

10.3. Failure Rate of German Air Delivered Ordnance

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

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

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

10.4. UXB Ground Penetration

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

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

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

10.4.1. The J-Curve Principle

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

10.4.2. WWII UXB Ground Penetration Studies

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

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

10.4.3. Site Specific Bomb Penetration Considerations

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

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

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

10.5. V-Weapons

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

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

11. The Likelihood of Contamination from German Air Delivered UXBs

11.1. World War I

During WWI Britain was targeted and bombed by Zeppelin Airships as well as Gotha and Giant fixed-wing aircraft. The objective of these raids was to unnerve the British public, to destroy strategic targets and to ultimately attempt to coerce Britain's capitulation from the war. A WWI bomb plot map of London was consulted, see **Annex G1**. Although this area of north London was targeted on 2nd/3rd September 1916 (see **Annex G2**), there is no evidence to indicate that the site was indeed bombed.

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

11.2. World War II Bombing of Municipal Borough of Hornsey

The Luftwaffe's main objective for the attacks on Britain was to inhibit the country's economic and military capability. To achieve this they targeted airfields, depots, docks, warehouses, wharves, railway lines, factories, and power stations. As the war progressed the Luftwaffe bombing campaign expanded to include the indiscriminate bombing of civilian areas in an attempt to subvert public morale.

During WWII the site was located within the Municipal Borough of Hornsey, which sustained an overall high density of bombing, as represented by bomb density data figures and maps, see **Annex H**. Unlike neighbouring Tottenham, which contained numerous targets within it (see the reservoirs highlighted in Luftwaffe target imagery in **Annex I**), Hornsey lacked such infrastructure. Bombing within the borough is therefore likely to have been less concentrated on any particular areas, with infrastructure, railways, industry and civilian centres targeted indiscriminately.

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

Records of bombing incidents are presented in the following sections.

11.3. WWII Home Office Bombing Statistics

The following table summarises the quantity of German air delivered bombs (excluding 1kg incendiaries and anti-personnel bombs) dropped on the Municipal Borough of Hornsey between 1940 and 1945.

Record of German Ordnance Dropped on the Municipal Borough of Hornsey		
Area Acreage		2,872
Weapons	High Explosive bombs (all types)	292
	Parachute mines	9
	Oil bombs	28
	Phosphorus bombs	5
	Fire pots	0
	Pilotless aircraft (V-1)	17
	Long range rocket bombs (V-2)	4
Total		355
Number of Items per 1,000 acres		123.6
Source: Home Office Statistics This table does not include UXO found during or after WWII.		

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

11.4. London Civil Defence Region Bomb Census Maps

During WWII, the ARP Department within the Research and Experiments Branch of the Ministry of Home Security produced both consolidated and weekly bomb census maps for the London Civil Defence Region, as well as census mapping of V-1 pilotless aircraft. These maps collectively show the approximate locations of bombs, mines and rockets dropped in the region. The site area was checked on each available map sheet. Those showing bomb incidents on and in the immediate vicinity of the site are discussed below and are presented in **Annex J1-J3**.

Consolidated London Bomb Census Maps – Annex J11	
Date Range	Comments
Night Bombing up to 7 th October 1940	No bomb strikes are plotted on or within the site's immediate vicinity.
7 th October 1940 to 6 th June 1941	One bomb strike is plotted directly south of the site, with another to the north-west.

Weekly London Bomb Census Maps – Annex J2-J3	
Date Range	Comments
7 th – 14 th October 1940	An incendiary bombing 'shower' is recorded across the site.
28 th October – 4 th November 1940	One HE bomb strike is plotted directly south of the site. Another bomb strike is recorded approximately 70m north-west of the site.
4 th – 11 th November 1940	One HE bomb strike is plotted within the north-western corner of the site / directly north-west.

V-1 Pilotless Flying Bomb Census Map – Annex K	
Date Range	Comments
30 th / 31 st July 1944	No V-1 strikes are plotted directly on site. The closest V-1 strike to the site is plotted approximately 460m north-west of the site.

11.5. Hornsey Bomb Plot Map

A local bomb map compiled by ARP wardens showing bomb strikes on the Municipal Borough of Hornsey was obtained from Haringey Archives. The section showing the area of the site is described in the table below and presented in **Annex L**.

Hornsey Bomb Plot Map – Annex L	
Date Range	Comments
1939-1945	No bomb strikes are plotted directly on site. However, one HE is plotted approximately 15m south-east of the site and another approximately 45m north-west of the site.

11.6. Middlesex County Council Log Book of Air Raid Incidents

The Middlesex County Council Log Book of Air Raid Incidents for Hornsey was obtained from the London Metropolitan Archives. A transcript of the relevant written records is presented in the table below. Example imagery of these entries are presented in **Annex M**.

Middlesex County Council Log Book of Air Raid Incidents – Annex M	
Date	Record Transcription
13 th September 1940	Minor Bombing HE + IB. Roseberry Gardens. Crouch End. Fire. <i>Roseberry Gardens was situated directly south-west of the site.</i>
1 st /2 nd November 1940	M.B. HE Tottenham Lane. Fairfield Rd and Hermiston Avenue / Tottenham Lane blocked. Minor damage. Flooding Tottenham Lane. Damage to [...] main. Tottenham Lane and Middle Lane blocked. MB. Fairfield Rd. damage by blast from incident Elmfield Rd. Gas & water main damage. <i>This occurred within the site vicinity. The site was bordered by Elmfield Avenue to the north and Tottenham Lane to the south-east.</i>
8 th November 1940	Minor bombing. HE's. Elmfield Avenue + Roseberry Gardens. Casualties: 6 (2 serious). <i>This incident occurred within the site vicinity. The site was situated between these two roadways, with Elmfield Avenue directly north and Roseberry Gardens directly south-west.</i>

11.7. Hornsey Register of Incidents

The Hornsey Register of Incidents was obtained from the Haringey Archives. A transcript of the relevant written records is presented in the table below. Example imagery of these entries are presented in **Annex N**.

Hornsey Register of Incidents		
Street	Date Range	Comments
Elmfield Avenue	1 st / 2 nd November 1940	Elmfield Avenue junction Hermiston Road. HE. <i>This incident occurred approximately 60m north-west of the site.</i>
	8 th / 9 th November 1940	36, 38 Elmfield Avenue. HE. <i>This incident occurred approximately 45m north-west of the site.</i>
Rosebery Gardens	12 th / 13 th September 1940	49 Rosebery Gardens. AA. <i>This incident occurred approximately 20m west of the site.</i>
	16 th November 1940	27 Rosebery Gardens. U.X.A.A. <i>This incident occurred approximately 90m west of the site.</i>
	19 th February 1944	18 Rosebery Gardens. IB. <i>This incident occurred approximately 115m west of the site</i>
Tottenham Lane	1 st / 2 nd November 1940	In roadway opposite Y.M.C.A <i>This incident occurred directly east of the site.</i>

11.8. Air Raid Damage Records

Air Raid Damage Records were obtained from the Haringey Archives. These contained information such as the date, location and type of bomb. A transcript of the relevant written records is presented in the table below. Example imagery of these entries are presented in **Annex O**.

Air Raid Damage Records		
Street	Date Range	Comments
Elmfield Avenue	8 th November 1940	HE at rear of 36 / 38 Elmfield Avenue. Serious damage to property. Main damaged. <i>This incident occurred approximately 40m north-west of the site.</i>
Hermiston Avenue	1 st November 1940	HE at Hermiston Avenue junction Elmfield Road. <i>This incident occurred approximately 60m north-west of the site.</i>
Rosebery Gardens	13 th September 1940	AA Shell. 39 Rosebery Gardens. Fire, slight damage to building. <i>This incident occurred approximately 50m west of the site.</i>
	16 th November 1940	AA U.X. 27 Rosebery Gardens. Slight damage to house. <i>This incident occurred approximately 90m west of the site.</i>
Tottenham Lane	1 st November 1940	HE at junction Elmfield Avenue / Tottenham Lane. Serious damage to property over a wide area. Damage to water main, serious flooding. 7 killed, 39 injured. <i>This incident occurred directly north-east of the site.</i>

11.9. Incident Records

Incident Records were obtained from the Haringey Archives. These contained information such as the date, location and type of bomb. A transcript of the relevant written records is presented in the table below. Example imagery of these entries are presented in **Annex P**.

Incident Records	
Date Range	Comments
11 th / 12 th September 1940.	AA Shell on 39 Rosebery Gardens. Damage to front of house. <i>This incident occurred approximately 50m west of the site.</i>
1 st / 2 nd November 1940.	HE on YMCA Tottenham Lane in roadway. Water main damage. Fire. 102 evacuated. Tottenham Lane, Elmfield Avenue & Rosebery Gardens blocked. <i>This incident occurred directly east of the site.</i>
	HE. Hermiston and Elmfield Avenue Junction. Water and coal gas. Mains. Fire. <i>This incident occurred approximately 60m north-west of the site.</i>
8 th / 9 th November 1940	HE at 36 / 38 Elmfield Avenue – rear. Damage: Coal gas. Serious to property. <i>This incident occurred approximately 40m north-west of the site.</i>
16 th November 1940	UX AA Shell. 27 Rosebery Gardens. Damage to roof and ceiling. <i>This incident occurred approximately 90m west of the site.</i>
19 th February 1944	Rocket Shell. 18 Rosebery Gardens. Small fire. The date of this incident was 19 th February 1944. <i>This incident occurred approximately 115m west of the site.</i>

11.10. Online Information

Several online sources indicate that the YMCA building sustained bomb damage during WWII, as did neighbouring buildings: see extracts from these sources in the table below.

Online / Anecdotal Sources
In the war the building sustained some bomb damage whilst neighbouring houses and the cinema opposite were completely destroyed. ¹
The Art Deco building, completed in 1929, was the culmination of years of fund-raising and planning. Little remains of this original structure: the centre was on the edge of a high explosive impact during World War II and suffered considerable damage. A red brick extension was opened in 1959, with a restaurant and greater number of hostel rooms. ²
In 1929, it was re-furbished and Western Electric(WE) sound equipment was installed. It was re-named Plaza Cinema. It was independently operated throughout its life and was closed in September 1939 at the outbreak of World War II. The Plaza Cinema was badly damaged in German air raids and never re-opened. ³

¹ <https://harringayonline.com/photo/crouch-hill-1905?context=latest>

² <https://www.lyndongoode.com/ymca-north-london.html>

³ <https://cinematreasures.org/theaters/28400>

11.11. Middlesex County Council War Damage Map

Map sheets compiled by Middlesex County Council (MCC) showing the extent of wartime bomb damage over the area of the site were consulted at London Archives. The section showing the area of the site is described in the table below and presented in **Annex Q**.

It should be highlighted that this source only records the following damage categories: 'Category 1: Total damage, building to be demolished', 'Category 2: Some repairs possible, but could become Cat 1' and 'Category 3: Borderline areas, uncertain whether repairs possible, might have to be demolished'. The lesser damage categories, such as seriously damaged but repairable at cost and general blast damage, were not used.

MCC War Damage Map	
Date Range	Comments
1939-45	The residential properties on site and adjacent are described as having sustained 'Category 2' damage: "some repairs possible, but could become Cat 1" (with Category 1 referring to "total damage, building to be demolished"). Meanwhile the YMCA building and adjacent properties are described as being subject to 'Category 3' damage; "border line areas, uncertain whether repairs possible, might have to be demolished". Further Category 2 damage is also recorded across Tottenham Lane to the south.

11.12. WWII-Era Aerial Photography

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

WWII-Era Aerial Photography	
Date/Title	Description
24 th July 1947	This post-war aerial photograph indicates that all of the residential properties on site had been cleared, along with the structures adjacent; a large area of clearance can be seen immediately north-west. A small part of the YMCA building had also been removed.

11.13. Abandoned Bombs

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

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

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

11.14. Bomb Disposal Tasks

The information service from the Explosive Ordnance Disposal (EOD) Archive Information Office at 33 Engineer Regiment (now part of 29 EOD & Search Group) no longer processes commercial requests for information. It has therefore not been possible to include any updated official information regarding bomb disposal/clearance tasks with regards to this site. A database of known disposal/clearance tasks has been referred to which does not make reference to such instances occurring within the site of proposed works.

If any relevant information is received at a later date, YMCA London City and North will be advised.

11.15. Evaluation of German Air Delivered UXO Records

German Air Delivered UXO Records Summary	
Factors	Conclusion
Density of Bombing <i>It is important to consider the bombing density when assessing the possibility that UXBs remain in an area. High bombing density could allow for error in record keeping due to extreme damage caused to the area.</i>	During WWII the site was situated in the Municipal Borough of Hornsey. According to official Home Office bombing statistics this borough sustained an overall high density of bombing, with 355 items of ordnance recorded to have fallen within the 2,872 acre borough, or an average of 123.6 items per 1,000 acres. Multiple HE bomb strikes were recorded within the site's immediate vicinity across mapping and written records in November 1940. London Bomb Census Mapping records one HE bomb strike directly on / directly north-west of the site, with another bomb strike directly south-east on Tottenham Lane. An incendiary bombing 'shower' is also recorded across the site in October 1940. This is generally corroborated by written records. The Hornsey Register of Incidents, Air Raid Damage Records and Incident Records each recorded one HE on the roadway outside the YMCA building on Tottenham Lane on the 1st/2nd November 1940; the YMCA building was situated on site. Another HE bomb fell on this date approximately 60m north-west of the site, and one further bomb is also recorded approximately 40m north-west of the site the following week, on the 8th/9th November 1940.
Damage <i>If buildings or structures on a site sustained bomb or fire damage, any resulting rubble and debris could have obscured the entry holes of unexploded bombs dropped during the same or later raids. Similarly, a high explosive bomb strike in an area of open agricultural land will have caused soil disturbance, increasing the risk that a UXB entry hole would be overlooked.</i>	Middlesex County Council (MCC) War Damage Mapping indicates that the residential properties on site and adjacent sustained 'Category 2' damage: "some repairs possible, but could become Cat 1" (with Category 1 referring "total damage, building to be demolished"). Meanwhile the YMCA building and adjacent properties are described as being subject to 'Category 3' damage; "border line areas, uncertain whether repairs possible, might have to be demolished". This is corroborated by both post-war OS mapping as well as post-war aerial photography dated 1947 which indicates that the majority of the structures on and adjacent to the site had been cleared, with only the YMCA still standing. Damage to the YMCA building and neighbouring residential properties on site is corroborated by online sources. One states that "the building sustained some bomb damage whilst neighbouring houses and the cinema opposite were completely destroyed". Another notes that "the centre was on the edge of a high explosive impact during World War II and suffered considerable damage."



Ground Cover <i>The nature of the ground cover present during WWII would have a substantial influence on any visual indication that may indicate UXO being present.</i>	Wartime aerial photography from 1947 along with post-war OS mapping indicates that all of the residential properties on site had been cleared, along with the structures adjacent, likely because of the bomb strikes in November 1940. The YMCA building is also recorded to have sustained considerable bomb damage. Any items of UXO are considered more likely to go missing, and thus unreported, in areas subject to clearance and bombing damage; ruins, rubble, and debris likely present across the site could easily obscure evidence of UXO, such as bomb entry holes, which could be as small as 20cm in diameter. Therefore, groundcover on site for the majority of the war is not thought to be conducive to UXO detection.
Access Frequency <i>UXO in locations where access was irregular would have a greater chance of passing unnoticed than at those that were regularly occupied. The importance of a site to the war effort is also an important consideration as such sites are likely to have been both frequently visited and subject to post-raid checks for evidence of UXO.</i>	Following the bomb strikes on and within the site's immediate vicinity, the YMCA building was significantly damaged, and all of the residential structures on and adjacent to the site had been cleared. As a result, access to the site is thought to have been significantly reduced. Evidence of UXO is more likely to go unnoticed and unrecorded within infrequently accessed areas.
Bomb Failure Rate	There is no evidence to suggest that the bomb failure rate in the locality of the site would have been dissimilar to the 10% normally used.
Abandoned Bombs	1 st Line Defence holds no records of abandoned bombs at or within the site vicinity.
Bombing Decoy sites	1 st Line Defence could find no evidence of bombing decoy sites within the site vicinity.
Bomb Disposal Tasks	1 st Line Defence could find no evidence of bomb disposal tasks within the site boundary and immediate area.

12. Introduction to Allied Ordnance

12.1. General

Many areas across the UK may be at risk from Allied UXO because of both wartime and peacetime military use. Typical military activities and uses that may have led to a legacy of military UXO at a site include former minefields, home guard positions, anti-aircraft emplacements, training and firing ranges, military camps, as well as weapons manufacture and storage areas.

Although land formerly used by the military was usually subject to clearance before returned to civilian use, items of UXO are sometimes discovered and can present a potential risk to construction projects.

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

12.2. Defending the UK From Aerial Attack

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

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

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

12.3. Anti-Aircraft Artillery (AAA)

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

Anti-Aircraft Artillery				
Item	Description			
HAA	These large calibre guns such as the 3.7" QF (Quick Firing) were used to engage high flying enemy bombers. They often fired large HE projectiles, which were usually initiated by integral fuzes, triggered by impact, area, time delay or a combination of aforementioned mechanisms.			
LAA	These mobile guns were intended to engage fast, low flying aircraft. They were typically rotated between locations on the perimeters of towns and strategically important industrial works. As they could be moved to new positions with relative ease when required, records of their locations are limited. The most numerous of these were the 40mm Bofors gun which could fire up to 120 x 40mm HE projectiles per minute to over 1,800m.			
Variations in HAA and LAA Ammunition	Gun type	Calibre	Shell Weight	Shell Dimensions
	3.0 Inch	76mm	7.3kg	76mm x 356mm
	3.7 Inch	94mm	12.7kg	94mm x 438mm
	4.5 Inch	114mm	24.7kg	114mm x 578mm
	40mm	40mm	0.9kg	40mm x 311mm
Z-AA	Rockets were commonly designed to destroy heavily armoured military vehicles (anti-tank weapon). The device contains an explosive head (warhead) that can be accelerated using internal propellants to an intended target. Anti-aircraft rocket batteries were also utilised as part of air defence measures.			

The conditions in which anti-aircraft projectiles may have fallen unnoticed within a site area are analogous to those regarding air delivered ordnance. Unexploded anti-aircraft projectiles could essentially have fallen indiscriminately anywhere within range of the guns. The chance of such items being observed, reported and removed during the war depends on factors such as land use, ground cover, damage and frequency of access – the same factors that govern whether evidence of a UXB is likely to have been noted. More information about these factors with regards to this particular site can be found in the German Air Delivered Ordnance section of this report.

Illustrations of Anti-Aircraft artillery, projectiles and rockets are presented at **Appendix iv**.

13. The Likelihood of Contamination from Allied Ordnance

13.1. Introduction

There are several factors that may serve to either affirm, increase, or decrease the level of risk within a site with a history of military usage. Such factors are typically dependent upon the proximity of the proposed area of works to training activities, munition productions and storage, as well as its function across the years.

This section will examine the history of the proposed site and assess to what degree, if any, the site could have become contaminated as a result of the military use of the surrounding area.

13.2. Evaluation of Contamination Risk from Allied UXO

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

Allied UXO Records Summary	
Sources of Allied UXO Contamination	Conclusion
Military Camps <i>Military camps present an elevated risk from ordnance simply due to the large military presence and likelihood of associated live ordnance training.</i>	1 st Line Defence could find no evidence of a military camp within the site.
Anti-Aircraft Defences <i>Anti-Aircraft defences were employed across the country. Proximity to anti-aircraft defences increases the chance of encountering AA projectiles.</i>	1st Line Defence could find no evidence of Anti-Aircraft defences such as a HAA or LAA gun emplacement occupying or bordering the site. The closest HAA was located approximately 3.1km south-east of the site. Despite this distance the maximum effective range of an AA projectile can be up to 15km. The conditions in which HAA or LAA projectiles may have fallen unnoticed within a site footprint are generally analogous to those regarding German air delivered ordnance.
Home Guard Activity <i>The Home Guard regularly undertook training and ordnance practice in open areas, as well as burying ordnance as part of anti-invasion defences.</i>	Evidence of Home Guard activity is often difficult to locate, owing to the ad-hoc nature of Home Guard activity within each local area. Such training was often conducted on a small scale at the discretion of individual commanders and as such was seldom recorded officially. As such, no positive evidence could be found to confirm the presence of HG units within proximity to the site.
Defensive Positions <i>Defensive positions suggest the presence of military activity, which is often indicative of ordnance storage, usage or disposal.</i>	There is no evidence of any pillbox, emplacement or other defensive features formerly located on or bordering the site footprint.
Training or firing ranges <i>Areas of ordnance training saw historical ordnance usage in large numbers, often with inadequate disposal of expended and live items. The presence of these ranges significantly impact on the risk of encountering items of ordnance in their vicinity.</i>	No evidence of training or firing ranges could be found within the site or surrounding area.



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

14. The Likelihood of UXO Contamination Summary

The following table assesses the likelihood that the site was contaminated by items of German air delivered and Allied ordnance. Factors such as the risk of UXO initiation, remaining, and encountering will be discussed later in the report.

UXO Contamination Summary	
Quality of the Historical Record	The research has evaluated pre- and post-WWII Ordnance Survey maps, Luftwaffe reconnaissance imagery, WWI Bomb Plot Maps of London, London Bomb Census Mapping, London V-1 'Flying Bomb' Map, Hornsey Bomb Plot Map, Middlesex County Council Log Book of Air Raid Incidents, Hornsey Incident Records, Middlesex County Council Bomb Damage Map, post-WWII RAF Aerial Photography, and anecdotal information available online. . The record set is of generally good quality, with most record sets corroborating the locations of bomb strikes on/around the site boundary. Furthermore, the availability of post-war aerial imagery has aided in the assessment of wartime and post-war conditions on site.
German Air-Delivered Ordnance	- During WWII the site was situated in the Municipal Borough of Hornsey. According to official Home Office bombing statistics this borough sustained an overall high density of bombing, with 355 items of ordnance recorded to have fallen within the 2,872 acre borough, or an average of 123.6 items per 1,000 acres. - During WWII, the south-western half of the site was occupied by a row of residential properties on Tottenham Lane whilst the north-eastern half of the site was occupied by the YMCA building. - Multiple bomb strikes were recorded within the site's immediate vicinity across mapping and written records in November 1940. London Bomb Census Mapping records one HE bomb strike directly on / directly north-west of the site, with another bomb strike recorded directly south-east on Tottenham Lane. An incendiary bombing 'shower' is also recorded across the site in October 1940. - Similarly, the Hornsey Register of Incidents, Air Raid Damage Records and Incident Records each recorded one HE on the roadway outside the YMCA building on Tottenham Lane on the 1st/2nd November 1940; with this building being situated on site, and the roadway directly bordering. Another HE bomb fell on this date approximately 60m north-west of the site, and one further bomb is also recorded approximately 40m north-west of the site the following week, on the 8th/9th November 1940. - Middlesex County Council (MCC) War Damage Mapping indicates that the residential properties on site and adjacent sustained 'Category 2' damage: "some repairs possible, but could become Cat 1" (with Category 1 referring to "total damage, building to be demolished"). Meanwhile the YMCA building and adjacent properties are described as being subject to 'Category 3' damage; "border line areas, uncertain whether repairs possible, might have to be demolished". This is corroborated by both post-war OS mapping as well as post-war aerial photography dated 1947 which indicates that the majority of the structures on and adjacent to the site had been cleared, with only the YMCA still standing. - Damage to the YMCA building and neighbouring residential properties on site is further corroborated by online sources; one states that "the building sustained some bomb damage whilst neighbouring houses and the cinema opposite were completely destroyed", and another notes that "the centre was on the edge of a high explosive impact during World War II and suffered considerable damage." - Any items of UXO are considered more likely to go missing, and thus unreported, in areas subject to clearance and bombing damage; ruins, rubble, and debris likely present across the site following the bombing in November 1940 could have easily obscured evidence of UXO, such as bomb entry holes, which could be as small as 20cm in diameter. Therefore, groundcover on site for the majority of the war is not thought to have been conducive to UXO detection. - Furthermore, following the bomb strikes and significant damage sustained on and within the site's immediate vicinity, access to the site is thought to have been significantly reduced, as the area would have been evacuated and deemed unsafe. Evidence of UXO is more likely to go unnoticed and unrecorded within infrequently accessed areas.



	• In summary, multiple bomb strikes were recorded on / within the site's immediate vicinity, along with a significant level of damage / clearance to the structures on and adjacent to the site. Following the bomb strikes and damage recorded, and the clearance evident on aerial photography and OS mapping, it is anticipated that access to the site would have been infrequent for the majority of the war, and groundcover would not have been conducive to UXO detection, with the potential for rubble to obscure a UXB entry hole. As a result of these factors, the site is therefore considered to be at a Medium Risk of UXO contamination.
Allied Ordnance	• No evidence could be found to indicate that the site formerly had any military occupation or usage that could have led to contamination with items of Allied ordnance, such as LSA and SAA. • The conditions in which HAA or LAA projectiles may have fallen unnoticed within the site boundary are however analogous to those regarding air delivered ordnance.

15. The Likelihood that UXO Remains

15.1. Introduction

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

15.2. UXO Clearance

1st Line Defence has found no evidence in the public domain or within internal records that any official ordnance clearance operations have taken place on site. Note however that we have not received confirmation of this fact from the 33 EOD Regiment Archive (now part of 29 EOD & Search Group). It should also be noted that in addition to 29 EOD & Search Group archival information, 1st Line Defence also do not currently have access to data that may be relevant including 5131(BD)SQN Archive, SD Training Technical Advisory Section (TAS) and MACA Records (bomb disposal callouts).

If such information is available at a later date, it is recommended that it be reviewed as it will assist with understanding both levels and types of contamination likely to be present, and may indicate risk reduction in certain areas.

15.3. Post-War Redevelopment

Pre-war residential buildings are shown to have been cleared on 1950s post-war OS mapping. Recent aerial imagery indicates an extension of the existing YMCA centre has taken place in the years since WWII.

The risk of UXO remaining is considered to be mitigated at the location of and down to the depth of any post-war redevelopment on site. For example, the risk from deep buried UXO will only have been mitigated within the volumes of any post-war pile foundations or deep excavations for basement levels. The risk will however remain within virgin geology below and amongst these post-war works, down to the maximum bomb penetration depth.