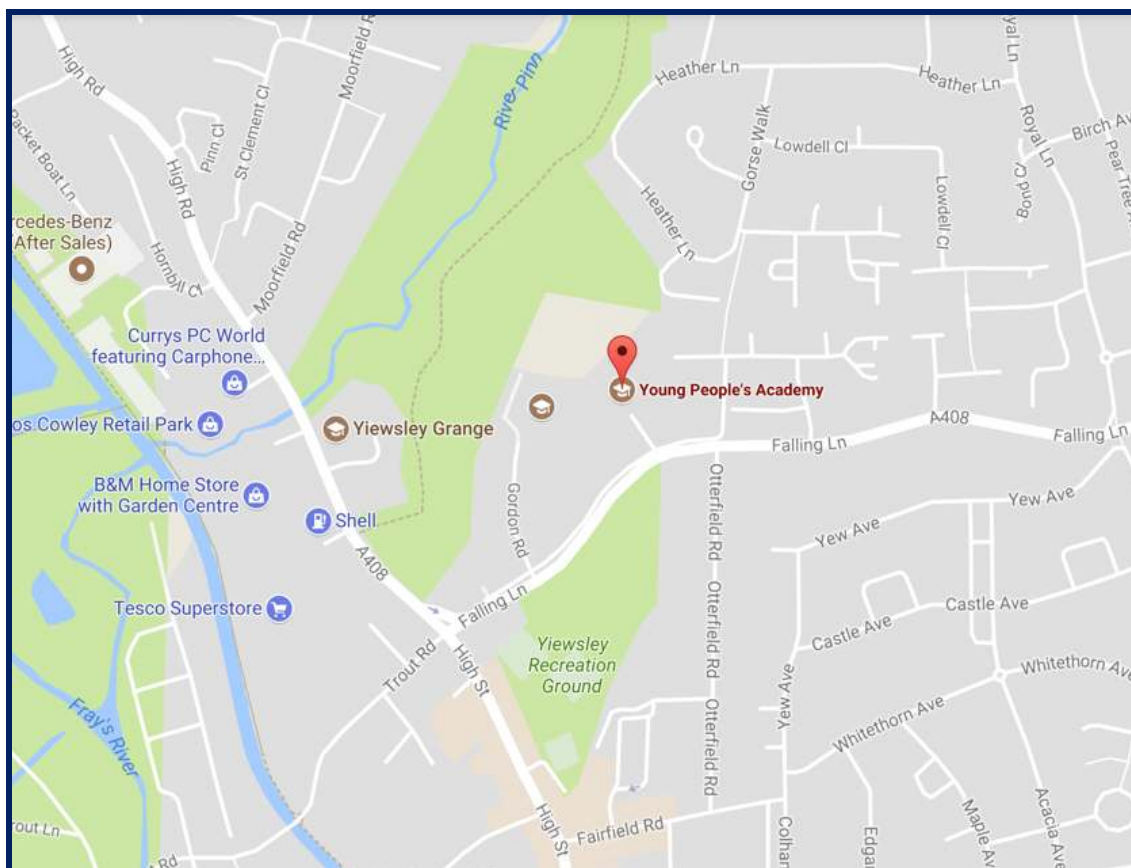
PHOTO 2.1: Clients Scope of works, This DTS will be covering all areas shown within the Red Boundary.



2.1

LOCATION

The site is located along Falling Lane, (London Borough of Hillingdon) (See [Annex A](#) for detailed description of building usage).



Title	Description (Centre of Site)
Address	Hillingdon Young Peoples Hub (Academy) West Drayton
Post Code	UB7 8AB
Grid Reference	TQ 061809 / TQ 0614480974
OS (X)	506144
OS (Y)	180974

3 SOURCES OF UXO CONTAMINATION

- 3.1 Through the use of thorough research (utilising both modern and historic data) EOD Contracts Ltd deem that the two main sources of UXO contamination pertaining to the site are as follows;
- 3.2 Air delivered ordnance bombs and sub munitions/incendiaries.
- 3.3 Anti Aircraft Ammunition (AA)

4 KEY FINDINGS

- 4.1 Based on the information researched by EOD Contracts Ltd for the proposed works being carried out at Hillingdon Young Peoples Hub, we can conclude the following:
- 4.2 London was subjected to bombardment during WWI, although accurate map records were not kept at the time to the level and accurateness that they were by the ARP during WWII you can see that the area did sustain bombardment in **Annex C**, however, items of ordnance that were dropped during WWI were from a lower altitude to those dropped during WWII, which meant the bomb penetration depth was lower and it is highly unlikely that items of UXO from this period would have remained undetected.
- 4.3 EOD Contracts have found viable evidence to suggest that West Drayton was the subject of direct attack during the Blitz; this also includes close proximity bombing to the site, however these were outside of the catchment area. See **Annex E**.
- 4.4 There is no evidence to suggest that the site itself was the subject of bombardment during WWII.
- 4.5 The closest HAA gun emplacements to the site were 2km SW of the site.
- 4.6 The Luftwaffe did not indicate that the site itself was of strategic importance.
- 4.7 EOD Contracts could find no evidence that the site had had any Military usage in the past. However the site was in full use throughout the WW2 as farmland.
- 4.8 The London Bomb density map (**Annex D**) indicates the number of Bombs per 1000 acres to be 50.
- 4.9 There has been major construction work in and around the site area (including the construction of the buildings within the site boundary) post WWII.
- 4.10 Therefore, the risk level on site is deemed as **LOW**.

5 **RECOMMENDATIONS**

- 5.1 No further Risk Mitigation is required for Hillingdon Young Peoples Hub.

- 6 EOD Contracts Ltd can supply a turnkey solution to your UXO requirements. Therefore, the following mitigation strategies can be supplied for land or water based operations:**
- 6.1 Intrusive survey using CPT (*Cone Pressure Testing*) or borehole equipment, *supplying risk mitigation to all Borehole and Pile locations, down to a maximum bomb penetration depth determined within this document.*
 - 6.2 Non-Intrusive Survey using multiple array system with DGPS (*Digital Global targets be identified.*
 - 6.3 Offshore, near-shore, estuarine and freshwater water environments magnetic, side scan and bathymetric supported by state of the art DGPS.
 - 6.4 The aforementioned surveys are supported with post processing of data and intrusive investigations if required.
 - 6.5 EOD Engineer over watch using Suitably Qualified and Experienced Personnel, normally former British Army, Navy or RAF Bomb Disposal specialists.
 - 6.6 Explosive Ordnance Safety Presentations.



1.0 INTRODUCTION

1.1 Instruction

EOD Contracts Ltd, have been commissioned by ASHDOWN (hereafter, “the Client”) to undertake a desktop study for potential historic Unexploded Ordnance (UXO) contamination for the future works at Hillingdon Young Persons Hub, West Drayton, London, UB7 8AB.

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PHOTO 1.1: Clients Scope of works, This DTS will be covering all areas shown within the Red Boundary (indicated as “site”)



1.3 Restrictions

It must be emphasized that a desk study can only indicate the potential for UXO to be present on the site. A geophysical survey and intrusive investigation is fundamentally important to provide proof that the site is free of the UXO threat.

This study was written with the site conditions prevailing at the time of the study and no liability can be accepted for any change in the condition of the area.

Please note that our appraisal relies on the accuracy of the information contained in the documents consulted and that EOD Contracts Ltd will in no circumstances be held responsible for the accuracy of such information or data supplied.

1.4 Sensitive Documentation

Information may be classified, restricted or deemed to be confidential in nature to EOD Contracts Limited, where such material has been gained a summary of the documentation has been approved.

1.5 Objective

The objective of this document is to define the UXO contamination routes as defined in Unexploded ordnance (UXO) A guide for the construction industry (C681) dated July 2015 and offer remediation methodologies if required.

2.0 SOURCES OF INFORMATION

Research of the site's history, with regard to military usage, bombing raids and bomb impacts has been undertaken to establish the following:

- Frequency and intensity of enemy bombing raids for the site and immediate vicinity up to 500m.
- Bomb impacts and associated damage on the Site and in the immediate vicinity.
- The potential for UXO to remain on the Site and in the vicinity.
- Records of UXO removal activities for the Site and immediate vicinity.

The main sources of information consulted include:

- EOD Contracts Ltd company records
- Ministry of Defence records
- Central and Local Government Records (London)
- Public Records Office (Kew)
- Historic Maps and Air Photography
- Open Source information (Internet)

2.1 Ministry of Defence (MOD) Records

33 Engineer Regiment (Explosive Ordnance Disposal) Royal Engineers is the unit responsible for maintaining the records concerning conventional Bomb incidents, reports, clearances and related UXO matters. These records are known to be incomplete and are no longer supplied. Based on in-house information released by the MOD previously, it is considered unlikely that any information released will have any significant impact on the findings of this study.

2.2 Attack Record Keeping

In general, the quality and accuracy of bombing and shelling records prior to 1939 varied greatly from one region to another. Records relating to the limited air attacks on the United Kingdom are considered to be sufficiently accurate in urban areas to provide a reasonable level of confidence in determining the likelihood that an area was or was not bombed during this period. Wartime records, maps etc held within the civil archives are considerably more comprehensive than those still in existence within the MOD, where it is acknowledged that large numbers of records have been disposed of since 1945. Records from some areas, particularly rural districts or near large bodies of water should still be regarded as an incomplete picture of the extent and effect of the bombing campaign.

2.3 Attack Record Accuracy.

While an Air Raid was in progress it was inevitable that mistakes would be made in the transcription of rushed verbal reports into the written records. Discrepancies did occur between the total of bombs dropped against detonations witnessed. In some cases records were made several hours after the event and mistakes were inevitable. Some reports were drafted before the full extent of the raid had been determined which has led to significant omissions in the records. Reports of raids on rural areas were often witnessed and submitted by untrained individuals and passed through third parties before being recorded. Suspect UXBs occasionally went unreported by local farmers and freeholders who saw the event as insignificant, or were reluctant to report their findings for fear of valuable land or crops being destroyed by the authorities in their attempts to find the UXB. It should also be noted that bomb strikes in water were notoriously difficult to spot, particularly if the bomb had failed to detonate. As a result bomb record accuracy in areas containing large bodies of water or marshland is considered to be questionable.

2.4 Errors and Omissions

The accuracy of bombing records has been shown to vary greatly; this may have been a result of the individual record keeper's expertise. Additionally, in some cases, errors occurred as a result of poor or incomplete transcription and copying. Some "errors and omissions" were intentional, designed to serve as dis-information to confuse German intelligence. So long after the event, official verification of such incidents has often proven to be impossible to obtain. At present, UXBs are found on construction sites and other locations where there had been no documentary evidence to suggest their presence. These events, although infrequent, do serve as confirmation that records cannot be considered definitive.

2.5 Bibliography

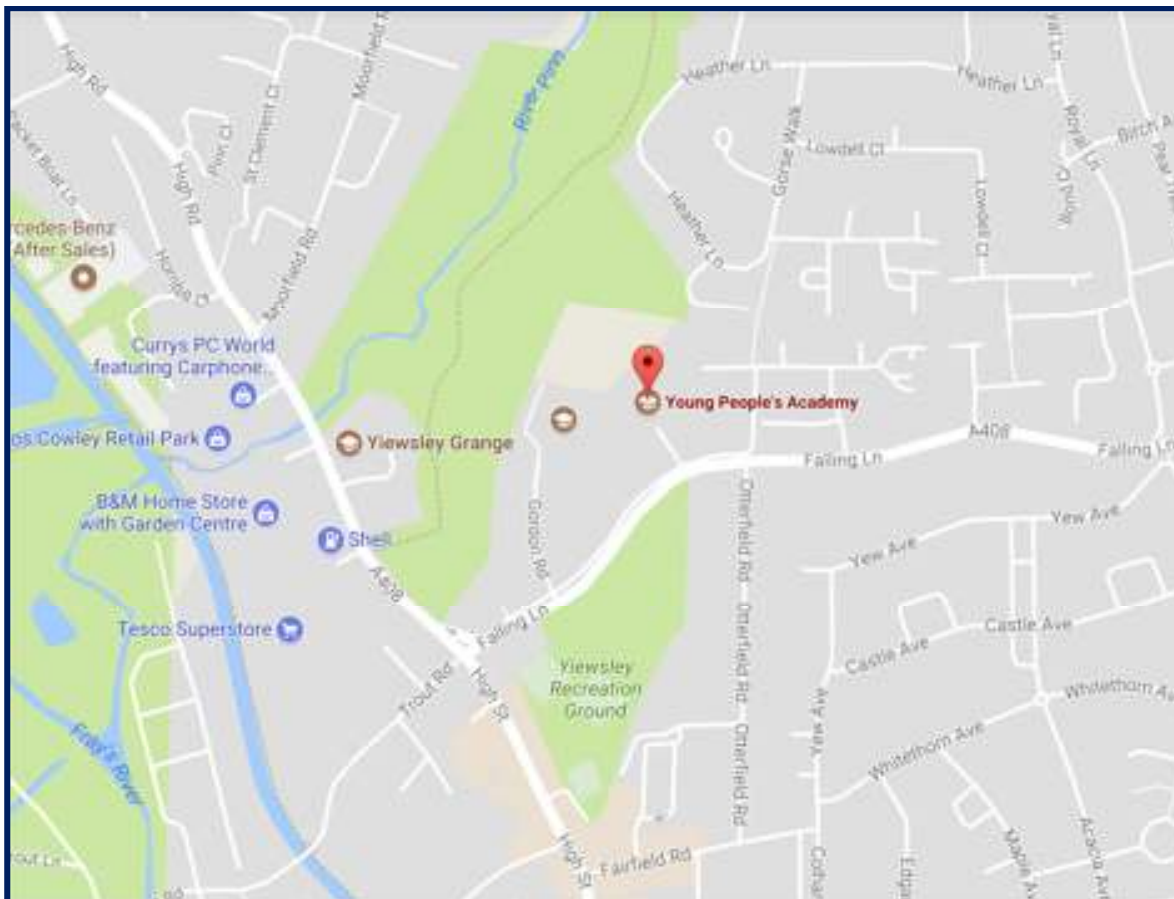
The significant published documents referred to during this study are listed below:

- HO 193 series from National Archives
- HO 198 series from National Archives
- The Blitz Then and Now Volumes 1 to 3
- AA Command Colin Dobinson
- German Air Raids on Britain 1914-1918
- Osprey - Campaign 193 - London 1914-17 - The Zeppelin Menace
- London City Council records
- The LCC Bomb Damage Maps 1939 - 1945

3.0 SITE DESCRIPTION AND DETAILS

3.1 Location

The site is located along Falling Lane, (London Borough of Hillingdon) (See [Annex A](#) for detailed description of building usage).



Title	Description (Centre of Site)
Address	Hillingdon Young Peoples Hub (Academy) West Drayton
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Grid Reference	TQ 061809 / TQ 0614480974
OS (X)	506144
OS (Y)	180974

3.2 Description

The site is currently occupied by Hillingdon Young Persons Academy, an education facility for students with social, emotional and behavioral difficulties. There are several buildings which make up the academy and all within the Clients scope, there are also play areas and access and egress roads.

3.3 Geology

The British Geological survey (BGS) map (London) (1:50,000 series) indicates the Geological sequence beneath the site comprises variable depths of Made Ground, underlain by London Clay. At depth, the London Clay, followed by the Thanet Sands and Chalk.

Geological Unit Description	Elevation at top of sequence	Typical strata description
Made Ground (Fill)	G/L +35.0	Loose to medium dense red-brown silty sandy GRAVEL. Gravel is angular to sub rounded fine to coarse brick, flint and concrete with occasional ash, timber, glass and ceramic. Rare rounded flint cobbles were recorded.
London Clay	+33.0	Upper Firm brown mottled grey slightly gravelly CLAY. Gravel is from 1.25m to 3.5mbgl, slightly gravelly and slightly sandy. Sub angular to sub rounded fine to coarse flint. Occasional partially decomposed rootlets. Occasional black flecks. Mid Stiff orange-brown CLAY. Occasional pockets of orange silt. Occasional selenite crystals and sub rounded fine to medium rare calcareous nodules.

3.4 Current Site Use

See **3.2 Description & Annex A**.

3.5 Future Works

At the time of writing this report it is understood that the site will be redeveloped (the exact scope of works is not known at this time). Therefore it is assumed that the following intrusive construction works will be carried out:

- Geotechnical investigations, percussive drilling/trial pits/window/samples
- Removal of buildings to ground level
- Removal of old foundations
- Foundations with large diameter rotary bored piling

4.0 HISTORICAL REVIEW

4.1 Historical Mapping

The Historic Mapping in **Annex B** detailing the land usage is attached.

4.2 WWI

Although many people associate wartime bombing with The Blitz during World War II, the first airborne terror campaign in Britain took place during the First World War. Air raids in World War One caused significant damage and took many lives. German raids on Britain, for example, caused 1,413 deaths and 3,409 injuries. Air raids provided an unprecedented means of striking at resources vital to an enemy's war effort. Many of the novel features of the war in the air between 1914 and 1918—the lighting restrictions and blackouts, the air raid warnings and the improvised shelters—became central aspects of the Second World War less than 30 years later. The East End of London was one of the most heavily targeted places. Poplar, in particular, was struck badly by some of the air raids during the First World War. Initially these were at night by Zeppelins, which bombed the area indiscriminately, leading to the death of innocent civilians.

The first daylight bombing attack on London by a fixed-wing aircraft took place on 13 June 1917. Fourteen German Gotha G bombers led by Squadron Commander Hauptmann Ernst Brandenburg flew over Essex and began dropping their bombs. It was a hot day and the sky was hazy; nevertheless, onlookers in London's East End were able to see 'a dozen or so big aeroplanes scintillating like so many huge silver dragonflies'. These three-seater bombers were carrying shrapnel bombs, which, were dropped just before noon. Numerous bombs fell in rapid succession in various districts. In the East End alone 104 people were killed, 154 seriously injured and 269 slightly injured.

The gravest incident that day was a direct hit on a primary school in Poplar. In the Upper North Street School at the time were girls' class on the top floor, a boys' class on the middle floor and an infant class of about 50 students on the ground floor. The bomb fell through the roof into the girls' class; it then proceeded to fall through the boys' classroom before finally exploding in the infant class. Eighteen students were killed, of whom sixteen were aged from 4 to 6 years old. The tragedy shocked the British public at the time.

Using the map located within **Annex C** it would appear that the area in which the subject site is located was not the subject of bombardment throughout WWI.

4.3 WWII

4.4 Hitler targets London

On 4 September Hitler, frustrated by the RAF's superiority over the Luftwaffe and enraged by its bombing of German cities, vowed to destroy the British capital and the spirit of its people.

In response, the Luftwaffe shifted its focus from attacking RAF Fighter Command's bases and communications networks to bombing Britain's cities. Hermann Goering, the Head of the Luftwaffe, had severely lost face over both the bombing of Berlin, and his force's failure to defeat the RAF. He hoped that the intense bombing of British cities would both destroy public morale and draw the remaining RAF fighters into battle and annihilation.

4.5 The bombing begins

After a preliminary raid on 5 September, the bombing started proper on the afternoon of the 7th. Almost 1,000 German aircraft - over 300 bombers escorted by 600 fighters - crossed the Channel. It was the largest collection of aircraft ever seen. Fighter Command had not expected raids on London, but now attempted to intercept the waves of bombers. A huge dogfight developed over London and the Thames Estuary.

Convinced that the German invasion of Britain was imminent, the country was put on the highest alert. Signals of impending invasion went out - the code word "Cromwell" was sent to military units and church bells rang.

Some of the German bombs did fall on their intended target of the docks, but many fell on the residential areas around them. Substantial parts of East and South-East London were devastated, 430 civilians were killed and 1600 seriously injured. Firestorms ravaged the city, acting as beacons for the second wave of bombers that evening.

After the raids Winston Churchill shared the public's fury and defiantly announced: "He [Hitler] has lighted a fire which will burn with a steady and consuming flame until the last vestiges of Nazi tyranny have been burnt out of Europe".

4.6 Bombing continues for the next 76 nights

Although no one knew at the time, this was the beginning of the Blitz. With the exception of one night, when the weather was bad, the bombing continued for the next 76 nights consecutively, with daytime raids as well. Liverpool, Manchester, Swansea, Cardiff, Bristol, Southampton were also targeted.

Now that the Luftwaffe's resources were directed into bombing civilians, Fighter Command had an opportunity to repair its infrastructure and attack anew. As well as their own lives, the pilots were now battling to protect their homes and loved ones all over the country.

4.7 Bombing raids over the rest of Great Britain

Ports and industrial centres outside of London were also targeted, this included Hull, Bristol, Cardiff, Plymouth, Portsmouth, Southampton and Swansea. Also bombed as part of Hitler's revenge bombings were the cities of Birmingham, Liverpool, Coventry, Sheffield, Glasgow and Manchester.

4.8 The London Blitz

- 10 May 1941 was the worst night of the Blitz (and the last). 3000 people were killed in London that night
- 3000 unexploded Bombs (UXBs) were dealt with during the Blitz
- 1,400,000 people were made homeless due to the Blitz
- Just over 20,000 people were killed in the London Blitz

4.9 West Drayton during the Blitz

The bomb density for Acton was 50 bombs per 1000 Acres, A copy of the London Bomb Density Map can be found in **Annex D**. A total of 32 HE Bombs, were dropped in and around West Drayton, as well as several incendiary bomb strikes (see **Annex E** for close proximity bombing to the site area). AS at the 30th May 1941, 1,489 Houses were destroyed and 2,264 were damaged approximately 4%. Giving a total of 1,611 persons killed and seriously wounded.

4.10 V1 & V2 Bomb strikes

EOD Contracts could find no indication that the site was subjected to any attacks from Hitler's Long Range Weapons (V weapons).

4.11 Abandoned Bombs/UXO

EOD Contracts records could find no evidence of any items of UXO abandoned in or around the subject site.

4.12 Anti Aircraft Artillery

The nearest recorded location of heavy anti aircraft gun (HAA) position was 2km SW from the site, situated in Ivor, Site Code: SM 1.

4.13 Prior Clearance Operations

EOD Contracts could find no evidence to suggest that there have been any prior UXO clearance operations in or around the site footprint.

5.0 SOURCES OF UXO CONTAMINATION

The main sources of UXO contamination that are deemed a threat to the site are:

- Air delivered ordnance bombs and sub-munitions/incendiaries.
- Anti Aircraft Ammunition (AA).

5.1 GENERAL

EOD Contracts conclude that a **LOW** risk is considered to exist with respect to UXO for areas within the site footprint.

UXOs are essentially dangerous; therefore further information on UXO and Safety is detailed in **Annex F**.

5.2 BOMB PENETRATION DEPTHS

5.3 Weapon Sub-surface Penetration.

The weapon penetration depths have been assessed as part of the tables in **Annex G**, however as no bombs were recorded no further information on bomb penetration is required.

5.4 Recent UXO finds within the UK

The present day threat of finding items of UXO within the UK is still high, as highlighted within **Annex H**.

6.0 RISK ASSESSMENT

6.1 Risk Assessment

Assessing both the likelihood of occurrence and the consequences of the encounter has derived the overall risk for the site from unexploded ordnance. Review of the site's history and geographic location can provide an overall likelihood of encounter factor, which is used in the subsequent determination of a risk level when a Figure can be determined for the consequence.

6.2 Likelihood of Encounter

Given the study findings and other criteria (See **Annex G** Tables) it is considered that there is a **LOW** risk of encountering UXO within the site footprint. This finding is based on assessment of all of the available information.

7.0 CONCLUSIONS

Based on the information researched by EOD Contracts Ltd for the proposed works being carried out at Hillingdon Young Peoples Hub, we can conclude the following:

London was subjected to bombardment during WWI, although accurate map records were not kept at the time to the level and accurateness that they were by the ARP during WWII you can see that the area did sustain bombardment in **Annex C**, however, items of ordnance that were dropped during WWI were from a lower altitude to those dropped during WWII, which meant the bomb penetration depth was lower and it is highly unlikely that items of UXO from this period would have remained undetected.

EOD Contracts have found viable evidence to suggest that West Drayton was the subject of direct attack during the Blitz; this also includes close proximity bombing to the site, however these were outside of the catchment area. See **Annex E**.

There is no evidence to suggest that the site itself was the subject of bombardment during WWII.

The closest HAA gun emplacements to the site were 2km SW of the site.

The Luftwaffe did not indicate that the site itself was of strategic importance.

EOD Contracts could find no evidence that the site had had any Military usage in the past. However the site was in full use throughout the WW2 as farmland.

The London Bomb density map (**Annex D**) indicates the number of Bombs per 1000 acres to be 50.

There has been major construction work in and around the site area (including the construction of the buildings within the site boundary) post WWII.

Therefore, the risk level on site is deemed as **LOW**.

8.0 RECOMMENDATIONS

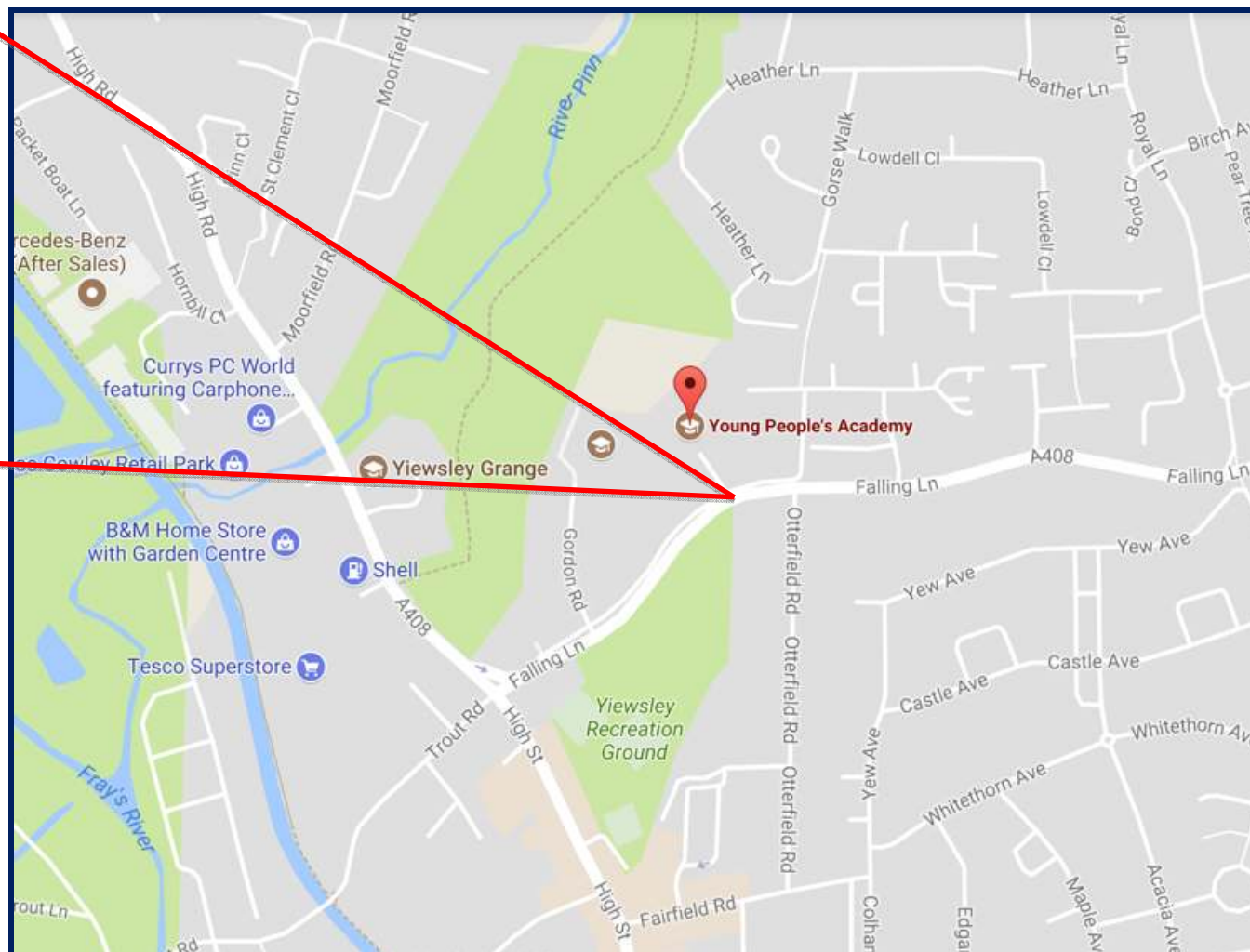
No further Risk Mitigation is required for Hillingdon Young Peoples Hub.

EOD Contracts Ltd

SITE LOCATION



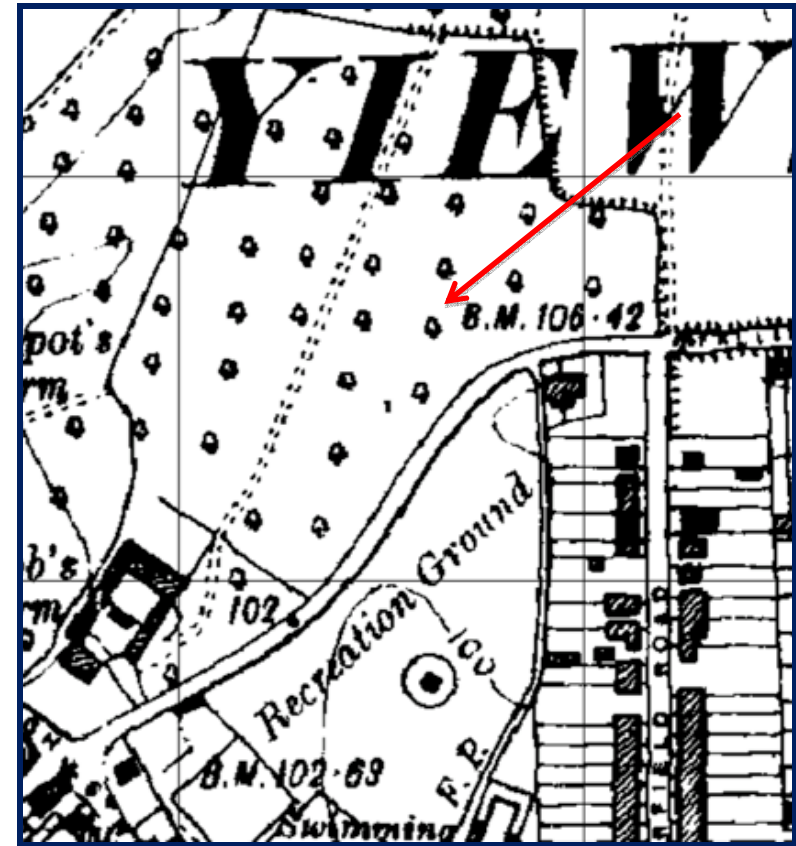
The site is currently occupied by Hillingdon Young Persons Academy, an education facility for students with social, emotional and behavioral difficulties. There are several buildings which make up the academy and all within the Clients scope, there are also play areas and access and egress roads.



CLIENTS DRAWINGS

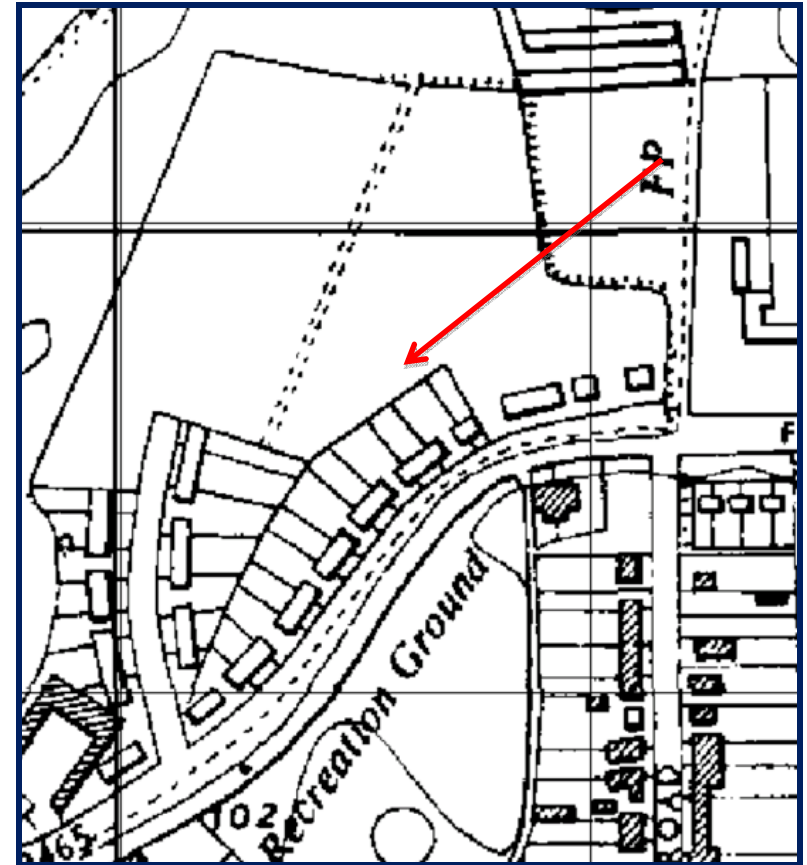
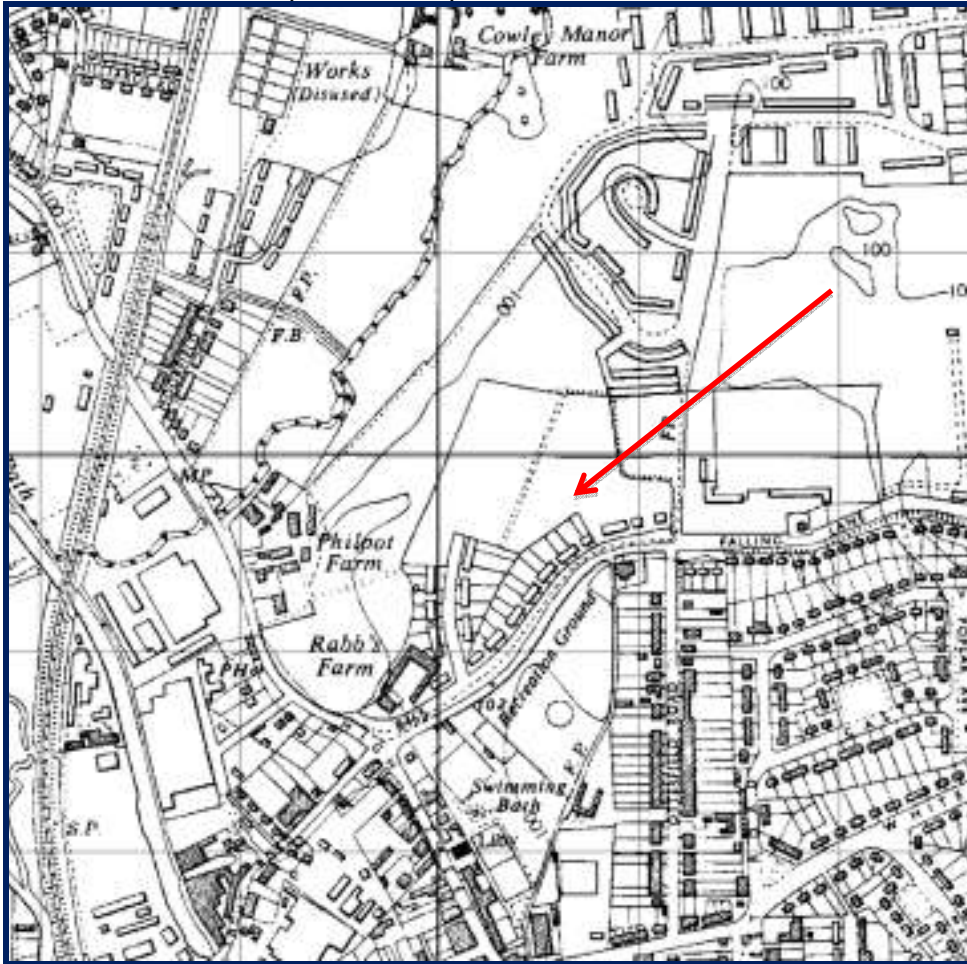


PHOTO 1: Historic map of the site published in 1934.



The above map shows that at the time of publishing the land is being utilised as farm/agricultural land. There are no significant structures within the sites boundaries

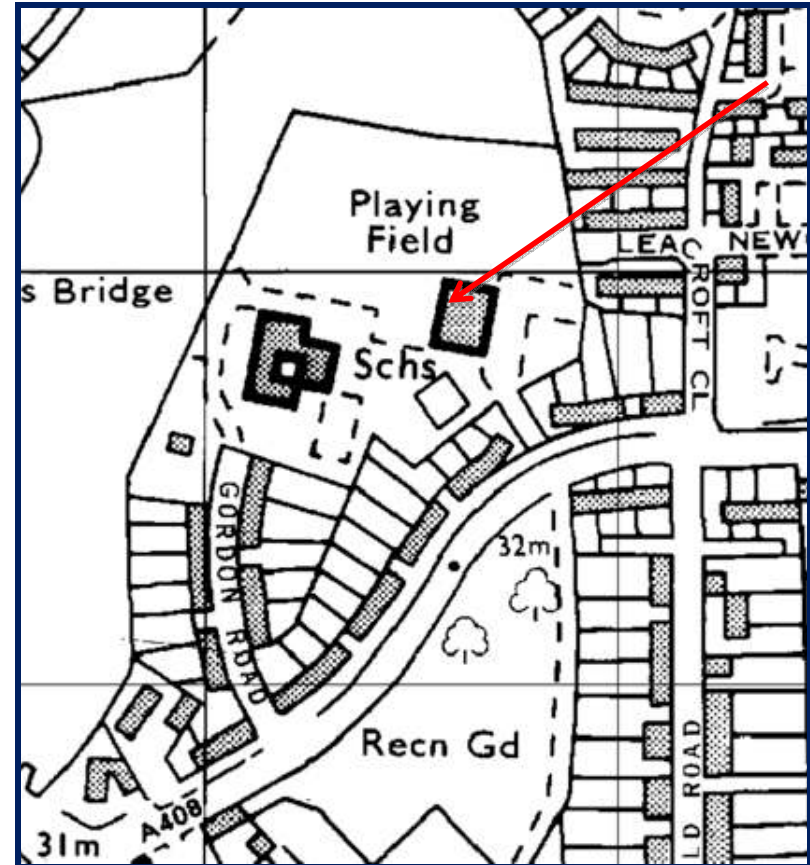
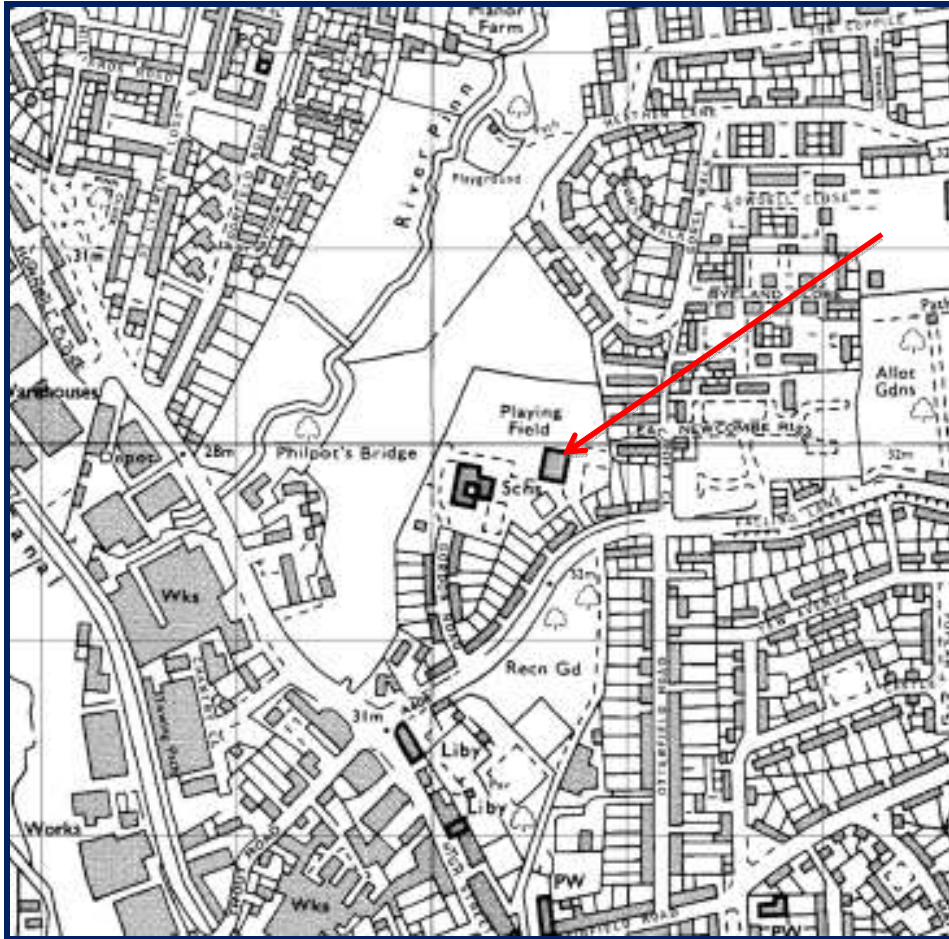
PHOTO 2: Historic map of the site published in 1960



Published – 1960
Site indicated – Red arrow
Map Scale – 1:10,560

The above map shows in that there has been significant change around the site area with some of the previous farmland being utilised for what appears to be residential housing. However the site itself is still undeveloped.

PHOTO 3: Historic map of the site published in 1990



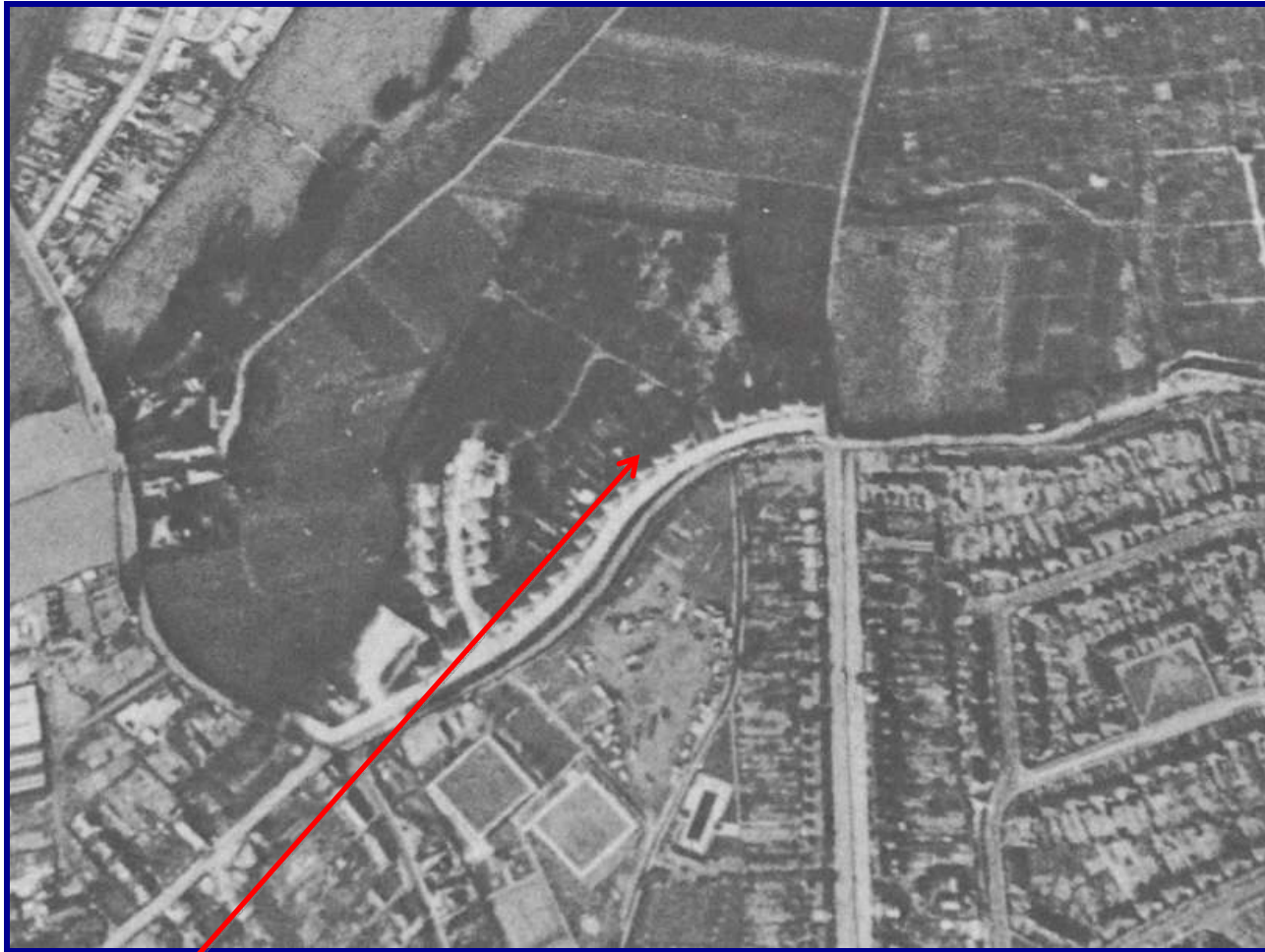
Published – 1990
Site indicated – Red arrow
Map Scale – 1:10,000

The above map indicates that the site has been further developed with the construction of the school. The grounds appear to be in a similar make up to as they are now, however

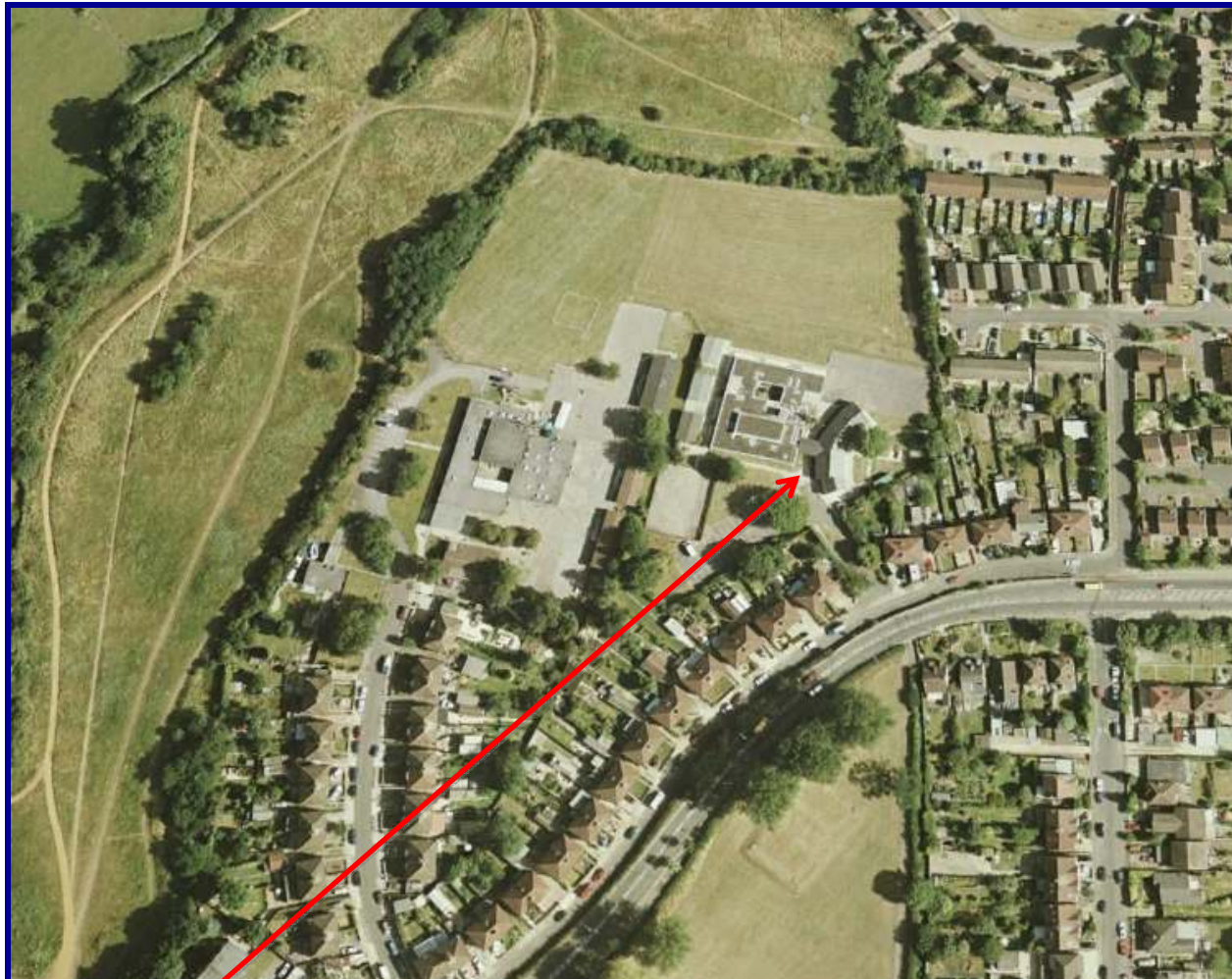
AERIAL PHOTOS

DATE: CIRCA 1945

Post War aerial photo of the site and its surrounding area, Photo indicates the site is being utilised with what appears to be farmland, with houses/residential buildings along its South border. The building that is in situ present day has not been constructed at the time of this photo.



SITE

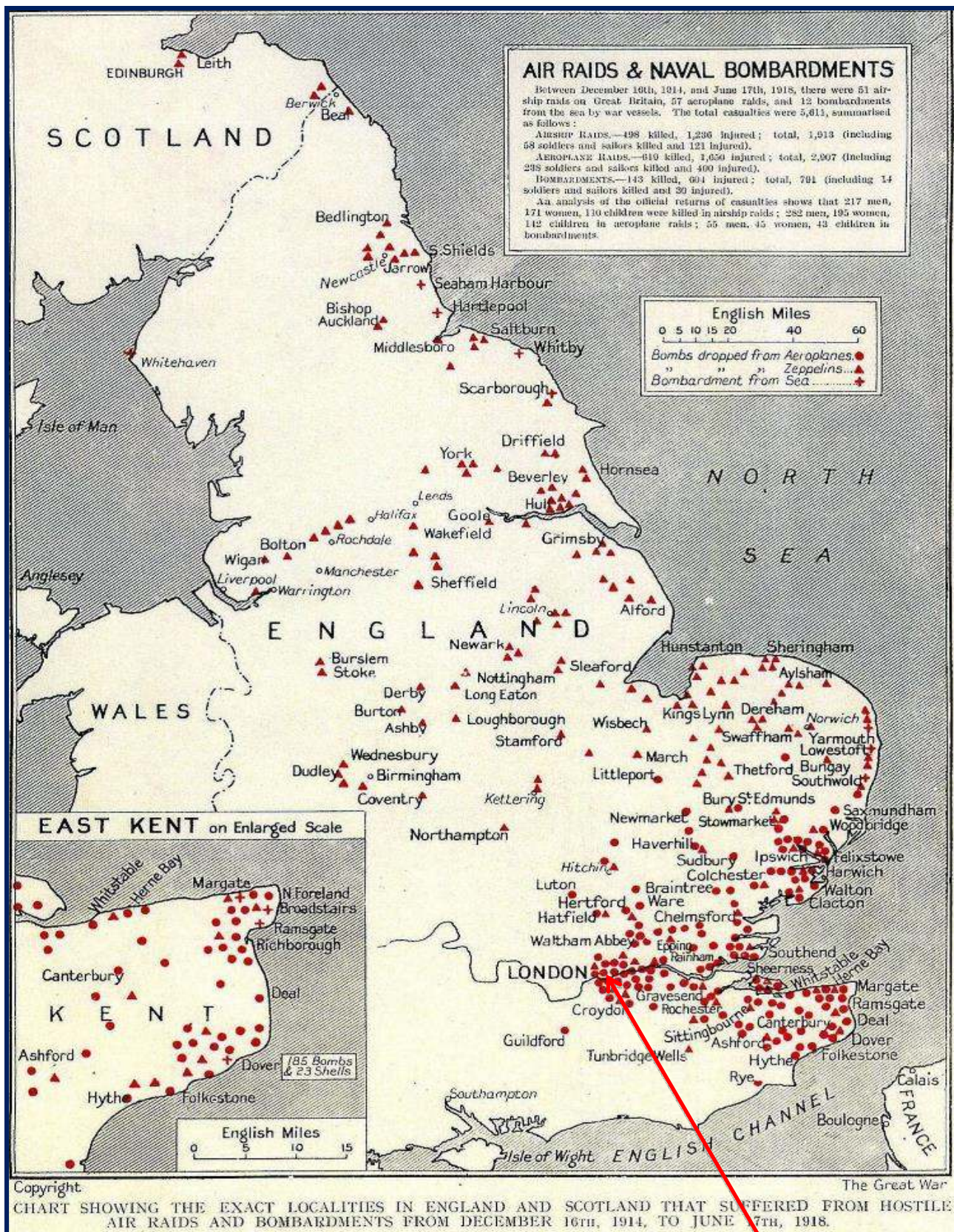


SITE

DATE: CIRCA 1999

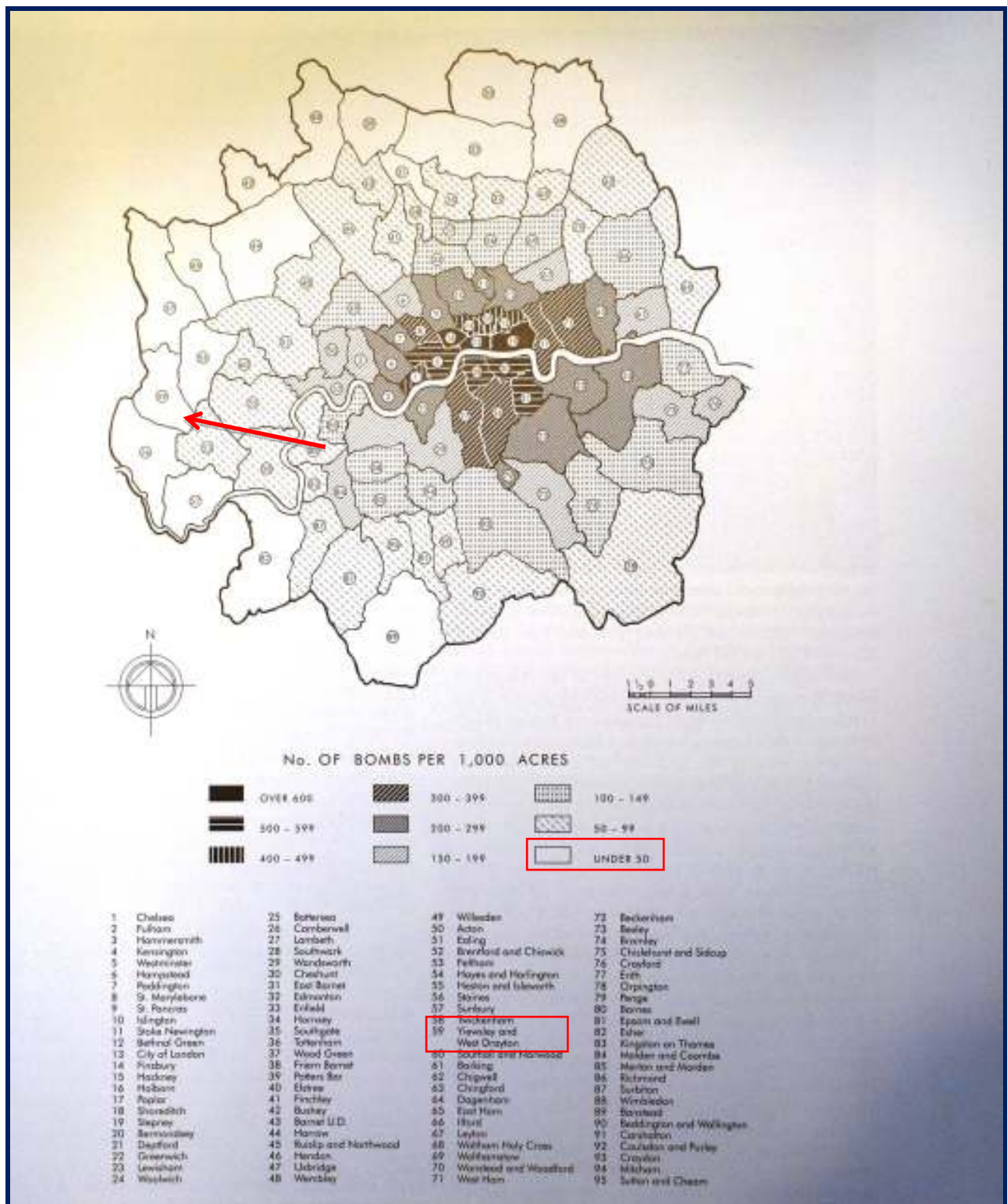
The more recent photo indicates that the previous farmland has now been converted in to its present day format, with the School to its West, open areas to its north and the remaining being utilised as residential housing.

BOMB RAIDS WWI



SITE

LONDON BOMB DENSITY MAP



BOMB IMPACT MAPS

LOW RISK

Map: London 53 – 23 SE. Provisional Edition GSGS No. 3906 Scale: 1 to 25,000

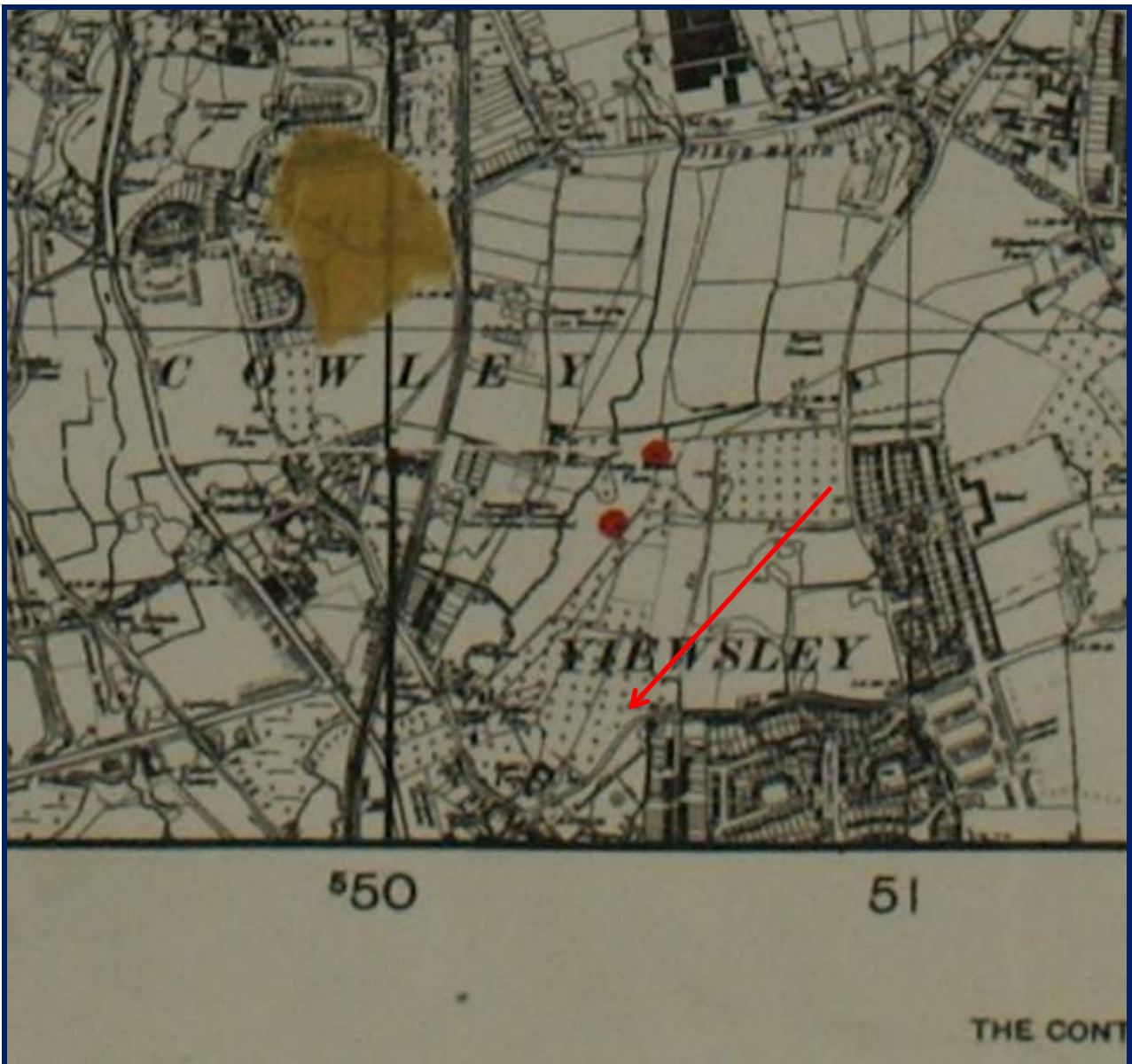
Key:

IBs	Indicated where applicable (usually denoted by hashed lines over a wide area.
UXB	⊙
HE Bomb	•
Para Mine	⊕

Map Reference OS: 504 003

Site Position: Indicated by a red Arrow 

MAP 1: HO 193 7th October – 6th June 1941



MAP SOURCE: HO 193
MAP REVISION: N/A
GRID REFERENCE: 504 003

NOTE: The red arrow highlights the approx centre of the subject site.

The above map indicates that the area was subjected to 2 HE strikes within close proximity too the site boundary.

MAP 2: HO 193-13 Night bombing between 7th October and the 6th June.



MAP SOURCE: HO 193
MAP REVISION: N/A
GRID REFERENCE: 504 003

NOTE: The red arrow highlights the approx centre of the subject site.

The above map indicates 3 HE Bomb strikes close proximity bombing to the site location.

EXPLOSIVE ORDNANCE SAFETY AND INFORMATION

UNEXPLODED ORDNANCE

Since the end of WWII, there have been a limited number of recorded incidents in the UK where bombs have detonated during engineering works, though a significant number of bombs have been discovered.

The threat to any proposed investigation or development on the site may arise from the effects of a partial or full detonation of a bomb or ordnance item. The major effects usually being shock, blast, heat and shrapnel damage. It should be noted that the detonation of a 50kg buried bomb could damage brick/concrete structures up to 16m away and unprotected personnel on the surface up to 70m away from the blast. Larger ordnance is obviously more destructive. Table 1 denotes recommended safe distance for UXO.

Table 1: Safety Distances for Personnel

UXO (Kg)	Safety Distances (m)			
	Surface UXO		Buried UXO	
	Protected	Unprotected	Protected	Unprotected
2	20	200	10	20
10	50	400	20	50
50	70	900	40	70
250	185	1100	120	185
500	200	1250	140	200
1000	275	1375	185	275
3000	450	1750	300	450
5000	575	1850	400	575

Explosives rarely become inert or lose effectiveness with age. Over time, fuzing mechanisms can become more sensitive and therefore more prone to detonation.

This applies equally to items that have been submersed in water or embedded in silt, clay, peat or similar materials.

Once initiated, the effects of the detonation of the explosive ordnance such as shells or bombs are usually extremely fast, often catastrophic and invariably traumatic to the personnel involved.

The degradation of a shell or bomb may also offer a source of explosive contamination into the underlying soils. Although this contamination may still present an explosion hazard, it is not generally recognised that explosives offer a significant toxicological risk at concentrations well below that at which a detonation risk exists.

TYPES OF ORDNANCE

German Air Delivered Ordnance. Technical information on the nature and characteristics of the ordnance used by the German Air Force during both world wars has been available for a number of years. Assessment that began during the 1930's has continued to the present day. Experts have conducted research in many countries as part of national research programmes and as individual research projects. Consequently a well-informed assessment of the threat posed by unexploded ordnance, and the hazards that they represent, can be made with a high degree of confidence.

Terminology. It should be noted that two terms used in bomb records can lead to some confusion as to their meaning and therefore significance. The term Unexploded Bomb (UXB) refers to a bomb that has fallen, failed to function and has been subsequently dealt with and removed from the site. The term Abandoned Bomb (A/UXB) refers to a UXB that could not be found or recovered, or the decision was taken not to pursue the matter further. Consequently the unexploded bomb remains where it came to rest when it was dropped or fell to the present day. It should also be noted the word 'bomb' can be used to describe an airdropped bomb or a shell as in some cases no differentiation was made and the term was interchangeable.

Abandoned Bombs. The records of known abandoned unexploded bomb locations in the London area were released in response to a written Parliamentary Question from Simon Hughes. (Hansard: Volume; 282. Dated 15th October 1996). The information was provided by the Ministry of Defence (MOD) and supplied under an indemnity.

Explosive Ordnance Failure Rates. Over the course of both World Wars a considerable quantity of ordnance dropped on UK targets failed to function as designed and subsequently penetrated the ground without exploding. Information gathered during the war by the MOD and its research partners provide typical failure rates for different types of ordnance. Figures significant to this study are:

- 10% of all German airdropped bombs failed to function as intended.
- 30% of all anti-aircraft and other types of shells failed to function as intended.

Deductions & Considerations. The following points were considered as part of the assessment and have been given due consideration:

Records were found that indicated that the general area was subjected to heavy bombing.

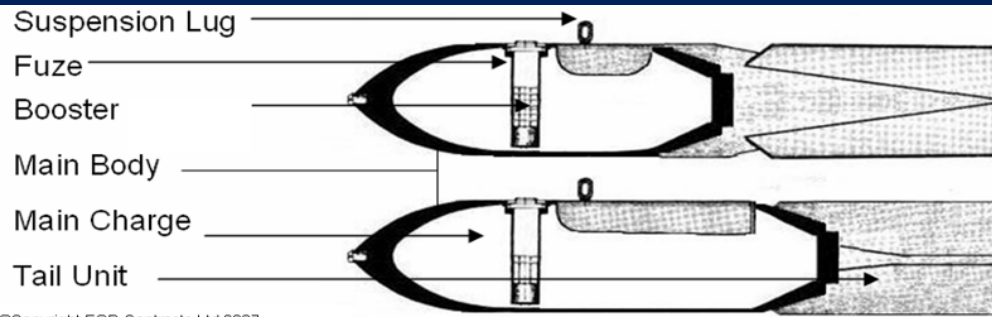
Bombs, which struck previously, hit or burned out targets and did not function; consequently their impact was unseen and therefore no report was ever made.

In all likelihood, the local anti-aircraft battery would have fired a far higher number of shells than the bombers dropped HE bombs. Contamination by anti aircraft shells can not be rules out.

Generic German Bomb Types. The majority of German bombs dropped were 50kg in weight, accounting for approximately 16% of the total bombs dropped. The range of common bombs increased in weight to a maximum of 1700kg. Regardless of size, German bombs were fitted with one or more Electrical Condenser Resistance (ECR) fuzes many of which included a mechanical component. The fuzes were mounted transversely in the bomb body with the booster directly below, and in contact with, the fuze. The booster; sometimes referred to as the Gaine, is composed of a sensitive explosive material (Picric Acid). Picric Acid is known to deteriorate over time becoming increasingly unstable. The internal layout of two common German bombs and a German fuze is shown in Figures 6.1 & 6.2.

FIGURE 1: Generic German Bomb Design.

Graphic Cross Section through the most common German bombs (50kg)



Note; the diagram shows that there can be a significant difference in the quantity of High Explosive contained within bombs of similar size and shape; the Grade 1 bomb on the bottom having 30% more HE than the Grade 2 shown at the top. This serves to demonstrate the importance of an accurate identification of any item of UXO.

FIGURE 2: Generic German Bomb Fuze Design.

Graphic Cross Section through a typical German fuze (ECR)

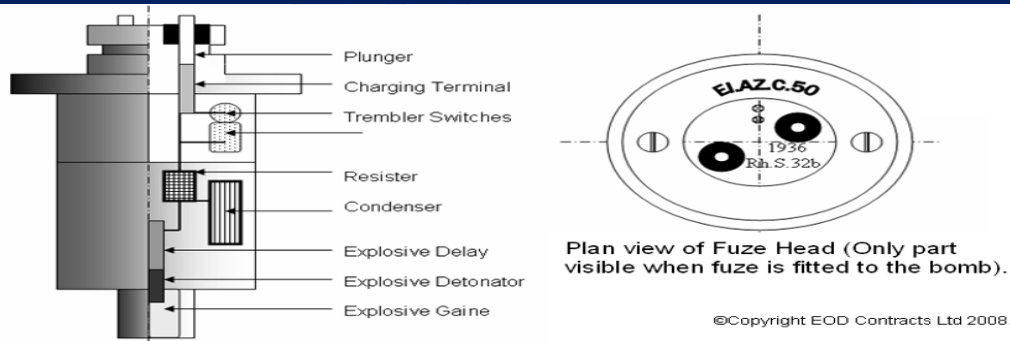


FIGURE 3: Range of HE bombs dropped on the United Kingdom.

German bombs



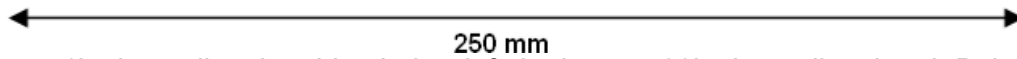
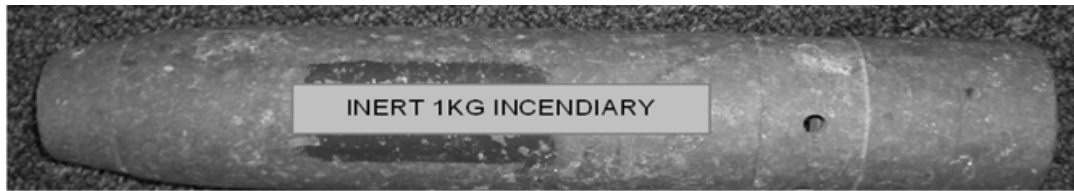
NOTE: The smaller sub-munitions (Bomblets) seen to the right, ranged in size between 1 and 3kg, were dropped in large numbers and were intended as incendiary bombs, anti-personnel bombs or as bombs filling both roles. The smaller bomblets were dropped in larger container bombs designed to hold between 360 and 620 of the bomblets. The containers were designed to burst open at a predetermined height above ground level, dispersing the bomblets over a wide area. Air raid damage was far greater by using both incendiary, and HE bombs on a single raid. The fires started by the incendiaries being rapidly spread by the blast waves from the HE bomb. This scenario was shown to devastating effect on the 14th February 1945 in the German city of Dresden. Where fires started and spread by the bombing increased to a point where the oxygen was being sucked into the flames at such a high speed that the fire became a "Fire Storm". At the time the city's population had increased due to a high number of refugees fleeing the Russian advance to the east, the exact civilian death toll from fire and suffocation will never be known, but is considered to be somewhere between 25,000 and 100,000.

High Explosive (HE) Bomb. Some of the most common type of ordnance to be dropped on the United Kingdom, HE bombs are often the type encountered as UXBs. Relatively thick cased, they are still recovered in remarkably good condition. Ranging in size from 50 to 1700 kg, their typical release height (1,500m) allowed them to penetrate deep into the ground as a result of design or flaw. Towards the end of the bombing campaign, as steel became scarce the German Engineers produced a range of bombs that used steel reinforced concrete as the bomb body. Figure 6.3 shows the range of steel HE bombs dropped on the UK.

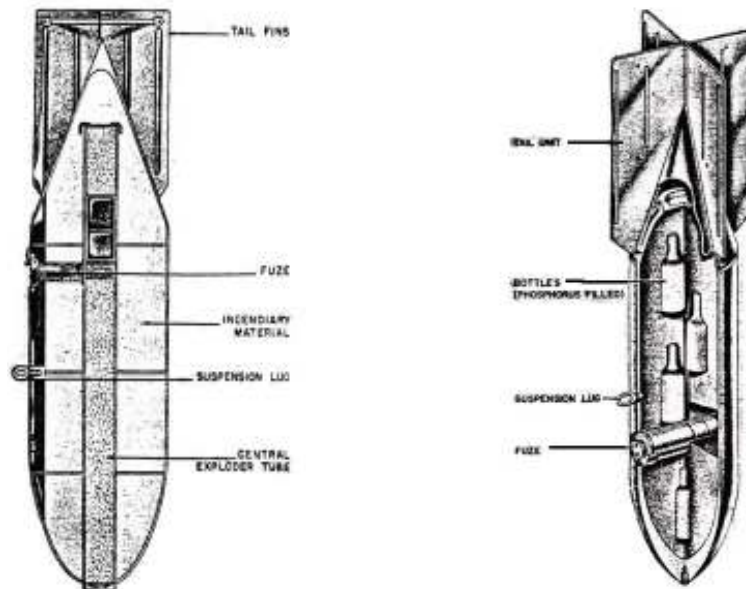
Incendiary Bomb. The larger incendiary bombs, containing bottles of white phosphorus and an incendiary mixture contained within a thin steel case were designed to burst on contact with the ground. A fixed dispenser on the aircraft delivered the smaller type of bomb or 'Bomblet' to the target area in container bombs or; both types of container would open dispersing the smaller Incendiary bombs. Relatively small and light they were unlikely to penetrate the ground to any significant depth. However, once concealed in bomb damage rubble or below water they were easily missed and are still unearthed today from in-fill and drained land. Later versions of the incendiary bomb contained an additional explosive charge used as a short delay "Booby Trap" device that contained a significant amount of high explosive. The Booby Trap component was designed to kill or injure fire fighters and hinder the damage control. See Figure 4.

FIGURE 4: Incendiary Bombs.

Common German Incendiary Bombs



Above 1kg incendiary bomblet, below left the larger 500kg incendiary bomb Below right a 50kg incendiary bomb containing bottles of white phosphorus.

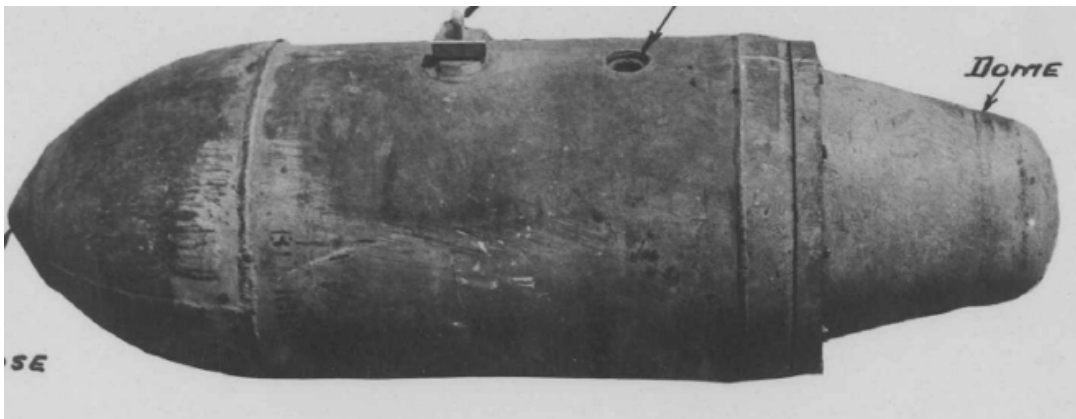


Note; Incendiary bomblets were made of a flammable alloy similar in appearance to aluminium, which resists corrosion well. The tail unit was made of thin tin-plate steel and is more prone to have rusted away. Some Incendiary models were fitted with a High Explosive (HE) steel nose. With the tail and explosive nose attached the bomb was 480mm long.

Blast Bomb / Parachute Mine. The parachute mine was extensively used on land and at sea and was fitted with specialist fuzes designed to trigger the weapon at a predetermined altitude, water depth or to switch on other magnetic influence mechanisms to trigger the weapon when a ship approached (Magnetic or Acoustic influence). While early versions were based on the standard 1000kg SD Bomb case others were specially designed and manufactured with an aluminium body, making them extremely difficult to detect using magnetometers. The thin cased versions would normally disintegrate on impact on land and are normally considered to pose little threat to work on land based projects, but the risk increases significantly on projects over water or in marshland. Thicker cased versions however will survive impact and pose a significant risk regardless of the local ground conditions. (See Figure 5)

FIGURE 5: Common Airdropped Mines.

Parachute & Ground Mines



Note; all mine fuzes were designed to arm after deployment from the ship, submarine or aircraft, some fuze designs incorporated anti-removal booby traps. Unexploded mines found today are the result of a failure within the arming mechanism or procedure whereby the mine never fully armed. Sudden shock or jarring of a weapon in this state has the potential to complete the arming sequence and could result in the mine detonating with lethal consequences.

Non Steel Cased Bombs. Used primarily in the construction of training or practice bombs, some high explosive variants were introduced towards the end of the war. With resources running scarce, German Engineers produced a small number of blast bombs with a concrete body. The design utilised a steel framework onto which concrete was cast. The explosive filling was also contained within a thin steel container within the bomb body. Very few “concrete” bombs were dropped on the UK. In common with standard steel cased weapons, this type of bomb can be detected using standard magnetometer detection techniques (albeit; providing a smaller ferromagnetic signature than its all steel counterparts). This type of bomb represents a very small percentage of the total number of bombs dropped worldwide and are not considered a significant threat, particularly when viewed from an overall bomb threat in the UK.

Anti-Personnel Bomb. Generally these were small weapons of 1-3 kilograms in weight and are often referred to as ‘Bomblets’ and possessing similar ground penetration ability as the Incendiary Bomblets. They were often located during the post-raid searches. This type of bomb has been recovered within the bomb rubble being cleared or used as in-fill on construction projects and poses the same potential to function as the Incendiary bomb with a greater potential to cause localised casualties.

Specialist Bomb. These types of bombs were designed to meet a specific mission requirement. Typically, this would be a design modification or special fusing to enable the bomb to destroy hardened/armoured targets or deep buried and sub-marine targets. Similar to the more common HE bombs, they differ in that they rarely contain large amounts of high explosive. Therefore the consequence of a detonation is reduced but remains a significant risk, particularly when the detonation occurs on or near the surface.

Depth Bombs & Depth Charges. These types of weapons were designed to meet a specific mission requirement. Typically, the modifications would include the type of explosive filling and special fusing to enable the bomb to penetrate to a significant depth into the ground or water before detonating. Depth bombs intended for maritime attack and sub-marine targets would be fitted with one or more fuzes, one of which would be a hydrostatic fuze designed to detonate the bomb at a predetermined depth. The bomb would be fitted with an anti skip ring to reduce the deflection of the bomb as it entered the water. Similar in many ways to Depth Bombs, Depth Charges were exclusively designed to detonate at a predetermined depth. This was achieved by fitting the Charge with a short time delay or hydrostatic fuze. Depth bombs; having a similar configuration to general purpose bombs had the potential to penetrate deeply into the sea bed where an attack occurred in the relatively shallower water of a dock.

Unmanned Rocket Bombs & Missiles. The most famous in this category of weapons were the V1 (Fi103 flying bomb) commonly known as the Doodlebug and the Larger V2 (A4 missile). Both V1 & V2 with high explosive warheads containing 850kg & 1000kg (respectively) represent some of the largest weapons to land in the United Kingdom. Both types were built in a similar manner to an aircraft and would generally disintegrate on impact even if the warhead failed to detonate. The impact would spread debris over a wide area which was difficult to miss and any resulting unexploded ‘V’ weapons were comprehensively dealt with at the time. For this reason they are rarely encountered on land. However, where a ‘V’ weapon landed in water the opportunity for the event to have been missed and/or follow-up action abandoned was greater and they continue to pose a significant risk. Other, less well known rocket bombs were also produced by the Luftwaffe to attack maritime targets. Some were equipped with TV/Radio guidance from the parent bomber. Two of the most common were the Fritz X which consisted of an adapted SD1400kg bomb and the Henschel Hs293 which was based on a smaller 500kg bomb. No record of one having been recovered on land as a UXB can be found but these large HE bombs are considered to pose a significant risk, particularly to maritime projects. No records were found to indicate this type of bomb was ever used on targets in the area.

Photoflash Bomb. This type of bomb was dropped by specialist “Pathfinder” aircraft and although this type of bomb can be included with the category of specialist bombs, it is worthy of

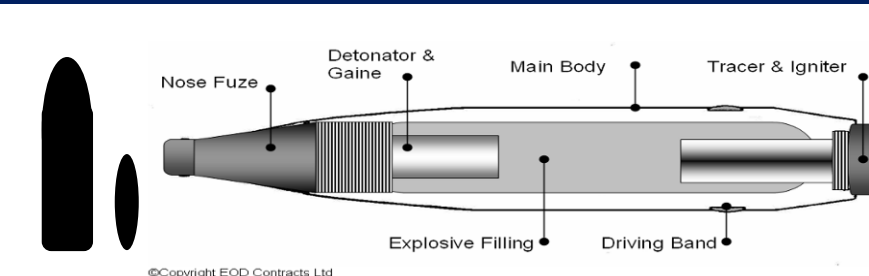
specific comment due to the danger it may still pose. Photoflash bombs were designed to explode with a blinding flash, rather like a camera flashbulb. They were used to enable photographs to be taken of targets at night and also served to identify ground targets for other aircraft to attack. The speed at which the highly energetic filling detonated, and energy it produced in doing so, was significant. Although these bombs were thin skinned and are prone to corrosion the functioning of one can be compared to a high explosive bomb detonation.

High Explosive Shells & Projectiles. As mentioned previously, one of the most common sources of UXO contamination encountered in the United Kingdom is High Explosive Shells and Projectiles. This is most commonly found to be as the result of firing practice ranges, bombardment and anti-aircraft defence, the latter often positioned to defend Major cities and Strategic installations and ports from German Bombing. Anti Aircraft Shells and projectiles are generally smaller (Up to 4.7" inch diameter) than the airdropped bombs and as a consequence were more easily missed amongst the bomb rubble. However, coastal bombardment guns could fire a shell weighing 1000kg, (larger than most common airdropped bombs) and capable of significant ground penetration. The generic layout of a projectile can be found at Figure 6.6. It should be noted that the fatal incident on the German autobahn in 2006 was thought to be the result of a shell or projectile detonating, not an airdropped bomb as first reported.

The Fuzes used in Anti-Aircraft Ammunition were designed to ensure the projectile would detonate in contact with the target, or at a pre-set altitude, or in close proximity to the target. The fuzes employed different means to achieve this, including; direct impact, or indirect impact, Barometric, Delay and Electro-magnetic influence. Some were fitted with more than one fuze, which served to reduce the chance of the projectile falling to earth and detonating. Artillery fuzes are activated during the firing process, using the projectile's acceleration or spin within the gun barrel to switch off the safety mechanisms. For this reason fired projectiles are considered more dangerous than unfired ones.

FIGURE 6: Generic Shell Design

Scale & Graphic Cross Section of a typical High Explosive (HE) Shell



Approximate size of a large shell used by battleships and coastal bombardment guns (Left) and Anti-aircraft shell (Right)

Other Types of Ordnance.

The following additional sources of ordnance types have been considered, and inherent risks taken account of:

Flares and Pyrotechnics. Flares and pyrotechnics were used for a variety of reasons throughout the war and continue to be found today in the most unlikely places. However, due to the thin casings of these weapons a high level of corrosion is likely to have occurred since manufacture. Depending on the specific nature of the weapon, this effectively renders them inert with the exception of any white phosphorous content or explosive gain.

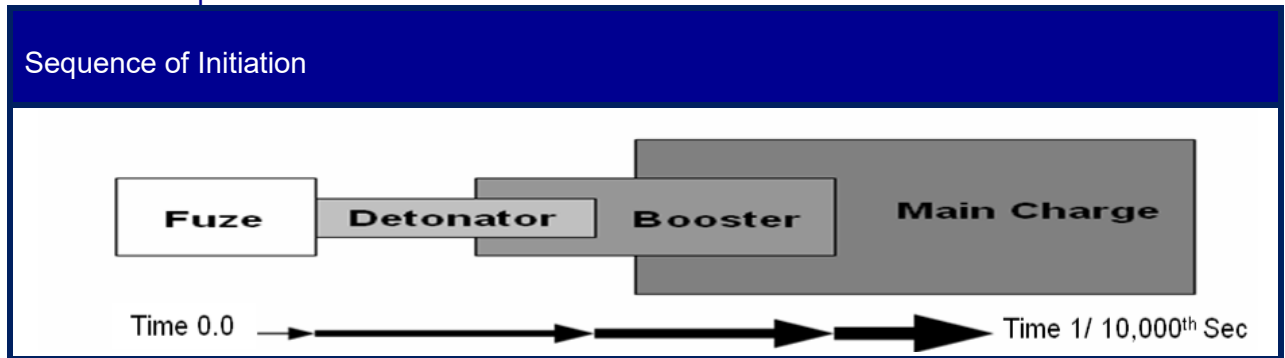
Land Service Ammunition (LSA). While as the name implies this type of ammunition was designed for use on land, it was also issued to naval personnel for close protection of vessels and their crew and to provide a limited offensive capability even to relatively small craft. This type of ammunition includes some shells and projectiles such as those covered previously. Other natures of LSA range from Small Arms Ammunition (SAA), having little or no high explosive content to Grenades, Mortars and Rockets which may pose a risk of detonation due to their explosive content and the design of their fuzes (impact) which; if subjected to sufficient shock or friction may result in the weapon functioning. (See Figure 7)

FIGURE 7: Common Categories of Land Service Ammunition



Initiation of Unexploded Ordnance. Explosive Ordnance is highly unlikely to spontaneously explode. The energetic chemical compounds, (Explosives) used in weapon manufacture are chosen to be as stable as possible and they all require a significant application of additional energy to create the right conditions for detonation to occur. If stored correctly, most explosive materials are designed to remain stable for the duration of their expected lifespan (typically 20 years). During this time, the correct functioning of the weapon is achieved by means of the 'Initiation Train' (See Figure 8).

FIGURE 8: Explosive Ordnance Initiation Train.



Initiation Train. This is a means by which, once the safety features have been switched off or removed, a chain reaction occurs through the weapon. Starting within the fusing system as a small ignition or spark, causing a detonator to explode, which in turn causes the booster charge to detonate with a greater energy and ending in the full detonation of the main explosive filling. Each part of the process has in-built safety features to prevent an unintended detonation. A failure in any of the components within the Initiation Train can result in a UXO. In the case of a UXB; the chain reaction has broken down and the Initiation Train is brought to a halt, albeit, a temporary one. There are a number of ways that sufficient energy could be introduced to the otherwise stable UXB / UXO that may allow the Initiation Train to set off once more, overcoming the initial reason for failure. In addition to subjecting the weapon to excessive heat, such as a fire, the most common methods to bring about an explosive detonation in such items are considered to be:

Direct impact onto the main body of the bomb by mechanical excavation or pile driving: Such an occurrence can cause the bomb to detonate, should the point of impact be on the bomb fuze; less force would be required to bring about a full or partial explosive detonation.

Re-starting the clock timer in the bomb fuze. Only a small percentage of bombs were fitted with clockwork fuzes. It is likely that corrosion has taken place within the fuze that may prevent the clockwork mechanism from functioning. However, the restarting of the clock is by no means a scenario that can be completely ruled out. This is considered to be one of the two most credible mechanisms by which sufficient energy could be introduced to the bomb and result in a detonation.

Induction of a static charge or exposure to an external power source (Electrical Services), causing a current in an electrical fuze. The majority of German bombs employed an electrical component within the fuzes, it is likely that corrosion would have taken place within the fuze mechanism and that it would no longer contain, or conduct sufficient electrical charge to initiate the bomb.

Friction initiating the sensitive fuze explosive. Some chemical constituents may have deteriorated, due to oxidation. Components designed with a high degree of stability at the time of manufacture may no longer be as safe. **This is considered to be the most likely mechanism by which sufficient energy could be introduced to the bomb and result in a detonation.**

Risk Assessment Tables

Table 1: Summary of Potential Contamination Sources

Source	Applicable	Not Applicable
Enemy Attack & Counter Measures		
Bombing WW1		☒
Manned Aircraft Bombing WW2		☒
Unmanned V1 & V2 Rocket Attack		☒
Shelling		☒
Anti-Shipping Mines & Depth Charges		☒
Anti-Aircraft Shells & Rockets		☒
Beach Mines & Coastal Defences.		☒
Airfield/Key Point Defensive Mines/Charges		☒
Abandoned Unexploded Bomb (A/UXB)		☒
Migration of UXO		
UXO Migration in Rubble & Infill		☒
UXO Migration by Tide & River Current		☒
UXO Migration by Marine Dredging		☒
Ship Wrecks		☒
Dispersal by Explosion, Fire & Accident		☒
Aeroplane Crash		☒
Private Collections		☒
MOD Facilities		
Bombing Range		☒
Artillery, Mortar & Tank Range		☒
Grenade Range		☒
Small Arms Firing Range		☒
Weapon Research & Development Facilities		☒
Ammunition Burial Grounds		☒
Docks & Harbour Facilities		☒
Offshore Ammunition Dumping Grounds		☒
Ammunition Storage & Manufacture Sites		☒
Airfields & Air Stations		☒
Bombing Decoy Site		☒
Army Barracks & Camps		☒
MOD Training / Concentration Areas		☒
Home Guard & SOE Weapon Caches		☒

Table 2: Baseline Bomb Penetration Assessment

Sub Soil Type	Bomb Weights			
	50kg	250kg	500kg	1000kg
Soft Rock	2.442	5.016	6.006	7.062
Gravel	2.442	5.016	6.006	7.062
Sand	2.442	5.016	6.006	7.062
Chalk	3.7	7.6	9.1	10.7

Sub Soil Type	Bomb Weights			
	50kg	250kg	500kg	1000kg
Shingle	3.7	7.6	9.1	10.7
Dry Clay	3.7	7.6	9.1	10.7
Wet Sand	5.55	11.4	13.65	16.05
Wet Clay	5.55	11.4	13.65	16.05
Average Offset (m)	0.8-1.6	1.6-3.7	3-4.5	3.4-5.3

Table 3: Site Specific Bomb Penetration Assessment

Input Figures			
Bomb Weight	Release Height	Velocity on Impact	Angle of Strike
500 kg	5000 m	340 m.s ⁻¹	10° to vertical
Geology	Made Ground – London Clay		
Output Figures			
Maximum Penetration Depth		Maximum Offset	
10.7 m		5.3 m	
The maximum threat depth from airdropped weapons is considered to be: Bombs 10.7 m The maximum threat depth for smaller shells is considered to be: AA Shells 3.0 m			
Input figures based on the most common bombing methods and largest common bomb type Figures derived from computer simulation. All depths based on 1939 levels.			

Table 4: Airdropped Weapon Strike Indicators (UK)

Item	Increasing Potential level →			
Site Location	Rural	Small Town	Brown Field Large Towns	Cities
Site Description and Use	Greenfield or Agricultural Land	Near Strategic Target	Adjacent to Strategic Target	Strategic Target
Site History	No history of Attack	Near area of Attack	Immediate Area Attacked	Direct Attack
Strategic Target: Military Installation, Industrial or Munitions Manufacturer, Power Station, Gas or Water Works, Port, Dock, Railway Yard, Decoy Site.				

Table 5: Weapon Strike Records (UK)

Source	Availability			
Archive	None	Non specific	Specific	Extensive
In-house	None	Non specific	Specific	Extensive
Anecdotal	None	Non specific	Specific	Confirmed

Table 6: Anti-Aircraft Weapon Strike Indicators (UK)

Item	Increasing Potential level ⇒			
Site Location	Rural	Town	City	Military Site
Fixed Battery Location	None	General Area	Nearby	Onsite
Mobile Battery	Rural	Town	City	Military Site
Military Site: Airfield, Port, Radar, Barracks, Depots, Arsenal or Similar.				

Table 7: Abandoned Bomb Records (UK)

Item	Increasing Potential level ⇒		
In-house	None	Yes	On-site
Other	None	Yes	On-site

Table 8: Bomb Strike Density Assessment

Bombs & Mines	Below 50 Bombs per 100 acres
---------------	------------------------------

Table 9: Opportunity to have detected Bomb or Shell Strikes (UK)

Increasing Potential level ⇒
Light bomb damage
Good ARP cover
Significant development
No significant ground cover
Light bomb damage
Moderate ARP cover
Moderate development
Frequent public access
Little ground cover
Significant bomb damage
Poor ARP cover
Minimal development limited to shallow excavations
Infrequent public access
Moderate ground cover
Heavy bomb damage
No ARP cover
Development limited to site clearance
Controlled private access
Heavy ground cover, vegetation, ploughing or body of water

Table 10: Post Contamination Development Indicators (UK)

Nature of Post Contamination Development	Increasing Potential level →
	100% excavations of the entire site to below contamination depth.
	Significant development
	Moderate development
	Minimal development
	No development

Table 11: Construction Activities Encounter Indicators

Activities	Increasing Potential level →
	Borehole Drilling
	Dynamic Sampling
	Shallow Trial Pit
	Services Trenching
	Bored (CFA) Piling
	Sheet Piling
	Shallow Excavations over extended area
	Deep Excavations over a limited area
	High Density Piles
	Deep Excavations over extended area
	Bulk Excavations



16th May 2017



Bomb disposal experts in Birmingham are taking part in a "major, delicate operation" to make a wartime bomb safe.

A major route into the city remains closed for a second day, rail services are affected and people have been evacuated from their homes.

The bomb disposal team said 13 lorry loads of sand had been brought in to create a "sizeable igloo" around the 250kg (551lb) bomb.

Junctions four to seven of the M6 have been closed ahead of detonation.

West Midlands Police, who has praised the bravery of the team at the scene, said the motorway between junction four near Coleshill and seven at Great Barr will shut in both directions while a controlled explosion is carried out.

Mike Luedicke, deputy commander of the Army's UK bomb disposal unit who is coordinating the operation, said the team was "very confident it was a classic Second World War German air drop bomb".

"It's called an SC2 50 - 250kg in weight, 139kg of high explosives," he said. He said a "large cave of sand bags" consisting of 250 tonnes of sand had been put around the site.

Major Luedicke said it had been a particularly "complex" case because the fuses were "on the underside and pressed into the earth and so our process of identification and diagnostics has been a real challenge".

"We need to either magnetically or chemically freeze the fuses to essentially put a handbrake on them," he said.

A 500m cordon was set up after the discovery at about 09:45 BST on Monday and hundreds of homes and businesses evacuated.

About 80 people were forced to spend the night in a rest centre, the Red Cross, said Paige Collins, of Aston, and her 10-month-old daughter, were among residents who spent the night at Alexander Stadium in Perry Barr.

"We're in a dusty gym - I think it is normally used for martial arts. It is a bit draughty," she said.

Ms Collins said she slept for about "an hour" on a mat and sheet after putting her daughter to sleep in her pushchair. She said cots should have been provided.

"I was trying to go into my house about 2:45pm [on Monday] and the police were at the bottom of my road saying everyone has to be evacuated," she said.

Residents were told they could be there until about 18:00 BST, she said.



Analysis by Birmingham historian Carl Chinn

Birmingham was a major munitions centre, as were Manchester and Coventry, and on 19 November 1940, the Germans attacked the city very heavily. At the time Aston and Tyseley were very industrial areas.

The raid carried on for nine hours on 19 November, but it could have been the next night when this device was dropped.

On 20 November, nearby Queen's Road was absolutely destroyed by a big bomb. Queen's Road is right next to where this bomb was found.



SOURCE: <http://www.bbc.co.uk/news/uk-england-birmingham-39932247>



Wembley WW2 live bomb posed 'risk to life'

🕒 22 May 2015 | London

🔗 Share



SERGEANT RUPERT FRERE RLC

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.

The 50kg (110lb) device was removed by a specialist Army team and safely detonated. The bomb, thought to date from the early 1940s German air raids on London, was found on Thursday.

Homes and businesses were evacuated and the Army built a blast wall around the device in case it exploded.

The device was taken away by the Royal Logistic Corps disposal teams to a safe area to be detonated in a controlled explosion.

Police confirmed it was blown up in an unspecified location in Bedfordshire shortly after 17:00 BST.

After the bomb was removed from its position near Wembley, street cordons were taken down and people were allowed back into the area.

Wembley Stadium said its weekend games would go ahead including the Championship Middlesbrough v Norwich play-off on Monday.

"This weekend's games remain unaffected and we look forward to welcoming supporters of all six Football League Play-Off finalists to Wembley", it **tweeted**.

The Army said the bomb was located about 200m (656ft) away from Wembley Stadium but there was no risk to the venue. Empire Way had been partially closed and a 400m cordon was in place while bomb disposal experts dealt with the device.

The bomb was reported at about 15:00 BST on Thursday and Met Police officers said about 300 properties had been evacuated, which included the TV studio where Britain's Got Talent is filmed.

Chief Supt Mick Gallagher, from Brent Police, said the public had been "very mature" in its response to the bomb.

He said 70 people had spent the night in an evacuation centre and more people joined them in the morning.

"I must also thank our courageous soldiers from various Army regiments for working tirelessly for over 24 hours, using their skill and experience to safely bring this incident to its conclusion," he added.

An Army spokesman said: "This bomb is a live munition in a potentially dangerous condition so it's important that people listen to the police and evacuate their homes if asked.

"Any bomb, even under a controlled explosion, could cause significant damage to property and there is a genuine risk to life."

The Met Police said it had worked with disposal experts and partner agencies "to keep disruption to local residents and businesses to an absolute minimum", while ensuring everyone's safety.



SOURCE: <http://www.bbc.co.uk/news/uk-england-london-32841971>

EveningStandard.

Friday 20th January 2017



Discovery: the unexploded German SD 50kg bomb was dropped by an aircraft during the second world war.

This is the World War Two bomb which caused chaos after it was found in the Thames near the Houses of Parliament on Thursday evening.

Waterloo and Westminster bridges were both closed for several hours, Westminster underground station was closed and river traffic was halted after the device was dredged up near the Victoria Embankment.

Scores of police carried out safety checks in the area and the riverfront remained closed until around 3am on Friday morning.

The Royal Navy operation to dispose of the unexploded bomb involved towing it along the river to Tilbury where a controlled detonation was carried out.

In pictures released by the Royal navy today, the German SD 50kg bomb appears to be covered in years of river slime but is still in a reasonable condition.

It is thought to have been dropped from an aircraft during the Blitz.

Lieutenant Mike St Pierre, the officer who led the bomb disposal team on scene, said: "It was a long night for me and the team but this is exactly what we are trained for so it was a successful operation, although it was a little surreal carrying out our job right next to the Houses of Parliament.

"I'd like to thank the authorities who worked with us so well on this operation, particularly

the Met Police. The bomb itself was in good condition considering how old it was, and it clearly still

"We removed it from the barge and towed it along the Thames, working very closely with the Met Police to safely close off bridges as we went, until we were sure we could detonate it safely."

Large crowds of tourists and passers-by had gathered at the police tape with some calmly taking photographs of the odd sight.



SOURCE: <http://www.standard.co.uk/news/london/pictured-ww2-bomb-found-in-thames-which-caused-chaos-in-london-a3445831.html>

APPENDIX B

Site Walkover Photographs



Main school building



One storey extension to east of site



Garden area in the east of the site



MUGA to the north east of the school building



Playing field in the north of the site



Mound separating playing field from school

APPENDIX C

Preliminary Conceptual Model

Hillingdon Young Person’s Hub, Falling Lane, Yiewsbury, West Drayton, Middlesex				Preliminary Conceptual Model		R17-12386/ds	
Potential Source	Potential Receptor	Potential Contaminants	Potential Pathway	Complete Linkage Present?	Probability	Consequence	Risk
Mound adjacent to playing fields	End Users	Heavy Metals, PAH Compounds and Asbestos	Dermal contact with soil and dust (indoor & outdoor)	Yes	P1: Very Low	C3: Moderate	Low
			Ingestion of soil and indoor dust	Yes	P1: Very Low	C3: Moderate	Low
			Consumption of home-grown produce and attached soil	No private gardens proposed			N/A
			Inhalation of soil dust (indoor and outdoor)	Yes	P1: Very Low	C3: Moderate	Low
			Inhalation of soil vapours	No potential contaminants identified			N/A
			Inhalation of soil gases/ Risk of explosion	No potential gas source identified			N/A
	End Users (via Water Supply Pipework)		Contamination of incoming services	No potential contaminants identified			N/A
	Groundwater	Heavy Metals and PAH Compounds	Migration to groundwater	Yes	P1: Very Low	C1: Very Minor	Negligible
Backfilled mineral sites in the vicinity of the site	End Users	Land Gases	Dermal contact with soil and dust (indoor & outdoor)	Off site source: Pathway not applicable			N/A
			Ingestion of soil and indoor dust	Off site source: Pathway not applicable			N/A
			Consumption of home-grown produce and attached soil	Off site source: Pathway not applicable			N/A
			Inhalation of soil dust (indoor and outdoor)	Off site source: Pathway not applicable			N/A
			Inhalation of soil vapours	Off site source: Pathway not applicable			N/A
			Inhalation of soil gases/ Risk of explosion	Yes	P1: Very Low	C3: Moderate	Low
	End Users (via Water Supply Pipework)		Contamination of incoming services	Off site source: Pathway not applicable			N/A
	Groundwater		Migration to groundwater	Off site source: Pathway not applicable			N/A

APPENDIX D

Classification of Probability, Consequence and Risk

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

Consequence of risk being realised		
Classification	Category	Definition
Severe	Human Health	Short term (acute) risk to human health likely to result in "significant harm" as defined by the Environment Protection Act 1990, Part IIA.
	Controlled Waters	Short term risk of pollution (note: Water Resources Act contains no scope for considering significance of pollution) of sensitive water resource.
	Property	Catastrophic damage to buildings/property.
	Ecological Systems	A short term risk to a particular ecosystem or organisation forming part of such ecosystem.
Moderate	Human Health	Chronic damage to Human Health.
	Controlled Waters	Pollution of sensitive water resources (note: Water Resources Act contains no scope for considering significance of pollution).
	Ecological System	A significant change in a particular ecosystem or organism forming part of such ecosystem.
Minor	Controlled Waters	Pollution of non-sensitive water resources.
	Property	Significant damage to crops, buildings, structures and services.
	Ecological Systems	Damage to sensitive buildings/structures/services or the environment.
Very Minor	Human Health	Non-permanent health effects to human health (easily prevented by means such as personal protective clothing, etc).
	Property	Easily repairable effects of damage to buildings, structures and services.
	Project	Harm, although not necessarily significant harm, which may result in a financial loss or expenditure to resolve.

Risk classification definitions	
Very High	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required.
High	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short term and are likely over the long term.
Moderate	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer term.
Low	It is possible that harm could arise to a designated receptor from an identified hazard, but there is a low likelihood of this hazard occurring and if realised, harm would at worst normally be mild.
Very Low	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised, it is not likely to be severe.