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BeFirst



# Detailed UXO Risk Assessment

**FIL Reference:** 2663R
**Client:** Be First (Regeneration) Ltd
**Project:** Claridge Road
**Site Location:** Claridge Road, Dagenham, RM8 1RR
**Report date:** 05 October 2020

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## Contents

Acronyms and Abbreviations ..... 3

1. Executive Summary ..... 4
2. Report Methodology ..... 6
3. Requirement for UXO Risk Assessment ..... 7
4. Site Description (Current) ..... 8
5. Dagenham & Ilford's Military History Military History ..... 9
6. Site Environment ..... 15
7. Sources of Potential Unexploded Ordnance ..... 16
8. Aerial Bombing ..... 17
9. UXB Risk at the Site ..... 24
10. Other Military Ordnance ..... 25
11. Overall UXO Risk Assessment ..... 31
12. Recommendations to Reduce UXO Risk to ALARP ..... 34
13. References ..... 35

# Acronyms and Abbreviations

| | |
|---|---|
| AAA | Anti-Aircraft Artillery |
| AP | Armour Piercing |
| AP | Anti-Personnel |
| ARP | Air Raid Precaution (Wardens) |
| BD | Bombing Density |
| BGL | Below Ground Level |
| BGS | British Geological Survey (UK) |
| BH | Borehole |
| CDM | Construction (Design and Management) Regulations 2015 (UK) |
| CIRIA | Construction Industry Research and Information Association |
| CPT | Cone Penetrometer Test |
| EOC | Explosive Ordnance Clearance |
| EOD | Explosive Ordnance Disposal |
| ERP | Emergency Response Plan |
| ERW | Explosive Remnants of War |
| FFE | Free From Explosives |
| GI | Ground Investigation |
| GPS | Global Positioning System |
| HE | High Explosive |
| HSE | Health and Safety Executive |
| HSWA | Health and Safety at Work Act 1974 |
| IB | Incendiary Bomb |
| JSEODOC | Joint Services Explosive Ordnance Disposal Operations Centre (UK) |
| LE | Low Explosive |
| LM | Luftmine (Germany) |
| LSA | Land Service Ammunition |
| MOD | Ministry of Defence (UK) |
| NEQ | Net Explosive Quantity |
| RAF | Royal Air Force |
| RN | Royal Navy |
| ROF | Royal Ordnance Factory |
| SAA | Small Arms Ammunition |
| SAP | Semi-Armour-Piercing |
| SI | Site Investigation |
| SIP | Self-Igniting Phosphorous |
| UXB | Unexploded Bomb |
| UXO | Unexploded Ordnance |
| V1 | Vengeance Weapon 1 - Flying bombs or doodlebugs |
| V2 | Vengeance Weapon 2 - Long range rocket |
| WW | World War |

# 1. Executive Summary

## Site details

The site is located alongside Claridge Road, Dagenham. The postcode for the site is RM8 1RR, with an approximate grid reference of TQ 47808 87147.

## Risk Assessment

Unexploded Ordnance (UXO) risk at the site is assessed as:

| UXO | RISK |
|---|---|
| German Air Service Munitions | Low Risk |
| British Anti-Air defensive munitions | Low Risk |
| Other (Land service Ammunition / Historic (Home Guard) / Military Training) | Negligible Risk |

Full detail of the UXO risk and the risk assessment process is within section 11.

## German Air Service Munitions

During the Second World War, both Dagenham and Ilford were repeatedly targeted by the Luftwaffe owing to numerous strategic targets contained within the boroughs. At the time of the conflict the site comprised of unmade ground, made up of allotments and gardens. Archival records reveal 22 HE bomb strikes within a 300m radius of the site, with no bombs recorded on the site itself. The closest was recorded falling approximately 150m north of the site. Given the sites small size and constant wartime use, and with no obvious bomb damage revealed on or in close proximity to the site in post-war photography, the risk of encountering buried German aerial UXBs has been assessed as low.

## AAA Emplacements

Research has identified five HAA batteries within 5km of the site, forming part of the Inner Artillery Zone (IAZ), which protected London. In addition, a 'Z' Type 3" Rocket Battery which was situated approximately 2.1km south of the site in Parsloes Park. Despite a relatively high concentration of AA defences, due to the sites small size and subsequent mitigating works, the risk of encountering 'fall to earth', AA munitions has been assessed as low.

## Other (Land service Ammunition etc.)

No military sites were located nearby, therefore these types of munitions would not have been present. It is assessed that the risk of encounter is negligible.

## UXO Risk mitigation recommendations

### For all works within the site area:

### UXO Awareness Training

A UXO Awareness Brief (UXOAB) be delivered to all site personnel. This can also include a site safety walk-through and provision of a UXO Emergency Response Plan for inclusion into the site H&S documentation.

### On-call Service

For areas / sites where on-site support is not considered necessary, Fellows provide an on-call service whereby clients can call Fellows between 0800 and 1800 Mon-Fri (out of these hours by prior arrangement) and a senior member of the operations team will be able to answer queries and offer advice on any items of potential UXO found during site works.

This can significantly reduce the risk of accidental detonation when items are found unexpectedly and can often fulfil local authority planning stipulations for UXO risk mitigation.

### Emergency Response Plan

A site-specific emergency response plan (ERP) should be produced to provide clear and precise guidance on what to do should UXO be encountered, and / or detonated as part of the site works. It should be accompanied by emergency management team roles and responsibilities.

The ERP should be included in the health and safety plan for the proposed works and communicated to the work force at the operational level, typically as part of a toolbox talk. The ERP should be appropriate to the level of risk identified in this desk study.

Fellows International Limited can provide all of the above services and would be pleased to provide a proposal accordingly.

For further information, or to discuss requirements, please get in touch.

Web – www.fellowsint.com Tel – 08000 424 424 Email – info@fellowsint.com

## 2. Report Methodology

The aim of this report is to conduct a comprehensive assessment of the potential risk from UXO at the site as described by the client.

Every reasonable effort has been made to ensure that all available historical information has been assessed and checked. Where possible, evidence has been included in the report to enable the client to understand the basis of the risk assessment. Fellows cannot be held responsible for any changes to the assessed level of risk or risk mitigation measures based on documentation or other information that may come to light at a later date. The accuracy of wartime records is frequently difficult to verify. As a result, conclusions as to the exact location, quantity and nature of the ordnance threat can never be definitive but must be based on the accumulation and careful analysis of all accessible evidence. Fellows cannot be held responsible for inaccuracies or gaps in the available historical information. All sources are referenced at Section 12.

The report recommends appropriate site and work-specific risk mitigation measures to reduce the risk from explosive ordnance during the envisaged works to a level that is as low as reasonably practicable (ALARP).

This report follows the guidelines outlined in CIRIA Report C681, 'Unexploded Ordnance (UXO) A Guide for the Construction Industry' and CIRIA C785, 'Unexploded Ordnance (UXO) Risk Management'.

Fellows has been supporting the UK construction industry with UXO Risk Management measures for over two decades and offer the complete UXO risk management process from the preliminary and detailed desk study though to the physical site survey and finally, the identification and removal or disposal of an item, either in house or in liaison with military disposal assets. Our desk top studies enable our clients to accurately assess the UXO risk and take proportionate, cost effective action to manage the risk posed by unexploded aerial bombs and other munitions.

As one of the first companies to offer this service in the UK, Fellows have unrivalled experience delivering the UXO Risk Management process and are proud of our reputation for quality and cost-effective delivery, gained from our years of experience. Fellows can support you through the whole risk management process from project start to final delivery. While Fellows is mainly active in the UK, we also have a long history of operating overseas on projects all over the globe. We are proud to support both the construction and offshore industries with the right experience, people, qualifications and equipment to best identify, quantify and mitigate the UXO risk wherever it may be.

# 3. Requirement for UXO Risk Assessment

## Background

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

## CDM Regulations 2015

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

Although CDM 2015 does not specifically reference UXO, the risk presented by such items is both within the scope and purpose of the legislation. It is therefore implied that there is an obligation on parties to:

- Provide or obtain an appropriate assessment of potential UXO risks at the site
- Emplace appropriate risk mitigation measures if necessary
- Supply all parties with relevant risk information
- Prepare a suitably robust emergency response plan.

## Other legislation

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

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

# 4. Site Description (Current)

## Site location

The site is located alongside Claridge Road, Dagenham. The postcode for the site is RM8 1RR, with an approximate grid reference of TQ  47808 87147.

## Mapping / Satellite Imagery




*Figure 1. Showing Satellite Imagery of the site area. [Google, 2020]*

# 5. Dagenham & Ilford's Military History Military History

## Dagenham & Ilford in WW1

During the First World War, Dagenham was a largely rural district, with industry confined largely to the northern bank of the River Thames. On the outbreak of war, the borough's limited manufacturing base was restructured to support the war effort. The Nitrogen Products & Carbide Company of Dagenham produced Ammonium Nitrate for the production of explosives. As part of the National Factories Scheme, the Ministry of Munitions constructed the National Cartridge & Box Repair Factory No. 15 built at Dagenham Dock. Opening in 1916, it was responsible for repairing salvaged artillery cartridge cases and ammunition boxes.

## Dagenham & Ilford in WW2

During the Second World War, the industrial capacity located within Dagenham and Ilford was restructured once again to produce materials for the war effort. In Ilford, Plessey Ltd., manufactured numerous aircraft components some 161,500 pieces of electrical equipment by wars end, in addition to radio equipment and shell cases. In Dagenham, the industrial capacity of the borough had increased dramatically during the inter-war years, with the construction of the Ford Factory, which opened in 1931. Throughout the conflict it was involved with the production of military vehicles and was consequently bombed on several occasions.

The Sterling Armament Company also located within the borough produced sub-machine guns for both the Royal Navy and British Army. The company continued to produced guns at its Dagenham factory until 1988. Owing to the large industrial presence the two boroughs were subjected to sustained aerial bombardment from 1940 until 1945. Over this period, high explosive and incendiary bombs were dropped across the area, in addition to parachute mines, V1 Flying Bombs and V2 Long Range Rockets.

In line with the rest of the country, both Dagenham and Ilford raised their own contingents of Home Guards which became the 11th City of London (Dagenham) and the 52nd Battalion (Ilford) Essex Home Guard. These battalions were charged with the safety and security of the local area. In 1940, part of the London Stop Line, (a network of anti-invasion defences), ran through Dagenham, as evidence by the high number of anti-tank obstacles still visible across the area. The Dagenham Home Guard, amongst others would have been responsible for manning these fortifications, alongside controlling the civilian population.

As the threat from invasion diminished, the Home Guard gradually expanded its duties, to include support for the Civil Defence Services in aftermath of air raids, including the demolition of damaged structures, crowd and traffic control and tending to the wounded.

The two closest operational military airfields have been located and identified as RAF FAIRLOP and RAF HORNCHURCH. RAF FAIRLOP became operational in 1941 as a Fighter Command Station operating Supermarine Spitfires. In 1944, the airfield became a barrage balloon centre, with four squadrons forming part of the defence of London. RAF HORNCHURCH, was a key RAF Fighter Command Station, supporting efforts during the Battle of Britain. The airfield was also used for the training of aircrew and remained an active RAF station until its eventual closure in 1962.

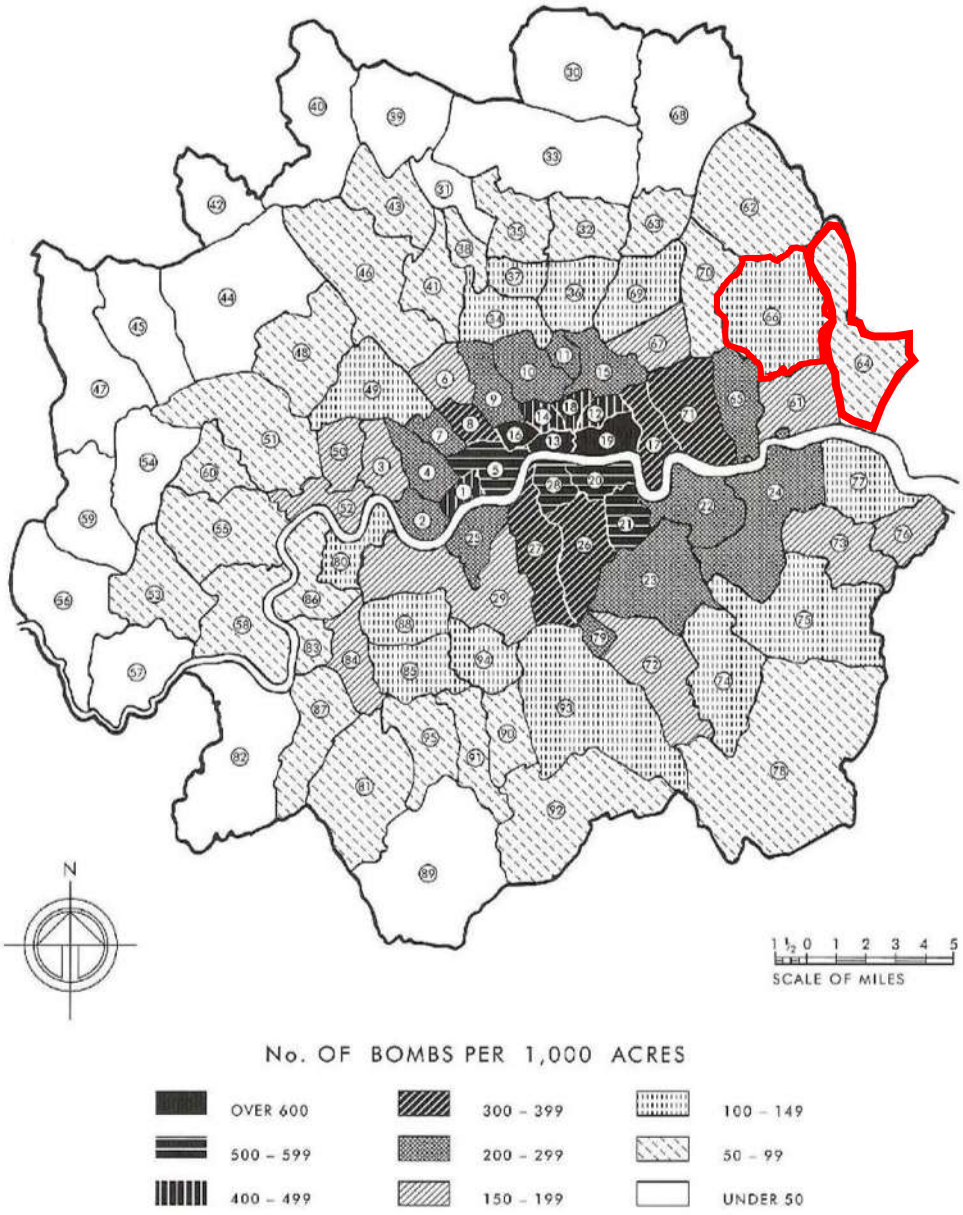



*Figure 2. Bombing density, by borough, in London during WWII. [London County Council Records]*

## Bombing activity near the site

Fellows has reviewed Air Raid Precaution (ARP) records, and Bombing Density information, held by the National Archives, alongside further ARP records held by the Barking and Dagenham Archives and Local Studies Centre at Valance House, alongside records from the Redbridge Central Library and Museum. In addition to readily available records and internal Fellows documents related to Dagenham and Ilford. It is worth noting historic records and maps of bomb strike locations cannot establish a full description of air raids that may have occurred during WW2 as the accuracy of wartime records are frequently difficult to verify.

| Administrative Area (Municipal Boroughs) | Land Area | | Numbers of items of Ordnance Recorded | | | | | | | | Ordnance Density | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Acres | Hectares | High Explosive Bombs | Parachute Mines | Oil Bombs | Phosphorus Bombs | Fire Pots | V1 | V2 | Total | Per 1,000 Acres | Per 100ha |
| Dagenham | 6554 | 2554 | 466 | 24 | 26 | 50 | 1 | 31 | 18 | 616 | 94 | 23 |
| Ilford | 8425 | 3412 | 734 | 31 | 50 | 31 | 11 | 34 | 35 | 926 | 110 | 27 |

*Table 1. Ministry of Home security record of German Ordnance dropped within the municipal boroughs of Dagenham and Ilford during WW2.*




*Figure 3. Showing HE, AA Shells and UXB, within a 300m radius of the site.*

## Historical developments

The table below depicts in chronological order the changes that the site has undergone from 1920 to 2020.

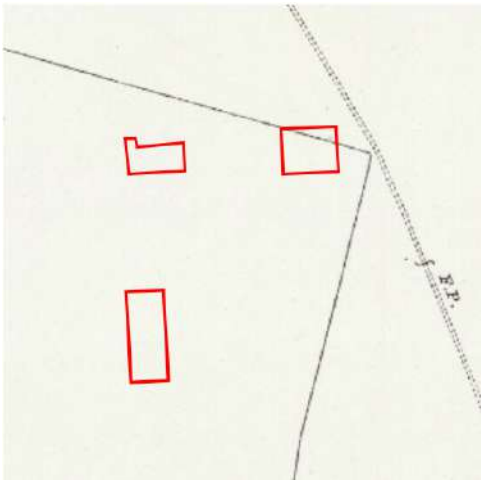
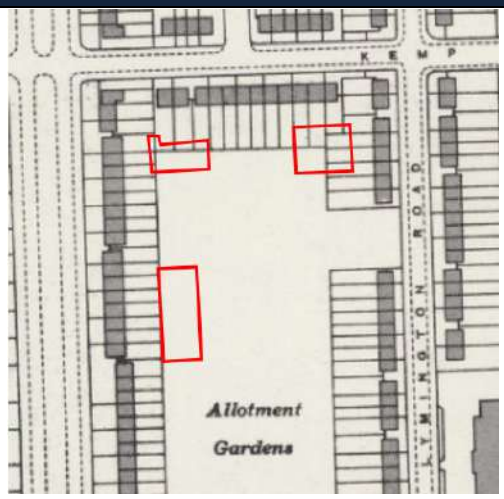
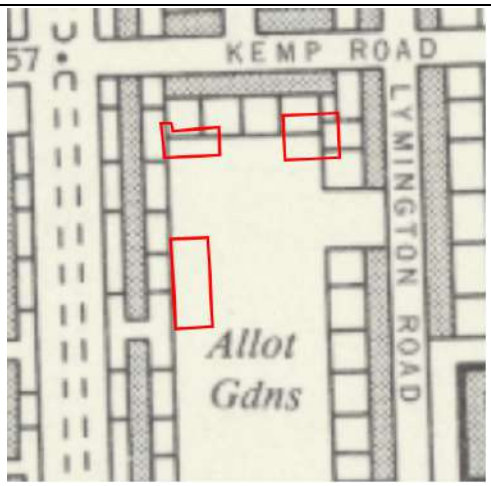
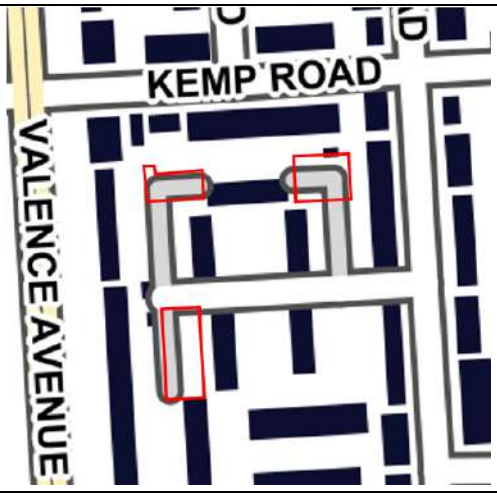
| OS Map | |
|---|---|
|  |  |
| Showing a section of 1920 OS mapping. The site occupies a section of open ground. | Showing a section of the 1946 revision of OS mapping, showing the site in its wartime composition, occupying allotments and gardens. |
|  |  |
| Showing a section of the 1949-69 revision of OS mapping, detailing no visible changes on the site. | Showing a section of the 2020 revision of OS mapping. Detailing the site in its current form, which dates from c. 1989. Further development of the surrounding area is visible. |

*Table 2. Summary table showing development of the site (Ordnance Survey Maps, 1920 – 2020).*

Historical analysis of the site area was carried out employing historic Ordnance Survey mapping and historic aerial photography.

The areas around the site have seen significant development since WW2. The site itself evidences only light development, with the construction of roads and prefabricated garages.



*Figure 4. Showing imagery of the site area dated 1945/498. The area comprises of allotment gardens.*

# 6. Site Environment

The site comprises three areas, which collectively make up an area of 0.109 hectares of made and shallow made ground comprising garages, pavement, and roadway.

## Proposed scope of works

No scope of works has been received by the client, consequently it has been assumed that there will be a range of shallow and deep excavation across the site.

## Ground conditions

Currently the site is comprised of shallow made (garages, roadway, and pavements) ground, beneath this is it assumed that the lithology would comprise primarily of clay, silt, gravel and sand.

## Site geological conditions

The local geology is comprised of superficial deposits of the Hackney Gravel Member (Sand and Gravel), overlying a bedrock geology comprised of the London Clay Formation (Clay, Silt and Sand), this is consistent across the entire site.

## Local Borehole information

The closest local borehole data has been collected from the British Geological Survey from a borehole conducted in 1972. The borehole is located at grid reference TQ 47360 87180 and is located approximately 404m east of the site.

| Borehole Reference | Date | Location | Hole Depth | Strata (Thickness) |
|---|---|---|---|---|
| TQ48NE113 | May 1972 | 547360 E 187180 N | 35'9" | (2'0") Road surface (made ground)<br><br>(35'9") Firm to stiff brown and grey mottled sandy and silty clay, becoming very sandy as depth increases |

*Table 3. Showing borehole logs for the nearest site (British Geological Survey, 2020).*

# 7. Sources of Potential Unexploded Ordnance

UXO found at construction and development sites in the UK originates from three principal sources:

- **Munitions deposited as part of military training or exercises.**

  In the UK, this can be historical from both World Wars and before but also more recent, especially as land reserved for military use is released for development.

- **Dumping**

  Munitions abandoned or dumped, either deliberately post war, accidentally lost in transit or due to ineffective working practices during manufacture, storage and transportation.

- **Wartime activity (including aerial bombing)**

  This includes ordnance resulting from wartime activities including enemy bombing, long range shelling, area or site denial weapons (mine fields or airfield pipe mines) and munitions from defensive activity such as anti-aircraft batteries or pre-invasion measures.

## Other factors which may increase UXO risk

Transportation of aggregates containing munitions to an area that was previously free of UXO has led to small munitions contaminating a previously low risk site. This is usually related to construction activities employing material dredged from a contaminated offshore borrow site although the use of explosive contaminated soil or fill from higher risk areas should also be considered.

# 8. Aerial Bombing

## General

During WW1 and WW2, many towns and cities across the UK were subjected to bombing which often resulted in extensive damage to city centres, docks, rail infrastructure and industrial areas. In addition to raids which concentrated on specific targets, indiscriminate bombing of large areas also took place, notably the London 'Blitz'. Bombing also affected many other towns and cities including Birmingham, Portsmouth and Bristol.

Approximately 10% of the bombs dropped on the UK did not detonate as designed. Although extensive efforts were made to locate and deal with these UXBs at the time, many still remain buried and can present a potential risk to construction projects.

Although the main focus of historical UXO research generally concerns German air-delivered ordnance dropped during WW2, all other forms of explosive contamination will also be considered.

One of the most common type of UXO discovered today is the aircraft delivered high explosive (HE) bomb. These are comparatively thick-skinned and dropped from enemy aircraft. If the bomb did not detonate when it was dropped, the force of impact enabled the bomb to penetrate the ground, often leaving behind it an entry hole. These entry holes were not always apparent, and some went unreported, leaving the bomb buried and unrecorded. The bomb then became an Unexploded Bomb or UXB.

Additional forms of German aerial UXO will be considered including WW2 'Vengeance' weapons (V1 and V2 rockets), small Incendiary Bombs (IBs), and Anti-personnel (AP) bomblets.

## World War One aerial bombing

WW1 bombs were generally smaller than those used in WW2 and were dropped from a lower altitude, resulting 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.

London was the target of a sustained aerial bombing campaign during the First World War, there is limited evidence of aerial bombing of the Ilford area, however given Dagenham's rural composition and limited industrial infrastructure was not itself a target and did not suffer from any recorded bombing. Consequently, the threat from First World War German UXBs will therefore not be considered any further in this report.

## World War Two aerial bombing

### Targeting

Although the Luftwaffe had designated primary bombing targets across the UK, their high-altitude night-time bombing was not accurate. As a result, thousands of buildings were damaged and civilian fatalities were common. Bombs were also jettisoned over opportunistic targets and residential areas were often struck.

When Luftwaffe aircraft wished to escape due to interception by fighter aircraft or anti-aircraft fire, they would jettison their bomb-load to increase speed and manoeuvrability. This is commonly referred to as tip and run and it has resulted in bombs being found in unexpected locations.

### Decoy sites

RAF and Royal Navy decoy sites were constructed in the vicinity of legitimate targets to deceive and decoy enemy bombers. For obvious reasons, such sites were often built in remote and uninhabited areas. Some were more successful than others and received relatively high bombing rates.

There are no records of decoy sites within 5km of the site.

## Aerial bombs

The most commonly dropped German aerial weapon was the SC50 (50kg). The next largest weapon is the SC250 (250kg) HE bomb. These were dropped primarily against soft targets such as gas and electricity installations, factories, housing and transport infrastructure.

Although the Luftwaffe deployed larger bombs in the area, their deployment was infrequent, the majority of bombs dropped were SC50 (50kg) and SC250 (250kg) HE bombs.

UXB risk of encounter has been assessed by using the SC50 and SC250 as the primary risk weapon.

## WW2 German Aerial Ordnance

| Type | | Description |
|---|---|---|
| High Explosive (HE) Bombs |  German SC250 (recovered casing)  German SC50 (London 2015) | The SC series of HE Bombs were a thin cased general-purpose bomb used as general demolition bombs.<br><br>Most bombs were 50kg, 250kg or 500kg, although larger bombs of up to 1,800kg were also used. About half the weight of these HE bombs comprised of explosive fill.<br><br>The SC50 had a one-piece drawn steel body and its total weight was 48 to 55 kg.[1] It was dropped on targets across the UK.<br><br>The SD series of bombs were thicker cased, with a lower charge weight used against hardened targets. |

| Type | | Description |
|---|---|---|
| Incendiary bombs |  1Kg Incendiary Bomb | The 1 kg B1E incendiary bomb consisted of a cylinder of magnesium alloy, with an incendiary filling of thermite. Rivetted to the body was a steel tail with three fins. These bombs did not explode but were ignited by a small percussion charge, fired upon impact. They were dropped in a variety of containers. Later an explosive head was incorporated into the IB. |

| Type | | Description |
|---|---|---|
| Anti-Personnel (AP) bombs |  SD2 'Butterfly' Bomb (Armed status) | A Butterfly Bomb (or *Sprengbombe Dickwandig* 2kg or SD2) was a German 2-kilogram anti-personnel sub munition used by the Luftwaffe during the Second World War. It was so named because the thin cylindrical metal outer shell which hinged open when the bomblet deployed gave it the superficial appearance of a large butterfly. The design was very distinctive and easy to recognise. SD2 bomblets were not dropped individually but were packed into containers holding between 6 and 108 sub munitions. These broke open in air and scattered the sub-munitions. |

## UXB Initiation

Unexploded ordnance does not normally spontaneously explode. Military high explosive is generally reasonably stable and requires significant energy, normally via a fuze and initiation system for detonation to occur. In the case of unexploded German bombs discovered within the construction site environment, there are a number of other potential initiation mechanisms.

## Direct impact

Unless the fuze or fuze pocket is struck, there needs to be a significant impact e.g. from piling machinery or large and violent mechanical excavation, onto the main body of the weapon to initiate a buried iron bomb. Although it is unlikely, such violent action could cause a bomb to detonate.

## Fuzes

Most German bomb and mine fuzes were electric and were highly engineered compared to their British equivalents. A small proportion of German WW2 bombs employed clockwork fuzes. It is probable that clockwork or mechanical fuze mechanisms would have corroded since WW2 and this will generally prevent them from functioning.

## Friction impact

Impact from construction machinery or processes could initiate the shock-sensitive fuze explosive. The effects of chemical breakdown of explosive fill and general degradation over time can cause explosive compounds to crystallise and extrude out from the main body of the bomb. It may only require a limited amount of energy to initiate the extruded explosive around the fuze pocket which could detonate the main charge.

## Consequence of interaction

When considering the potential consequences of a detonation, it is necessary to identify who may be affected. These will vary depending on the site-specific conditions but can be summarised as:

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

## Failure Rate of German air-delivered ordnance

It has been estimated that 10% of the German HE bombs dropped during WW2 failed to explode as designed. There are a number of reasons why an air-delivered weapon might fail to function as designed:

- Malfunction of the fuze or initiation mechanism (either electric or clockwork)
- Failure of the bomber aircraft to arm bombs correctly
- Jettisoning of the bomb before it was armed or from a very low altitude. Likely if the bomber was under attack or attempting a forced landing due to damage.

Unexploded ordnance is still regularly encountered across the UK and is dealt with on a routine basis by military and commercial Bomb Disposal teams.

## Bomb penetration

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

- Size 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 alluvial deposits are easier to penetrate than gravel and sand. Layers of hard strata will significantly retard and may stop the trajectory of a UXB.

## Impact angle and velocity

It is assumed that bombs struck at an angle 80-85° from vertical and at c. 270 metres per second. These are standard figures used for bomb release from an aircraft at normal altitude. Other factors such as low speed or altitude of the bombing aircraft may alter these figures, but no records are available to suggest any low-level raids or incidents.

## Buried bombs

When bombs strike but do not detonate, they can easily remain undetected. Note that the entry hole of an SC50 (the most commonly deployed German HE bomb) could have been as small as 20cm in diameter and therefore easily obscured within dense crops, or unmaintained vegetation, rough soil or rubble from previous damage.

## The J-Curve Effect

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 up to 15m leading to bombs settling underneath undamaged buildings.

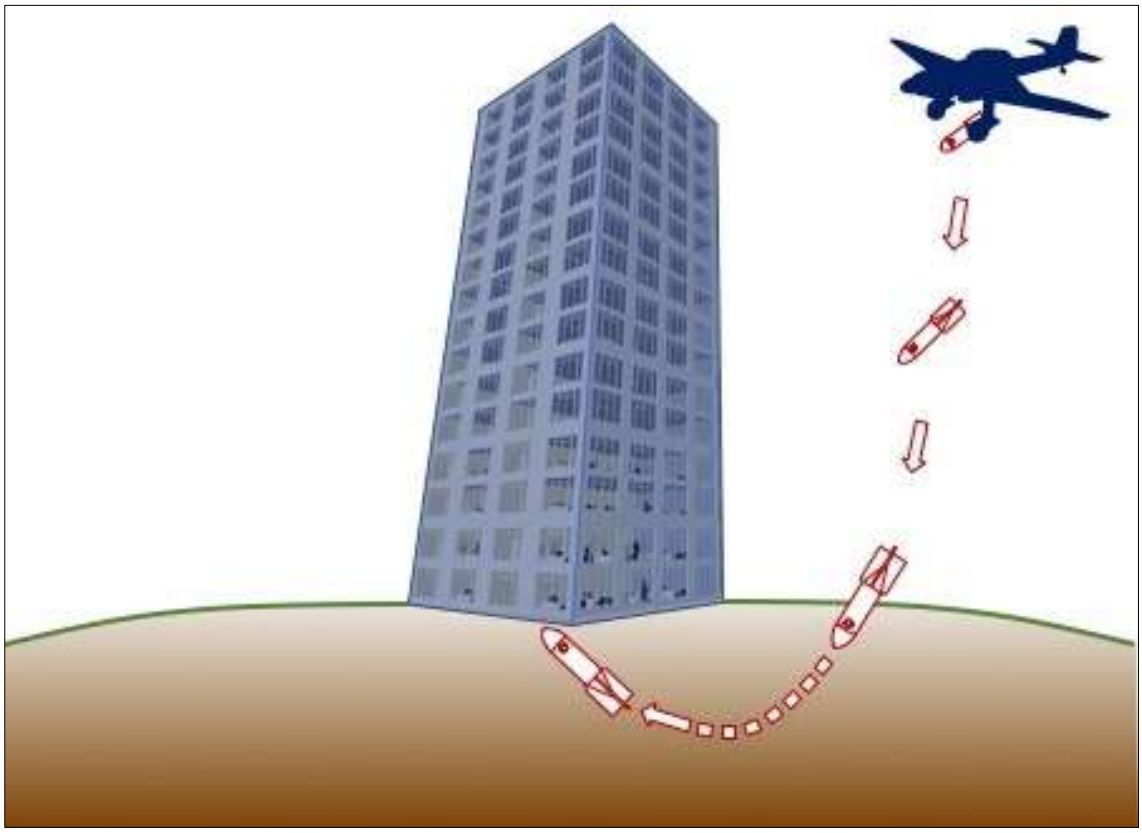


*Figure 5. Demonstrating the J-Curve.*

# 9. UXB Risk at the Site

## Abandoned bombs

Research did not indicate the presence of any abandoned bombs within the site boundary. The closest abandoned bomb is recorded approximately 4.1km north east of the site on Hog Hill Road.

## Bombing density at site

Archival records show that there were 22 HE bomb strikes within a 300m radius of the site. No bombs were recorded as having fallen on the site, with the closest recorded falling approximately 150m north of the site boundary.

## Local geology

The local geology is comprised of superficial deposits of the Hackney Gravel Member (Sand and Gravel), overlying a bedrock geology comprised of the London Clay Formation (Clay, Silt and Sand), this is consistent across the entire site.

## Post war / previous works

Through the examination of post-war aerial photographs and mapping, it has been possible to chart the development of the site. During the Second World War, the site comprised of allotments, comprising unmade ground. The site in its current form dates from c.1987

## Bomb penetration depth at this site

Due to the local geology, the previous land usage and the history of the area, maximum bomb penetration depth for an SC50 (50kg) bomb is assessed to be 4m bgl. The SC250 (250kg) bomb is considered to have a maximum bomb penetration depth of 8m bgl.

## 10. Other Military Ordnance

In addition to aerial bombs, there may also be a risk from other items including discarded or forgotten land munitions from both wartime and peacetime military use. Typical military activities may include:

- Former minefields; often on beaches on the South and East coasts of England
- Home Guard weapons and munitions
- Anti-Aircraft sites
- Training & firing ranges
- Military bases
- Munitions manufacture and storage sites

During the early years of WW2 huge preparations were underway to defend the UK against German attack. This often included the hiding or caching of defensive ordnance at or near to strategically or tactically important locations.

Items may include small arms ammunition, mortar bombs and hand grenades or even crudely manufactured defensive weapons designed for Home Guard use such as the No.76 SIP (Self Igniting Phosphorus) grenades. These items, resembling a milk bottle are frequently found in original crates during shallow excavations or building demolition and although small in size can inflict life-changing injuries if not dealt with correctly. The potential risk of encountering allied ordnance on construction sites is particularly elevated in areas previously associated with military activity. This includes munitions deposited by military training exercises, dumped as a result of poor working practices, or deliberately placed to prevent adversary occupation.

## Anti-Aircraft Artillery

Urban areas can be at risk from shallow buried unexploded Anti-Aircraft projectiles fired during WW2.

At the onset of WW2 two types of Anti-Aircraft Artillery (AAA) guns were deployed:

- Heavy Anti-Aircraft Artillery (HAA), using large calibre weapons, such as the 3.7" QF (Quick Firing) gun. Normally fixed batteries.
- Light Anti-Aircraft Artillery (LAA) using smaller calibre weapons, such as 40mm Bofors gun. Often mobile, vehicle mounted batteries.

| Type | | Description |
|---|---|---|
| Anti-Aircraft Shells |  40mm AA Shells found at W Sussex site | Fixed (Heavy) Anti-Aircraft batteries were set up all around the country to defend potential targets from aerial attack. Size of guns and shells ranged from small, quick-firing 40mm Bofors guns to larger 3.7 or 4.5inch guns.<br><br>3.7 Inch = 12.7kg 94mm x 438mm<br>40mm = 0.9kg 40mm x 311mm<br>4.5 Inch = 24.7kg 114mm x 578mm |

LAA batteries were intended to engage fast, low flying aircraft and were typically deployed around military bases, RAF airfields or important installations. These batteries were mobile and could be moved to new positions with relative ease when required. The most numerous of these were the 40mm Bofors gun, which could fire up to 120 x 40mm HE shells per minute to over 1,800m.

HAA projectiles were high explosive shells, usually fitted with a time delay or a barometric pressure fuze to make them explode at a pre-determined height. If they failed to explode or strike an aircraft, they would eventually descend back to earth. Dependent on-site conditions, larger AAA projectiles can be encountered beyond a depth of 2m.

The smaller 40mm projectiles are similar in appearance and effect to SAA and, although still dangerous, present a lower hazard due to its decreased explosive content. Numerous unexploded AAA shells were recovered during and following WW2 and are still occasionally encountered on sites today.

## AAA Emplacements

Records show that there were five HAA emplacements and a Z Type 3" Rocket Battery within 5km of the site. This is shown in Table 4 below:

| AA Site / Location | Distance from Site |
|---|---|
| Parsloes Park ('Z' Type 3" Rocket Battery) | 2.1km South |
| Chadwell heath | 2.8km North East |
| Barking Park | 3.6km South West |
| Asylum | 4.7km North West |
| Creek Mouth | 4.8km South |
| Dagenham | 5km South East |

*Table 4. Showing HAA Anti-Aircraft emplacements within 5km of the site.*

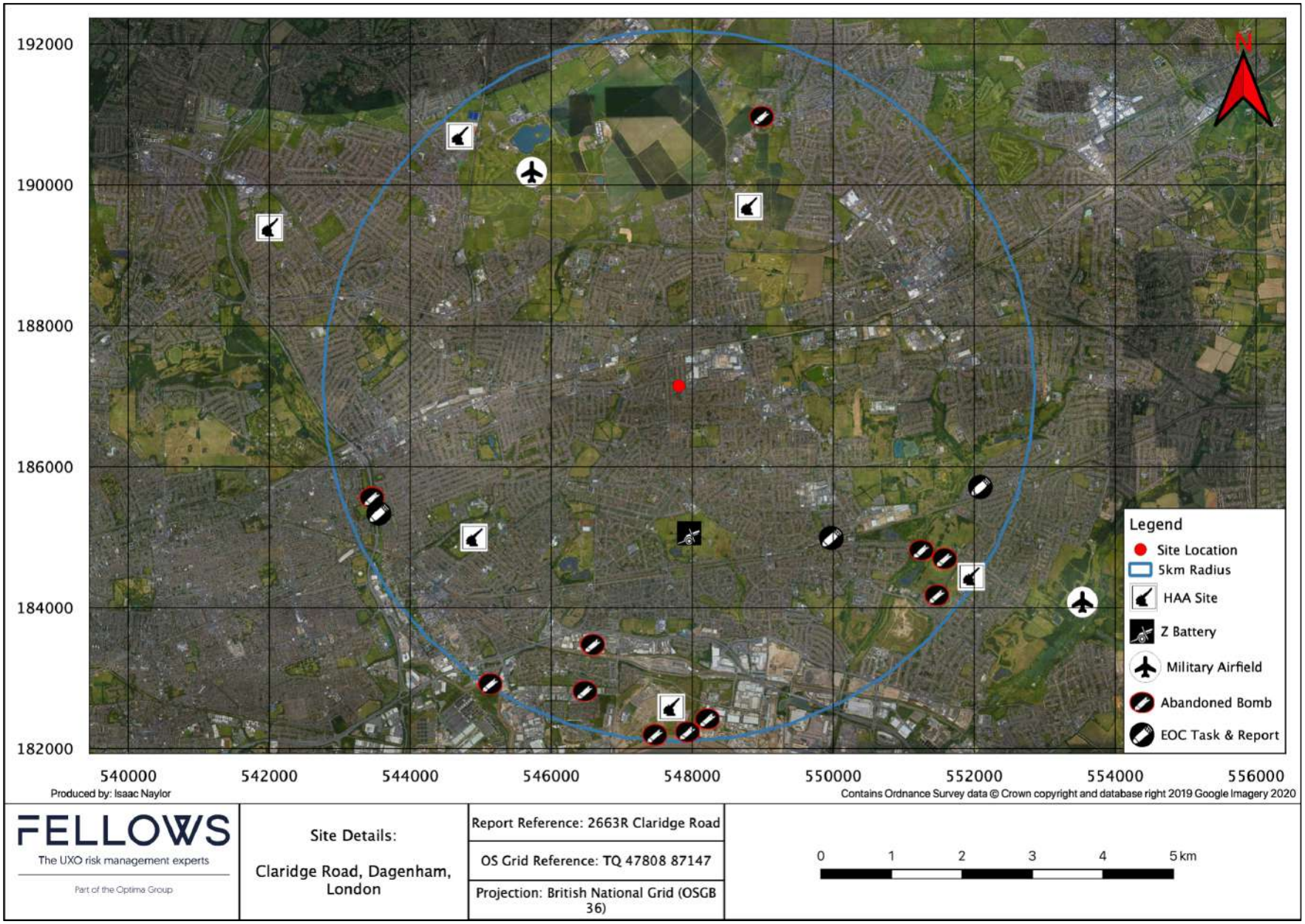



*Figure 6. Showing military activity within a 5km radius of the site.*

## Other defensive munitions

As the threat of invasion lingered over Britain during WW2, large areas of land were requisitioned for military training and exercises. Thousands of tonnes of munitions including HE bombs, artillery projectiles, Naval shells, bulk explosives and infantry weapons such as grenades and small arms ammunition were used in weapon testing and military training. It has been estimated that at least 20 per cent of the UK's land has been used for military training at some point.

| Type | | Description |
|---|---|---|
| No.76 SIP Grenade |  | No.76 SIP (Self Igniting Phosphorus) grenades. These items, resembling a milk bottle are frequently found during shallow excavations or building demolition and although small in size can inflict life-changing injuries if not dealt with correctly.<br><br>Found in wooden crates of 24 items. |

| Type | | Description |
|---|---|---|
| Hand Grenades | <br>British Mills No.36 Grenade | Contains a small amount of High Explosive and a rudimentary time delay fuze.<br><br>The absence of a pin and fly-off handle indicate the item is potentially live.<br><br>The distinctive segmented (Pineapple) casing gives the fragmentation effect on detonation. |

## Small Arms Ammunition

The most common type of ordnance encountered on land formerly used by the military are items of Small Arms Ammunition (SAA). SAA refers to the complete round or cartridge designed to be used with hand-held infantry weapons such as rifles, machine guns and pistols. SAA can include bullets, cartridge cases and primers/caps. Items of SAA can be accidentally initiated by striking the casing or coming into contact with fire. SAA presents only minimal risk although it must be disposed of correctly if found on-site.

| Type | | Description |
|---|---|---|
| Small Arms Ammunition |  Small Arms Ammunition | Small arms of various sizes from 4 or 5mm calibre (diameter) up to 12 to 13mm.<br><br>Generally, the head is inert and made of lead or similar dense material.<br><br>Brass cases without the head pose no risk. |

# 11. Overall UXO Risk Assessment

In establishing the UXO risk at this site, Fellows take the following factors into account:

- The amount and nature of WW1 and WW2 German aerial bombing
- The nature and conditions of the site during at the time
- Other military use of the site i.e. AA Gun sites, storage, training
- The extent of post-war development and UXO clearance operations on site
- The scope and nature of the proposed works and assessed bomb penetration depth
- The nature of non-aerial ordnance that may have contaminated the site area

## Risk Assessment

The risk assessment matrix below is based upon the chance of encountering items of ordnance and the consequence of interaction with them. This can range from the detonation by design (via fuzing and explosive train) of a large aerial bomb to the accidental breakage of old Home Guard glass bottle grenades.

In accordance with standard UK risk assessment methodologies, the overall risk is gained by multiplying the likelihood (chance of encounter) with the consequence (consequence of interaction) and is graded from negligible to Very High risk.

## Descriptors

### Chance of encounter

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Not at all likely | Unlikely | Possible | Likely | Almost certain |

### Consequence of interaction with munition

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| First aid incident | Minor injuries | Severe injuries | Fatalities | Multiple fatalities |

### Overall risk calculation (Chance of Encounter X Consequence of interaction)

| 1-5 | 6-10 | 11-15 | 16-20 | 21-25 |
|---|---|---|---|---|
| Negligible | Low Risk | Medium Risk | High Risk | Very High Risk |

## Summary

### German Air Service Munitions

During the Second World War, both Dagenham and Ilford were repeatedly targeted by the Luftwaffe owing to numerous strategic targets contained within the boroughs. During the conflict, the site comprised of unmade ground, made up of allotments and gardens. Archival records reveal 22 HE bomb strikes within a 300m radius of the site, with no bombs recorded on the site itself. The closest was recorded falling approximately 150m north of the site. Given the sites small size and given the site's constant wartime use, and with no obvious bomb damage revealed on or in close proximity to the site in post-war photography, the risk of encountering buried German aerial UXBs has been assessed as low.

### AAA Emplacements

Research has identified five HAA batteries within 5km of the site, forming part of the Inner Artillery Zone (IAZ), which protected London. In addition, a 'Z' Type 3" Rocket Battery was situated approximately 2.1km south of the site in Parsloes Park. Despite a relatively high concentration of AA defences, due to the sites small size and subsequent mitigating works, the risk of encountering 'fall to earth', AA munitions has been assessed as low.

### Other (Land service Ammunition etc.)

No military sites were located nearby therefore these types of munitions would not have been present. It is assessed, therefore, that the risk of encounter is negligible.

## Risk Assessment

| ACTIVITY | THREAT ITEM | CHANCE OF ENCOUNTER | CONSEQUENCE | RISK |
|---|---|---|---|---|
| Shallow Excavation (<2m) or Trial Pits | HE Bombs | 2 | 5 | 10 |
| | AAA Shells / IBs | 2 | 4 | 8 |
| | Other munitions | 1 | 3 | 3 |
| Window Sampling / shallow boreholes (<2m) | HE Bombs | 2 | 5 | 10 |
| | AAA Shells / IBs | 2 | 4 | 8 |
| | Other munitions | 1 | 3 | 3 |

| ACTIVITY | THREAT ITEM | CHANCE OF ENCOUNTER | CONSEQUENCE | RISK |
|---|---|---|---|---|
| Deeper excavations (>2m) i.e. Basement excavations | HE Bombs | 2 | 5 | 10 |
| | AAA Shells / IBs | 2 | 4 | 8 |
| | Other munitions | 1 | 3 | 3 |
| Piling and deep boreholes | HE Bombs | 2 | 5 | 10 |
| | AAA Shells / IBs | 2 | 4 | 8 |
| | Other munitions | 1 | 3 | 3 |

# 12. Recommendations to Reduce UXO Risk to ALARP

For all works within the site area:

UXO Awareness Training

A UXO Awareness Brief (UXOAB) be delivered to all site personnel. This can also include a site safety walk-through and provision of a UXO Emergency Response Plan for inclusion into the site H&S documentation.

On-call Service

For areas / sites where on-site support is not considered necessary, Fellows provide an on-call service whereby clients can call Fellows between 0800 and 1800 Mon-Fri (out with these hours by prior arrangement) and a senior member of the operations team will be able to answer queries and offer advice on any items of potential UXO found during site works.

This can significantly reduce the risk of accidental detonation when items are found unexpectedly and can often fulfil local authority planning stipulations for UXO risk mitigation.

Emergency Response Plan

A site-specific emergency response plan (ERP) should be produced to provide clear and precise guidance on what to do should UXO be encountered, and / or detonated as part of the site works. It should be accompanied by emergency management team roles and responsibilities.

The ERP should be included in the health and safety plan for the proposed works and communicated to the work force at the operational level, typically as part of a toolbox talk.

The ERP should be appropriate to the level of risk identified in this desk study.

Fellows International Limited can provide all of the above services and would be pleased to provide a proposal accordingly.

For further information, or to discuss requirements, please get in touch.

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## 13. References

The following sources of information were consulted in putting together this report:

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Fellows is recognised as one of the leading UXO Risk Management companies specialising in UXO Risk Assessments, Site Survey, Ground Investigation Support and UXO Awareness Training.

Conducting these operations requires not only the most experienced field staff, but also dedicated and experienced project management. Careful planning and co-ordination are needed from start to finish, backed up by detailed operational procedures. With many years' experience, Fellows has built up a reputation for reliability, whatever the risk. In recognition of our commitment to the quality of our work and the health and safety of our workforce, Fellows has been awarded UKAS accreditations in both ISO 9001-2015 (Quality) and ISO 45001-2018 (Occupational Health & Safety).

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