Unexploded Ordnance Risk Mitigation

Explosive Ordnance Desk Top Study for:

LAND SURROUNDING – FRONTIER BUSINESS PARK, BRADFORD ROAD, BATLEY, WF17 6JD

PROJECT 26080

On behalf of – **REDBRICK YORKSHIRE**

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Institute of Explosives Engineers
VOICE OF THE EXPLOSIVES INDUSTRIES

EXPLOSIVE ORDNANCE DESKTOP STUDY

For

LAND SURROUNDING – FRONTIER BUSINESS PARK, BRADFORD ROAD, BATLEY, WF17 6JD

Conducted by **EOD Contracts Limited**

On behalf of **ROGERS LEASK LTD**

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Conditions of Release

CONTENTS

TERMS AND DEFINITIONS

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

Air Raid Precautions (ARP)
An organisation in the United Kingdom set up in 1937 dedicated to the protection of civilians from the danger of air raids. It included the Raid Wardens' Service that was to report on bombing incidents.

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 Pilotless Aircraft.
V2 see Long Range Rocket.

WWI
World War 1 (1914 – 1918)

WWII
World War 2 (1939 – 1945)

EXECUTIVE SUMMARY

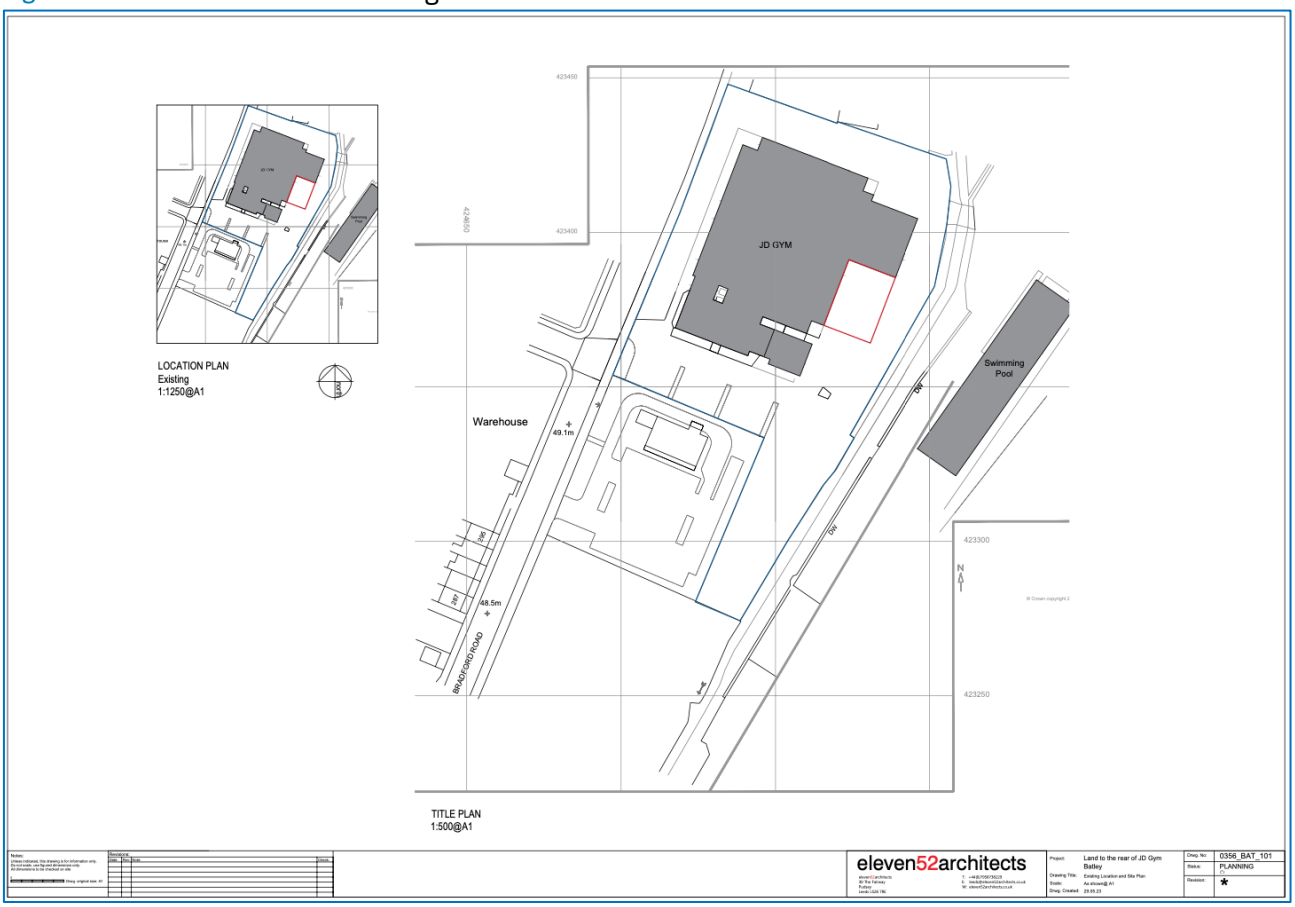
INSTRUCTION

EOD Contracts Ltd, have been commissioned by REDBRICK YORKSHIRE to undertake a Desktop Study (DTS) for potential historic Unexploded Ordnance (UXO) contamination for the future works on the parcel of lands described as per the historic mapping as Land at (AND SURROUNDING):- Frontier Business Park, Bradford Road, Batley, WF17 6JD. Hereafter referred to as the Site.

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 The Site (See Figure 1.1 & 1.2), in view of further development. A further aim was to evaluate the implication from UXO contamination during any future intrusive land use.

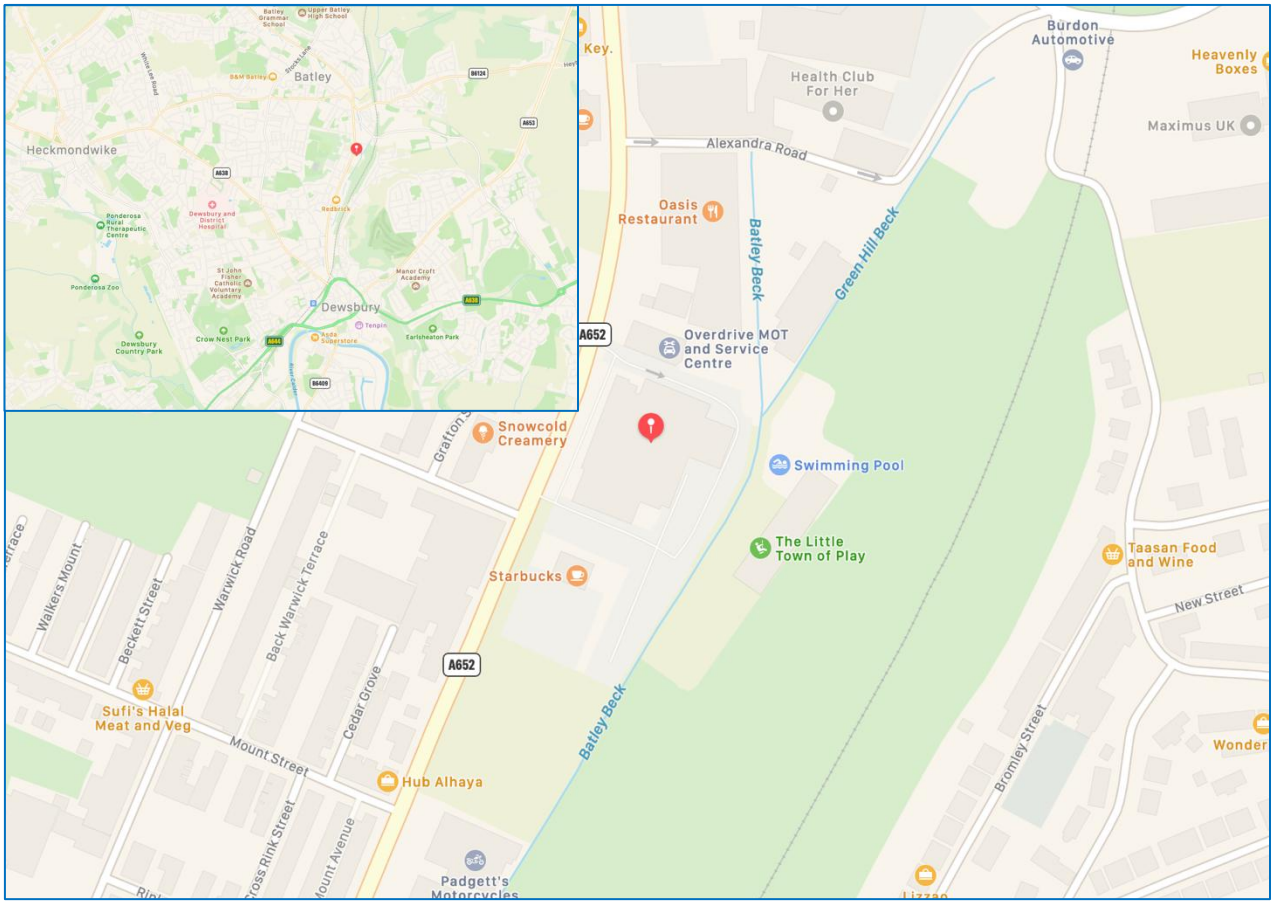
Figure 1.1: This DTS will be covering the area bordered in Blue.



LOCATION

Site Location (red flag). An exact meeting point will be determined by the Client should the need arise.

Table 3.1 Site 1 Location.



Title	Description
Address	Land Surrounding: - Frontier Business Park, Bradford Road, Batley.
Post Code	WF17 6JD
Nat Grid Reference	SE 247233 / SE 2474223399
what3words	occurs.lakes.scarcely

SOURCES OF UXO CONTAMINATION

The main sources of potential UXO contamination that have been researched for the site are:

- Air delivered ordnance bombs and sub-munitions/incendiaries.

KEY FINDINGS

Based on the historical record for Batley and the former Bradford Road sewage works site, the likelihood of discovering UXO in modern times is considered low.

Overall Probability

- Low probability of encountering UXO during routine groundworks.
- The site is not associated with known bombing strikes, military storage, or wartime training activity.

Factors Reducing Modern Risk

- The area was already heavily developed and disturbed during post-war redevelopment, including construction of the Batley Variety Club and later commercial units.
- There is no documented UXO contamination zone covering the site.
- West Yorkshire inland towns generally experienced limited strategic bombing compared with major industrial or coastal targets.

Residual Risk

- Although unlikely, a residual precautionary risk remains because:
    - Historical records cannot completely rule out stray munitions.
    - Urban sites can occasionally reveal isolated unexploded items during deep excavation.

Practical Conclusion

- Modern UXO encounter risk at this location would be classified as precautionary rather than significant, and standard construction health and safety procedures are considered sufficient unless unusual ground conditions are identified.

NOTE: Encounters of UXO are not uncommon, recent UXO finds are in Annex E.

Risk Level

Based on available historical data, bombing maps, and risk assessments, the likelihood of encountering unexploded ordnance (UXO) within Stanhope, Kent is considered to be a **LOW** risk.

Historical UXO Contamination.

Conclusions

Based on the available historical evidence, the risk of encountering unexploded ordnance at the former sewage works site in Batley is considered low. There is only one recorded bombing incident within the town during the Second World War. The site does not fall within known military training zones, munitions disposal areas, or documented UXO contamination corridors. The land has also been subject to substantial post-war disturbance through redevelopment, including construction associated with the Batley Variety Club and subsequent commercial development, which would have further reduced the likelihood of shallow buried hazards. While a residual precautionary risk cannot be entirely eliminated, any UXO threat at the site is regarded as minimal and consistent with that expected for long-established urban land in a region with limited wartime bombing activity. Standard construction health and safety precautions are therefore considered sufficient unless unexpected ground conditions or suspect items are encountered during intrusive works.

The indicators for UXO contamination are:

Bomb Strikes	There are no recorded incidents of the Site being the subject of bombardment throughout WW1. No recorded evidence of the Site area being targeted throughout WW2. However, there are no available bomb maps to show where the known bombs struck.
Bomb Damage	No recorded damage.
Reconstruction	No obvious signs.
Military Usage	No obvious signs.
Explosive/Munition Factory	No obvious signs.
Landfills/Backfill	No obvious signs

Risk Level

The overall risk has been determined to apply to all ground works within the site footprint.

Risk Level	Therefore, so far as reasonably practicable the risk level on Site has been deemed as a **LOW** risk.
Risk Depth	N/A

PART 8: RECOMMENDATIONS

It is recommended that the following risk mitigation strategy be executed during phases of the project indicated previously as a **LOW** risk.

No further mitigation measures required.

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:

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.*

Non-Intrusive Survey using multiple array system with DGPS *(Differential Global Positioning System).*

Offshore, near-shore, estuarine and freshwater water environments magnetic, side scan and bathymetric supported by state-of-the-art DGPS.

The aforementioned surveys are supported with post processing of data and intrusive investigations if required.

EOD Engineer over watch using Suitably Qualified and Experienced Personnel, normally former British Army, Navy, or RAF Bomb Disposal specialists.

Explosive Ordnance Safety Presentations.

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
- English Heritage
- Bombing Britain Database

PART 1: INTRODUCTION

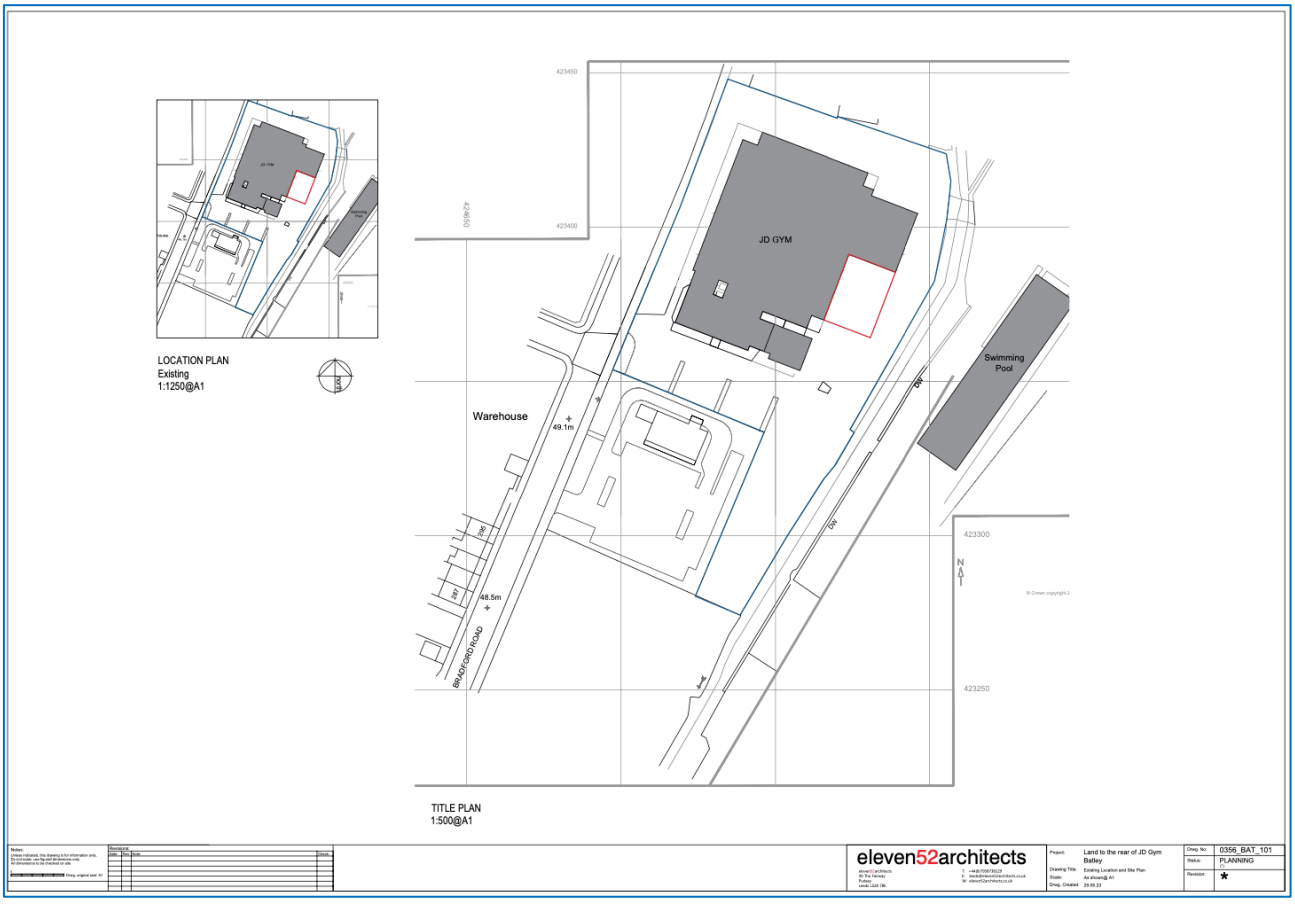
Instruction

EOD Contracts Ltd, have been commissioned by REDBRICK YORKSHIRE to undertake a Desktop Study (DTS) for potential historic Unexploded Ordnance (UXO) contamination for the future works on the parcel of lands described as per the historic mapping as Land at (AND SURROUNDING):- Frontier Business Park, Bradford Road, Batley, WF17 6JD. Hereafter referred to as the Site.

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 The Site (See Figure 1.1), in view of further development. A further aim was to evaluate the implication from UXO contamination during any future intrusive land use.

Figure 1.1: This DTS will be covering the areas bordered in blue.



Restrictions

It must be emphasized that a desk study can only indicate the potential for UXO to be present on the site. 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 Contacts Ltd will in no circumstances be held responsible for the accuracy of such information or data supplied.

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.

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 2009 and offer remediation methodologies if required.

CIRIA Framework

The CIRIA report is intended to provide good practice guidance (code of practice) on how to identify whether a site is likely to be at significant risk of UXO encounter and, if so, to set-out a process that will allow this risk to be managed. To be effective this process must start early in the life of the project (usually before intrusive works commence) and have involved Clients, Advisors and Principal Contractors. Therefore, the ground contractor should be provided with a systematic appraisal of the UXO risk when they become involved. The CIRIA report recommends the following stages be undertaken as part of the risk management process:

- Phase 1 Preliminary Risk Assessment
- **Phase 2 Detailed Risk Assessment (Completed and updated in this document)**
- Phase 3 Risk Mitigation (The act of ameliorating the risk, the clearance methodology)
- Phase 4 The UXO Risk Management and Implementation Plan

PART 2: 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:
    a. EOD Contracts Ltd company records
    b. Ministry of Defence records
    c. Central and Local Government Records
    d. Public Records Office (Kew)
    e. Historic Maps and Air Photography
    f. Open-Source information (Internet)

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.

Attack Record Keeping

In general, the quality and accuracy of bombing and shelling records prior to 1942 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.

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.

Errors and Omissions

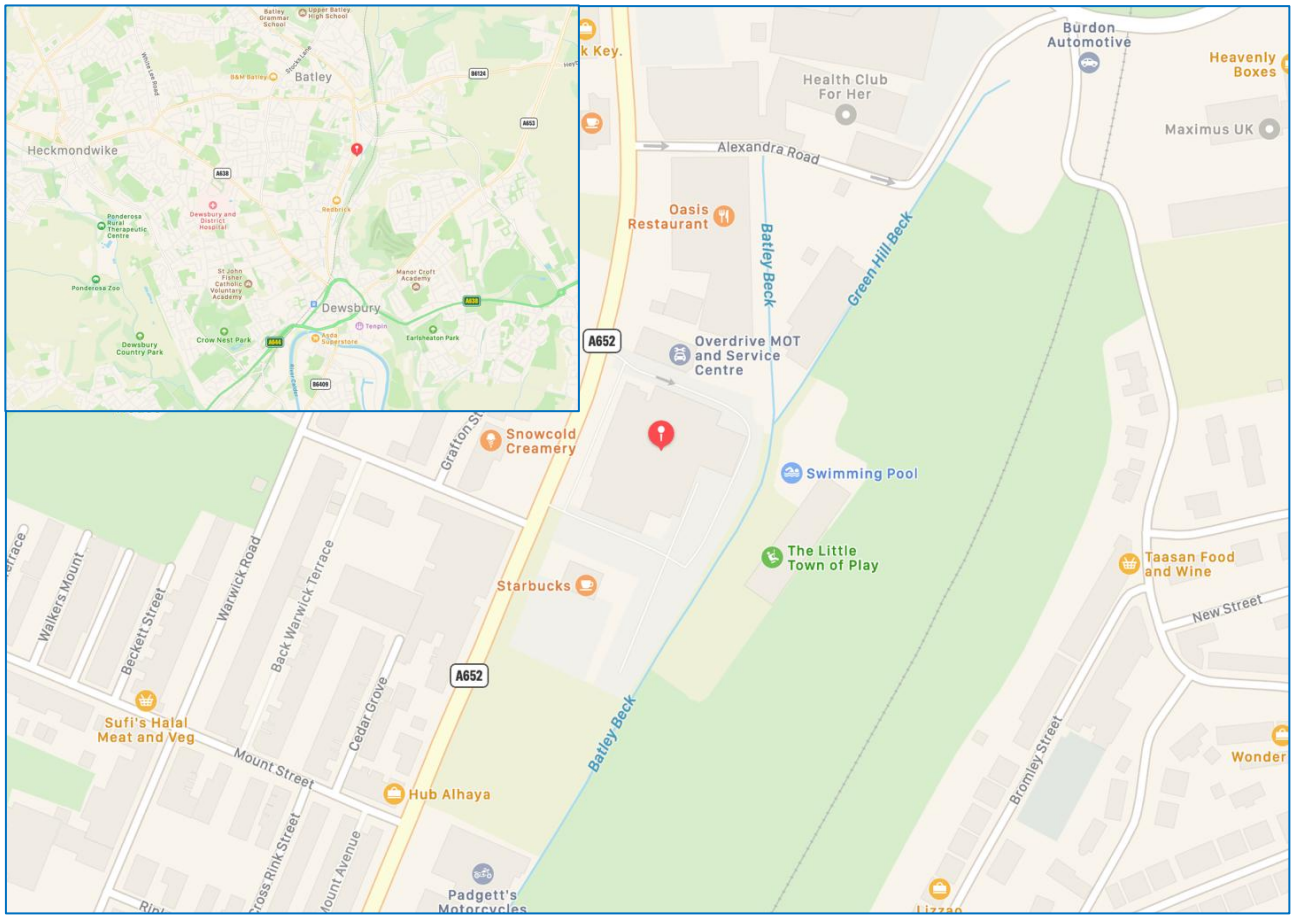
The accuracy of bombing records has been shown to vary greatly; this may have been a result of the individual record keeper's expertise. Additionally, in some cases, errors occurred as a result of poor or incomplete transcription and copying. Some "errors and omissions" were intentional, designed to 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.

PART 3: SITE DESCRIPTION AND DETAILS

Location

The Location (red flag). An exact meeting point will be determined by the Client should the need arise.

Table 3.1 Site 1 Location.



Title	Description (Centre of Site)
Address	Land Surrounding: - Frontier Business Park, Bradford Road, Batley.
Post Code	WF17 6JD
Nat Grid Reference	SE 247233 / SE 2474223399
what3words	occurs.lakes.scarcely

Description and Current Usage

The Site boundary at present is occupied by existing buildings which includes JD Gyms and Zucchini's Italian restaurant. Immediately adjacent JD Gyms, also fronting Bradford Road, is a Starbucks drive thru and to the rear are two new units occupied by Swim! and The Little Town of Play Ltd.

Geology

BGS (British Geological Survey) indicates the following geology.

Pennine Lower Coal Measures Formation-Mudstone, siltstone, and sandstone. These sedimentary rocks are fluvial, palustrine, and shallow marine in origin. They are detrital, forming deposits reflecting the channels, floodplains, and deltas of a river in a coastal setting (with periodic inundation from the sea).

Future Works

At the time of writing this report it is understood that the sites will be subjected to some form of redevelopment (the exact scope of works is not known at this time). The supplied requirement is usually for, geotechnical investigations, possibly percussive drilling/trial pits/window/samples.

PART 4: HISTORICAL REVIEW

Historical Mapping

The historical maps in Annex B have been reviewed and a brief synopsis is in Table 4.1:
Historical Map Synopsis 1936 – 2025

Date	Scale	Description/Remarks
1933 - 38	1:2,500	In 1933 - 38, the land along Bradford Road in Batley was occupied by a municipal sewage treatment works serving the town's domestic and industrial wastewater. Batley was a heavily industrialised woollen-mill town at the time, and the facility formed part of the essential public health infrastructure required to manage sewage safely. The site typically comprised primary settlement tanks, where solid waste was allowed to settle out of incoming sewage, and bacteria (percolating) filter beds, where wastewater was filtered through stone or clinker media to allow natural biological processes to break down organic matter. Sludge removed from the tanks was deposited on drying beds or in lagoons, where it was left to drain and dry before disposal or reuse, sometimes as agricultural fertiliser. The works was surrounded by open land and access tracks, creating a buffer between the treatment processes and nearby residential areas due to odour and health considerations.
1955	1:2,500	Aerial photography from 1949 confirms that the sewage treatment works on Bradford Road, Batley, remained operational in the immediate post-Second World War period, with filter beds and associated infrastructure still visible on the site. During the 1950s, the works appears to have entered a period of decline or redundancy, likely reflecting wider modernisation and consolidation of wastewater treatment facilities in the region. While precise closure dates

Date	Scale	Description/Remarks
		require confirmation from local authority records, evidence suggests that the site was decommissioned sometime between the early 1950s and early 1960s. By the mid-1960s, the former sewage works had been cleared, and the land was redeveloped. In 1967, the site became home to the Batley Variety Club, marking a significant change from municipal infrastructure use to commercial entertainment purposes. Overall, the period around 1955 represents a transitional phase in which the site was moving from active public utility use toward eventual redevelopment.
1977 - 91	1:1,250	By the late 1970s, the former sewage treatment works site on Bradford Road, Batley, had been fully redeveloped for commercial leisure use. Following its decommissioning in the 1950s and subsequent clearance in the early 1960s, the land was transformed into the Batley Variety Club, which opened in 1967. During the 1970s the venue was well established as a major national music and entertainment destination, marking a complete change in character from its earlier municipal infrastructure function. Wastewater treatment serving the area had by this time been consolidated at larger regional facilities elsewhere.
2025	1:10,000	Following the demolition of the Batley Variety Club, which had occupied the site from 1967, the land was redeveloped to provide modern retail, trade counter, and light industrial units. The site now forms part of the established commercial corridor along Bradford Road and retains an employment-generating function, with no remaining visible evidence of its former sewage treatment or entertainment uses.

Post War Construction/Works

See above.

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.

Site Specific Bombing Information (Batley)

There is no recorded evidence that Batley was directly bombed during the First World War. Although German air raids on Britain during 1914–1918 targeted major cities, coastal towns, and key industrial centres, Batley was not considered a strategic target and did not experience documented bombing

incidents during this period. The town's role as a textile manufacturing centre did not result in it being subjected to aerial attack in the First World War.

WWII

Bombing started as early as October 1939, by the end of the WWII the Luftwaffe had dropped approximately 50,000 tonnes of high explosive bombs and 110,000 tonnes of incendiary bombs, this caused over 40,000 UXBs, killed 43,000 people and over 250,000 homes were destroyed.

Batley throughout WW2

Historical records indicate that there was an enemy air raid on Batley during the Second World War on the night of 12–13 December 1940, when German aircraft dropped bombs on the town. This was part of Luftwaffe operations over northern England during The Blitz.

- Local accounts and wartime reports describe the night of 12 December 1940 as Batley's first air raid, with bombs falling on and around the town.
- A Kirklees Council history notes that bombing raids at Dewsbury and Batley on that same night killed seven people.

These bombs typically included a mix of high explosive and incendiary devices, which was common in Luftwaffe raids aimed at causing fires and disruption as well as structural damage. However, most surviving references focus on the fact of the raid and casualties rather than listing specific incendiary strikes over Batley itself.

Abandoned Bombs/UXO

There have been no recent finds of unexploded wartime ordnance (UXO) in or around the Batley area, below is a list of the most recent finds in and around Yorkshire.

Hornsea, East Riding of Yorkshire

- A piece of unexploded ordnance was found on Hornsea beach, prompting a safety cordon and disposal by explosive ordnance teams. The coastline here, particularly between Hornsea and Cowden, has a documented history of wartime bombing and air gunnery practice, with many practice bombs and other Ordinance exposed over time, especially through erosion.

East Riding – Construction Site UXO Discoveries

- In 2021, an unexploded World War II bomb was discovered at a construction site near Goole (East Yorkshire), halting works and requiring controlled disposal. The area has some recorded low-level bombing incidents in WWII, though the site itself was not heavily attacked.

Sheffield and South Yorkshire

- Multiple UXO finds have been reported in and around Sheffield in recent years including suspected WWII bombs discovered during construction or in gardens, as well as in retail park development areas such as Meadowhall. Other devices like wartime grenade fragments have also turned up in residential areas nearby.

North Yorkshire (Redcar)

- A suspected unexploded WWII bomb was found at Teesworks in Redcar, North Yorkshire, in 2023 during excavation work, requiring temporary road closures and disposal procedures.

North York Moors

- Large historic explosive items (including bombs and shells) exposed by wildfire on Langdale Moor land used for tank training in WWII have detonated spontaneously in recent years, demonstrating the lingering presence of UXO in former training areas.

These kinds of discoveries are rare but not unusual in areas that were heavily bombed or industrially active during WWII; when they do occur, police cordons are established, and explosive ordnance disposal (EOD) specialists are called in to assess and safely remove or detonate the device.

Anti-Aircraft Defenses in and around Batley.

During the Second World War, Batley was covered by the wider air-defence network established across West Yorkshire rather than having major anti-aircraft installations within the town itself. Heavy industry and population centres across the region were protected by a combination of gun batteries, searchlight stations, and RAF fighter defence zones. Records do not indicate the presence of large permanent anti-aircraft gun emplacements directly within Batley, although nearby towns in the West Riding hosted defensive positions designed to intercept aircraft approaching industrial targets such as Leeds and Bradford. Civil defence measures within Batley focused primarily on air-raid precautions, including blackout enforcement, warning sirens, and local shelter provision for residents and workers. Overall, the town was considered part of the regional defensive perimeter rather than a principal anti-aircraft deployment site.

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.

PART 5: SOURCES OF UXO CONTAMINATION

The main sources of UXO contamination that have been researched for the site are:

Air delivered ordnance bombs and sub-munitions/incendiaries.

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

General

UXO contamination pathways from:

- Air delivered ordnance bombs between 100m and 200m.
- The nearest Anti-Aircraft Weapons (AA) is over 3km.
- No recorded use as an Explosive or Munition Factory
- Has had no Military Usage

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

Bomb Penetration Depths

The weapon penetration depths have been assessed as part of the tables in Annex G.

Factors Affecting Penetration

The penetration of sub-surface bombs will be affected by the following:

- Height of release
- Weight, shape, and design of bomb
- Aerodynamic qualities
- Angle of flight and impact
- Nature of impact surface
- Nature of sub soil

The expected bomb depths for the site assuming the following criteria:

- 15,000 feet, the vast majority of bombs were dropped from height to avoid AA fire and balloons.
- General Purpose Bombs of 50kg to 1000kg
- Near Vertical impact 80 to 90 degrees
- Surface geotechnical conditions are made ground.
- Subsurface geotechnical conditions are generally clays.

Therefore, the expected depths for Air dropped UXBs on site are indicated in RED in the following table:

TABLE 5.1: Bomb Penetration Depths

	Bomb Weights			
Sub-Soil Type	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
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

PART 6: RISK ASSESSMENT

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.

Key Risk Factors for UXO around the former Sewage Works in Batley.

The likelihood of encountering unexploded ordnance (UXO) around the former sewage works site on Bradford Road should be considered low to moderate, but several historical and environmental factors are relevant when assessing risk.

Limited Direct Bombing History

- There is only one incident of a recorded attack on Batley (and Dewsbury) on the night of 12th Dec 1940, when the town(s) were attacked with Incendiary and HE bombs, Information on this attack is limited to online sources.

Urban Redevelopment and Ground Disturbance

- The site was redeveloped in the post-war period, including construction of the Batley Variety Club in the 1960s and later commercial units.
- Past excavation, piling, and foundation work would likely have disturbed or removed shallow buried hazards.

Distance from Known Military Training Zones

- The site is not located within documented WWII artillery ranges, coastal defence firing zones, or large-scale training grounds where UXO contamination is more common in Yorkshire.

Type of Historical Land Use

- The former sewage works function involved:
  - Filter beds
  - Settlement tanks
  - Lagoons and engineered ground structures

These environments are generally not associated with intentional munitions disposal, which sometimes occurs in isolated rural or military sites.

Regional Context Risk

- While UXO discoveries do occur across West Yorkshire during construction activity, they are typically:
  - Isolated finds rather than evidence of widespread contamination
  - More commonly associated with areas that experienced heavy wartime industrial bombing or military training.

Overall Assessment

- The former sewage works site is not considered a known high-risk UXO location based on available historical evidence.
- Any UXO risk would be considered residual and precautionary, consistent with standard construction risk management in historically developed urban land.

If this is for a planning or contamination report, I can also help you draft a formal UXO risk statement suitable for submission.

Likelihood of Encounter within the Study Site

Based on the historical record for Batley and the former Bradford Road sewage works site, the likelihood of discovering UXO in modern times is considered low.

Overall Probability

- Low probability of encountering UXO during routine groundworks.
- The site is not associated with known bombing strikes, military storage, or wartime training activity.

Factors Reducing Modern Risk

- The area was already heavily developed and disturbed during post-war redevelopment, including construction of the Batley Variety Club and later commercial units.
- There is no documented UXO contamination zone covering the site.
- West Yorkshire inland towns generally experienced limited strategic bombing compared with major industrial or coastal targets.

Residual Risk

- Although unlikely, a residual precautionary risk remains because:
  - Historical records cannot completely rule out stray munitions.
  - Urban sites can occasionally reveal isolated unexploded items during deep excavation.

Practical Conclusion

- Modern UXO encounter risk at this location would be classified as precautionary rather than significant, and standard construction health and safety procedures are considered sufficient unless unusual ground conditions are identified.

NOTE: Encounters of UXO are not uncommon, recent UXO finds are in Annex E.

Consequence of Encounter

The consequence (see Annex D) of an uncontrolled encounter with UXO, given its lethal design and its unpredictable nature could be catastrophic and warrants a high severity factor. With regards to the consequences, the following factors were considered:

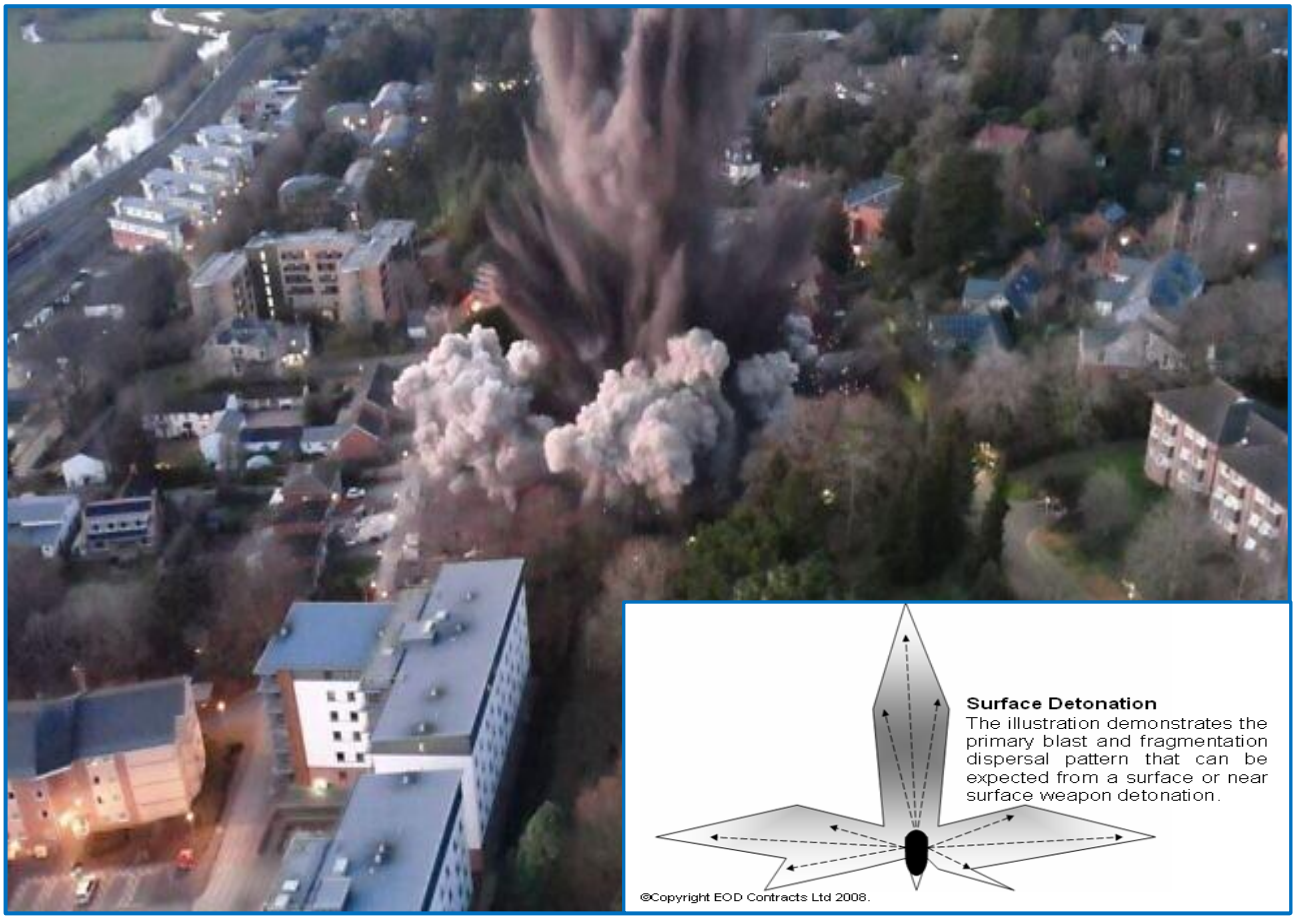
The project works may make use of a number of common ground investigation and construction techniques in its methodology during the project. Any intrusive groundwork has the potential to encounter UXO.

Intrusive earthwork, piling driving and dynamic ground compaction are by nature, aggressive, significant force (kN) is often required to achieve the desired results. As a precaution it is prudent to assume that any external stimulus, no matter how slight, may result in an unstable weapon detonating.

Records of encounters with UXO, particularly where plant machinery has been involved have resulted in detonations of the items with varying degrees of consequence; ranging from slight injuries sustained to piling contractors when a bomb detonated at 6.0m bgl to fatal injuries sustained to a construction worker while conducting near surface machine works on a motorway.

Detonation on land; the effects of a detonation at depth will be more localised and less destructive than one occurring on the surface. Figure 6.1 shows an illustration of the primary blast and fragmentation dispersal from explosive ordnance when it detonates on the surface. The weapon's design, and other key factors such as the ratio of explosive charge weight to total weapon weight (CWR) and the Net Explosive Quantity (NEQ) will determine the size and effects of a blast. The effects will also be enhanced or reduced by a number of factors including, the presence of other energetic materials in close proximity to the blast or if the weapon is buried or exposed on the surface. As a guide Annex E Table 1 gives an indication of the likely blast radius for common types of UXO.

Figure 6.1: Primary Blast & Fragmentation on Land



In addition to the dangers of explosion, many common chemicals used in the manufacture of explosive ordnance fillings are in sufficient quantity, and level of exposure, toxic or poisonous. Although it is unlikely that such chemicals would be encountered in significant quantity to represent a significant risk to personnel, leakage or venting could pose a risk to the local marine environment. In addition to heavy metals, copper, lead, zinc etc used in the weapon body and fuze, hydrocarbon propellants such as Kerosene may also be present.

Risk Level

The prevailing risk level has been determined to be a **LOW** risk for Site.

PART 7: CONCLUSIONS

Based on the available historical evidence, the risk of encountering unexploded ordnance at the former sewage works site in Batley is considered low. There is only one recorded bombing incident within the town during the Second World War. The site does not fall within known military training zones, munitions disposal areas, or documented UXO contamination corridors. The land has also been subject to substantial post-war disturbance through redevelopment, including construction associated with the Batley Variety Club and subsequent commercial development, which would have further reduced the likelihood of shallow buried hazards. While a residual precautionary risk cannot be entirely eliminated, any UXO threat at the site is regarded as minimal and consistent with that expected for long-established urban land in a region with limited wartime bombing activity. Standard construction health and safety precautions are therefore considered sufficient unless unexpected ground conditions or suspect items are encountered during intrusive works.

Historical UXO Contamination.

The indicators for UXO contamination are:

Bomb Strikes	There are no recorded incidents of the Site being the subject of bombardment throughout WW1. No recorded evidence of the Site area being targeted throughout WW2. However, there are no available bomb maps to show where the known bombs struck.
Bomb Damage	No recorded damage.
Reconstruction	No obvious signs.
Military Usage	No obvious signs
Explosive/Munition Factory	No obvious signs.
Landfills/Backfill	No obvious signs

Risk Level

The overall risk has been determined to apply to all ground works within the site footprint.

Risk Level	Therefore, so far as reasonably practicable the risk level on Site has been deemed as a **LOW** risk.
Risk Depth	N/A

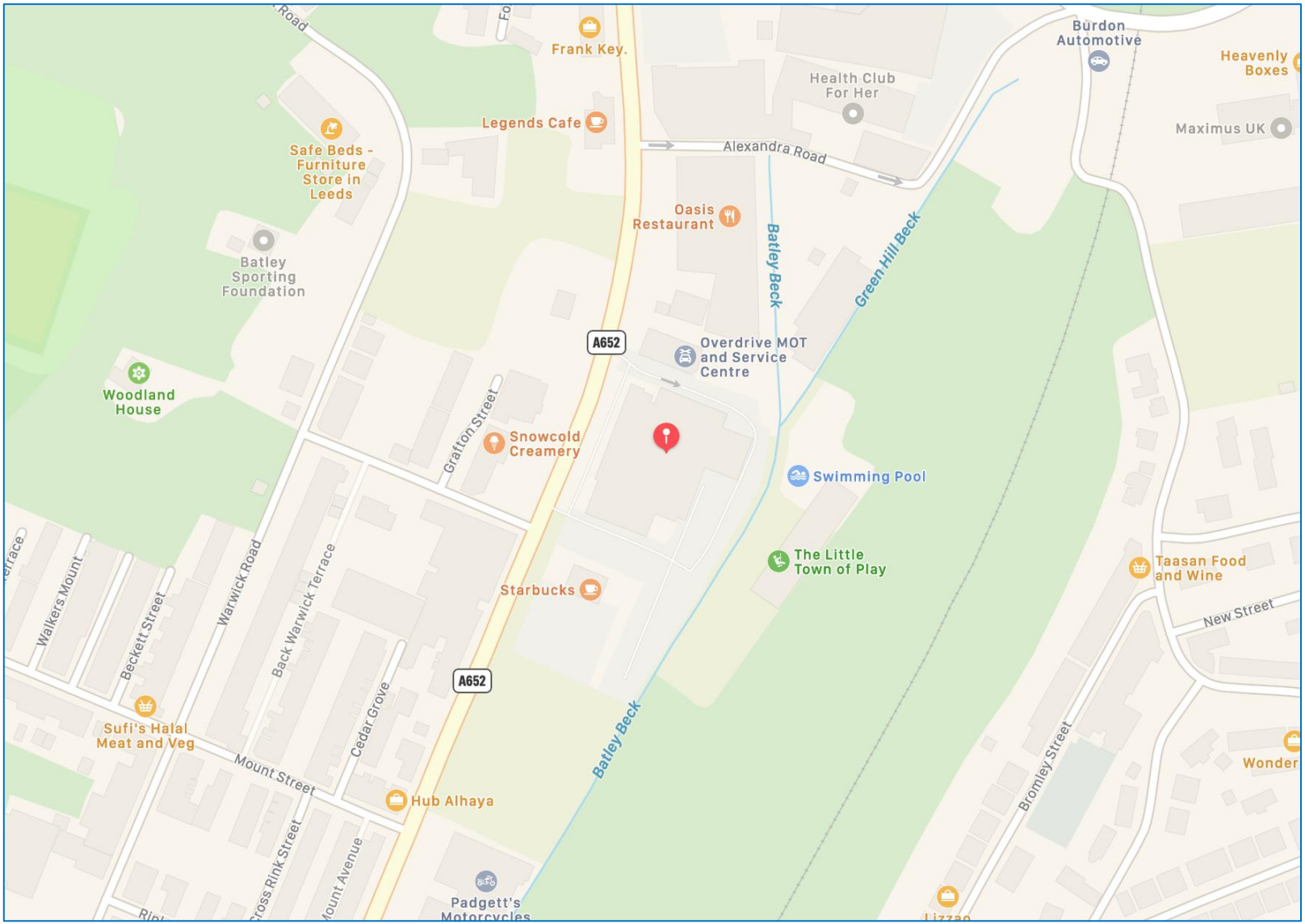
PART 8: RECOMMENDATIONS

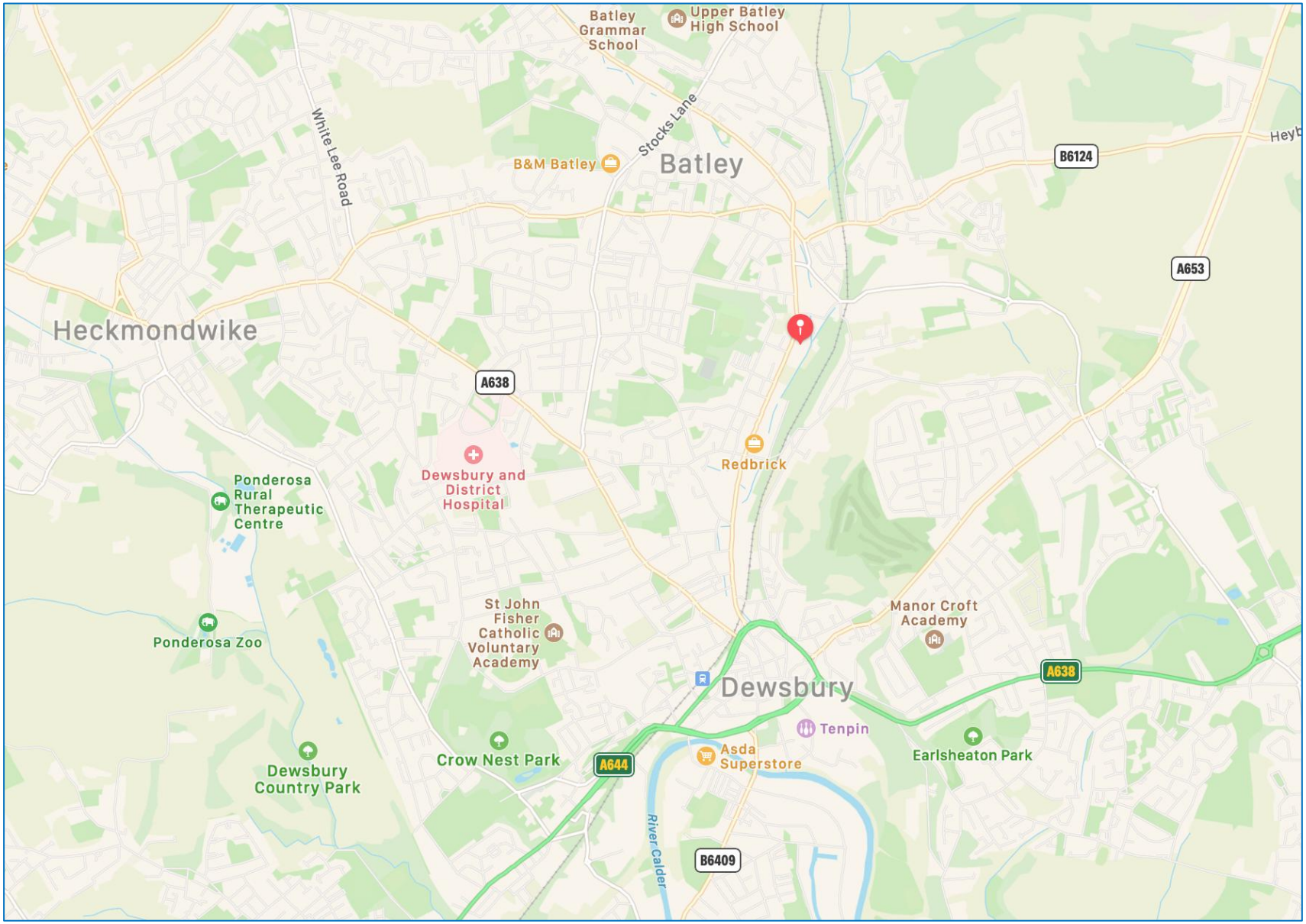
No further mitigation measures required.

Annex A

SITE LOCATION

The Site Location (red flag). An exact meeting point will be determined by the Client should the need arise.





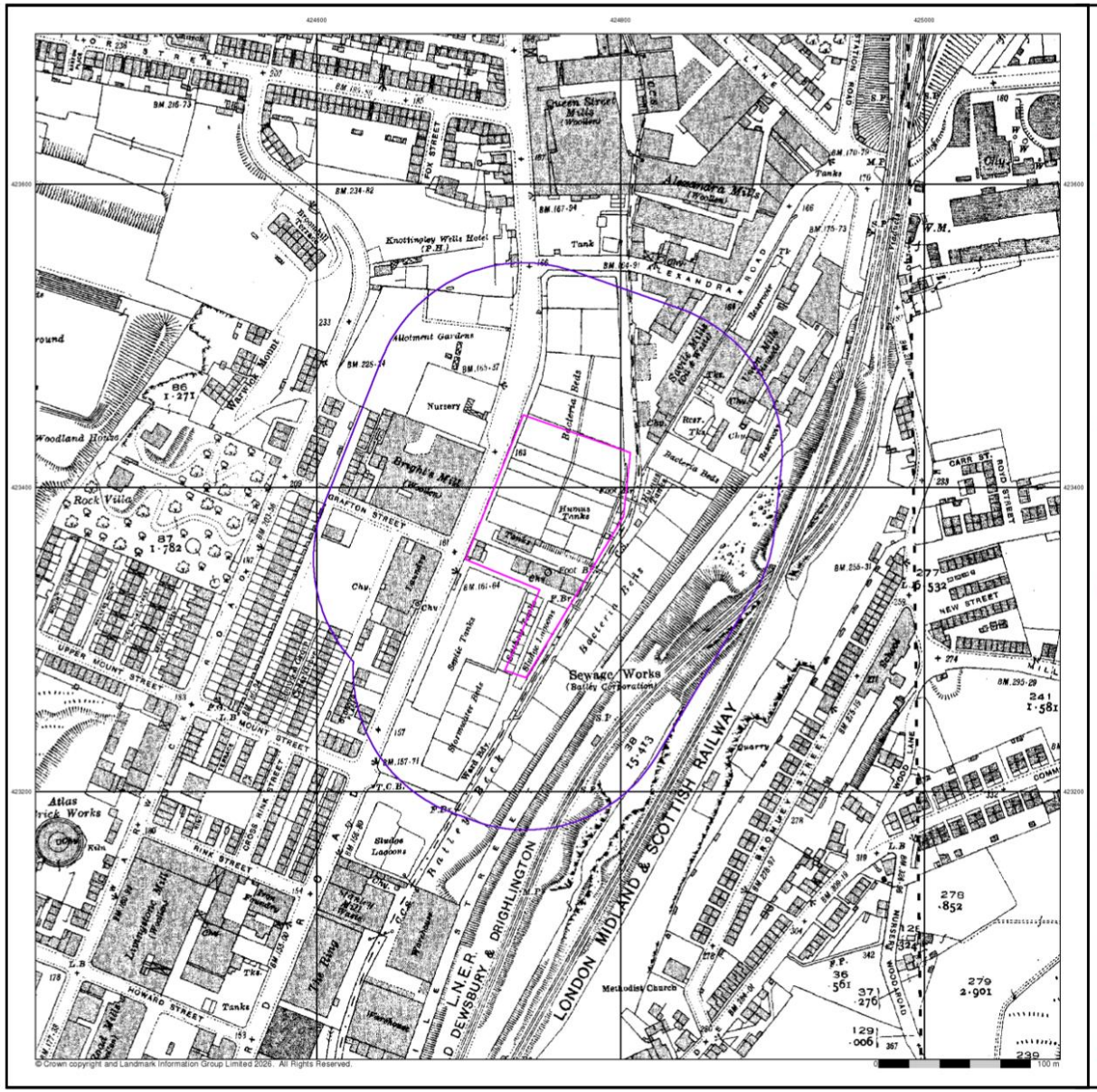
Annex B

HISTORIC MAPS

Historical Map Synopsis 1933 – 2026

Page No.	Date	Scale	Description/Remarks
B-2	1933 - 38	1:2,500	In 1933 - 38, the land along Bradford Road in Batley was occupied by a municipal sewage treatment works serving the town's domestic and industrial wastewater. Batley was a heavily industrialised woollen-mill town at the time, and the facility formed part of the essential public health infrastructure required to manage sewage safely. The site typically comprised primary settlement tanks, where solid waste was allowed to settle out of incoming sewage, and bacteria (percolating) filter beds, where wastewater was filtered through stone or clinker media to allow natural biological processes to break down organic matter. Sludge removed from the tanks was deposited on drying beds or in lagoons, where it was left to drain and dry before disposal or reuse, sometimes as agricultural fertiliser. The works was surrounded by open land and access tracks, creating a buffer between the treatment processes and nearby residential areas due to odour and health considerations.
B-3	1955	1:2,500	Aerial photography from 1949 confirms that the sewage treatment works on Bradford Road, Batley, remained operational in the immediate post-Second World War period, with filter beds and associated infrastructure still visible on the site. During the 1950s, the works appears to have entered a period of decline or redundancy, likely reflecting wider modernisation and consolidation of wastewater treatment facilities in the region. While precise closure dates require confirmation from local authority records, evidence suggests that the site was decommissioned sometime between the early 1950s and early 1960s. By the mid-1960s, the former sewage works had been cleared, and the land was redeveloped. In 1967, the site became home to the Batley Variety Club, marking a significant change from municipal infrastructure use to

Page No.	Date	Scale	Description/Remarks
			commercial entertainment purposes. Overall, the period around 1955 represents a transitional phase in which the site was moving from active public utility use toward eventual redevelopment.
B-5	1977 - 91	1:1,250	By the late 1970s, the former sewage treatment works site on Bradford Road, Batley, had been fully redeveloped for commercial leisure use. Following its decommissioning in the 1950s and subsequent clearance in the early 1960s, the land was transformed into the Batley Variety Club, which opened in 1967. During the 1970s the venue was well established as a major national music and entertainment destination, marking a complete change in character from its earlier municipal infrastructure function. Wastewater treatment serving the area had by this time been consolidated at larger regional facilities elsewhere.
B-5	2025	1:10,000	Following the demolition of the Batley Variety Club, which had occupied the site from 1967, the land was redeveloped to provide modern retail, trade counter, and light industrial units. The site now forms part of the established commercial corridor along Bradford Road and retains an employment-generating function, with no remaining visible evidence of its former sewage treatment or entertainment uses.



EOD Contracts Ltd

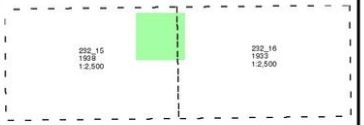
Yorkshire

Published 1933 - 1938

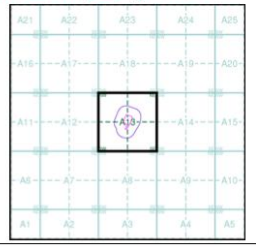
Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

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National Grid Reference:	424750, 423370
Slice:	A
Site Area (Ha):	0.95
Search Buffer (m):	100

Site Details

J d Gym, Bradford Road, Batley, WF17 6JD

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Web: www.envirocheck.co.uk

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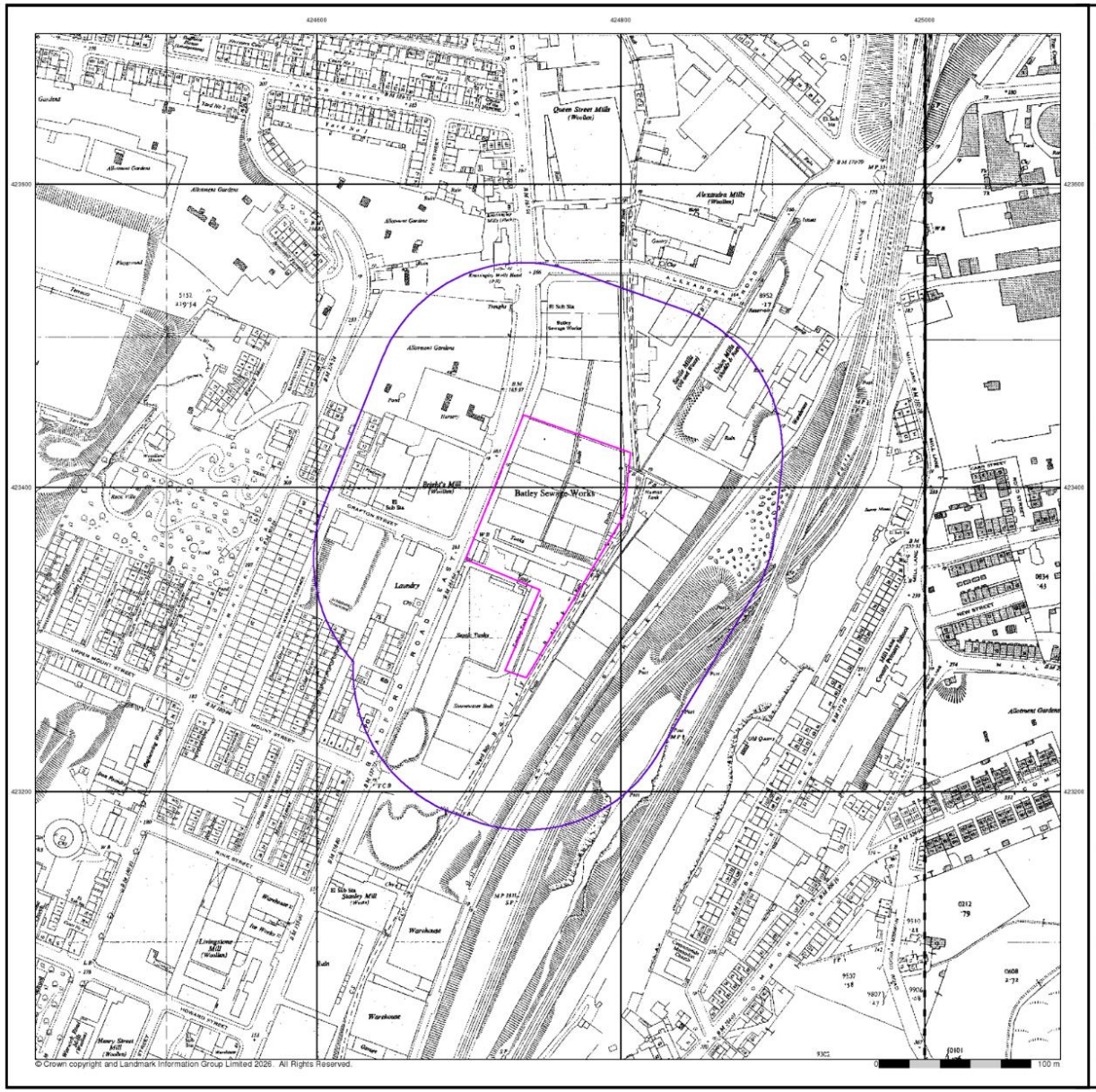

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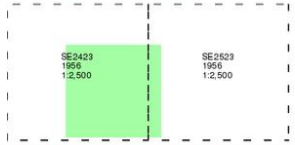
Ordnance Survey Plan

Published 1956

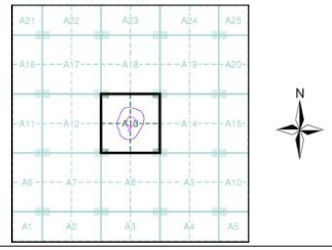
Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A13



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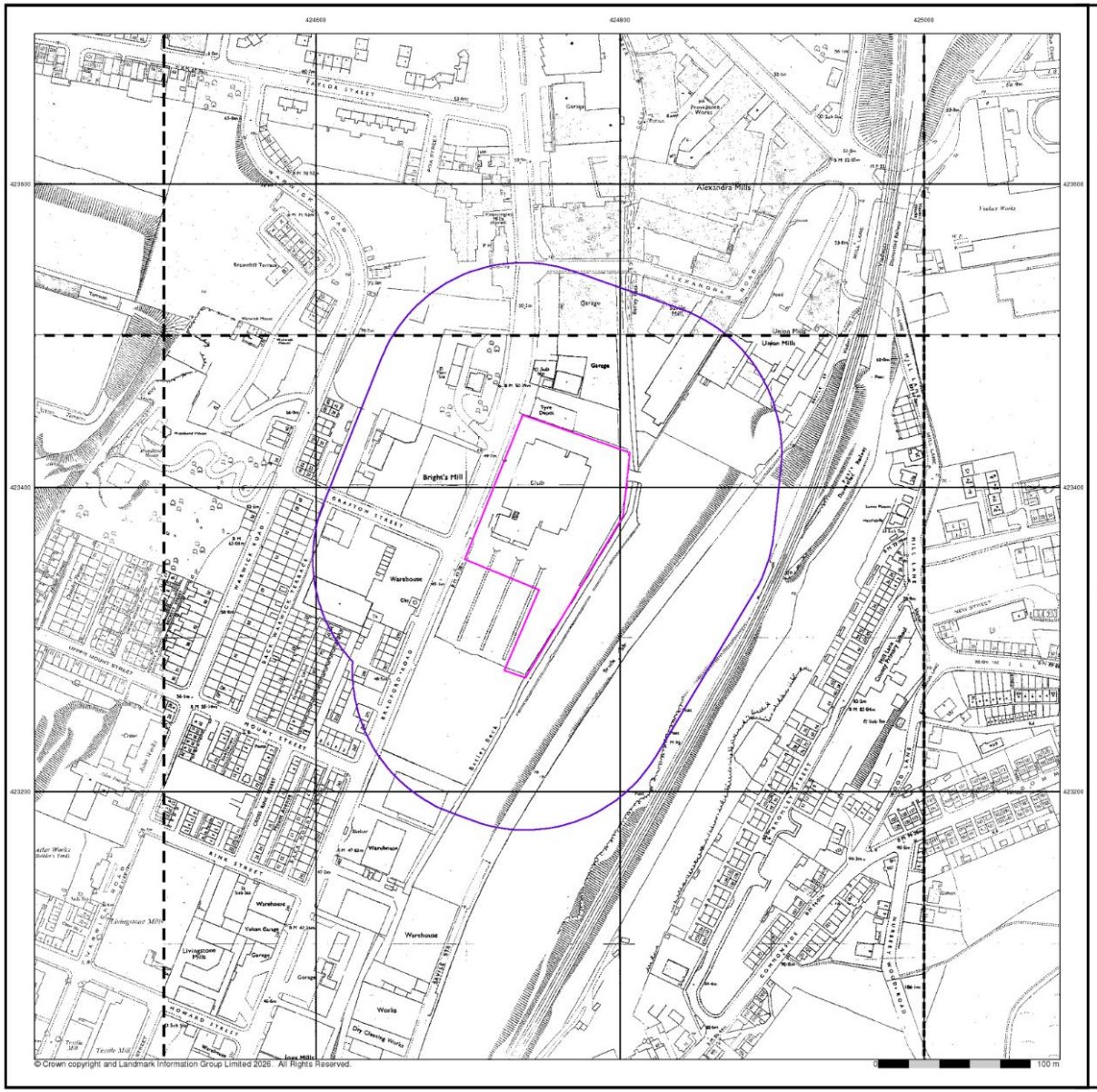

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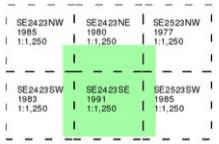
Additional SIMs

Published 1977 - 1991

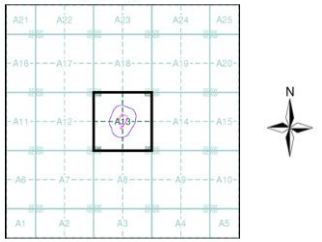
Source map scale - 1:1,250

The SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') are further, minor editions of mapping which were produced and published in between the main editions as an area was updated. They date from 1947 to 1994, and contain detailed information on buildings, roads and land-use. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A13



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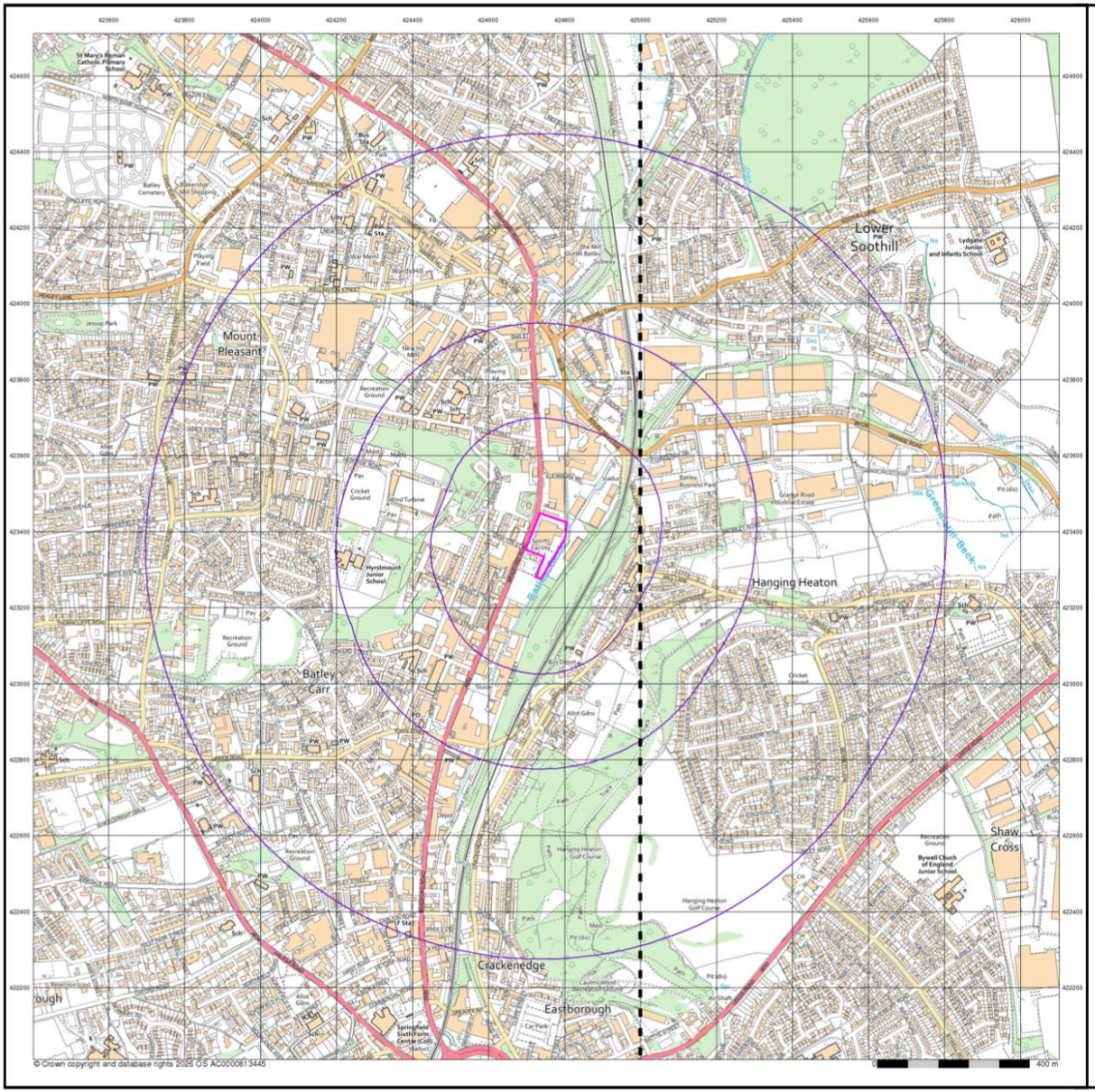

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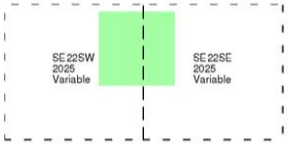
VectorMap Local

Published 2025

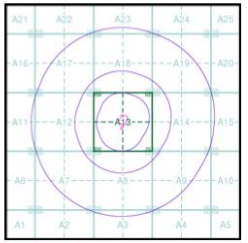
Source map scale - 1:10,000

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

Map Name(s) and Date(s)



Historical Map - Slice A



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Slice:	A
Site Area (Ha):	0.95
Search Buffer (m):	1000

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Annex C

BOMB RAIDS WWI

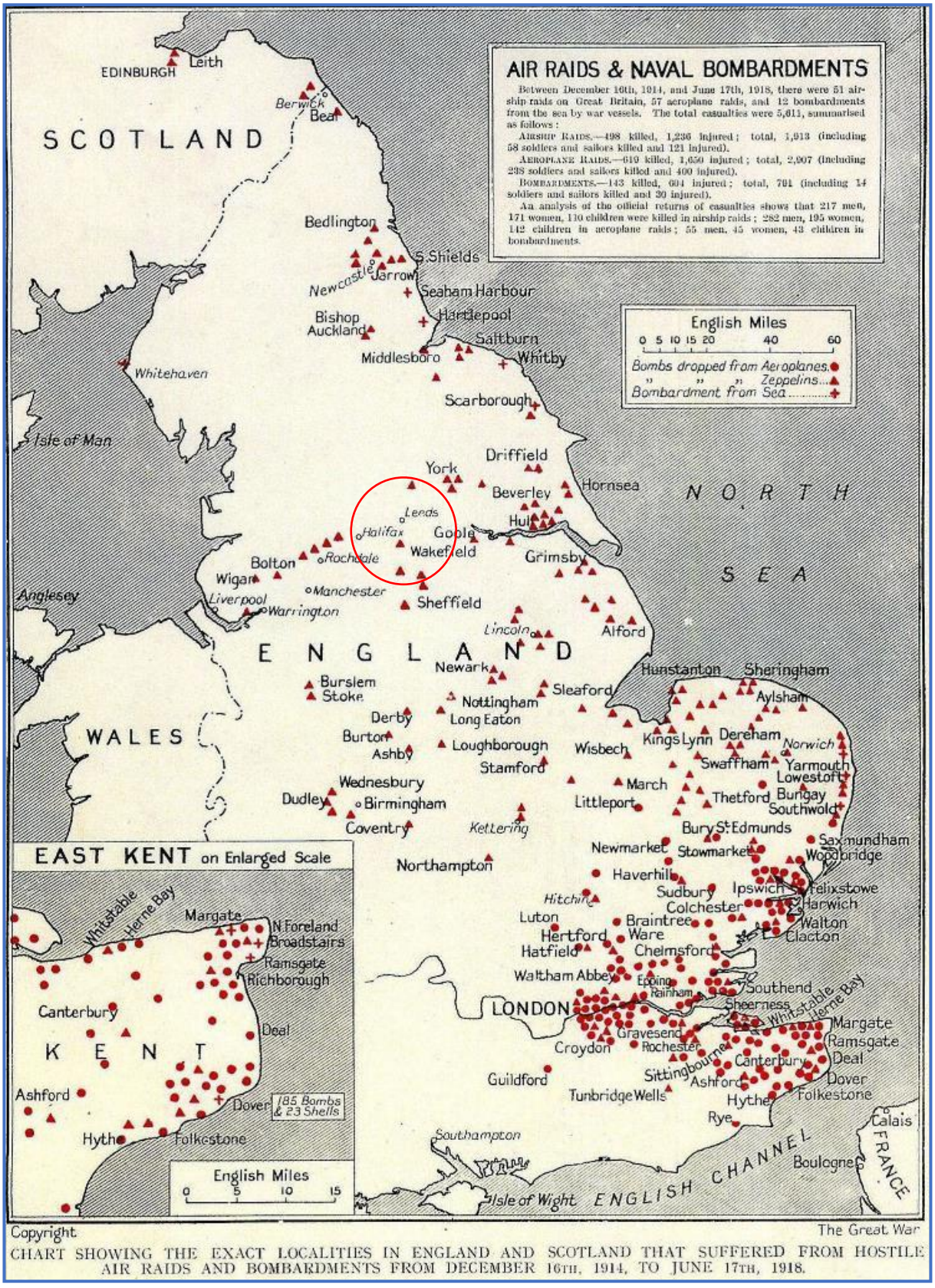


CHART SHOWING THE EXACT LOCALITIES IN ENGLAND AND SCOTLAND THAT SUFFERED FROM HOSTILE AIR RAIDS AND BOMBARDMENTS FROM DECEMBER 16TH, 1914, TO JUNE 17TH, 1918.

Annex D

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.

BOMB PENETRATION DEPTHS

Weapons penetrate a significant depth into the ground and other types of ammunition are designed to permit the weapon time to penetrate deeply into the target before detonating a short time after coming to rest or a considerable number of hours afterwards. The second reason is where the weapon has failed to function as designed becoming a UXB. A number of studies have been carried out into weapon penetration and it is an inevitable consequence of a number of variable factors acting on the bombs trajectory that figures can and do differ significantly. Careful consideration must be given to the weapon's velocity, trajectory and shape. Also surface

conditions and subsurface geology. The largest of the common German bombs, (500kg) can penetrate to significant depths given favourable conditions for penetration. In the case of projectiles and shells, the potential for deep penetration is significantly less.

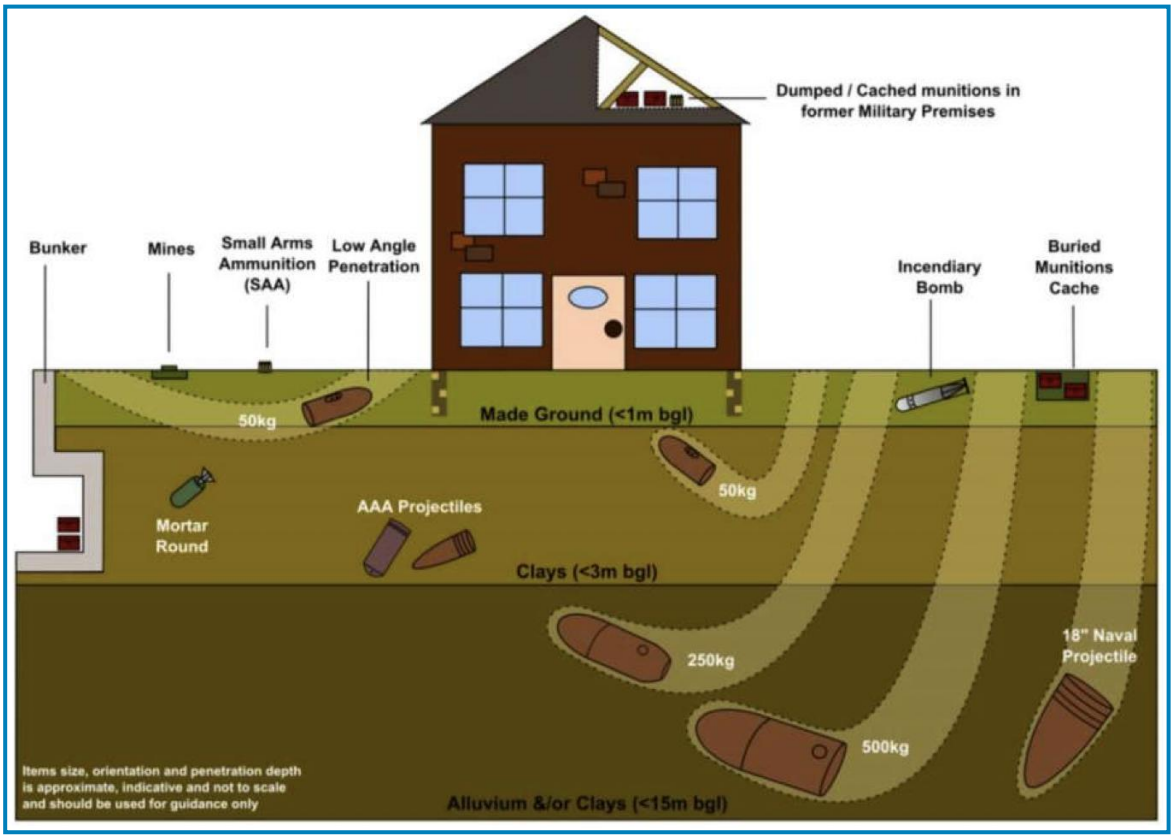
A number of assumptions were used in determining the maximum threat depth within the project footprint, which were.

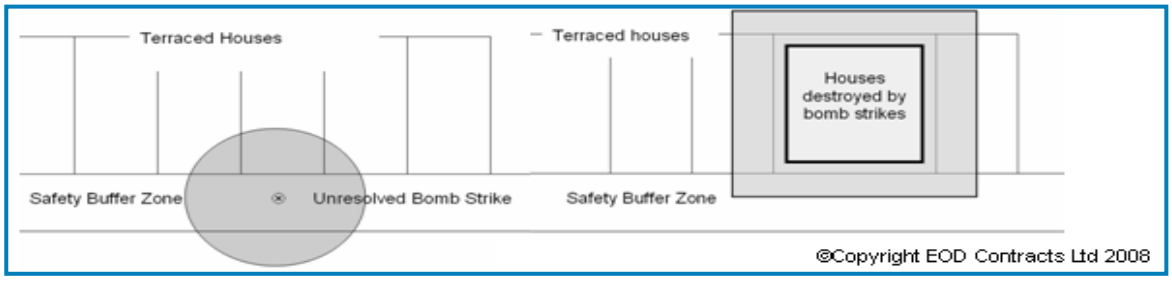
The penetration of sub-surface bombs will be affected by the following:

- Height of release
- Weight, shape and design of bomb
- Aerodynamic qualities
- Angle of flight and impact
- Nature of impact surface
- Nature of sub soil

Bombs on penetration of the surface do not follow a straight-line trajectory they can and do curve; this is called a "J" curve where the bomb's path bends back towards the surface. This gives what is known as the Offset, which may place a bomb under a structure and at a shallow depth.

Figure 1: Sub-Surface Trajectories & Safety Buffers





Note; the common sub-surface trajectory will follow a path best described as a 'J' curve. The curve can result in a weapon coming to rest some distance from its impact point. The distance from impact point to resting place is referred to as the "Off set Distance and is normally considered to be 1/3 of the depth. This mechanism can permit a weapon to strike outside a building and travel below ground finally coming to rest within the building footprint. Where a strike is known to have occurred close to a building or structure such as a dock wall, a danger zone should be considered to exist around the area of the strike of sufficient size to accommodate the likely sub-surface travel distance for the weapon.

Note; the typical offset distance is shown as the shaded area, on rare occasions a near surface deflection of the weapon can occur and the offset distance can be substantially increased up to 5/4 of the penetration depth. This mechanism does however reduce the penetration depth considerably with the net result that while the offset is increased the overall travel distance is for the most part unaffected.

Note; scenario 1 shown top left shows a hypothetical bomb strike outside a structure or building. The strike location has been accurately identified and as a consequence; a potential danger zone (circular shaded area) can be placed around the point of impact. Scenario 2 shown top right; depicts a direct HE bomb or Incendiary strike within a building which totally destroyed the building. In circumstances such as this UXB entry the building rubble may have concealed hole and the weapon may still be present within the building footprint or it may have travelled sub-surface and come to rest outside the footprint. Here the danger zone (square shaded Area) extends outwards on all sides of the original building footprint.

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 several 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.

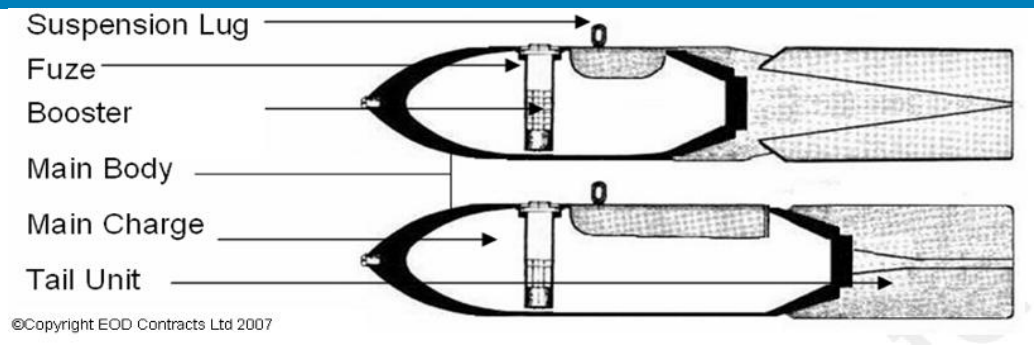
Bombs, which struck previously, hit or burned-out targets and did not function; consequently their impact was unseen and therefore no report was ever made.

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 2 & 3.

Figure 2: 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 3: Generic German Bomb Fuze Design.

Graphic Cross Section through a typical German fuze (ECR)

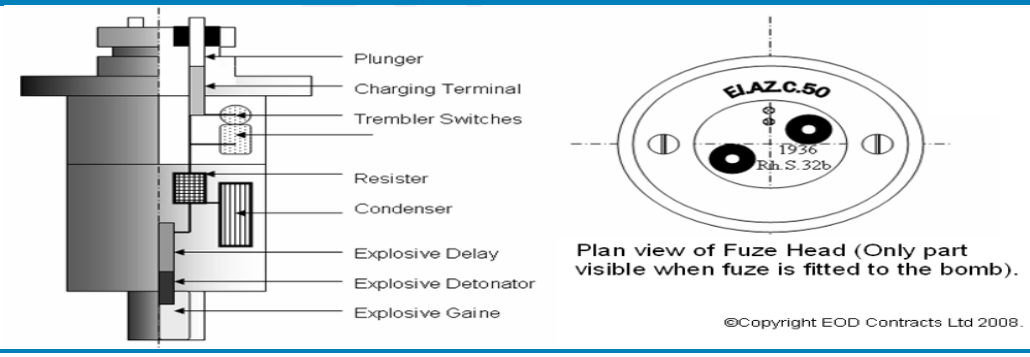


Figure 4: Range of HE bombs dropped on the United Kingdom.

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

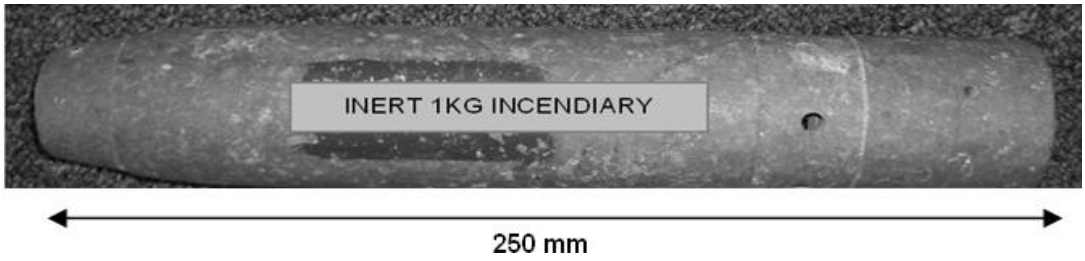
refugees fleeing the Russian advance to the east, the exact civilian death toll from fire and suffocation will never be known, but is considered to be somewhere between 25,000 and 100,000.

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 4 shows the range of steel HE bombs dropped on the UK.

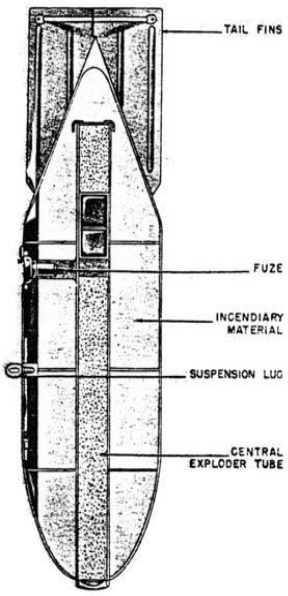
Incendiary Bomb. The larger incendiary bombs, containing bottles of white phosphorus and an incendiary mixture contained within a thin steel case were designed to burst on contact with the ground. A fixed dispenser on the aircraft delivered the smaller type of bomb or 'Bomblet' to the target area in 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 5.

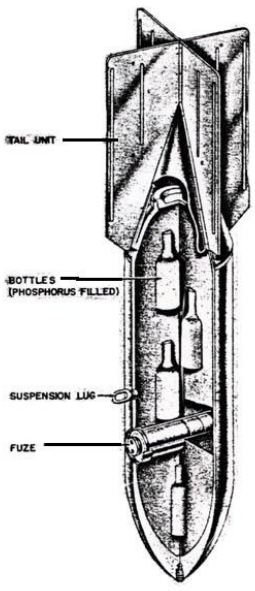
Figure 5: Incendiary Bombs.

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.



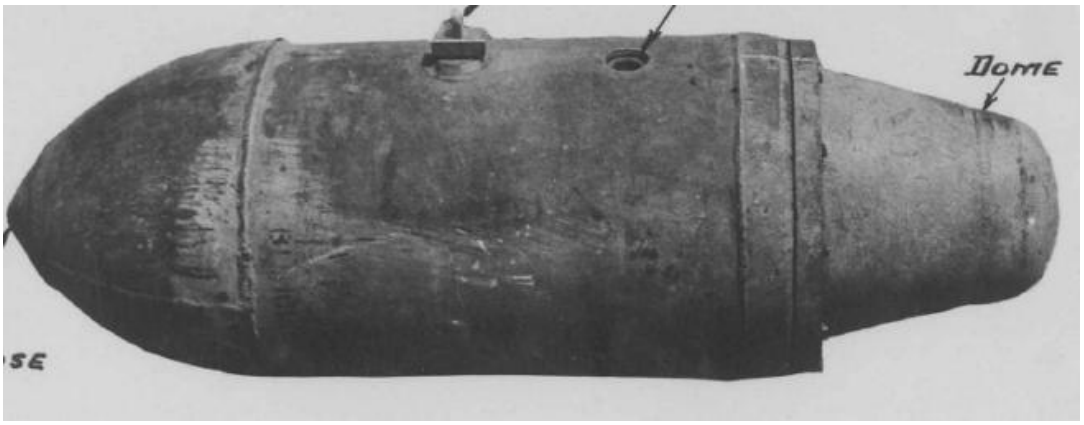


Note; Incendiary bomblets were made of a flammable alloy similar in appearance to aluminium, which resists corrosion well. The tail unit was made of thin tin-plate steel and is more prone to have rusted away. Some Incendiary models were fitted with a High Explosive (HE) steel nose. With the tail and 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 6)

Figure 6: 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.

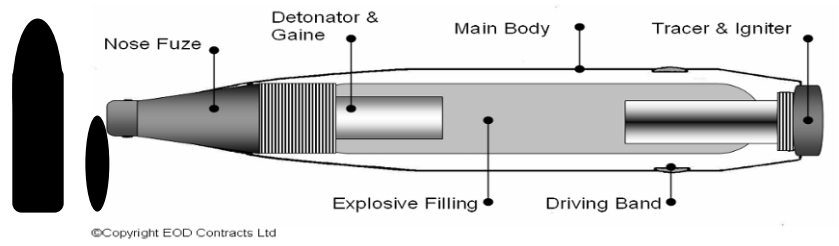
Photoflash Bomb. This type of bomb was dropped by specialist "Pathfinder" aircraft and although this type of bomb can be included with the category of specialist bombs, it is worthy of specific comment due to the danger it may still pose. Photoflash bombs were designed to explode with a blinding flash, 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 7. 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 7: 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 gaine.

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 8).

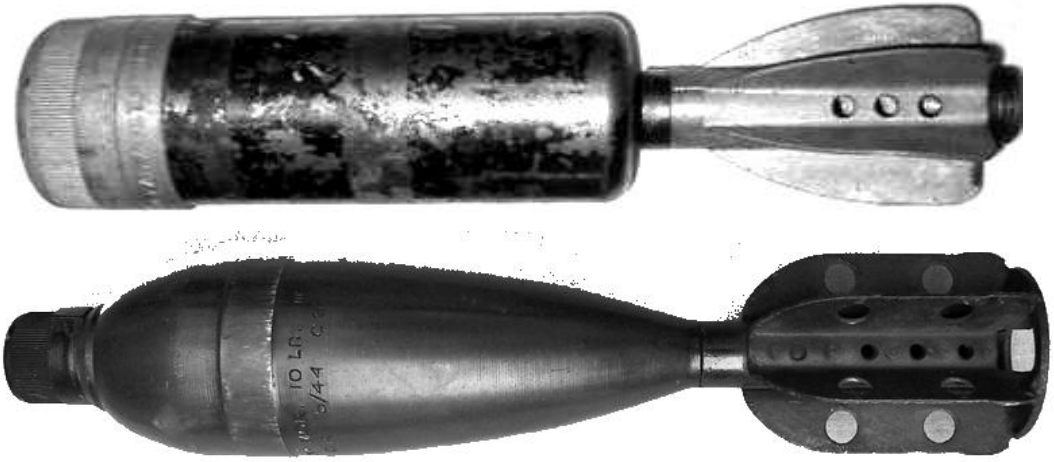
Figure 8: Common Categories of Land Service Ammunition

Land Service Ammunition

Small Arms Ammunition

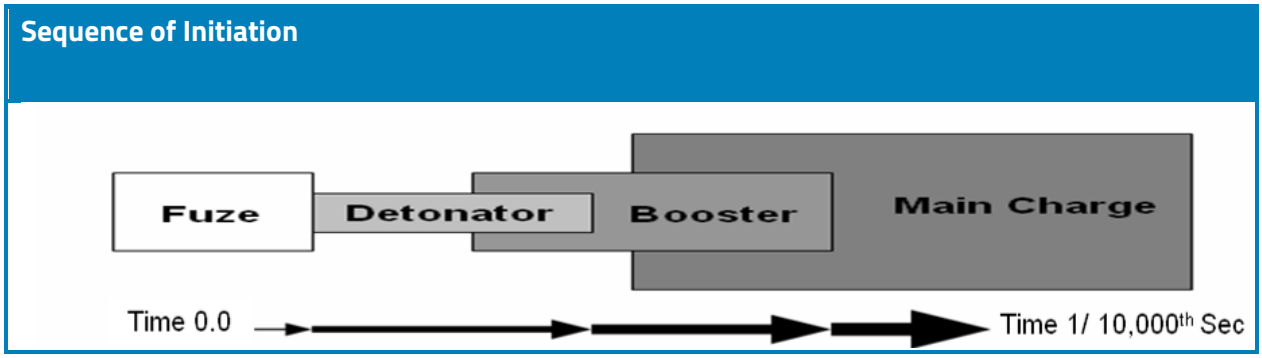
Grenades

Mortar Bombs



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 9).

Figure 9: 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 oxidisation. 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.

Annex E

Source:	Plymouth +
Date:	14th January 2026
Description:	A major emergency response has been launched following the discovery of the ordnance at a construction site on Martin Street in the Millbay area of the city. Officers quickly put a 100m cordon in place, which has since been extended to 400 metres, along with associated road closures. Residents within the cordon have been evacuated. The bomb is believed to be a WW2 SC50, a type of German aerial bomb dating back to the Second World War. It was uncovered during survey work carried out by S.I UXO, a company specialising in site investigation and ordnance risk management. The Devon based specialist firm brought in CPT Percy, their Cone Penetration Testing machine, to survey the area for suspected unexploded ordnance. The testing discovered an anomaly 4.3m beneath the ground, and further target investigation confirmed it to be a wartime bomb. Royal Navy bomb disposal experts have now arrived at the scene and are assessing the device. The bomb is expected to be carefully removed from the site and is likely to be taken out to sea for a controlled detonation.

Source:	Liverpool Echo
Date:	24th October 2024
Description:	Construction workers have described how they discovered two unexploded bombs while digging at a site in Bootle this week. Merseyside Police were called to North Atlantic Avenue, near Dunnings Bridge Road, in Bootle, at around 11.45am today, Thursday, October 24, following the discovery. It followed a report of an unexploded ordnance being found for the second time this week. Police were called to the same area on Tuesday after another device was found, leading to a road block being put in place on Dunnings Bridge Road between Park Lane and Boundary Road, with the junction of Netherton Way.

Source:	Kent Online
Date:	15th November 2023
Description:	**Dig uncovers V2 Nazi rocket in Halstow Marshes, Hoo – 78 years after it was fired at London from German occupied Holland.** Remains of a Nazi V2 rocket fired at Britain during the Second World War have been unearthed in a Kent field. The 12.5-tonne German missile was launched towards London from The Hague in occupied Holland 78 years ago but fell short of its target instead landing in the Halstow Marshes on Medway's Hoo Peninsula. The force also noted: "The Warwickshire Police goalkeeper won't be happy. it was blown up in the six-yard box of the pitch." Researchers have pinpointed the exact date and time of its explosion as February 17, 1945, at 2pm. Hitler used the missiles – the world's first ballistic missiles – as part of his terror weapons programme in an effort to force Britain into surrender. Around 100 of these "Vengeance Weapons" were fired towards Britain each week between 1944 and 1945, in the hopes of causing maximum destruction of the V2's weight, 8.5 tonnes was made up of fuel, three tonnes comprised the missile's body, and one tonne made up the weapon's warhead. The find is the second V2 rocket found in Kent in the past few years, with the team at Research Resource Archaeology previously digging up a missile at St Mary's Platt near Sevenoaks back in 2021.

Source:	BBC
Date:	10th February 2023
Description:	**Army bomb disposal experts have carried out a controlled explosion after World War Two ordnance was found in the River Leam in Leamington Spa.** Warwickshire Police closed part of Willes Road around the Mill Gardens Park during Sunday's operation. A group called the Peaky Dippers, that trawls the river with magnets to hunt for metal, said on social media that it made the find. The roads and the park reopened by 19:00 GMT. A member of the Peaky Dippers group claimed on Facebook: "There wasn't just one bomb found, there [were] numerous WW1 and WW2 guns, grenades and artillery tips..." Warwickshire Police confirmed magnet fishers made the find and said the 18-pound British shell was taken back to its Leek Wootton headquarters for safe disposal. It said the 80-year-old shell "was clearly very well made" and still had the power to "produce one almighty boom and shake the ground after decades under water". The force also noted: "The Warwickshire Police goalkeeper won't be happy... it was blown up in the six-yard box of the pitch."

Source:	BBC
Date:	10th February 2023
Description:	**A World War Two bomb found in Great Yarmouth has detonated while work was being done to defuse it, causing a huge blast that was heard for miles.** Army specialists were attempting to disarm it when there was an unplanned detonation at about 17:00 GMT. People on social media said they heard a loud bang and felt buildings shake 15 miles (24km) away. There have been no reports of injuries among the Army, emergency services or the public, Norfolk Police said. Cordons were put in place when the bomb was first discovered close to two gas pipes on Tuesday, and work began to make it safe. The cordons, at 200m (656ft) and 400m (1,312ft) from the bomb, were lifted on Friday evening. Most roads have been reopened and residents have been allowed to return to their homes.

Source:	BBC
Date:	24 July 2021
Description:	A live World War Two bomb unearthed by builders on a housing development has been destroyed in a controlled explosion. The 500lb (227kg) device was found on the new-build estate in Goole, East Yorkshire, on Thursday. Eight homes were evacuated and the M62 was shut between junctions 35 and 37 as a safety precaution. Humberside Police said the device was successfully detonated at 16:22 BST on Saturday. All residents have been able to return to their homes and local business are no longer being asked to remain closed. The force also said a no-fly zone and the closures of the M62 and other roads nearby had since been lifted. John Sharpe, site manager of the Beal Homes development, said he received a call from workers just after midday on Thursday. "They didn't know what they'd dug up at first and a guy went down into the hole because we thought it was a metal pipe. "As he uncovered it he realised it was a bomb and got out pretty quickly," he said.

Source:	The Sun
Date:	27 February 2021
Description:	A WORLD War II bomb which sparked a mass evacuation in Exeter has been detonated by army experts leaving a crater the "size of a double decker bus." The noise from the huge blast - which sent debris flying more than 250 metres - could be heard five miles away with some residents claiming the aftershock rattled their windows. Personnel from the Army's Royal Logistics Corps took over from Royal Navy bomb disposal experts this morning. They used 400 tonnes of sand to create an enclosing "box" before it was "made safe" at around 6.10pm. He added: "Around 400-tonnes of sand was transported to the site of the device, which is at a building site on private land, and walls were erected... to mitigate the impact of the detonation. "Trenches were also dug to prevent ground shock. Despite these mitigation measures, the impact of the blast has been significant and debris has been thrown at least 250-metres away. "The crater is around the size of a double decker bus.

Source:	UKNIP
Date:	04 May 2020
Description:	Officers from Kent Police are working with Army Bomb Disposal officers after the discovery of two unexploded WW2 bombs were located in Kings Hill, Kent. Police were called just after 4:30pm Monday afternoon to Warwick Way after the discovery of an unexploded ordnance. The Army Bomb disposal service were called in to action to attend the scene to evaluate the discovery and make it safe. Shortly after a second ordnance was found in the adjacent road Gibson Drive. Officers have placed a cordon on the area whist the Army investigate and decide if a controlled explosion is needed.

Source:	The Bolton News
Date:	10 February 2020
Description:	A worker who found an unexploded bomb in a back garden has spoken about the discovery. Aram Mahmoud found the item while putting fence posts in for a house on Bradford Road, and said he recognised the explosive instantly due to growing up in Iraq. Mr Mahmoud said: "We were putting up concrete posts and we were digging and we found a rocket. "We called the police immediately and they came round. The bomb disposal team told Mr Mahmoud that the device was "very very dangerous". Bradford Road was closed between Green Lane and Bishops Road, and Oakleigh Avenue was also shut off with residents evacuated. Both roads have now reopened and the police have left the scene.

Source:	Sky News
Date:	4 February 2020
Description:	London's Soho Evacuated as World War Two Bomb Discovered A large part of central London's busy Soho area was evacuated after an unexploded Second World War bomb was found at a building site. Police were called at 1.42pm on Monday to Dean Street, connecting Oxford Street to Shaftesbury Avenue, which they cordoned off after the device was discovered near the Soho Hotel. A Royal Engineers bomb disposal unit was called in and removed the half-tonne device. The Metropolitan Police's Soho team said the cordons in Oxford Street, Charing Cross Road, Shaftesbury Avenue, Lexington Street and Poland Street had been lifted shortly after 8:30pm.

Source:	Express and Star
Date:	May 17, 2019
Description:	Second World War Bomb Detonated in Bilston. A Second World War bomb was detonated by the army in Bilston last night following a discovery by a workman. The detonation took place on what appeared to be a building site at around 8.30pm. A West Midlands Police spokesman said: "We were called to reports of an unexploded World War 2 bomb at a building site on Coseley Road, Bilston, at 3.40pm. A controlled explosion was carried out."

Annex F

Risk Assessment Tables

Table 1: Summary of Potential Contamination Sources

Source	Applicable	Not Applicable
Enemy Attack & Counter Measures		
Bombing WW1		☒
Manned Aircraft Bombing WW2 (possible)		☒
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		☒
Shipwrecks		☒
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 (Close Proximity)		☒
Bombing Decoy Site		☒
Army Barracks & Camps		☒
MOD Training / Concentration Areas		☒
Home Guard & SOE Weapon Caches		☒

Table 2: 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 3: 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 4: 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 5: Abandoned Bomb Records (UK)

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

Table 6: Bomb Strike Density Assessment

Bombs & Mines	Placed at less than 100per 1000a

Table 7: Opportunity to have detected Bomb or Shell Strikes (UK)

Increasing Potential level
No KNOWN recorded bombs or damage
Good ARP cover
Significant development
No significant ground cover
Light bombing or damage (Surrounding Area)
Moderate ARP cover
Moderate development
Frequent public access
Little ground cover
Significant bombing or damage (Surrounding Area)
Poor ARP cover
Minimal development limited to shallow excavations (within some areas of the Site)
Infrequent public access
Moderate ground cover
Heavy bombing or damage (surrounding area)
No ARP cover
Development limited to site clearance
Controlled private access
Heavy ground cover, vegetation, ploughing or body of water

Table 8: Post Contamination Development Indicators (UK)

	Increasing Potential level
Nature of Post Contamination Development	100% excavations of the entire site to below contamination depth.
	Significant development
	Moderate development
	Minimal development (within some areas of the Site)
	No development

Table 9: Construction Activities Encounter Indicators

	Increasing Potential level
Activities	**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