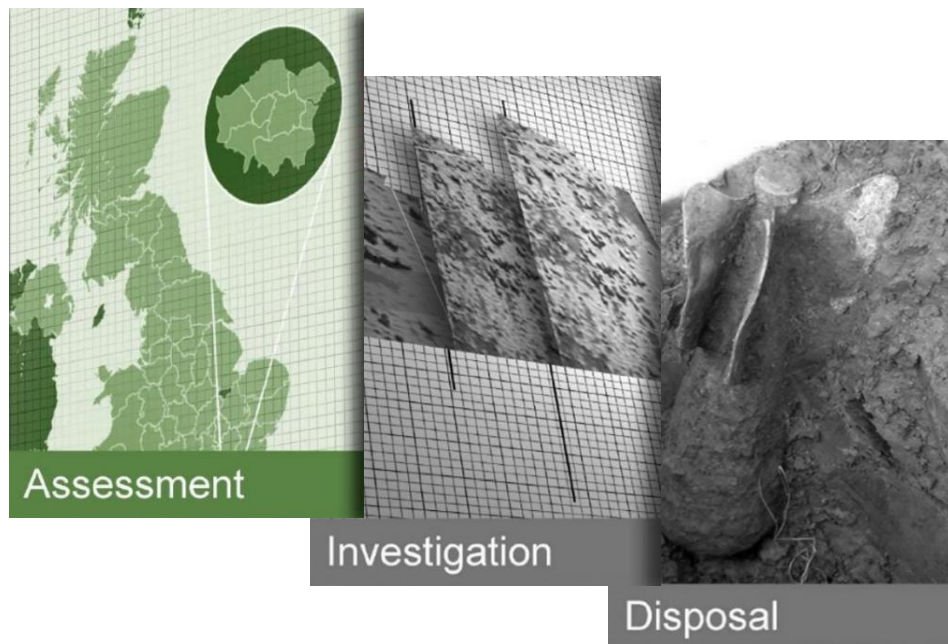




UXO Desk Study & Risk Assessment

Document Ref. P14415-24-R1

Revision A

Project Title Embassy Village, Manchester

Client Vermont Construction Group

Date 9th May 2024

Drafted by Cameron Muncer

Checked by Ellie Chaston

Authorised by Stefan Lang

UXO DESK STUDY & RISK ASSESSMENT

EXECUTIVE SUMMARY

Key findings: No significant sources of Unexploded Ordnance (UXO) hazard have been identified.

Key actions: Proceed with works. An UXO awareness briefing is prudent for staff involved in excavations.

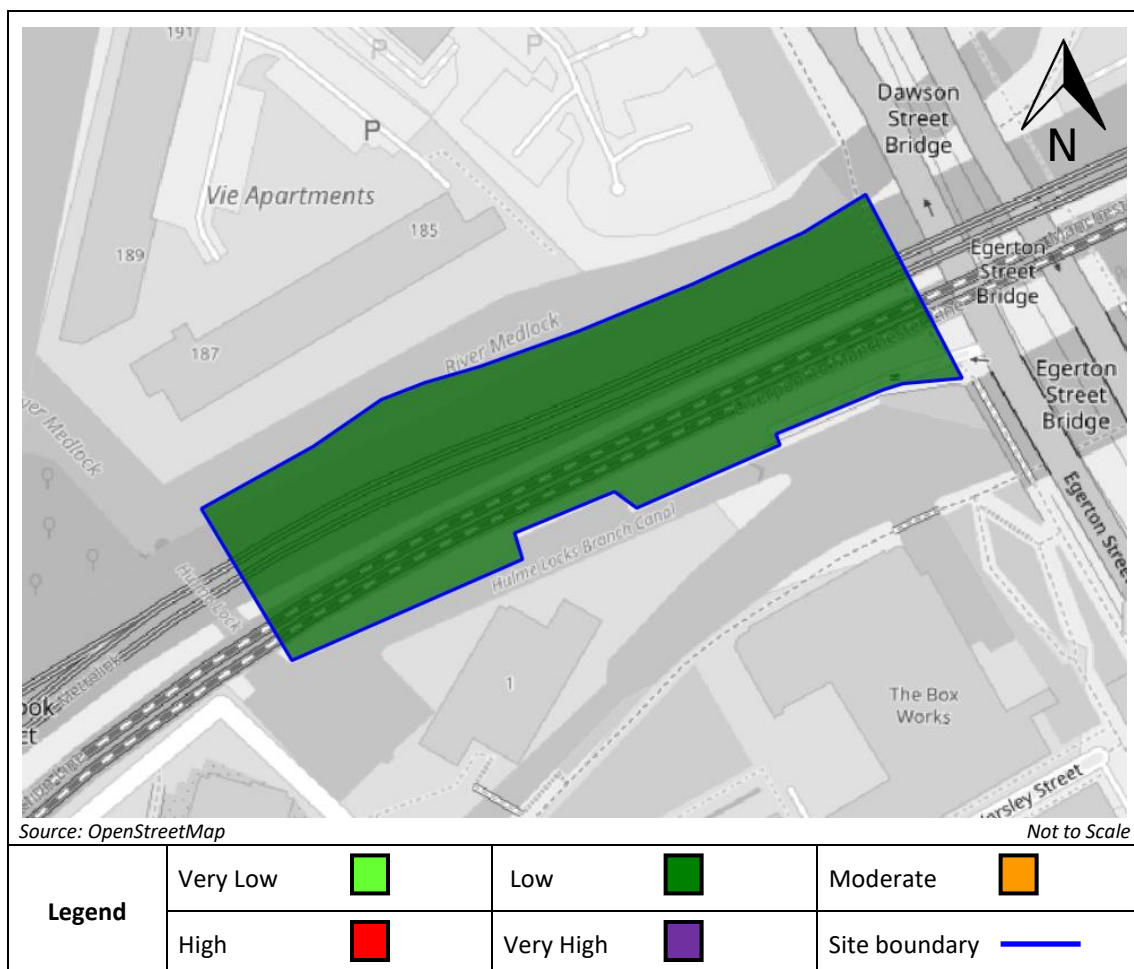
UXO hazard assessment

Records indicate that 1No. High Explosive (HE) bomb fell on the Site during World War Two (WWII) and exploded. No further bombing and no other significant sources of UXO hazard have been identified on the Site.

Given this, it is considered that the Site has a low UXO hazard level, as shown in the following Figure, reproduced as Figure 5 in the main report.

The UXO hazard zone plan of the Site is also given in the accompanying P14415-24-R1-MAP01-A.

UXO hazard zone plan of the Site



The main findings of the report are summarised below.

- No records of military activity on the Site during World War One (WWI) or WWII have been found.

- During WWII the main strategic targets in the vicinity of the Site included Salford Docks and the Manchester Ship Canal, Manchester Central and Victoria railway stations, Manchester Gas Works, mills, and the Broughton Copper works.
- Records have been found indicating 1No. HE bomb fell on the Site during WWII and exploded. No further bombing is recorded on the Site.
- There were 36No. Heavy Anti-Aircraft (HAA) and Rocket AA (ZAA) batteries within 10km of the Site during WWII. The potential for an Unexploded AA (UXAA) shell to have fallen on the Site cannot be discounted.

Proposed works

It is understood that works on the Site are associated with the construction of homes, a village hall, and green spaces for the homeless.

Works on the Site will include demolition of walls, mini piles designed to a depth of 5m below ground level (bgl), with the potential to go up to 8m bgl, and the installation of a pump station and raising main.

Risk assessment

The Table below, reproduced as Table 3 in the main report, provides a UXO risk assessment for the proposed works on the Site.

Further details on the risk assessment methodology are given in Section 7.2 of the main report.

UXO risk assessment for the Site

Potential UXO Hazard	Anticipated Works	PE	PD	P = PE x PD	Likelihood	Severity	Risk Rating	UXO Risk
UXB	Excavations	1	1	1	1	5	5	Low
	Piling	1	1	1	1	4	4	Low
Other UXO	Excavations	1	1	1	1	4	4	Low
	Piling	1	1	1	1	3	3	Low

PE = Probability of Encounter; PD = Probability of Detonation; P = Likelihood

Risk mitigation plan

The Table below, reproduced as Table 4 in the main report, summarises the UXO risk for proposed works on the Site and recommended actions.

Summary of UXO risk and mitigation recommendations

Proposed Works	UXO Risk	Recommended Mitigation
Excavations		Proceed with works – an UXO awareness briefing is prudent for staff involved in excavations.
Piling		Proceed with works

In summary, no additional measures are considered essential to reduce the UXO risk on the Site to As Low As Reasonably Practicable (ALARP). An UXO awareness briefing for staff involved in excavations is always prudent.

What do I do next?

If you have any comments or require further assistance, contact us and we can help.

	01993 886682		<u>uxo@zetica.com</u>		<u>zeticauxo.com</u>
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If you have requirements to identify other buried hazards (such as mapping utilities or obstructions) we can provide these surveys.

If proposed works on the Site change, or additional works are planned, contact Zetica for a re-assessment of the UXO risk and the risk mitigation requirements.

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Accompanying GIS data

P14415-24-R1-MAP01-A (UXO Desk Study)

ABBREVIATIONS

AA	Anti-Aircraft
ALARP	As Low As Reasonably Practicable
AP	Anti-Personnel
ARP	Air Raid Precaution
AXO	Abandoned Explosive Ordnance
BGS	British Geological Survey
CIRIA	Construction Industry Research and Information Association
DCLG	Department of Communities and Local Government
EO	Explosive Ordnance
EOC	Explosive Ordnance Clearance
EOR	Explosive Ordnance Reconnaissance
ERFTS	Elementary and Reserve Flying Training School
ERW	Explosive Remnants of War
ESA	Explosive Substances and Articles
HAA	Heavy Anti-Aircraft
HE	High Explosive
HER	Historic Environment Record
IB	Incendiary Bomb
IWM	Imperial War Museum
LAA	Light Anti-Aircraft
MAP	Ministry of Aircraft Production
MoD	Ministry of Defence
NAC	National Air Communications
NAF	National Aircraft Factory
NARA	National Archives & Records Administration
NCAP	National Collection of Aerial Photography
OB	Oil Bomb
OSNGR	Ordnance Survey National Grid Reference
PM	Parachute Mine
RAF	Royal Air Force
RE	Royal Engineers
UXAA	Unexploded Anti-Aircraft
UXB	Unexploded Bomb
UXO	Unexploded Ordnance
WD	War Department
WO	War Office
WWI	World War One
WWII	World War Two
ZAA	Rocket Anti-Aircraft

UXO DESK STUDY & RISK ASSESSMENT

Please read: Zetica has colour coded each paragraph. Paragraphs with black text on a white background provide site-specific information or information specifically researched as part of this project.

Boxed paragraphs in a dark green text with a green background provide general information and, where appropriate, links to online resources giving further detail. These are all available at www.zeticauxo.com. If you cannot gain access to these resources, Zetica can forward them on request.

1 INTRODUCTION

1.1 Project outline

Zetica Ltd was commissioned by Vermont Construction Group to carry out a detailed Unexploded Ordnance (UXO) Desk Study and Risk Assessment for an area of approximately 0.6 hectares (ha) off Egerton Street in Manchester (the 'Site').

The aim of this report is to gain a fair and representative view of the potential UXO hazard on or affecting the Site in accordance with the Construction Industry Research and Information Association (CIRIA) C681 'Unexploded Ordnance (UXO), a Guide for the Construction Industry'.

Where appropriate, this hazard assessment includes:

- Likelihood of ordnance being present.
- Type of ordnance (size, filling, fuze mechanisms).
- Quantity of ordnance.
- Potential for live ordnance.
- Probable location.
- Ordnance condition.

It should be noted that some military activity providing a source of UXO hazard may not be recorded and therefore there cannot be any guarantee that all UXO hazards affecting the Site have been identified in this report.

1.2 Sources of information

Zetica Ltd researched the World War One (WWI)/World War Two (WWII) bombing and military history of the Site and its surrounding area using a range of information sources. The main sources of information are detailed in the following sections and referenced at the end of this report.

1.2.1 Zetica Ltd records

Zetica Ltd's in-house records were consulted, including the Zetica Ltd bomb risk maps (<https://zeticauxo.com/guidance/risk-maps/>), previous requests for information from government bodies, reference books, and archive materials from past work in the region.

Relevant documents have been cited in the bibliography of this report.

1.2.2 Historical records, maps, and drawings

Numerous reference documents including historical maps, aerial photographs and drawings have been consulted from sources such as the National Archives, the US National Archives & Records Administration (NARA), the Imperial War Museum (IWM), Historic England, National Collection of Aerial Photography (NCAP), the Defence of Britain Project, and relevant archaeological bodies.

The British Geological Survey (BGS) was consulted for borehole information.

1.2.3 Local records

Manchester City Council, Salford City Council, Greater Manchester County Record Office, Salford Local History Library, Lancashire Record Office, local historical groups, and the Greater Manchester Historic Environment Record (HER) were consulted for records.

1.3 Data confidence level

In general, there is a high level of confidence in the researched information sources used for this report. Further detail is given in the text of the report where appropriate.

Definitions of data confidence level		
Data Confidence Level		Definition
	Low	There are very few sources of information, and/or those available are lacking in detail.
	Moderate	There is a limited range of available sources of information, a key source of information is missing, and/or some sources may be contradictory or lacking in detail.
✓	High	There is a wide range of available sources of information, which are detailed and corroborate each other.

2 THE SITE

2.1 Site location

The Site is centred on Ordnance Survey National Grid Reference (OSNGR) SJ 827974. It is located approximately 1.4km west-southwest of central Manchester.

The Site comprises 1No. railway bridge and hardstanding. It is bounded to the north by the River Medlock and commercial buildings, to the east by Egerton Street and Egerton Street Bridge, to the south by Hulme Lock Branch Canal and commercial buildings, and to the west by the Liverpool to Manchester railway line and the River Irwell.

Figure 1 is a Site location map and Plate 1 is a recent aerial photograph of the Site.

Figure 1 Site location map

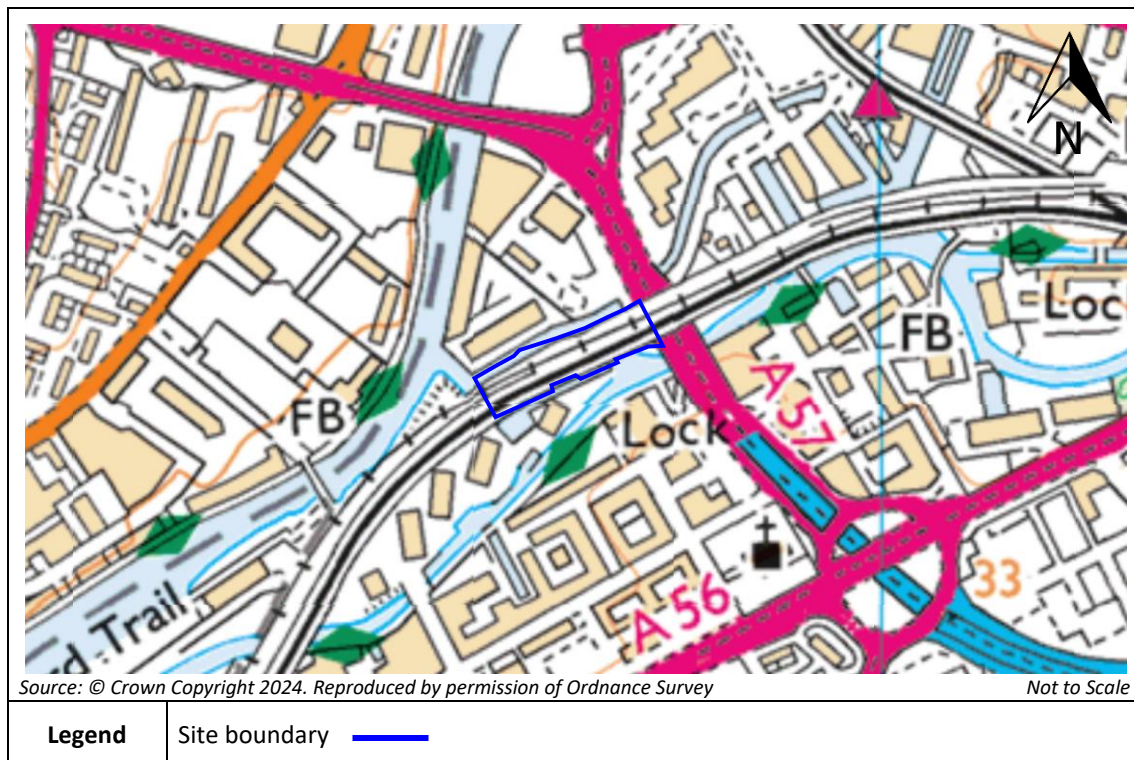
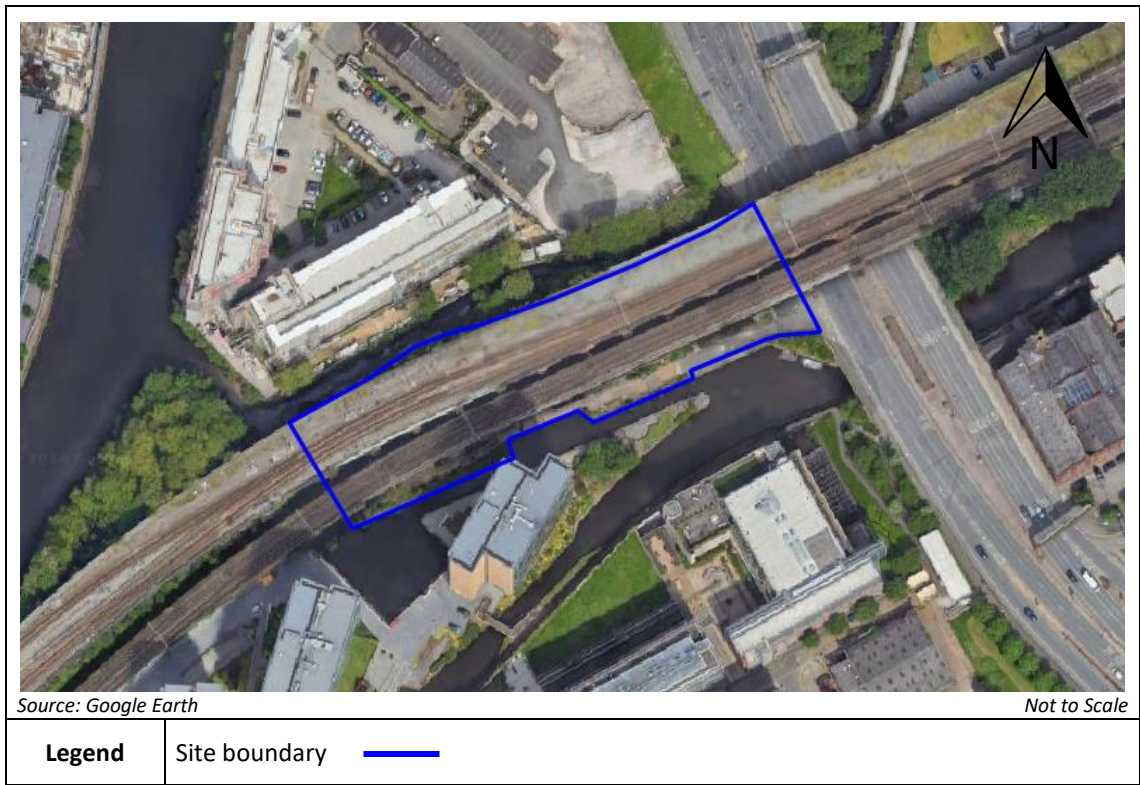


Plate 1 Recent aerial photograph of the Site



3 MILITARY ACTIVITY

The following sections outline the recorded military activity in the vicinity of the Site. The potential UXO hazard from WWI and WWII bombing is detailed in Section 4.

3.1 Defences

For further information on military defences, and the potential UXO hazards associated with them, follow the links below:

- [Anti-Aircraft Guns](#)
- [Anti-Invasion Defences](#)
- [Barrage Balloons](#)
- [Bombing Decoys](#)
- [Home Guard](#)
- [Mined Locations](#)
- [Mortar & Gun Emplacements](#)
- [Pillboxes](#)

No military defences have been identified on the Site. The nearest are described below.

3.1.1 Anti-Aircraft (AA) guns

During WWI there were 10No. AA batteries recorded within 10km of the Site. The nearest was located at Pendleton (SJ 812991), approximately 2.2km northwest of the Site. It was armed with 1No. 18-pounder (pdr) gun.

During WWII there were 36No. Heavy AA (HAA) batteries recorded within 10km of the Site. The nearest was located at Lower Broughton (SJ 821993), approximately 1.9km north-northwest of the Site. Its armament is unknown.

The nearest recorded WWII AA shell incident to the Site is described below.

4th June 1941

1No. AA shell fell on the Wholesale Meat Market, Water Street, approximately 0.1km north of the Site.

Potential UXO hazard

Given the number of AA gun batteries in the surrounding area, the potential for an Unexploded AA (UXAA) shell to have fallen on the Site unnoticed, whilst unlikely, cannot be totally discounted.

3.2 Military airfields

For further information on military airfields, and the potential UXO hazards associated with them, follow the link below:

- [Military Airfields](#)

No records of any military airfields on or in close proximity to the Site have been found.

During WWI, the nearest operational airfield was Alexandra Park Aerodrome, approximately 4km south of the Site.

Alexandra Park Aerodrome opened in May 1918 by the War Department (WD) for assembly, test flying, and delivery of aircraft for the Royal Air Force (RAF), built in the Manchester area by A.V. Roe (Avro) at Newton Heath, approximately 3.6km northeast of the Site, and the National Aircraft Factory (NAF) No. 2 at Heaton Chapel, approximately 6.7km southeast of the Site.

At the end of WWI, Alexandra Park Aerodrome became a civilian airfield before closing in 1924. It has since been redeveloped into a housing estate and playing fields.

During WWII, the nearest operational airfield was RAF Barton, approximately 8km west of the Site.

Barton Airfield opened on the 1st June 1930 as a civilian airfield. In the mid-1930s, Barton Airfield was used for testing Fairey Battle light bomber aircraft that were built at Heaton Chapel. From 1937 No. 17 Elementary and Reserve Flying Training School (ERFTS) was stationed at Barton Airfield flying Tiger Moth training aircraft.

At the outbreak of WWII, Barton Airfield was requisitioned by National Air Communications (NAC) and continued to operate civilian flights. It was then taken over by the Ministry of Aircraft Production (MAP) and was established to repair Avro Anson training aircraft, Fairey Fulmer and Vought F4U Corsair carrier fighter aircraft.

After WWII, the RAF operated 2No. training units out of Barton Airfield until October 1948. Barton Airfield is still open today used by the Lancashire Aero Club and a variety of private clubs and owners.

Military airfields are not considered to provide a source of UXO hazard to the Site.

3.3 Aircraft crashes

For further information on military aircraft crashes, and the potential UXO hazards associated with them, follow the link below:

- [Aircraft Crashes](#)

No records of any aircraft crashes on or in close proximity to the Site have been found.

3.4 Explosives factories, munitions depots, and disposal areas

For further information on explosives factories, munitions depots and disposal areas, and the potential UXO hazards associated with them, follow the links below:

- [Explosives Factories](#)
- [Munitions Depots](#)
- [Munitions Disposal Areas](#)

No records of any explosives factories, munitions depots or munitions disposal areas on or in close proximity to the Site have been found.

3.5 Firing ranges and military training areas

For further information on firing ranges and military training areas, and the potential UXO hazards associated with them, follow the links below:

- [Artillery Ranges](#)
- [Bombing Ranges](#)
- [Military Training Areas](#)
- [Small Arms Ranges](#)

No records of any firing ranges or military training areas on or in close proximity to the Site have been found.

3.6 Other military establishments

No other military establishments have been identified on the Site. The nearest are detailed below.

3.6.1 Hulme Cavalry Barracks

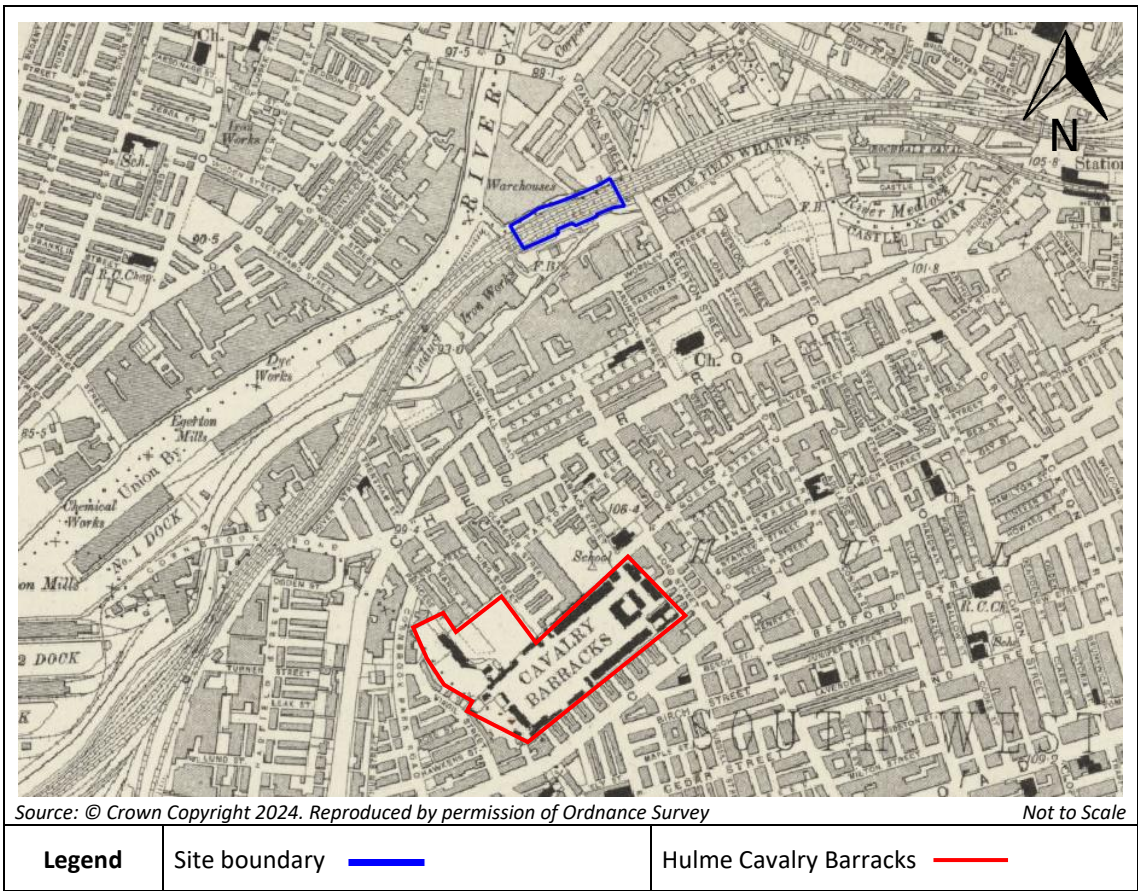
In 1804, the Hulme Cavalry Barracks was established approximately 0.5km south of the Site, as part of the re-organisation and restructuring of the British Army to establish purpose-built cavalry barracks in strategic towns and cities across the country.

Hulme Cavalry Barracks housed the 15th The King's Hussars until 1895. The barracks could house up to 399No. soldiers and 20No. officers.

From 1895 to 1914, it was used to house infantry battalions before its sale to the Manchester Corporation.

Figure 2 is a historical map dating from 1913, showing Hulme Cavalry Barracks.

Figure 2 Historical map showing the Hulme Cavalry Barracks, 1913



After Hulme Cavalry Barracks closed, many of the buildings were demolished and the area is now occupied by playing fields and residential buildings.

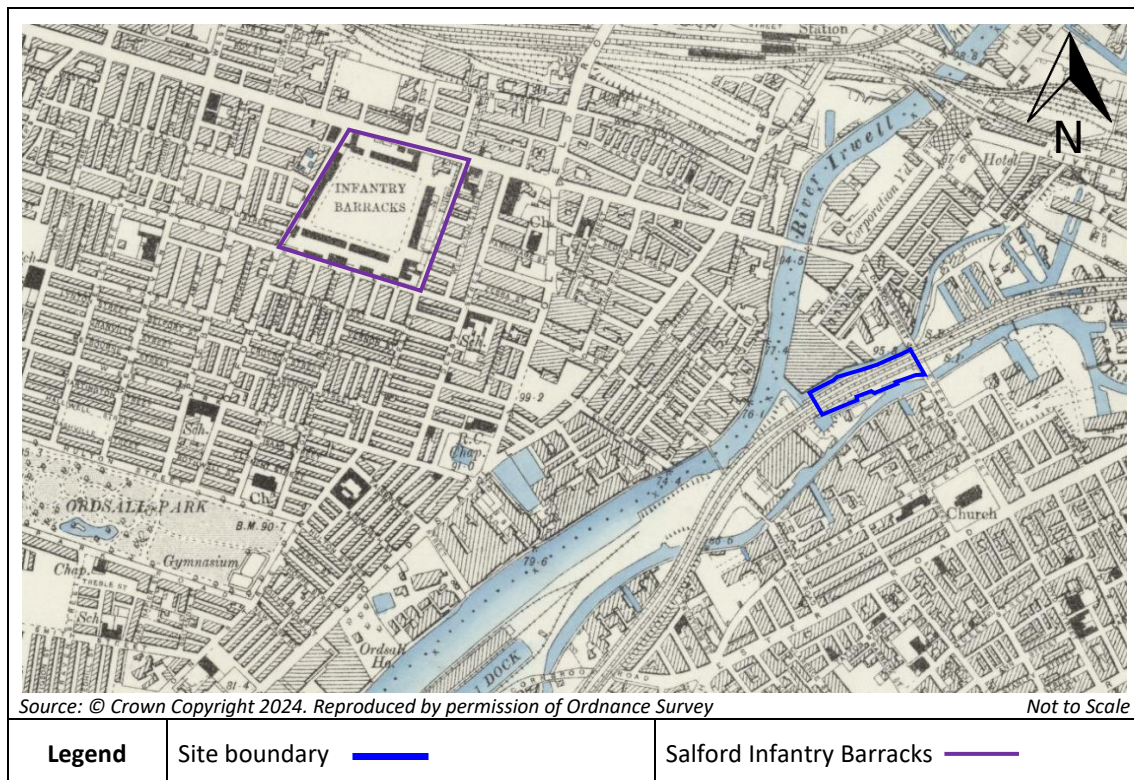
Hulme Cavalry Barracks is not considered to provide a source of UXO hazard to the Site.

3.6.2 Salford Infantry Barracks

In 1819, the Salford Infantry Barracks was established approximately 0.7km west-northwest of the Site.

Throughout the 19th century, the Salford Infantry Barracks accommodated the Regiment of Foot and other infantry regiments.

Figure 3 is a historical map dating from 1896, showing the Salford Infantry Barracks.

Figure 3 Historical map showing the Salford Infantry Barracks, 1896

On the 30th April 1896, the Salford Infantry Barracks were vacated and the garrison moved to Hulme Cavalry Barracks (see Section 3.6.1). In 1900, the barracks buildings were sold, and by 1904 the land had been redeveloped into a housing estate.

Salford Infantry Barracks is not considered to provide a source of UXO hazard to the Site.

4 BOMBING

4.1 WWI bombing

For further information on WWI bombing in the UK, and the potential UXO hazard associated with it, see Appendix 2.1 or use the following link.

- [WWI Bombing](#)

No records have been found indicating that the Site was bombed during WWI.

4.2 WWII bombing

For further information on WWII bombing in the UK, and the potential UXO hazard associated with it, see Appendix 2.2 or use the following link.

- [WWII Bombing](#)

Records have been found indicating that the Site was bombed during WWII. Further details on bombing in the vicinity of the Site are given in the following sections.

4.2.1 Bombing in Manchester

Manchester's industrial conurbations and port made it a principal target for enemy bombers. Despite being protected by anti-invasion defence structures, including barrage balloons and a smokescreen, the city was hit by significant numbers of High Explosive (HE) bombs and Incendiary Bombs (IBs) during WWII.

Air raids began in August 1940 and continued until 1942. The heaviest raids on the city occurred between the 22nd and 24th December 1940, the 'Manchester Blitz', during which over 276No. HE bombs and 10,000No. IBs were dropped across the area.

During WWII, the Manchester region was raided on at least 314No. occasions with approximately 1,710No. HE bombs and 115No. Parachute Mines (PMs) falling. Bombing was mostly concentrated on Manchester city centre, approximately 1.4km east-northeast of the Site, and Salford Docks, approximately 1.5km west-southwest of the Site. The concentration of major industrial works at Trafford Park, approximately 3.2km west of the Site, also attracted heavy raids.

4.2.2 Strategic targets

From prior to the declaration of war in 1939, Britain was subjected to reconnaissance flights by the Luftwaffe which was building up a photographic record of potential targets.

The Site was located in an area which contained numerous strategic targets, including the Salford Docks and the Manchester Ship Canal, Manchester Central and Victoria railway stations, Manchester Gas Works, mills, and the Broughton Copper works.

Plate 2 is a Luftwaffe target photograph of Manchester, dated the 4th October 1939. This shows Manchester Central Station (Target B), approximately 0.8km east of the Site, Manchester Victoria Station (Target A), approximately 1.8km northeast of the Site, and the Broughton Copper Works (GB 717), approximately 1.7km north of the Site.

Plate 2 Luftwaffe target photograph of Manchester, 4th October 1939

Source: NARA

Not to Scale

Legend

Site boundary

**4.2.3 Bombing densities and incidents**

Table 1 gives details of the overall bombing statistics recorded for the Local Authority Districts of the Site (highlighted by bold text) and surrounding districts. These were categorised as Rural Districts (RD), Urban Districts (UD), Municipal Boroughs (MB), Metropolitan Boroughs (MetB), and County Boroughs (CB). WWII bomb density levels are defined below:

<5 bombs per 405ha is a Very Low regional bombing density.

5-15 bombs per 405ha is Low.

15-50 bombs per 405ha is Moderate.

50-250 bombs per 405ha is High.

>250 bombs per 405ha is Very High.

Official UK bombing statistics have been compiled from both British and German sources. There were differences in the way the figures were originally reported and collated which has led to discrepancies in the summary data.

Note that Table 1 excludes the figures for IBs. Discrepancies between the below list and other records, such as bomb clearance records, demonstrate that this data is likely to under-represent actual bombing.

Table 1 Bombing statistics

Area	Bombs Recorded				Bombs per 405ha (1000 acres)
	High Explosive	Parachute Mines	Other	Total	
Manchester MB	712	18	7	737	27.0
Stretford MB	456	64	0	520	147.3
Salford CB	406	29	16	451	86.7
Sale MB	34	0	0	34	9.4
Failsworth UD	2	2	0	4	3.7

It should be noted that during WWII, many Unexploded Bombs (UXBs) were mapped and subsequently removed as and when conditions and demands on Bomb Disposal teams allowed. Their removal was not always accurately recorded and sometimes records were later destroyed. In practice, most UXBs were probably removed and only a much smaller number were actually registered as officially abandoned bombs.

Details of the nearest recorded bombing incidents to the Site are given in the following section. Appendix 5 provides further recorded bombing incidents in the vicinity of the Site.

7th October 1940

1No. HE bomb fell on the Wholesale Meat Market, Track Street, approximately 0.2km north-northeast of the Site.

29th October 1940

1No. HE bomb fell on Dawson Street, approximately 0.1km north-northwest of the Site.

22nd – 24th December 1940

The Manchester region was heavily bombed between the 22nd and 24th December 1940 (the 'Manchester Blitz'). Over 400No. HE bombs and more than 30,000No. IBs fell across the region.

1No. HE bomb fell on Chester Lines Railway line near Egerton Street, on the Site.

1No. HE bomb fell on a warehouse off the River Irwell, approximately 20m north-northwest of the Site.

1No. IB fell on a warehouse off Water Street, approximately 40m north-northwest of the Site.

1No. HE bomb fell on the Wholesale Meat Market, Track Street, approximately 0.1km north of the Site.

1No. HE bomb fell on buildings off Mill Street, approximately 0.1km west of the Site.

2No. HE bomb fell on Ellesmere Street Electrical Works, approximately 0.2km south-southeast of the Site.

1No. HE bomb fell on Cawdor Street, approximately 0.2km south of the Site.

1No. HE bomb fell on Water Street, approximately 0.2km north-northwest of the Site.

1No. HE bomb fell on Calder Street, approximately 0.2km north-northwest of the Site.

1No. HE bomb fell on St George's School, Ellesmere Street, approximately 0.2km south-southeast of the Site.

11th March 1941

1No. HE bomb fell on Bigland Street, approximately 0.2km northwest of the Site.

1No. HE bomb fell on houses between Cawdor Street and Church Street, approximately 0.2km south of the Site.

1No. HE bomb fell on the junction between Bigland Street and South Hall Street, approximately 0.2km west-northwest of the Site.

12th March 1941

1No. HE bomb fell on Cheshire Lines Railway line, near St George's Fishing Works, approximately 0.2km southwest of the Site.

2nd June 1941

Several IBs fell on Water Street, approximately 0.1km north-northwest of the Site.

1No. HE bomb fell between 15 and 29 Water Street, approximately 0.1km north-northwest of the Site.

Figure 4 is a map showing the approximate location of recorded bomb impacts in the immediate vicinity of the Site. IBs shown are indicative of larger numbers of similar devices that fell within the given area.

The map has been compiled from different sources, including air raid incident reports, historical aerial photographs, and bomb census maps.

The bomb map is also given in the accompanying P14415-24-R1-MAP01-A.

Figure 4 Compiled bomb impact map for the vicinity of the Site

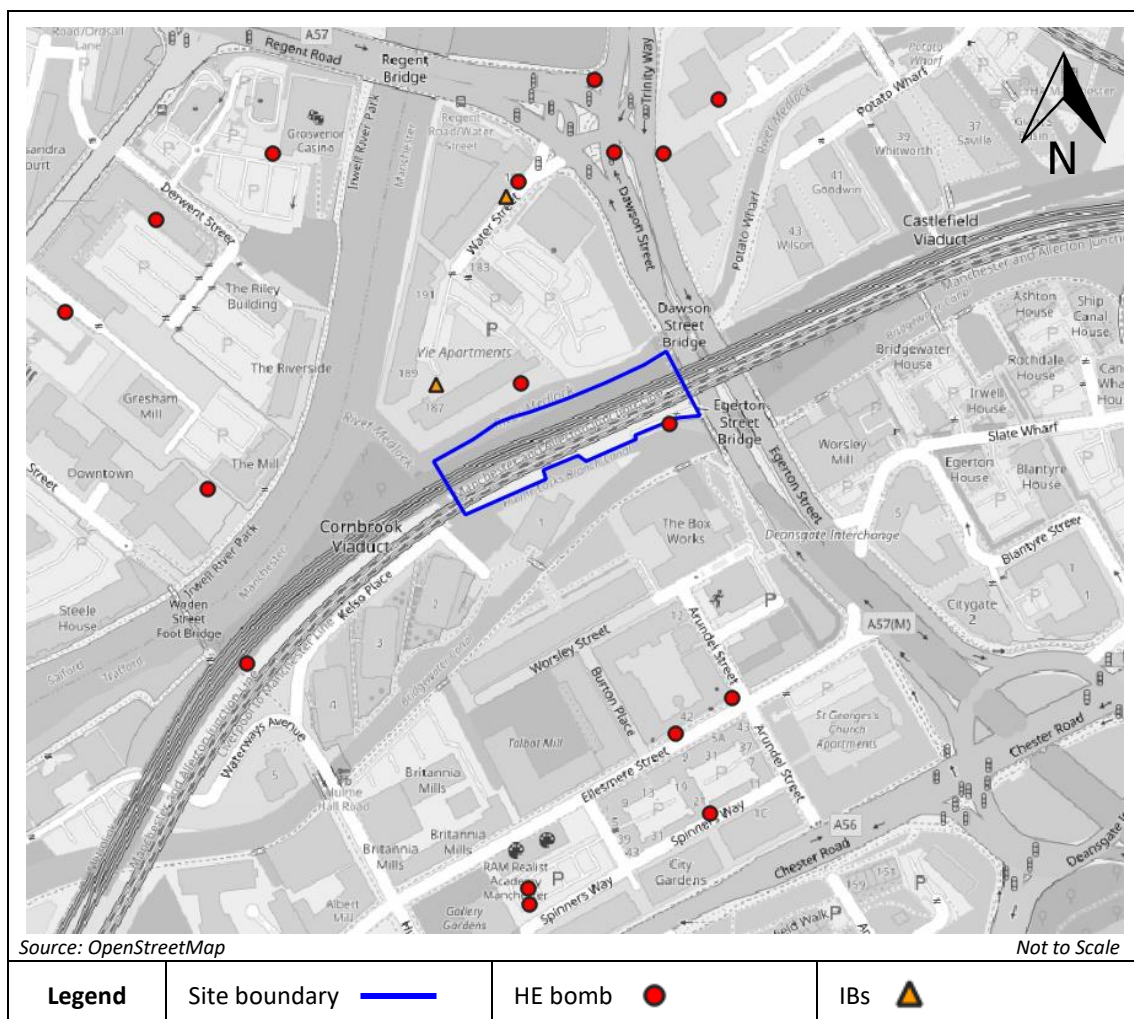
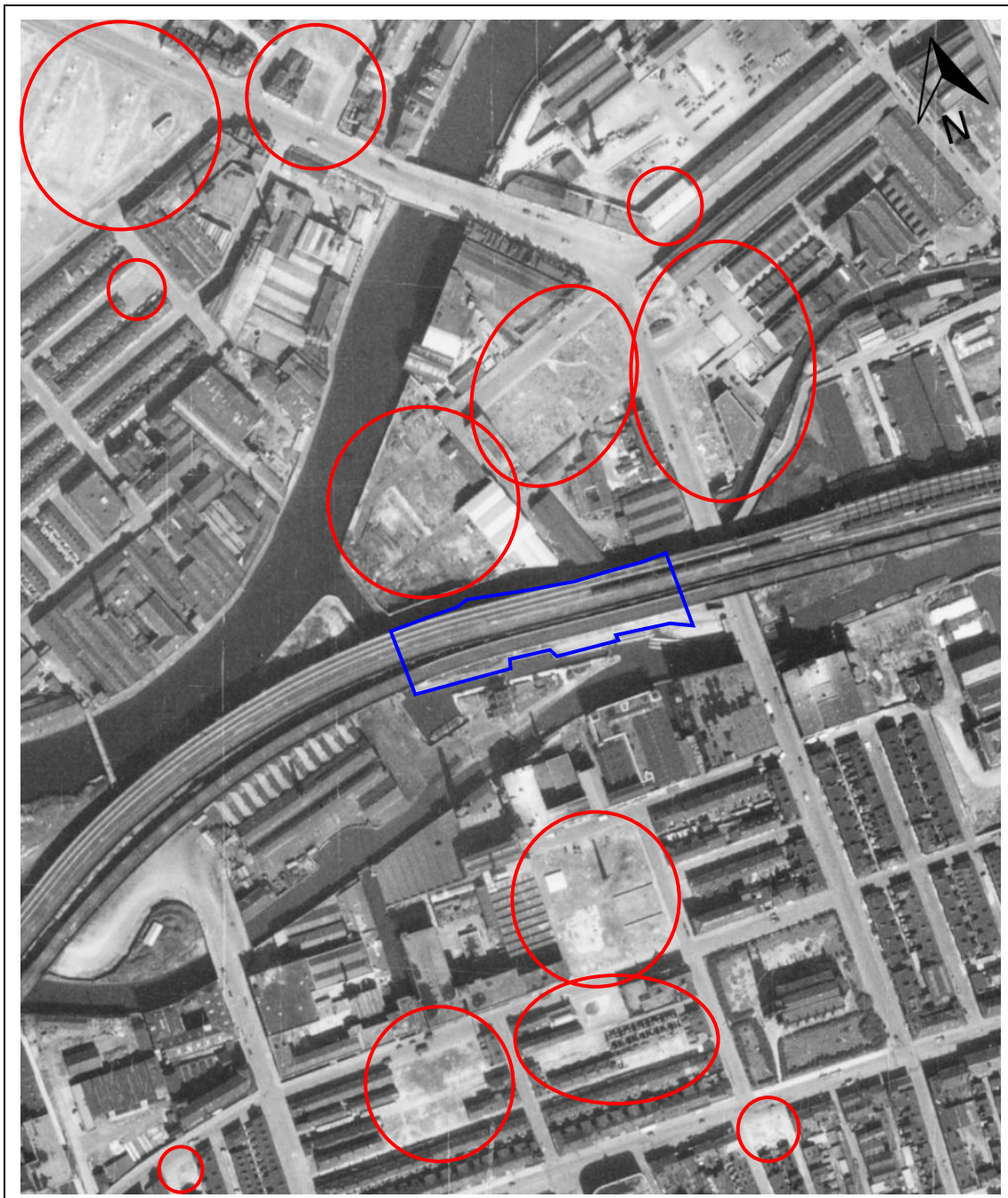


Plate 3 is an aerial photograph dated the 10th August 1945. No bomb damage has been identified on the Site. Several areas of bomb damage have been identified to the north and south of the Site.

Plate 3 Aerial photograph, 10th August 1945



Source: Historic England

Not to Scale

Legend	Site boundary —	Possible bomb damage ○
---------------	-----------------	------------------------

Potential UXO hazard

Records have been found indicating that 1No. HE bomb fell on the Site during WWII and exploded.

No further bombing has been identified on the Site and no bomb damage has been identified on the Site on historical aerial photography. The Site comprised railway infrastructure, which would have been regularly checked for evidence of UXBs after each air raid.

WWII bombing is not considered to provide a significant source of UXO hazard to the Site.

4.2.4 Abandoned bombs

No records have been found indicating that any officially abandoned bombs are located on the Site.

4.2.5 Bomb penetration depths

Information provided by the Client, BGS 1:50,000 Sheet 85 Manchester (Solid & Drift) and BGS borehole records from nearby investigations have been consulted to get an indicative overview of the Site geology.

The WWII geology of the Site is understood to consist of Made Ground, over sand and clay, overlying sandstone of the Chester Formation.

Table 2 provides an estimate of average maximum bomb penetration depths for the Site assuming WWII ground conditions of 4m of Made Ground (modelled as gravel), over 5m of sand and clay, overlying more than 20m of weak rock.

Table 2 Estimated average maximum bomb penetration depths

Estimated average bomb penetration depths for anticipated geology		
Bomb Weight	50kg	2.5m
	250kg	3.5m
	500kg	7.5m

These calculations can be refined on receipt of further Site-specific information.

The estimated bomb penetration depths given in Table 2 are from the WWII ground level and are based on the following assumptions:

- a) High-level release of the bomb resulting in an impact velocity of 260m/s (>5,000m altitude).
- b) A strike angle of 10 to 15 ° to the vertical.
- c) That the bomb is stable, both in flight and on penetration.
- d) That no retarding units are fitted to the bomb.
- e) That the soil type is homogenous.

Assuming the above, a bomb will enter the ground and travel on the same trajectory until momentum is nearly lost. The bomb will then turn abruptly to the horizontal before coming to rest. The horizontal distance between the centre of the entry hole and the centre of the bomb at rest is known as the 'offset'. A marked horizontal movement from the original line of entry is common.

Low-level attacks may have an impact angle of 45° or more, which will frequently lead to a much greater amount of offset movement during soil penetration.

The average offset is one third of the penetration depth. If hardstanding or Made Ground were present during WWII, bomb penetration depths would have been significantly reduced but offset distances may have been up to four times greater.

5 POST-WWII EXPLOSIVE ORDNANCE CLEARANCE (EOC) ACTIVITIES

Based on data from 1939 to 1945, War Office (WO) statistics indicate that 200,195No. HE bombs exploded within Great Britain. Additionally, 25,195No. HE bombs (approximately 11%) were recorded as UXBs. However, records from the Royal Engineers (RE) who were responsible for bomb disposal at the time indicate that by 27th February 1946, more than 45,000No. UXBs were disposed of.

On average, 8.5% of UXBs later self-exploded. In some cases, the bombs had delayed action fuzes or were never intended to explode, their purpose being to cause inconvenience and fear. Given the discrepancy in records and the fact that UXBs are still being found unexpectedly, it is clear that the original figures are understated and provide only an approximation of the number of potential UXBs in the UK.

WO statistics also show that between October 1940 and May 1941 most UXBs (93%) were either 50kg or 250kg. It should be noted that details of the recovery and size of the UXB were not always accurately reported.

The larger WWII UXBs are often difficult to recover due to both penetration depths and the presence of two or more fuzes, combined with more sensitive fillings of explosive mixtures including Amatol and Trialen.

5.1 EOC tasks

Zetica holds the following records of post-WWII EOC tasks having taken place in the vicinity of the Site.

8th October 2007

1No. UXB was found on a building site on Middlewood Street, Salford, approximately 0.6km north of the Site. It was made safe and removed.

24th October 2018

1No. WWII anti-tank shell was found on a building site between Irwell Street and New Quay Street, Salford, approximately 0.8km northeast of the Site. It was made safe and removed.

6 UXO HAZARD ASSESSMENT

6.1 UXO hazard level

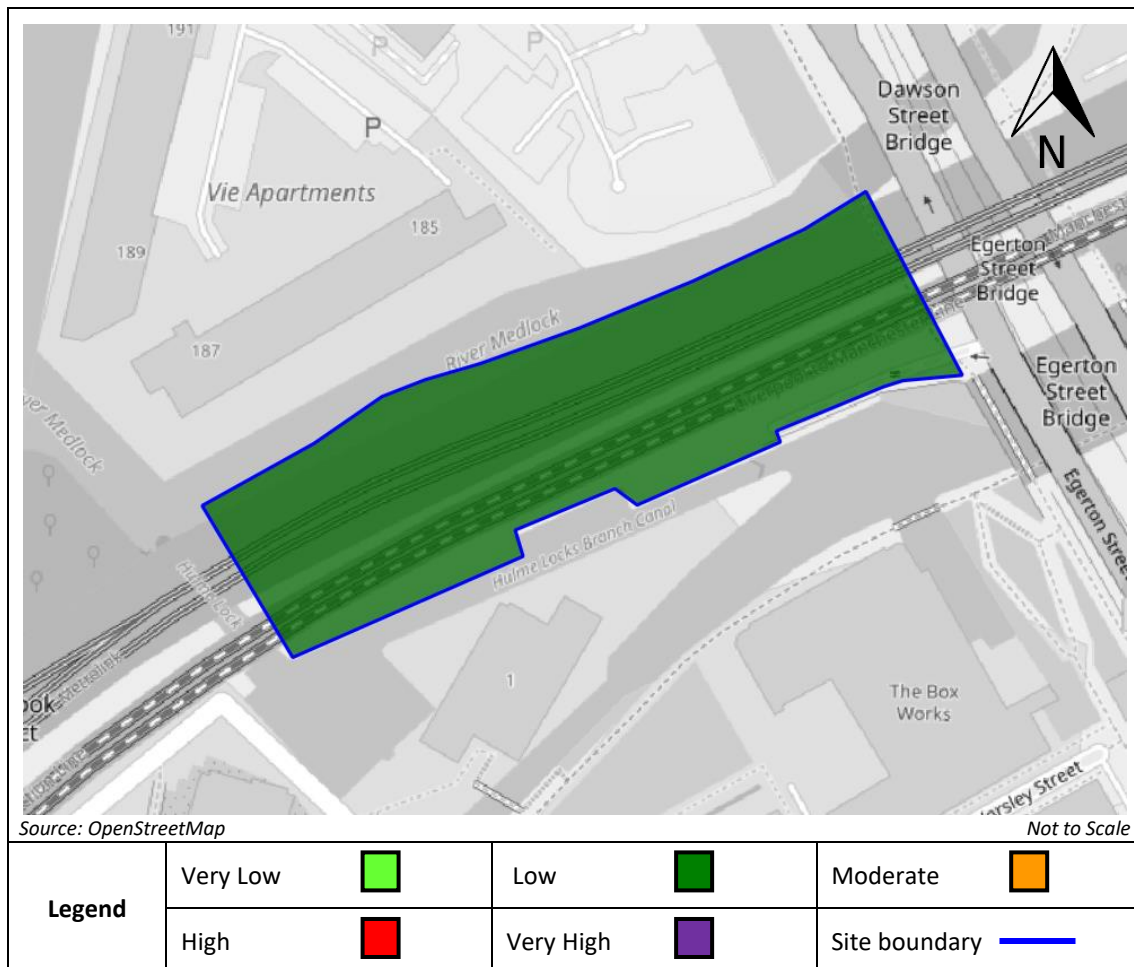
Definitions of UXO Hazard Level for a Site	
Hazard Level	Definition
Very Low	There is positive evidence that UXO is not present, e.g. through physical constraints or removal.
Low	There is no positive evidence that UXO is present, but its occurrence cannot be totally discounted.
Moderate	There is positive evidence that ordnance was present or that other uncharted ordnance may be present as UXO.
High	There is positive evidence that UXO is present.
Very High	As high, but requires immediate or special attention due to the potential hazard.

Records indicate that 1No. HE bomb fell on the Site during WWII and exploded. No further bombing and no other significant sources of UXO hazard have been identified on the Site.

Given this, it is considered that the Site has a low UXO hazard level, as shown in Figure 5.

The UXO hazard zone plan of the Site is also given in the accompanying P14415-24-R1-MAP01-A.

Figure 5 UXO hazard zone plan of the Site



7 UXO RISK ASSESSMENT

7.1 Proposed works

It is understood that works on the Site are associated with the construction of homes, a village hall, and green spaces for the homeless.

Works on the Site will include demolition of walls, mini piles designed to a depth of 5m below ground level (bgl), with the potential to go up to 8m bgl, and the installation of a pump station and raising main.

7.2 Risk assessment methodology

A UXO risk assessment has been undertaken for the proposed works, taking into consideration the identified UXO hazard(s).

Firstly, the probability of encountering UXO (PE) has been considered and rated for the proposed construction techniques, as detailed below.

Probability of Encounter (PE)	Rating
Frequent, highly likely, almost certain.	5
Probable, more likely to happen than not.	4
Occasional, increased chance or probability.	3
Remote, unlikely to happen but could.	2
Improbable, highly unlikely.	1
Impossible	0

Secondly, the probability of detonating an item of UXO (PD) has been considered and rated for the proposed construction techniques, as detailed below.

Probability of Detonation (PD)	Rating
Frequent, highly likely, almost certain.	5
Probable, more likely to happen than not.	4
Occasional, increased chance or probability.	3
Remote, unlikely to happen but could.	2
Improbable, highly unlikely.	1
Impossible	0

Next, the probability of encountering and detonating the UXO (PE x PD) have been used to generate an overall likelihood rating (P).

P = PE x PD	LIKELIHOOD of Encounter and Detonation	Rating
21 to 25	Frequent, highly likely, almost certain.	5
16 to 20	Probable, more likely to happen than not.	4
6 to 15	Occasional, increased chance or probability.	3
2 to 5	Remote, unlikely to happen but could.	2
1	Improbable, highly unlikely.	1
0	Impossible	0

P ranges from 25, a certainty of UXO being encountered and detonated on the Site by engineering activity, to 0, a certainty that UXO does not occur on the Site and will not be detonated by engineering activity.

The likelihood of encountering and detonating UXO during site works (P) is multiplied by the severity (S) of such an event occurring (P x S), to provide a risk level using the following matrix.

Severity (S)	Rating
Multiple fatalities	5
Major injury, long term health issues, single fatality.	4
Minor injury, short term health issues, no fatalities.	3
First aid case but no lost time or ill health.	2
Minor injuries, no first aid.	1
No injuries.	0

UXO Risk Matrix							
LIKELIHOOD (P)	SEVERITY (S)						
		5	4	3	2	1	0
	5	25	20	15	10	5	0
	4	20	16	12	8	4	0
	3	15	12	9	6	3	0
	2	10	8	6	4	2	0
	1	5	4	3	2	1	0
	0	0	0	0	0	0	0

7.3 UXO risk level

The UXO risk assessment for proposed works on the Site is given in Table 3.

Table 3 UXO risk assessment for the Site

Potential UXO Hazard	Anticipated Works	PE	PD	P = PE x PD	Likelihood	Severity	Risk Rating	UXO Risk
UXB	Excavations	1	1	1	1	5	5	Low
	Piling	1	1	1	1	4	4	Low
Other UXO	Excavations	1	1	1	1	4	4	Low
	Piling	1	1	1	1	3	3	Low

PE = Probability of Encounter; PD = Probability of Detonation; P = Likelihood

8 RISK MITIGATION PLAN

Key findings: No significant sources of UXO hazard have been identified.

Key actions: Proceed with works. An UXO awareness briefing is prudent for staff involved in excavations.

8.1 UXO risk summary

Table 4 summarises the UXO risk for proposed works on the Site and recommended actions.

Table 4 Summary of UXO risk and mitigation recommendations

Proposed Works	UXO Risk	Recommended Mitigation
Excavations		Proceed with works – an UXO awareness briefing is prudent for staff involved in excavations.
Piling		Proceed with works

In summary, no additional measures are considered essential to reduce the UXO risk on the Site to As Low As Reasonably Practicable (ALARP). An UXO awareness briefing for staff involved in excavations is always prudent.

8.2 Risk mitigation techniques

8.2.1 UXO awareness briefing

It is prudent that all staff involved in intrusive works are provided with a formal UXO awareness briefing.

The briefing should offer some recognition skills for typical UXO, and suitably sensitise staff to be vigilant during site works.

An UXO awareness briefing ensures that in the unlikely event that UXO is encountered:

- All site staff take appropriate action.
- A support mechanism and points of contact are established.
- The likelihood of harm to people or property is reduced.
- Significant delays to site work are prevented.

8.3 What do I do next?

If you have any comments or require further assistance, contact us and we can help.

	01993 886682		<u>uxo@zetica.com</u>		<u>zeticauxo.com</u>
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If you have requirements to identify other buried hazards (such as mapping utilities or obstructions) we can provide these surveys.

If proposed works on the Site change, or additional works are planned, contact Zetica for a re-assessment of the UXO risk and the risk mitigation requirements.

APPENDICES

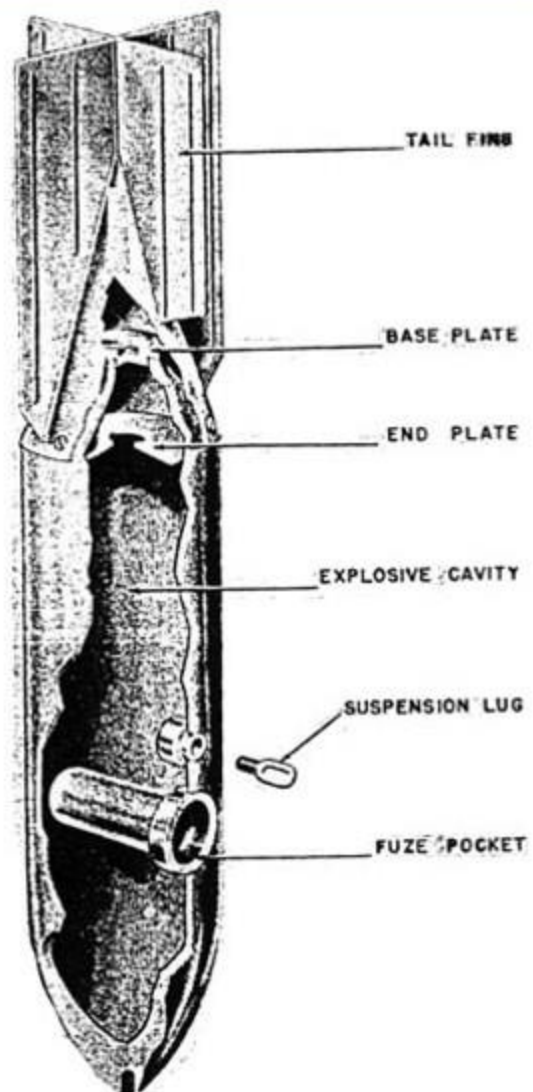
Appendix 1 Anticipated ordnance types

For a more comprehensive set of ordnance data sheets, see <https://zeticauxo.com/guidance/ordnance-data-sheets/>.

Information Data Sheet



50kg High Explosive Bomb



Specifications

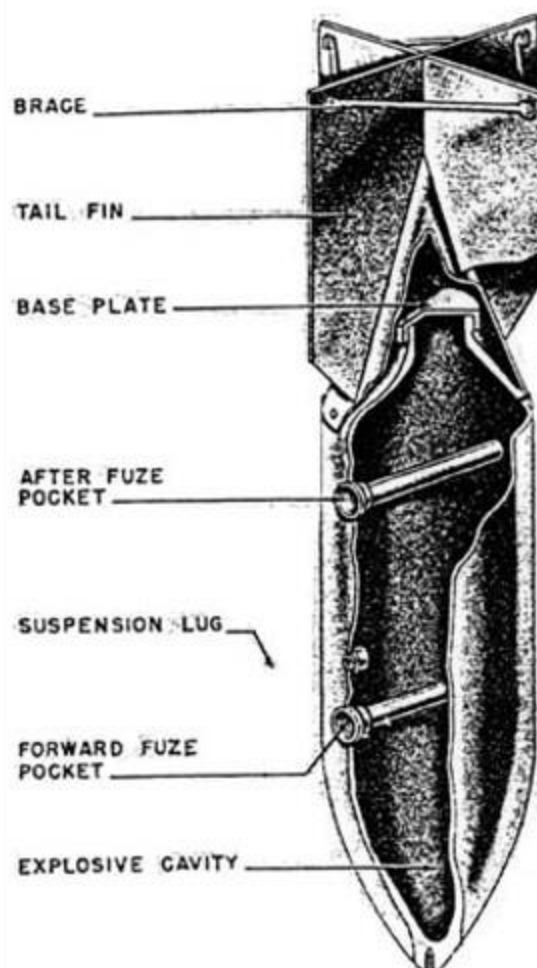
Description	Cylindrical with pointed nose and four-fin tail	Function	General Purpose (Blast and Fragmentation)
Dimensions	Total 1090mm x 280mm (42.9" x 11") Body 765mm x 200mm (30.2" x 7.9")	Activation by	Impact, Time, or Tamper fuze
Material	Steel	Variations	Minor variations in length

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Information Data Sheet

zetica^{uxo}

250kg High Explosive Bomb



Specifications

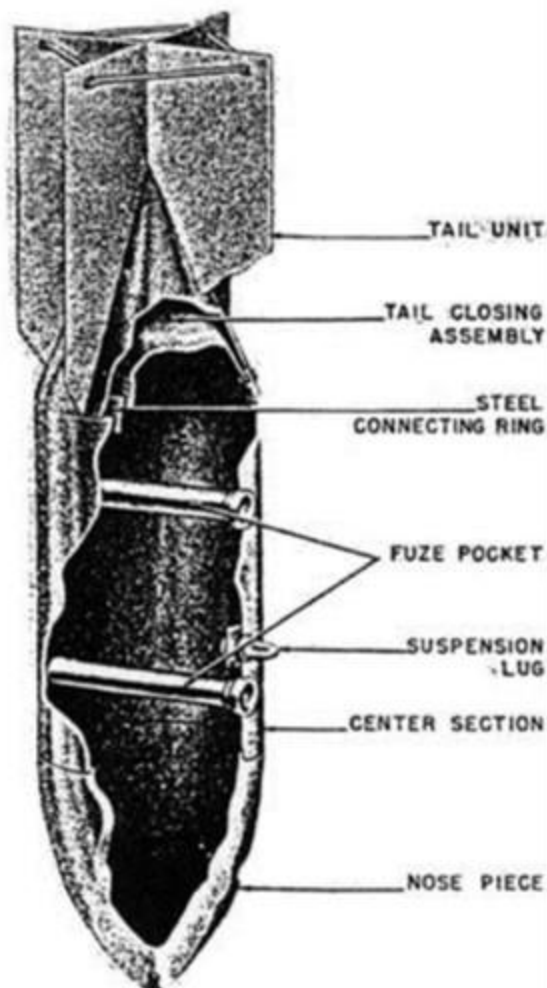
Description	Cylindrical with pointed nose and braced four-fin tail	Function	General Purpose (Blast and Fragmentation)
Dimensions	Total 1640mm x 512mm (64.6" x 20.2")	Activation by	Impact, Time, or Tamper fuze
	Body 1172mm x 368mm (46" x 14.5")		
Material	Steel	Variations	Minor variations in length

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Information Data Sheet

zetica^{UXO}

500kg High Explosive Bomb



Specifications

Description	Cylindrical with pointed nose and braced or ring-bound four-fin tail	Function	General Purpose (Blast and Fragmentation)
Dimensions	Total 1957mm x 640mm (77" x 25.2") Body 1423mm x 470mm (56" x 18.5")	Activation by	Impact, Time, or Tamper fuze
Material	Steel body, Steel or Magnesium Alloy tail	Variations	Minor variations in length

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Information Data Sheet



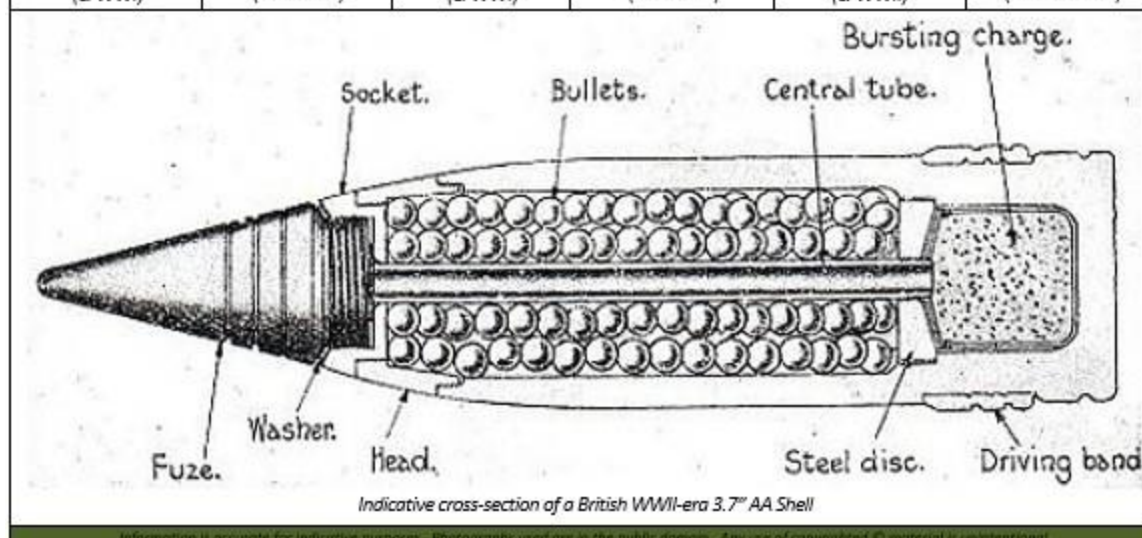
Anti-Aircraft Shells



Anti-Aircraft (AA) guns are artillery pieces designed to engage aircraft. They may be classed as Heavy AA (HAA) or Light AA (LAA). HAA shells are typically streamlined, made of steel, and equipped with driving bands. They usually carry a High Explosive (HE) or shrapnel filling and use time or proximity fuzes. LAA guns are often autocannons. Indicative specifications for common British HAA shells are given below.

Specifications

Shell	Dimensions	Shell	Dimensions	Shell	Dimensions
6-pdr (c. WWI)	307mm x 57mm (12.1" x 2.2")	13-pdr (c. WWI)	294mm x 76mm (11.6" x 3")	3.7" (c. WWII)	675mm x 94mm (26.6" x 3.7")
75mm (c. WWI)	350mm x 75mm (13.8" x 3")	3" (c. WWI)	420mm x 76mm (16.5" x 3")	4.5" (c. WWII)	695mm x 113mm (27.4" x 4.5")
12-pdr (c. WWI)	445mm x 102mm (17.5" x 4")	4" (c. WWI)	445mm x 102mm (17.5" x 4")	5.25" (c. WWII)	782mm x 133mm (30.8" x 5.25")



Information is accurate for indicative purposes. Photographs used are in the public domain. Any use of copyrighted © material is unintentional.

Appendix 2 Sources of UXO hazard

The sections below provide background information on the potential sources of UXO hazard affecting the Site. For a more comprehensive set of UXO information sheets, see <https://zeticauxo.com/guidance/uxo-hazard-sources/>.

Appendix 2.1 WWI bombing

Information Data Sheet

Category World War One (WWI) Bombing

Description:

During WWI, significant bombing took place across some areas of the UK. An estimated 9,000No. German bombs were dropped on Britain during the course of 51No. airship and 52No. aircraft raids. It was the first time that strategic aerial bombardment had been used.

Nearly 100No. air raids were carried out on London and Southeast England, over 40No. of which were by Zeppelin airships. Areas along the East Coast was also targeted regularly due to their proximity to the European continent. Bombing raids further inland were rare and West England and Wales were out of reach for German aircraft of the time.

Aerial bombing during WWI initially relied on visual aiming, with bombsights not developed until later in the war. The inaccuracy inherent in this method meant that bombs often fell some way from their intended targets.

The first recorded raid against England occurred on the 21st December 1914 when 2No. High Explosive (HE) bombs fell near the Admiralty Pier at Dover. Zeppelin raids intensified during 1915 and 1916, with aircraft raids becoming more frequent after 1917. The last raid of WWI took place on the 19th May 1918, when 38 Gotha and 3 Giant aircraft bombed London and surrounding districts, dropping a total of more than 2,500lbs of bombs.



A variety of WWI German bombs

Hazard:

The potential of coming across an Unexploded Bomb (UXB) from WWI is far less likely than an UXB from World War Two (WWII), given the lower bombing densities during raids in WWI.

Some areas which were subjected to sustained bombing raids recorded a higher number of UXBs. In these areas, where there has been no significant development for the last century, the potential of a UXB remaining from WWI cannot be totally discounted.

Appendix 2.2 WWII bombing**Information Data Sheet****Category** World War Two (WWII) Bombing**Description:**

Bombing raids began in summer 1940 and continued until the end of WWII. Bombing densities generally increased towards major cities, such as London, Birmingham, Coventry, and Hull, or strategic targets such as docks, harbours, industrial areas, and airfields. Coastal towns, such as Eastbourne, and cathedral cities, such as Canterbury were also heavily targeted.

The German bombing campaign saw the extensive use of both High Explosive (HE) bombs and Incendiary Bombs (IBs). 50kg and 250kg HE bombs were most commonly used, although 500kg were also used to a lesser extent. More rarely 1,000kg, 1,400kg and 1,800kg bombs were dropped. HE bombs tended to contain about half of their weight in explosives and were fitted with one or two fuzes. Not all HE bombs were intended to explode on impact and some contained timing mechanisms where detonation could occur more than 70 hours after impact.

Incendiary devices ranged from small 1kg thermite filled, magnesium bodied IBs, to 250kg and 500kg Oil Bombs (OB). Occasionally IBs were fitted with a bursting charge which exploded after the bomb had been alight for a few minutes, causing burning debris to be scattered over a greater area. Large OBs were similar in appearance to HE bombs, although their design was sufficiently different to warrant a specially trained unit of the Royal Engineer (RE) to deal with their disposal.



Variety of WWII bombs

Anti-Personnel (AP) bombs and Parachute Mines (PMs) were also deployed. The most common AP bombs were 1kg and 2kg, which could inflict injury across an area up to 150m away from the impact. PMs could be up to 4m in length and were typically detonated either magnetically or by noise/vibration. Anti-shipping PMs were commonly dropped over navigable rivers, dockland areas, and coastlines. Whilst the Royal Navy (RN) was responsible for ensuring that anti-shipping PMs were made safe, their removal and disposal was still the responsibility of the RE.

In 1944, new offensive weapons were introduced. The Flying Bomb (V1), a pilotless guided missile, exploded on impact and could cause significant damage. The Long Range Rocket (V2), a ballistic missile rocket, travelled at such speed that no one could see or hear its approach.

WWII bomb targeting was inaccurate, especially in the first year of the war. A typical bomb load of 50kg HE bombs mixed with IBs aimed at a specific location might not just miss the intended target but could fall a considerable distance away.

Local Civil Defence authorities in urban areas typically had a comprehensive system for reporting bomb incidents and dealing with Unexploded Bombs (UXB). In more rural and coastal areas where fewer bombing raids occurred, it is known that Air Raid Precaution (ARP) records under-represent the number and frequency of bombs falling. Bombs could be released as part of 'tip and run' raids where bomber crews would drop their bombs to avoid Anti-Aircraft (AA) fire or Allied fighter aircraft, on route to and from other strategic targets. Bombs dropped as a result of poor targeting or 'tip and run' raids often went unrecorded or were recorded as 'fell in open country' or 'fell in the sea'. The Luftwaffe are thought to have dropped approximately 75,000 tons of bombs on Britain throughout WWII and an estimated 11% of all bombs dropped during the war failed to detonate.



Removal of an UXB

Hazard:

The potential for a UXB hazard to exist on a site depends on a variety of factors:

- Were their strategic targets in the surrounding area?
- Was the site bombed and how heavy were the raids?
- Could an UXB impact have been missed, masked by rubble or debris?

Even in rural areas, the potential for UXBs cannot be totally discounted and therefore it is essential that detailed local bombing records are obtained when assessing the UXB hazard on any site.

Appendix 2.3 Anti-Aircraft defences

Information Data Sheet

Category Anti-Aircraft (AA) Defences

Description:

As aerial bombardment first began during World War One (WWI), AA gun batteries were gradually established throughout much of England to counter German bombing raids. By June 1916, there were approximately 271No. AA guns and 258No. searchlight installations defending London alone.

Common WWI AA defences included 3", 75mm, 6-pounder (pdr), and 1pdr guns. Many of these guns were mobile and would follow the course of an airship, firing from areas of open land.

During WWI, Unexploded AA (UXAA) shells, could land up to 13km from the firing point, although they more typically fell within 10km.



WWI 3-pdr mobile Vickers AA gun



WWII 3.7" static AA gun

During World War Two (WWII), AA gun batteries were used extensively to counter the threat posed by enemy aircraft. AA shells could be distributed over a wide area and could land up to 27km from the firing point, although they more typically fell within 15km.

3No. types of AA batteries existed:

- Heavy AA (HAA) – typically 3.7", 4.5", and 5.25" calibre guns designed to engage high flying bomber aircraft. These tended to be permanent gun emplacements.
- Light AA (LAA) – typically used 40mm shells and machine gun ammunition and designed to counter low flying aircraft. These were often mobile and were moved periodically.
- Rocket AA (ZAA) – fired 3" or 3.7" AA rockets with a maximum altitude of 5,800m and a ground range of 9km. These tended to be permanent gun emplacements.

Hazard:

AA batteries had munitions stores which stored shells for the batteries and Small Arms Ammunition (SAA) for troops manning the position. Such stores were typically removed at the end of WWII, although some disposal may have occurred in the immediate vicinity of the gun battery.

In areas heavily protected by AA batteries, it is prudent to consider the potential for UXAA shells in the area surrounding a battery, taking into consideration the likely extent within which shells would have fallen. Finding an UXAA shell immediately adjacent to a former gun battery is less likely.

Appendix 3 Recent UXO finds

Information Data Sheet

Category Recent UXO Finds

UXO finds in the UK are a regular occurrence, although they almost never result in an accidental detonation.

Explosives rarely lose effectiveness with age. In some instances, mechanisms such as fuzes and gaines can become more sensitive and more prone to detonation, regardless of whether the device has been submersed in water or embedded in silt, clay, or similar materials.

Zetica Ltd, and other commercial EOD companies, uncover and make safe thousands of items of UXO each year, though details are rarely made public knowledge.

Publicly recorded discoveries also occur regularly, as shown by the list of recent significant UXO finds in the UK below. Click [here](#) to keep up to date with the latest UXO finds.

On the 26th February 2021, a 1,000kg German "Hermann" UXB was discovered by builders at Exeter University campus (see below). It was investigated and detonated in-situ following the evacuation of nearby properties and University halls of residence.



1,000kg German UXB discovered in Exeter, 2021

On the 29th March 2021, 1No. 250lb UXB was discovered on the seabed near Hinkley Point C harbour, Bristol. A maritime exclusion was imposed while the item was investigated and then destroyed in a controlled explosion.

On the 1st June 2021, a cache of approximately 100No. WWII-era hand grenades were found in a Nottinghamshire forest, a possible relic from nearby WWII camps. They were destroyed.

On the 24th July 2021, 1No. 500lb British UXB was uncovered during construction works in Goole, East Yorkshire. Reports indicated that the UXB had been jettisoned by a Lancaster bomber aircraft prior to crashing nearby in WWII. The item was investigated and destroyed.

On the 18th August 2021, 1No. UXB was found by construction workers on a Site in Earl Sterndale, Derbyshire. Upon inspection the UXB was deemed to be dangerous, and a controlled detonation was undertaken.

On the 10th September 2021, EOD teams destroyed 25No. mortar bombs which had been washed up onto beaches around Nairn and Ardersier in Morayshire. These beaches had been used during WWII for training prior to the D-Day landings in Normandy.



Mortar bombs found on beaches in Nairn and Ardersier, 2021

On the 15th December 2021, approximately 200No. artillery shells were discovered at a construction site located within the former Royal Ordnance Factory at Swynnerton in Staffordshire. The shells were removed and destroyed.

On the 2nd January 2022, 1No. heavily deteriorated 105mm artillery shell was discovered by dogwalkers on a beach in Cumbria. This may have originated on one of the several offshore ranges which have been operational along the nearby coastline since WWII.

Between the 24th and 27th January 2022, 5No. empty artillery shells were uncovered at a construction site in Manchester. These were likely linked to a shell-production factory which had been active on the site during WWII.

On the 14th July 2022, 1No. 2" mortar bomb and several Small Arms Ammunition rounds were discovered on a beach near Ardnamurchan. An EOD team disposed of the items.

On the 28th November 2022, 45No. Self-Igniting Phosphorus grenades were discovered during construction works at a school in Swindon. They were disposed of by an EOD team.

On the 5th December 2022, 1No. UXB was discovered during construction at Biggin Hill Airport. An EOD team removed the UXB for safe disposal.

On the 7th February 2023 1No. 250kg bomb was found during dredging works in the River Yare, Great Yarmouth. It detonated unplanned whilst being disarmed by an Army EOD team.

On the 17th April 2023, 1No. unexploded mortar bomb was discovered at Cavenham Heath Nature Reserve. It was destroyed in a controlled explosion by an EOD team. This followed 2No. other similar discoveries on the 7th March and 12th March in the same stretch of canal.

On the 27th July 2023, 1No. 250kg WWII bomb was discovered off the coast of Guernsey by a recreational diver. It was detonated in situ by a Royal Navy EOD diver team.

Appendix 4 Glossary and definitions

Abandoned Explosive Ordnance (AXO)	Explosive ordnance that has not been used during an armed conflict, that has been left behind or disposed of by a party to an armed conflict, and which is no longer under control of that party. Abandoned explosive ordnance may or may not have been primed, fuzed, armed or otherwise prepared for use.
Demil	Derived from the term 'Demilitarisation', demil refers to the break down and the recycling or disposal of ordnance components.
Detonation	The high-speed chemical breakdown of an energetic material producing heat, pressure, flame, and a shock wave.
Device	Any component, sub-assembly or completed ordnance, which may or may not have an explosive risk. It can apply to detonators, primers, gaines, fuzes, shells, or bombs.
Explosive	Compounds forming energetic materials that under certain conditions chemically react, rapidly producing gas, heat, and pressure. These are extremely dangerous and should only be handled by qualified professionals.
Explosive Ordnance (EO)	All munitions containing explosives, nuclear fission or fusion materials, and biological and chemical agents. This includes bombs and warheads, missiles, artillery, mortar, rocket, Small Arms Ammunition, mines, torpedoes, depth charges, pyrotechnics, cluster bombs and dispensers, cartridge and propellant devices, electro-explosive devices, clandestine and improvised explosive devices, and all related items/components which are explosive in nature.
Explosive Ordnance Clearance (EOC)	The operation of ordnance detection, investigation, identification, and removal, with Explosive Ordnance Disposal being a separate operation.
Explosive Ordnance Disposal (EOD)	The detection, identification, on-site evaluation, rendering safe, recovery, and final disposal of Unexploded Ordnance.
Explosive Ordnance Reconnaissance (EOR)	The detection, identification, and on-site evaluation of Unexploded Ordnance before Explosive Ordnance Disposal.
Explosive Remnants of War (ERW)	Unexploded Ordnance and Abandoned Explosive Ordnance, excluding landmines.
Explosive Substances & Articles (ESA)	Explosive substances are solid or liquid substances (or a mixture) which are either: capable by a chemical reaction of producing gas at a speed, temperature, and pressure to cause damage to the surroundings; or designed to produce an effect by heat, light, sound, gas, or smoke (or a combination) as a result of a non-detonative, self-sustaining, exothermic reaction. One or more explosive substances form an explosive article.

Fuze	The part of an explosive device that initiates the main explosive charge to function. In common usage, the word fuze is used indiscriminately, but when being specific (and especially in a military context), fuze is used to mean a more complicated device, such as a device within military ordnance.
Gaine	Small explosive charge that is sometimes placed between the detonator and the main charge to ensure ignition.
Geophysical survey	A range of methods that can be used to detect objects or identify ground conditions without the need for intrusive methods (such as excavation or drilling). This is particularly suited to ordnance, as disturbance of ordnance is to be avoided where possible.
High Explosive (HE)	Secondary explosives (commonly known as HE) make up the main charge or filling of an ordnance device. They are usually less sensitive than primary explosives. Examples of secondary explosives are Nitro-glycerine (NG), Trinitrotoluene (TNT), Amatol (Ammonium nitrate and TNT), gunpowder, and Cyclotrimethylenetrinitramine (RDX).
Land Service Ammunition (LSA)	Items of ordnance thrown, propelled, or placed during land warfare, to include grenades, mortar bombs, projectiles, rockets, and landmines.
Munition	The complete device charged with explosives, propellants, pyrotechnics, initiating composition, or nuclear, biological, or chemical material for use in military operations, including demolitions. This includes those munitions that have been modified for use in training, ceremonial, or non-operational purposes. These fall into three distinct categories: inert (contain no explosives), live (contain explosives and have not been fired), and blind (have fired but failed to function as intended.)
Primary Explosive	Explosives used to initiate less sensitive explosives and usually extremely sensitive to friction, heat, and pressure. Primary explosives are commonly found in detonators. Examples of primary explosives are lead azide, lead styphnate, and mercury fulminate.
Propellants	Provide ordnance with the ability to travel in a controlled manner and deliver the ordnance to a predetermined target. Propellants burn rapidly producing gas, pressure, and flame. Although usually in solid form they can be produced in liquid form. Examples of propellants are ballistite, often in flake form, and cordite, often in string form.
Pyrotechnic	An explosive article or substance designed to produce an effect by heat, light, sound, gas, or smoke (or a combination), as a result of non-detonative, self-sustaining, exothermic chemical reactions.
Small Arms Ammunition (SAA)	Projectiles around 12mm or less in calibre and no longer than approximately 100mm. They are fired from a variety of weapons, including rifles, pistols, shotguns, and machine guns.

Unexploded Anti-Aircraft (UXAA) Shell	Ordnance containing High Explosives, although they can also contain pyrotechnic compounds that produce smoke. They ranged from 2" to 5.25" calibre, although most common were 3.7" and 4.5" HE shells.
Unexploded Bomb (UXB)	A common term for unexploded air-dropped munitions.
Unexploded Ordnance (UXO)	Explosive ordnance that has been primed, fuzed, armed, or prepared for use and subsequently fired, dropped, launched, projected, or placed in such a manner as to present a hazard to operations, persons, or objects, and remains unexploded either by malfunction or design.
V1	The Vergeltungswaffe-1, also designated Fieseler Fi 103/FZG-76, known colloquially in English as the Flying Bomb, Pilotless Aircraft, Buzz Bomb, or Doodlebug, was the first guided missile used in WWII and the forerunner of today's cruise missile.
V2	The Vergeltungswaffe 2 ('Reprisal Weapon 2') was the first ballistic missile. It was used primarily against Belgian and British targets during the later stages of WWII. It was also the first man-made object launched into space, during test flights in 1944.

Appendix 5 WWII bombing incident list

31st August 1940

1No. HE bomb fell on Castle Street, approximately 0.4km east of the Site.

7th October 1940

1No. HE bomb fell on the Wholesale Meat Market, Track Street, approximately 0.2km north-northeast of the Site.

1No. HE bomb fell on Chester Road, approximately 0.3km south-southeast of the Site.

1No. HE bomb fell on the Cleansing Depot, Water Street, approximately 0.3km north of the Site.

29th October 1940

1No. HE bomb fell on Dawson Street, approximately 0.1km north-northwest of the Site.

22nd – 24th December 1940

1No. HE bomb fell on Chester Lines Railway line near Egerton Street, on the Site.

1No. HE bomb fell on a warehouse off the River Irwell, approximately 20m north-northwest of the Site.

1No. IB fell on a warehouse off Water Street, approximately 40m north-northwest of the Site.

1No. HE bomb fell on the Wholesale Meat Market, Track Street, approximately 0.1km north of the Site.

1No. HE bomb fell on buildings off Mill Street, approximately 0.1km west of the Site.

2No. HE bomb fell on Ellesmere Street Electrical Works, approximately 0.2km south-southeast of the Site.

1No. HE bomb fell on Cawdor Street, approximately 0.2km south of the Site.

1No. HE bomb fell on Water Street, approximately 0.2km north-northwest of the Site.

1No. HE bomb fell on Calder Street, approximately 0.2km north-northwest of the Site.

1No. HE bomb fell on St George's School, Ellesmere Street, approximately 0.2km south-southeast of the Site.

1No. HE bomb fell on the Cleansing Depot, Water Street, approximately 0.3km north of the Site.

1No. IB and 1No. Oil Bomb (OB) fell on the Cleansing Depot, Water Street, approximately 0.3km north of the Site.

1No. HE bomb fell on Chester Road, approximately 0.3km south-southeast of the Site.

1No. HE bomb fell on Groves & Whitehall's, Wilburn Street, approximately 0.3km north-northwest of the Site.

1No. HE bomb fell on Bigland Street, approximately 0.3km west of the Site.

1No. IB fell on junction between Regent Street and Larbrook Street, approximately 0.3km north-northwest of the Site.

1No. IB fell on Christ Church Square, Tatton Street, approximately 0.4km south-southeast of the Site.

1No. HE bomb fell on Wilburn Street, approximately 0.4km north-northwest of the Site.

1No. IB fell on Bridgewater Canal Offices, Chester Road, approximately 0.4km east-southeast of the Site.

1No. PM fell on Cornbrook Brewery, Ellesmere Street, approximately 0.4km south-southwest of the Site.

11th March 1941

1No. HE bomb fell on Bigland Street, approximately 0.2km northwest of the Site.

1No. HE bomb fell on houses between Cawdor Street and Church Street, approximately 0.2km south of the Site.

1No. HE bomb fell on the junction between Bigland Street and South Hall Street, approximately 0.2km west-northwest of the Site.

1No. HE bomb fell on Crookell Street, approximately 0.3km northwest of the Site.

1No. HE bomb fell on junction of Regent Road and Deane Street, approximately 0.3km north-northwest of the Site.

1No. HE bomb fell on Wilburn Street, close to the Cleansing Depot on off Water Street, approximately 0.4km north of the Site. This was recorded as an UXB.

12th March 1941

1No. HE bomb fell on Cheshire Lines Railway line, near St George's Fishing Works, approximately 0.2km southwest of the Site.

1No. HE bomb fell on Christ Church Square, Tatton Street, approximately 0.4km south-southeast of the Site.

2nd June 1941

2No. HE bombs fell on Wilburn Street, approximately 0.3km north-northwest of the Site.

2nd June 1941

Several IBs fell on Water Street, approximately 0.1km north-northwest of the Site.

1No. HE bomb fell between 15 and 29 Water Street, approximately 0.1km north-northwest of the Site.

Appendix 6 Bibliography

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