BRIMSTONE

DETAILED UXO RISK ASSESSMENT

STAGE 2 DETAILED UXO RISK ASSESSMENT

Client:	IDOM
Project Ref:	IDOM121R
Site Name:	Land to the South of Ashford Road, Sellindge, Kent
Report Ref:	DRA-24-1799-IDOM121R-LandtotheSouthofAshfordRoad,Sellindge,Kent
Revision:	0
Status:	Final
Date:	17th January 2025

Author:	Deanna-Leigh Stuart	Project Researcher	deanna.stuart@brimstoneuxo.com
Reviewed By:	Chris Birch	Research Training Coordinator	chris.birch@brimstoneuxo.com
Authorised By:	Aaron Florence	Managing Director	

EXECUTIVE SUMMARY

RESULT: Brimstone concludes that unexploded ordnance (UXO) poses a **MODERATE RISK** to the proposed works.

THE SITE: The Site (approximately centred on the National Grid Ref: TR 09968 38232) is located in Sellindge, within the county of Kent, approximately 2.9km north-west of Westenhanger railway station. It comprises entirely undeveloped, open ground with mature vegetation present periodically around the Site. Grove House and associated open ground are located in the centre of the Site; however, these are not included within the Site boundary for this assessment.

The Site is bound to the north by Ashford Road, to the east by Bulls Lane, to the south by a residential structure on Bulls Lane and an additional area of undeveloped ground, and to the west by a residential structure off Ashford Road and undeveloped ground.

THE PROPOSED WORKS: Site Investigation (SI) works will comprise a 20m rotary borehole, eight windowless sampler boreholes to a maximum depth of 5m below ground level (bgl), and six trial pits to approximately 3.5m bgl.

Development works will comprise the construction of 75 – 80 residential structures with associated access and landscaping in the west.

UXO RISK ASSESSMENT:

German UXO:

- During World War II (WWII), the Site was situated within the Rural District of Elham, which experienced 24.2 bombs / 1,000 acres, a low-to-moderate bombing density, according to official Home Office statistics. The Site was situated approximately 2.1km north-west of RAF Lympne and associated radio stations, which were identified as primary bombing targets in the region within Luftwaffe target photography.
- Kent daily bomb and shell plot mapping records approximately five high-explosive (HE) bomb strikes, one incendiary bomb (IB) strike and two machine gunning incidents as occurring within an approximate 1km radius of the Site; one bomb stick has been identified that appears to straddle the Site area, with one HE bomb strike appearing to be plotted over the Site / in the immediate vicinity. However, due to the large scale of these maps and the large plot points, the precise locations of the Site and of these incidents could not be confirmed.
- Furthermore, a collection of written ARP war diaries and a bomb and shell register for the Elham Rural District were assessed; collectively, 17 HE bomb strikes are recorded within an approximate 1km radius of the Site, as well as an unknown number of IBs, one anti-aircraft (AA) shell, two unexploded HEs (UXHE), one unexploded AA (UXAA) shell, and two V1 bomb strikes. The closest strike, an IB strike, is recorded approximately 280m north-west of the Site. However, no bombing incidents are recorded on Site or in the immediate surrounds.
- Note, the map references within these records use the Modified British System based on a Cassini use of a grid reference of the United Kingdom, which has an approximate 300m margin for error; therefore, it would be possible for recorded incidents to have occurred closer to the Site, potentially within its boundary, as well as further away.

- Post-WWII aerial photography dated 1945 identifies a potential ground disturbance in the western extent of the Site boundary, as well as additional potential cratering approximately 95m south within an adjacent area of open ground. An area of ground disturbances is also visible immediately south of the Site in the surrounds of the aforementioned crater. Furthermore, a potential crater is also visible approximately 550m south-west of the Site within this imagery, as well as approximately 820m north-west within post-WWII aerial photography dated 1946. However, no immediately obvious evidence of bomb damage is visible on Site or in the vicinity within WWII-era aerial photography dated 1940.
- The entirety of the Site comprised undeveloped, open ground, likely of an agricultural nature, during WWII. It is therefore anticipated that access may have been infrequent throughout WWII; although this would have depended on the landowner(s) and seasonal agricultural activity. Infrequent access reduces the likelihood that evidence of an unexploded bomb (UXB) strike would have been observed and reported; however, the undamaged residential structures present adjacent to the eastern extent of the Site may have added a degree of access to / monitor over areas of the Site in close proximity. Furthermore, any evidence of a UXB strike, such as a small entry hole, could feasibly have become obscured within vegetation, especially if it became overgrown at any point during WWII. Any such UXB could feasibly remain in-situ, given the lack of significant post-conflict redevelopment across the Site.
- In conclusion, while no bombing incidents are recorded on Site, numerous bomb strikes are recorded in the vicinity, with a potential bomb stick appearing to straddle the Site. Although no immediately obvious evidence of bomb damage is visible within the Site boundary itself, ground disturbances potentially indicative of German bomb damage are visible immediately south of the Site within an area of open ground. Given this, coupled with the margin of error associated with Cassini grid references, the Site's entirely undeveloped nature creating conditions unconducive to the detection of unexploded ordnance (UXO), and an anticipated lack of frequent access, it cannot be ruled out that a UXB strike could have occurred within the Site boundary unnoticed and unrecorded, becoming obscured within vegetation, could have come to rest within the Site boundary. As such, a **Moderate Risk** for German UXO has been assessed across the Site.

British / Allied UXO:

- Sellindge was designated as a 'Category A' Nodal Point during WWII, and defensive features were erected across the town. Indeed, anti-landing trenches are visible immediately south-west of the Site within WWII-era aerial photography dated 1940, as well as approximately 225m north-west.
- Multiple defensive emplacements have been identified within an in-house geodata set and on Heritage Gateway within an approximate 1km radius of the Site boundary. A searchlight battery is recorded approximately 300m south-east of the Site, while a railway gun is recorded approximately 685m south-east. Given the presence of trenches in the immediate surrounds and multiple defences emplacements in the vicinity, it is considered possible that the Site was further utilised for ad hoc training purposes or for the erection of additional temporary defensive emplacements, and associated ordnance may have come to contaminate the Site through failing to explode during training exercises or being disposed of through improper means; although, no evidence of the Site being requisitioned in any significant way has been identified.
- In conclusion, although the Site comprised undeveloped, open ground and was situated immediately adjacent to an area of anti-landing trenches, no evidence of the Site being utilised for defensive / training purposes has been identified. However, given the Site's open nature and situation within a Nodal Point, with associated defences identified in the vicinity, it cannot be completely ruled out that the Site was accessed by armed troops stationed in the wider study area. Therefore, a **Low-Moderate Risk** of encountering Allied UXO has been assessed across the Site.

- 10 permanent heavy anti-aircraft (HAA) batteries were active within range of the Site during WWII. Light anti-aircraft (LAA) guns likely defended vulnerable points within the borough also. Luftwaffe activity was somewhat frequent over the wider area and therefore these guns may have expended a reasonable quantity of ammunition. Consequently, there is an elevated likelihood of unexploded AA shells striking the Site; one such incident is recorded in the vicinity, approximately 465m north-east. As such, the risk of an unexploded AA shell striking the Site is considered to be analogous to German UXBs; a **Moderate Risk** has been assessed across the Site.

Likelihood of UXO Remaining and UXO Encounter:

- No significant post-conflict ground works are anticipated to have taken place across the Site boundary. Post-WWII, general maintenance / agricultural ploughing may have disturbance WWII-era soil to very shallow (<1m bgl) depths across the Site. However, no shallow (1-2m bgl) or deep (>2m bgl) intrusions are anticipated to have taken place across the Site.
- The risk associated with any very shallow buried UXO may have been largely mitigated across the Site. The risk associated with any shallow to deep buried UXO almost certainly remains unmitigated.
- Please note, the risk of a UXO encounter can be considered mitigated in the exact locations and down to the exact depths of any post-WWII intrusive works.

RECOMMENDED RISK MITIGATION MEASURES: The measures detailed below are recommended to mitigate the risk to ALARP level.

Risk Mitigation Measure	Recommendation
UXO Safety Awareness Briefings	Prior to all intrusive works commencing.
Intrusive Magnetometer Probe Survey	Of all / any pile positions.
EOD Engineer - On Site Supervision	Watching brief of all open excavations and magnetometer survey of all borehole locations.
Non-Intrusive Magnetometer Survey	Open excavations on greenfield land.

CONTENTS

FIGURES

APPENDICES

QUALITY POLICY

Brimstone Site Investigation Ltd, known as Brimstone, is committed to the delivery of unexploded ordnance (UXO) risk mitigation services, including safe removal and disposal of explosive ordnance, in the UK and overseas. Since our incorporation in 2016 it has been our goal to provide unsurpassed and unbiased UXO risk mitigation services. Brimstone is a client-centric organisation, with the aim to provide the client the services they need, to the agreed requirement, in accordance with national and international standards or standard operating procedures.

We are committed to providing a safe, cost-effective, and quality service, underpinned by our core values:

- **Integrity:** We are unwavering in our commitment to providing pristine, unbiased counsel and superior services. Our ethical compass guides every interaction, ensuring we maintain the highest standards of conduct in all our endeavours.
- **Professionalism:** We embody professionalism at every level, conducting our business with unparalleled excellence. Our commitment to quality guarantees top-tier service and a seamless experience for every client.
- **Knowledge:** We are devoted to perpetual growth, consistently expanding our expertise to stay at the forefront of industry innovation and strategy. Our thirst for knowledge ensures we are equipped to lead and succeed in an evolving marketplace.
- **Innovation:** We champion innovation, continuously advancing our services and processes. Our pursuit of inventive strategies and pioneering solutions ensures we not only meet but exceed the evolving needs of our clients and the industry.

We are committed to the applicable requirements of the ISO 9001:2015 standards. We set and review quality monitoring objectives using the plan, do, check, act cycle to measure the performance of our quality management system. Brimstone wholly endorses the ethos of 'continual improvement efforts' and allocates resources to meet this requirement.

This policy applies to the whole of the Brimstone services and involves all personnel including the managing director. All personnel are responsible for helping manage quality, seeking improvement through constant review, and by encouraging supplier and subcontractor involvement. We are committed to achieving customer satisfaction using quality procedures, which will be operated to meet or exceed the applicable requirements of ISO 9001.

Aaron Florence
Founder and Managing Director
Brimstone Site Investigation Ltd.

1 INTRODUCTION

1.1 Background

IDOM (the Client) has commissioned Brimstone to carry out a Stage 2 Detailed Unexploded Ordnance Risk Assessment (DRA) of the proposed redevelopment works at the Land to the South of Ashford Road, Sellindge, Kent site (the Site).

1.2 Legislation

There are no regulations that specifically govern the UXO risk mitigation industry in the UK. However, there are two pieces of legislation that require consideration. It is industry best practice (and common sense) to frame your site in the context of UXO, and to put in place measures to protect people from risks. In 2009, CIRIA published Unexploded Ordnance (UXO) - A Guide for the Construction Industry C681. This publication, though not legally binding, provides the gold-standard framework to which UXO and construction companies operate.

1.2.1 Construction Design and Management Regulations (CDM) 2015

The regulations identify the client, the CDM coordinator, the designer, and the principal contractor as responsible parties. Under the regulations, responsible parties are held accountable for the way a construction project is managed and for the health and safety of workers. Responsible parties must:

- Provide an appropriate assessment of potential UXO risks, or ensure an assessment is completed by another party.
- Put in place appropriate risk mitigation measures if necessary.
- Supply all parties with information relevant to the risks.
- Ensure the preparation of an emergency response plan.

1.2.2 The Health and Safety at Work Act 1974

The Health and Safety at Work Act 1974 had a transformative impact on health and safety, saving thousands of lives since its enactment. Employers must consider their employees, workers not in their employment, and members of the public. The act places a duty on every employer 'as far as is reasonably practicable' to protect workers from risks. It also says that information must be provided about aspects of health and safety that affect their role.

1.3 Commercial Contractor and the Authorities

1.3.1 Commercial Contractors

If your site has been given a moderate or high-risk rating, then control measures will be recommended. The measures will be specific to the scope of works on site, usually in relation to the depth and extent of excavations, piling and similar activities. There are a range of different methods at Brimstone's disposal, including:

- Non-intrusive surveying (including drone surveying)
- Intrusive surveying
- Search and clear
- Watching brief
- Support to geotechnical investigations
- Target investigation
- Site-specific training packages
- Site safety briefings

Our UXO Engineers can assess suspicious items on site when they are found. This will avoid unnecessary site evacuations. If our engineer(s) decide the item is UXO, they will coordinate with the authorities, manage disruptions, and advise on control measures, such as evacuations and a cordon.

1.3.2 UK Authorities

If Brimstone is not on site and a suspicious item is found, the local police must be immediately called on the non-emergency number. Police will visit the site. They will then inform the Joint Services Explosive Ordnance Disposal (JSEOD) office, which will coordinate the callout of an army or navy response team.

A precautionary cordon will initially be put into effect, with possible evacuation of homes and businesses, road and rail closures. The cordon may be extended following the advice from JSEOD's response team.

To manage their resources, JSEOD triages incidents. A consideration of the type, size and location of the UXO is made. If an incident is not given a high priority rating, a team may not be available for up to two days following the initial report.

The use of JSEOD is under the Military Aid to Civil Authorities (MACA) framework, therefore the budget and personnel is limited, and there are no statutory obligations made of the MOD. Often the MOD will recommend involvement of a commercial UXO contractor to manage the ongoing risk – this is especially true of former airfields and training areas where contact with land service ammunition can be frequent.

1.4 UXO Risk in the UK

Fortunately, to the best of our knowledge, there has not been a single post-war incident in the UK where a construction worker has been killed or injured because of an item of UXO exploding. There have been cases in mainland Europe where UXO had been struck and then exploded, killing workers. In 2019, a WWII general purpose bomb spontaneously detonated in a field north of Frankfurt, Germany.

However, the incident in Frankfurt is not comparable to the UK, due to the way different countries manufactured ordnance. Bombs made in different countries have different associated hazards. British WWII bombs, for example, have a fuzing system which uses chemicals which makes them very unsafe. Please see **APPENDIX 1** for recent examples of UK UXO incidents.

Between 2013 and 2016 JSEOD responded to 7,500 callouts. These callouts range from falsely identified objects, inert objects, small items of UXO and large WWII German unexploded bombs (UXBs). Each year the construction industry inadvertently unearths UXO; often this goes unreported. UXO contamination comes from three main sources:

- **Enemy action:** during WWI and WWII the air forces of Germany, and to a lesser extent Italy, bombed targets throughout the UK. The German navy bombarded several coastal targets in eastern England during WWI and then in WWII German long-range artillery on the French coast bombarded parts of Kent.
- **Allied military activity:** during WWI and WWII several Allied nations used the UK as a staging area for military action in the European Theatre; predominantly the US and Canada.
- **UK military activity:** domestic British Army, Royal Air Force (RAF) and Royal Navy (RN) training activities during peacetime and conflict as well as anti-aircraft gun and rocket batteries during WWI and WWII.

1.5 UXO Detonations

A detonation is a violent chemical reaction which creates a huge volume of gas. This reaction appears to happen instantaneously – the velocity of the shockwave moving is up to 9,000m per second. This chemical reaction is started using a small amount of very sensitive explosives called primary explosives. These types of explosives are highly sensitive to shock, friction, heat, and spark. As the explosive charge undergoes high order decomposition (detonation), the brisance, or shattering effect, causes the casing to splinter, projecting razor-sharp shrapnel across long distances.

The blast wave effect and the shrapnel effect can cause significant damage. Calculating safety distances is a complex process. As a rule of thumb, in open ground, a 250kg explosive charge (as would be found inside a typical 500kg bomb) would require an omnidirectional safety distance of at least 1.6km.

Bombs work by amplifying the explosive charge from the sensitive primary explosive through to the main charge or fill of the item. This process is called an explosive train, if any link in that chain is broken, the item will fail to function as intended. This can be due to mechanical, electrical, or manufacturing tolerances or faults. Amongst other reasons, detonation of UXO could occur under the following circumstances:

- **UXO body impact:** A substantial impact onto the main body of a UXO; borehole rigs, piling rigs, jack hammers and mechanical excavator buckets.
- **Fuse impact:** Environmental conditions during decades of burial can result in the primary explosives located in the fuse pocket to crystallise and become shock sensitive. It would then take a relatively small impact or friction impact to cause the fuse to function and detonate the UXO.
- **Re-starting a timer:** A small proportion of German WWII bombs used clockwork fuses. In 2002, an Army EOD Engineer reported that the clockwork fuse in a UXB re-started. Decades of burial causes substantial corrosion in WWII German UXBs and therefore an incident such as this is extremely rare.

2 ASSESSMENT METHODOLOGY

2.1 Introduction

This assessment has been produced in accordance with the relevant CIRIA guidelines; *Unexploded Ordnance (UXO) - A Guide for the Construction Industry C681* (published in 2009). CIRIA C681 is a publication which originated from round table best practice discussions from industry leaders.

2.2 Source, Pathway, Receptor, Consequence Risk Model

The Source, Pathway, Receptor, Consequence (SPRC) risk model can be applied to buried UXO as follows:

- **Sources:** UK and Allied UXO sources include military firing ranges, bases, storage depots, munitions factories, anti-aircraft batteries, amongst others. There are many wartime causes of UXO contamination. The source for enemy contamination is overwhelmingly from WWII German air raids.
- **Pathways:** the pathway describes how the UXO reaches receptors. Usually, UXO is buried and therefore pathways can be any activity which involve breaking ground. Examples include ground investigation works, site enabling works and excavations.
- **Receptors:** receptors are the people, assets and infrastructure that can be adversely affected by UXO exposure. This includes site personnel, plant, equipment, buildings, the general public, and the environment.
- **Consequence:** the consequences of an inadvertent UXO detonation are catastrophic. They include injury and loss or life, as well as damage to property. Fortunately, the likelihood of UXO detonating is low, even when it is uncovered during works. However, another consequence to consider is delays to works, which itself can be a risk.

2.3 Assessment Structure

In accordance with CIRIA C681 this assessment addresses the following considerations in the appropriate order:

- The likelihood that the site was contaminated with UXO.
- The type of UXO that could have contaminated the site, and their associated hazards.
- The likelihood that UXO remains on the site.

- Theoretical bomb penetration depths.
- The likelihood that UXO will be uncovered during the proposed works.
- Risk rating and risk mapping (as appropriate).
- Risk mitigation recommendations.

2.4 Information Sources

To complete this risk assessment, Brimstone has gathered information from a wide range of sources. Brimstone's research team has completed detailed historical research, including access of original archived records. The list below is a general list of information sources that are consulted during the research process. For Site-specific sources consulted for this risk assessment, please refer to **APPENDIX 5**.

- The National Archives,
- Local archive centres,
- Ministry of Defence,
- The Council for British Archaeology,
- Groundsure mapping services,
- Historical aerial photography (Historic England, Britain from Above, NCAP),
- Google open-source mapping,
- The British Geological Survey,
- Open sources; published book, articles, web resources,
- Site-specific information supplied by the Client,
- Brimstone's library and historical database, and
- Brimstone's former armed forces employees.

2.5 As Low as Reasonably Practicable Principle

The ALARP (as low as reasonably practicable) principle corresponds to the actions that should be taken to reduce risks. The term 'ALARP' is in the Health and Safety at Work Act 1974, which says that risks must be controlled in a reasonable way.

Infinite time, effort and money could be spent trying to eliminate risk entirely. HSE uses the example that spending £1m to prevent five employees bruising their knees is disproportionate, whereas spending the same amount to prevent an explosion which could kill 150 people is proportionate.

Using this principle, Brimstone aims to reduce client costs by recommending strategies that are proportionate to the assessed risks, if any elevated risk is found at all.

2.6 Risk Tolerances

The Brimstone risk assessment process divides UXO risk into two tolerances:

- **Tolerable:** Low Risk and Low-Moderate Risk ratings are tolerable. Where the risk cannot be completely discounted, it may be a useful strategy to opt for a low-cost measure, such as a UXO safety briefing from a qualified UXO engineer.
- **Intolerable:** Moderate, Moderate-High, and High-Risk ratings are intolerable. Proactive risk mitigation measures should be put in place. Various strategies are at Brimstone's disposal to meet your project-specific needs.

2.7 Reliance and Limitations

This report has been prepared using published information and information provided by the Client. Brimstone is not liable for any information which has become available following the publication of this report. No third-party liability or duty of care is extended. Any third-party using information contained in this assessment do so at their own risk.

3 THE PROJECT

3.1 The Site

The Site (approximately centred on the National Grid Ref: TR 09968 38232) is located in Sellindge, within the county of Kent, approximately 2.9km north-west of Westenhanger railway station. It comprises entirely undeveloped, open ground with mature vegetation present periodically around the Site. Grove House and associated open ground are located in the centre of the Site; however, these are not included within the Site boundary for this assessment.

The Site is bound to the north by Ashford Road, to the east by Bulls Lane, to the south by a residential structure on Bulls Lane and an additional area of undeveloped ground, and to the west by a residential structure off Ashford Road and undeveloped ground.

FIGURE 1: Site Location Maps **FIGURE 2:** Recent Aerial Photograph

3.2 The Proposed Works

Site Investigation (SI) works will comprise a 20m rotary borehole, eight windowless sampler boreholes to a maximum depth of 5m below ground level (bgl), and six trial pits to approximately 3.5m bgl.

Development works will comprise the construction of 75 – 80 residential structures with associated access and landscaping in the west.

FIGURE 3: Existing Site Plan

4 SITE HISTORY

4.1 Site Introduction

Site-specific history can be assessed by reviewing historical mapping, historical aerial photography and by carrying out additional Site-specific research where appropriate. Below are descriptions of a selection of records relevant to the Site:

4.2 Mapping

The below table describes the composition of the Site, structural changes in pre- and post-WWII Ordnance Survey (OS) editions, and relevant points of interest. All maps were retrieved from National Library Scotland (NLS) online database and the Landmark Promap OS database.

Period	Map Date	Map Scale	Review
Pre-WWI	1896	1:10,560	The Site comprises entirely undeveloped, open ground. It is bound to the north by Ashford Road, to the east by an unnamed roadway, and to the south and west by undeveloped, open ground. Grove House and associated open ground are present within the eastern extent of the Site.
	1906	1:2,500	No significant changes appear to have occurred on Site or in the vicinity.
Pre-WWII	1931	1:10,560	No significant changes appear to have occurred on Site or in the vicinity.
	1939	1:2,500	**FIGURE 4.1**: No significant changes appear to have occurred on Site or in the vicinity.
Post-WWII	1961	1:10,000	**FIGURE 4.2**: No significant changes appear to have occurred on Site. A residential structure has been constructed immediately west of the Site boundary.

4.3 Photography/Aerial Photography

The below table describes the composition of the Site visible in WWII-era and post-WWII aerial photography, including areas of possible damage and other possible features of note. All photographs were retrieved from Historic England's (HE) Royal Air Force (RAF) Photography Archive, the National Library of Scotland (NLS), and the National Collection of Aerial Photography (NCAP).

Period	Photo Date	Review
WWII	15th August 1940	**FIGURE 5.1 – 5.2:** The composition of the Site appears to corroborate that visible within pre-WWII OS mapping. No immediately obvious evidence of bomb damage, such as cratering, appears to be visible on Site or in the vicinity. An area of anti-landing trenches is visible within an area of undeveloped, open ground immediately west of the Site, as well as approximately 240m north-west. However, no such features are visible within the Site boundary.
Post-WWII	July 1945	**FIGURE 5.3 – 5.4:** A potential ground disturbance is visible within the western extent of the Site; however, it has not proved possible to determine the precise nature of this disturbance, and it does not appear to corroborate the typical composition of a bomb crater due to appearing elevated rather than sunken. An additional potential crater is visible approximately 95m south of the Site, as well as an area of ground disturbances immediately south in the surrounds of this potential cratering. The aforementioned anti-landing trenches are no longer visible within this imagery.
		FIGURE 5.5 – 5.6: The potential disturbance visible on Site, as well as a potential crater in close proximity visible in the aforementioned imagery is not visible within this imagery. Although, the ground disturbances immediately south remain visible. An additional potential crater is visible approximately 550m south-west of the Site.
	12th January 1946	**FIGURE 5.7 – 5.9:** No immediately obvious evidence of bomb damage is visible on Site or in the immediate surrounds. While areas of ground disturbances are visible in the north-east of the Site and approximately 40m east of the Site, these are anticipated to have been caused by agricultural activity, as opposed to evidence of German bombing, due to their lack of appearance within aforementioned imagery. Given the positioning of the disturbance on Site being situated immediately south of Ashford Road, it is possible that this was caused by frequent access on to the Site; although, this could not be confirmed. Potential cratering is visible approximately 820m north-west of the Site. An area of ground disturbances is visible approximately 1km south-west of the Site; the composition of these disturbances does not appear to corroborate the general appearance of bombing craters. Instead, these appear to resemble potential vehicle tracks, potentially indicating that Allied activity occurred in this area.

4.4 Additional Site-Specific History

Some sites will have been occupied by landmarks or significant buildings historically and in such cases specific written histories including significant wartime details are occasionally available in the public domain. No such information was available.

5 UXO RISK - GERMAN BOMBING

5.1 WWI Bombing History

5.1.1 Britain during WWI

During World War I (WWI), an estimated 9,000 German bombs were dropped on London, Eastern England and South-Eastern England during some 51 Zeppelin airship raids and 52 fixed-wing aircraft raids. London suffered the worst of the bombing with an estimated 250 tonnes of HE and incendiary bombs recorded across the Capital, over half of which fell on the City of London district.

The WWI bombing campaign waged by Germany was on a far smaller scale than the WWII campaign, in terms of the number of raids, the weight of ordnance dropped during each attack and the size of the bombs used. When coupled with the fact that most WWI-bombed locations have since been redeveloped, German WWI UXB finds are extremely rare. Furthermore, most air raids took place during daylight hours and as it was the first time Britain had experienced strategic aerial bombardment, the raids often attracted public interest and even spectators, increasing the chances of any UXBs being reported.

5.1.2 Site Specific

A collection of written reports describing each air raid in the region was reviewed (I. Castle, 2024). No evidence that Sellindge was targeted by enemy bombing during WWI was uncovered.

5.2 WWII Bombing History

5.2.1 Kent

In the summer and autumn of 1940, the Luftwaffe targeted the RAF's airfields and support network with the intention of achieving air supremacy prior to a planned amphibious invasion of south-east England. The resulting Battle of Britain campaign (July to October) resulted in many air raids across England, although these were mainly concentred in the south-east, especially Kent.

In early September 1940, the Luftwaffe changed their tactics and commenced an indiscriminate carpet-bombing campaign over London. The resulting nine-month Blitz began on 7th September 1940 and ended on 12th May 1941 - one of the heaviest raids of the Blitz. The vast majority of the Luftwaffe units based in occupied Europe were then redeployed to the Russian front.

During 1942 and 1943, a number of small-scale fighter bomber raids were carried out against the capital and towns in Kent, as well as the Baedeker Blitz against Canterbury. In 1944, the Luftwaffe commenced Operation Steinboch. This campaign comprised 31 major raids against London and other southern England targets, executed by inexperienced Luftwaffe crews, between January and May. However, poor navigation and improved defences resulted in unsustainable Luftwaffe losses. Many formations were broken up by RAF fighters, resulting in numerous random bombing incidents within the Home Counties, including Kent. The final major Luftwaffe raid on the capital took place in May 1944.

Immediately following the final air raids on London, the Luftwaffe launched the V Weapons campaign, commencing in June 1944. The V1 (Flying Bomb or Doodlebug) and later the V2 (Long Range Rocket) were launched from occupied Europe. 2,419 of the former and 517 of the latter were recorded in the London Civil Defence region and thousands more landed in the Home Counties.

Both carried a large 1,000kg HE warhead and were constructed of thin sheet steel, rather than the thick steel used on the Luftwaffe's free fall bombs. V Weapons were designed to detonate on the surface (like parachute mines), as opposed to free fall bombs which were designed to have some penetration ability through multi-storey buildings. Consequently, any V Weapons which failed to detonate broke up on impact, resulting in an easily identifiable debris field. V Weapons caused widespread destruction and therefore, at V Weapon impact sites, the accurate assessment of pre-1944 UXB risk can be hampered.

5.2.2 Site Specific

Luftwaffe target photography identifies RAF Lympne and associated radio stations, approximately 2.1km south-east of the Site, as primary bombing targets in the region. Westenhanger railway station, approximately 2.9km south-east of the Site, may also have been identified as a target of opportunity.

5.2.3 Bombing Decoy Sites

In mid-1940 bombing decoys were introduced. The decoys used either:

- A system of lighting to simulate an urban area or a military airfield's runway,
- Deliberately started fires to simulate a previously bombed target,
- Dummy buildings and vehicles to simulate a military facility.

792 static decoy sites were built at 593 locations in Britain. They were estimated to have drawn at least 5% of the total weight of bombs away from their intended targets. No decoys were operational within a significant radius of the Site during WWII. The closest was approximately 4.6km to the north-east.

5.3 WWII Bombing Records

5.3.1 Introduction

The bomb census recorded the location and type of bomb strikes to help with intelligence gathering and planning. It was compiled using information recorded by ARP wardens. These records were gathered by the Ministry of Home Security to calculate bombing density within administrative areas.

The bomb census was unreliable in the early stages of the war, though by 1941 procedures had been standardised. The quality of the census records also depended on where in the UK the records were produced. Some records are held at the National Archives and some are held at local borough archives.

Relevant records held at the National Archives and the Kent History and Library Centre were obtained for this risk assessment.

5.3.2 Bombing Density Statistics

The table below records the Ministry of Home Security's bombing density calculation for the Rural District of Elham. It gives a breakdown of the types of large German bombs reported and is understood to not include UXBs.

Admin Area	Elham
Area Acreage	36,676
High Explosive Bombs (all types/weights)	856
High Explosive Parachute Mines	6
Flam (Oil) Bombs	7
40kg Phosphorus Incendiary Bombs (IBs)	13
40kg 'Fire Pot' IBs	7
V1 Flying Bomb	64
V2 Long Range Rocket	0
Total (excluding V-Weapons and 1kg / 2kg IBs)	889
Bombs Per 1,000 Acres	**24.2**

1kg / 2kg incendiary bombs and 2kg anti-personnel (AP) bombs were often too numerous to record accurately and therefore are not included in the above figures.

5.3.3 Kent Daily Bomb and Shell Plot Maps

Brimstone has reviewed a collection of original Kent daily bomb and shell plot maps for the wider study area, held by the Kent History and Library Centre. These large-scale maps cover the entire bombing campaign and records high-explosive (HE) bombs, incendiary bombing (IB), plane crashes, and shelling. Relevant maps are displayed at **FIGURE 6**.

- Approximately five HE bomb strikes are recorded in the vicinity of the Site; note, while only three plot points are visible within relevant mapping, one map dated 21st January 1944 records three HE bombs under a singular plot point. Additionally, one IB strike and two machine gunning incidents are also recorded in the vicinity.
- One potential bomb stick is visible within a map dated 28th November 1940, which appears to potentially straddle the Site area.
- Due to the large scale of these maps and the plot points, the precise locations of bombs in the vicinity or of the Site could not be confirmed; it is therefore possible that plotted bomb strikes occurred closer or further away from the Site than mapping suggests.

5.3.4 Written Records Bombing Overlay

Brimstone has created a composite bombing map using Geographical Information System software, utilising data collected from available written records regarding bombing in Kent and the study area, as assessed in detail below. The incidents (identified within an approximate 1km radius) were plotted based on a variety of information, including road names, establishment and building names provided within the sources. Please note, the source information available did not always provide specific locational data from grid references; therefore, these bombing incidents may not be precisely plotted, and the map has been provided for indicative purposes only.

This map is presented at **FIGURE 7**, and source specific information is discussed below.

- Approximately 17 HE bomb strikes and 22 IB strikes are recorded within an approximate 1km radius of the Site, as well as one anti-aircraft (AA) shell, two unexploded HEs (UXHE), one unexploded AA (UXAA) shell, and two V1 bombs.
- No incidents are recorded within the Site boundary. The closest strike, an IB strike, is recorded approximately 280m north-west of the Site.

5.3.5 Kent ARP Written Incident Reports

Brimstone has reviewed a collection of war diaries held by the Kent History and Library Centre; original ARP written incident reports for the Site. Some of these incidents include a Cassini Grid (WWII mapping system) reference number which has been measured to give an approximate distance from the Site boundary. Note, map references, where provided, use the Modified British System, based on a Cassini use of a grid reference of the United Kingdom, which has an approximate 300m margin for error. Therefore, incidents may have occurred in closer proximity to the Site than recorded.

The collection for the Rural District of Elham, covering the entire bombing campaign, was reviewed and the following incidents identified within the study area (within approximately 1km of the Site). See **FIGURE 7** for a bombing overlay showing the approximate locations of recorded strikes; the incident numbers below correspond to the plotted incident numbers on the overlay.

ID	Date and Time	Type of Bomb(s)	Location (*relative to the Site*)
3	02/11/1940, 10:45	1 x IB	'Sellindge Farm' (*Grid Reference: MR 533 566, approximately 280m north-west*)
4	28/11/1940, 23:00	9 x HE Bombs 18 x IBs	'Dropped in a straight line' (*Between Grid References: MR 536 572 and MR 558 540, approximately 670m north-west and 3.1km south-east*)
7	23/01/1944, 17:15	1 x IB	'Somerfield Court Farm' (*Grid Reference: MR 535 555, approximately 915m south-west*)

5.3.6 Register of Bombs and Shells dropped in the Elham Rural District

Brimstone has reviewed a register of bombs, shells and V1 bombs within the Rural District of Elham, covering the entire bombing campaign, held by the Kent History and Library Centre. This collection records both exploded and unexploded bombs and shells, as well as recording V1 bombing incidents within the area. It records the date and time of the strike, as well as a location, type of bomb and remark on the damage caused; however, it should be noted that not all incidents are provided with a specific location or grid reference. See **FIGURE 7** for a bombing overlay showing the approximate locations of recorded strikes.

ID	Date and Time	Type of Bomb(s)	Location (*relative to the Site*)
1	24/09/1940, 12:00	3 x HE Bombs	'Swan Lane' (*Approximately 440m south-east*)
2	08/10/1940, 04:25	5 x HE Bombs	'Somerfield Court' (*Approximately 465m south-east*)
5	22/12/1942, 09:55	1 x UXHE Bomb	'Swan Lane' (*Approximately 440m south-east*)
6	21/01/1944, 21:35	Unknown no. of IBs	'Near Somerfield Court Farm, 2 containers of incendiary bombs' (*Approximately 465m south-east*)
8	27/06/1944, 02:20	1 x V1	'Hoddiford Farm' (*Approximately 645m north-west*)
9	28/06/1944	1 x UXAA Shell	'Cygnet, Swan Lane' (*Approximately 470m east*)
10	10/07/1944	1 x AA Shell	'Somerfield Court Farm' (*Approximately 465m south-east*)
11	06/08/1944, 17:00	1 x V1	'Hedward's Bakery, Stone Hill' (*Approximately 965m north-west*)
12	22/09/1944	1 x UXHE Bomb	'12-acre field at Rotherhythe Farm… shall finally be abandoned' (*Approximately 555m south-west*)

5.3.7 V Weapons

Brimstone has reviewed an original V1 bomb plot map of Kent (presented in **FIGURE 8**), held at the Kent History and Library Centre. Brimstone has also reviewed a contemporary plot map of V2 rocket incidents, produced using original written records held at the National Archives.

No V1 strikes are plotted within the Site's vicinity; however, due to the small scale of this map, the precise locations of the Site and plotted incidents could not be confirmed. No V2 rocket strikes occurred within the wider study area.

5.3.8 Abandoned Bomb Register

Due to the overstretched bomb disposal units during WWII, many bombs were intentionally left undisturbed. UXBs were triaged based on where they were and how big they were. If they didn't pose a significant risk, they were 'abandoned'. The locations of these bombs were recorded on the abandoned bomb register.

The abandoned bomb register is a public record document held at the Parliamentary Archives of the House of Commons, from which Brimstone has obtained a copy. The register should not be relied on for completeness or accuracy. The closest abandoned bomb is recorded approximately 585m south-west of the Site; this is anticipated to be Incident No. 12, as recorded within the register of bombs and shells dropped in the Elham Rural District (see ***Section 5.3.6***). However, no further information regarding this bomb has been identified, including whether this has since been removed.

5.3.9 Secondary Source / Anecdotal Evidence

A search of online resources, as well as a review of local history publications was carried out with the intention of locating any eyewitness accounts of local bombing incidents. However, no such evidence was found.

5.4 Likelihood of UXB Contamination

Where detailed bombing records exist, it is possible to predict whether any UXBs could be found on a site. This likelihood is discussed in the following table:

Density of Bombing	
Number of Air Raids in the Vicinity:	A comparison of the bombing incident records confirms that at least 15 air raids affected the study area.
Intensity of these Air Raids:	All bombs dropped locally were likely part of small-scale opportunistic bombing raids, some of which were carried out at night.
Bomb Strike Positions	
Closest Bomb Strikes	HE bombs: 440m south-east. 1kg / 2kg IBs: 280m north-west.
Alignment of recorded Bomb Strikes:	One potential bomb stick has been identified within a Kent daily bomb and shell plot map dated 28th November 1940; a bomb stick is also recorded within the Kent ARP written reports on the same date. The bomb stick recorded within the mapping appears to be plotted north-to-south and straddles the Site area, with one HE bomb strike appearing to be plotted over the Site; however, the strikes recorded within the written records do not corroborate this, being plotted north-west to south-east, and do not appear to straddle the Site area. As it has not been possible to identify the majority of bomb sticks over the wider study area, there may have been multiple occasions during which a UXB (unobserved and unplotted) could have been released over and landed within the Site boundary. For most small IB spreads (covering a wide area) it is impossible to correctly identify the aircraft's flightpath and thus bomb-stick alignment. Furthermore, such bombs were significantly affected by the wind, further hampering analysis.
Bomb Failure Rate	
Evidence to suggest that the generally accepted failure rate of 10% differs in the vicinity of the Site:	None.
UXBs recorded in close proximity to the Site:	Closest plotted UXB strike to the Site is approximately 555m south-west.

5.5 Likelihood of Subsequent UXB Detection

A range of circumstances determine whether a UXB strike location would have been identified, during and after the war. This is discussed in the following table. This includes level of access to the Site during WWII, bomb damage, as well as the ground cover during WWII. This is discussed in the following tables.

Historic Access
A UXB falling on a site which was frequently accessed would have had a better chance of being found. ARP Wardens actively searched for UXBs in heavily bombed residential areas. The importance of a site or nearby buildings and infrastructure was also a factor. Many industrial facilities had fire watchers tasked with extinguishing incendiary bombs and reporting UXBs.
As some of the air raids in the immediate vicinity occurred during the hours of darkness, there is an elevated probability that any UXB strike to the Site could have occurred unobserved as residents / employees were inside. Furthermore, no evidence of fire watchers providing night-time observation in the vicinity was found. These factors decrease the likelihood that any UXB fall would have been witnessed and reported. The Site comprised entirely undeveloped, open ground, likely to have been used for agriculture, during WWII. Therefore, it is conceivable that the Site experienced an infrequent level of access; however, this would have depended on the landowner(s) and seasonal agricultural usage. Nonetheless, infrequent access reduces the likelihood that evidence of a UXB strike would have been observed and dealt with at the time. Although, Grove House may have added a degree of monitor over the Site, albeit limited to the areas of open ground immediately surrounding.

Bomb Damage
As the bombing campaign continued, damaged areas became vulnerable to unreported UXBs. Bomb site wreckage or soil disturbance at a bomb crater could obscure evidence of a subsequent UXB strike.
A potential ground disturbance is visible in the western extent of the Site within post-WWII aerial photography dated July 1945; however, this disturbance does not appear to corroborate the typical appearance of a bomb crater (i.e., raised boundary), and therefore its precise nature could not be determined. Although, potential craters are visible within post-WWII aerial photography approximately 95m south and 550m south-west within additional areas of open ground, as well as an area of ground disturbances immediately south. Furthermore, potential cratering is visible approximately 820m north-west of the Site within post-WWII aerial photography dated 1946. No immediately obvious evidence of bomb damage is visible within WWII-era aerial photography dated 1940 on Site or in the vicinity.

Ground Cover Type
A UXB which falls on open field could easily go unnoticed, whereas a UXB dropped on a hard-surfaced car park would have been easily observed.
At the onset of WWII, the Site comprised entirely undeveloped, open ground, likely used for agriculture. Any evidence of a UXB strike could have occurred unnoticed and unrecorded due to an anticipated infrequent access, which may have led to vegetation becoming unmaintained and overgrown during WWII. This could also apply to any crop growth on Site, which could feasibly also have obscured such evidence. The smallest German HE bomb (50kg), also the most commonly deployed over Britain during WWII, was just 20cm in diameter; a UXB strike could therefore leave a small, easily obscured entry hole. Due to the presence of additional open ground in the immediate surrounds of the Site, evidence of a UXB could have also occurred unobserved within these areas; it would be possible for such a strike to have occurred in close proximity to the Site and come to rest under its boundary due to the J-Curve Effect, whereby a UXB may travel laterally from its point of penetration.

6 WWII GERMAN BOMBS

6.1 Bombs Dropped on the UK

Nazi Germany used different types of ordnance against the UK for different effects. Some types were designed to cause fires, others for their destructive blast effect and other for their penetration capability. Each type of ordnance was fitted with at least one fuze. For some bombs multiple fuzes were used. Many different types of fuzes were available for use – each with its own set of associated hazards.

Data sheets on those bombs most likely to be encountered today are included at **APPENDIX 2**.

- **HE bombs – moderate NEQ (net explosive quantity):** the most common types of HE bombs dropped were the SC (general purpose - GP) and SD (semi-armour piercing - SAP) series of bombs. The NEQ is between 30-50%. SAP bombs are engineered to attack light fortifications, whereas GP bombs are used in a mixed destructive blast and anti-personnel fragmentation role. 70% of bombs dropped on the UK were the 50kg type.
- **HE bombs – high NEQ:** blast bombs and parachute mines have bodies made of thin steel, allowing for larger HE charges. These were designed to detonate above ground, maximising the blast effect. Parachute mines were weapons slowed by parachutes and designed to detonate without penetrating the ground. Although, in some marshland areas, partially buried parachute mines have been observed. Consequently, it is highly unlikely that any unexploded blast bombs remain buried in the UK today.
- **HE bombs – low NEQ:** The PC series were armour piercing bombs used against heavy fortifications and reinforced bunkers. They were not commonly used over the UK.
- **Small incendiary bombs:** The 1kg and 2kg incendiaries were the most dropped bomb. Up to 620 x 1kg incendiaries could be packed into the largest container unit, which opened at a pre-determined height scattering its payload over a wide area. These small bombs could fully penetrate soft ground due to their small diameter. Variants of the 1kg and 2kg incendiary bombs contained a small HE charge designed for an anti-personnel role, and to increase its incendiary effect.
- **Large incendiary bombs - Thick skinned:** The C50 has a thick body and contained a mixture of incendiary liquids and white phosphorus. Another version of the C50 had a white phosphorus fill. The C50 ‘firepot’ contained thermite incendiary containers (aka firepots) and a small HE charge.

- **Large incendiary bombs - Thin skinned:** The Flam 250 and Flam 500 models had thin steel bodies designed to break up on impact, spreading their oil-incendiary mixture, which was ignited by a small HE charge. Consequently, it is highly unlikely that any unexploded Flam bombs remain buried in the UK today. Their unreliability meant withdrawal from frontline use by January 1941.
- **Submunitions:** The SD2 'butterfly' bomb was a 2kg submunition dropped on several British cities and towns. It contained a 225gram HE charge. SD2s had no ground penetration ability so the vast majority were recovered at the time. However, SD2s are still found across Britain today.
- **V1 flying bombs and V2 rockets:** In the final year of WWII Germany began using pilotless weapons against England. Both V Weapons had 1,000kg HE warheads. Due to their light-body construction, they had no penetration ability, and any impact left a noticeable debris field. As such, there is negligible risk from unexploded V Weapons today.

6.2 Bomb Failures

Records from September 1940 to July 1941 show that an average of 84 UXBs were dropped on civilian targets each day. Around 8% of these were time delay bombs – designed to strike the ground and start a predetermined countdown which could last days.

There is a generally accepted 10% failure rate for WWII German HE bombs. This is estimated from records gathered by bomb disposal units. These statistics do not account for UXBs that went by unnoticed.

Failures can happen for different reasons, including:

- Equipment or human error in arming the bombs before release,
- Failure of a mechanism within the fuze (out of tolerance),
- Jettisoning payloads if the bomber was under attack or crashing, or
- Partially functioned bombs (e.g. cracks in the cast TNT).

6.3 Bomb Ground Penetration

6.3.1 Introduction

Using data gathered during WWII by the Ministry of Home Security, estimations can be made about how deep a bomb is likely to penetrate the ground. Over one thousand incidents were reported by the bomb disposal units to support this research. Further tests were carried out, dropping bombs of different sizes into chalk and measuring the depths they reached. This research is held at the National Archives. The estimates are:

Bomb weight (kg)	Ground Type (m)									
	Sand		Gravel		Chalk		Clay		Sandstone	
	Average	Max.	Average	Max.	Average	Max.	Average	Max.	Average	Max.
50	2.8	7.8	2.8	7.8	3.5	7.7	4.0	9.1	2.7	6.0
250	4.8	13.7	4.8	13.7	6.0	13.1	6.8	15.8	4.6	10.4
500	6.0	17.3	6.0	17.3	7.6	16.4	8.7	19.8	5.8	13.1
1,000	7.6	21.9	7.6	21.9	9.6	20.7	10.9	24.9	7.3	16.5

Different layers of geology affect penetration depths. For example, 1m of made ground, then 1m of gravel before reaching clay – as is many areas of London – is not easily calculated from the data above.

When calculating how deep a bomb could have reached, we must make three assumptions:

- **Impact velocity:** German bombing raids were carried out at altitudes in excess of 5,000m. The velocity of impact is roughly 313ms^{-1} (not accounting for resistance). It is the same velocity regardless of mass.

- **Impact angle:** strike angles of 10 to 15 degrees to the vertical. It must be assumed that the bomb was stable at the moment of ground penetration.
- **Bomb design:** Some larger German bombs were occasionally fitted with 'kopfrings' - a metal ring, triangular in cross section, fitted around the nose of the bomb to help prevent penetration. It must be assumed that no 'kopfrings' were fitted.

6.3.2 The J-Curve Effect

During WWII, Bomb Disposal Units (BDUs) reported that most buried UXBs were found horizontal or upturned. This observation confirmed the 'J-curve effect'. As an HE bomb penetrates the ground, slightly offset from the vertical, its passage underground creates a 'J' shape.

This is relevant because the J-curve effect results in a horizontal offset between the buried UXB and its point of entry. This is distance is estimated to be one third of the theoretical penetration depth. A low altitude attack, meaning a low impact angle, could produce an even greater offset, of up to 15m.

6.3.3 Site Specific Geology

BGS Mapping	**Superficial Deposits:** Head – Clay and Silt	**Bedrock Deposits:** Sandgate Formation – Sandstone, Siltstone and Mudstone
SI Data	No recent SI data was provided by the Client. However, local BGS borehole logs were available. The closest BGS SI through the same mapped geology as the Site is located approximately 640m south-east of the Site (BGS ID: 15619152). This SI (April 1996) encountered the following ground conditions: - 1.20m of made ground. - 1.40m of made ground – soft brown mottled orange, brown clay. - 2.20m of made ground – firm dark grey, brown and brown slightly sandy clay. - 0.30m of grey, brown moderately weathered limestone. - 0.40m of brown sandy clay. - 0.45m of brown, slightly clayey, silty, fine and medium sand. - 3.65m of light grey, slightly to moderately weathered limestone. - 6.65m of stiff dark grey sandy to very sandy clay. - 13.25m of very stiff dark grey fissured clay. - 0.50m of stiff brown mottled dark grey fissured clay.	

6.3.4 Site Specific Maximum Bomb Penetration Depth

During WWII, the Luftwaffe dropped many different types of HE bomb. The SC (general purpose) series was by far the most numerous and of this series, the SC 500 model (weighing 500kg) was the largest of the most commonly deployed and therefore this will be used as the benchmark weapon for the Site-specific bomb penetration depth calculations.

In order to calculate the most likely maximum depth to which a bomb would penetrate, Brimstone has taken the average of the average and maximum figures for the predominant Site-specific geology (clay) in the table above. This gives a likely maximum bomb penetration depth of 14.25m below WWII ground level for a 500kg bomb.

Note, the Ministry of Home Security data indicates that the maximum bomb penetration depth could be down to 19.8m for a 500kg bomb, or 24.9m for a 1,000kg bomb; however, in line with the ALARP principle, it is not considered to be a likely scenario that a bomb would penetrate so deeply. Furthermore, while evidence

indicates that a 1,800kg HE bomb could penetrate to over 30m, these types of bombs were not dropped frequently. For example, War Office statistics confirm that between October 1940 and May 1941 the majority of HE UXBs (>90%) were either 50kg or 250kg, with the 500kg bombs making up most of the remaining 10%.

7 UXO RISK - BRITISH/ALLIED ACTIVITY

7.1 Introduction

The table below lists potential sources of UXO (excluding enemy action). Those which are potentially relevant to the Site are discussed in the subsequent section(s).

Potential UXO Source	Potentially Significant
Army or RAF training areas / ranges	×
Military bases and other installations	×
Munitions and explosives factories	×
Military storage depots	×
Defensive fortifications	×/✓
Wartime site requisitions	×
WWII defensive mining (landmines)	×
WWII Home Guard activity	×/✓
Wartime anti-aircraft fire	✓

7.2 Potential Sources of UXO

7.2.1 Introduction

Research has not located any evidence of significant British or Allied army, RAF or Royal Navy activity specifically on Site; although, numerous training / defensive features have been identified in the vicinity of the Site, including anti-landing trenches immediately south-west of the Site. RAF Lympne was also situated approximately 2.1km south-east. Potential sources of UXO contamination are described below.

7.2.2 Anti-Invasion Defences

During WWII, the War Office designated certain key towns, such as Sellindge, as anti-tank islands (Category A Nodal Point) within its strategy of anti-invasion defence measures. Anti-tank islands were located at 'choke points' along the expected line of German advance following anticipated amphibious invasion of south-east England. An anti-tank island was to consist of coordinated, strategically located defence points with an all-round fire plan covering the whole area where enemy lines of attack were thought to be most likely.

Category A (strongest defence) Nodal Points were to be garrisoned by both Home Guard battalions and regular army units and they were expected to hold out against an enemy invasion for up to one week. They usually comprised a number of outer roadblocks and a ring of more numerous inner roadblocks. Within the inner ring, at town / city centre locations would be one or more strongpoints, usually occupying high ground.

Multiple defensive emplacements and training features have been identified within an approximate 1km radius of the Site. Two areas of anti-landing trenches have been identified in the vicinity, the closest identified immediately south-west of the Site within post-WWII aerial photography. An additional area of anti-landing trenches was identified approximately 225m north-west of the Site. Furthermore, Heritage Gateway records a

searchlight battery approximately 300m south-east of the Site.[1] A railway gun, namely the 13th Super-Heavy (railway) Battery, is also recorded approximately 675m south-east.[2]

Due to multiple defensive and training features identified in close proximity to the Site, it is anticipated that military activity in the wider Site area was potentially relatively frequent; however, no evidence has been identified to confirm that the Site itself was accessed by armed troops / utilised for training or defensive purposes. Although, the possibility of the Site being utilised for the purposes of ad hoc training using live ammunition or the erection of temporary defences cannot be ruled out completely given its undeveloped nature during WWII.

7.2.3 Home Guard

The Home Guard (HG), originally the Local Defence Volunteers, was formed in the summer of 1940. It was a volunteer force comprising men who were either too young, too old, or in reserved occupations (those jobs vital to the war effort). Battalions were established in most urban areas and some large organisations (such as railway networks) created their own platoons.

Their main purpose was to bolster regular Army units in the event of German invasion. By the end of June 1940, over one million had signed up. Initially, only shotguns, old hunting rifles, bayonets, knives and an array of improvised weapons were available, however by mid WWII, conventional weapons were available, and some were even designed specifically for the Home Guard, such as SIP grenades, the Northover anti-tank projector and the Blacker Bombard spigot mortar. Furthermore, ammunition in very short supply during 1940 became more readily available.

Home Guard units had a variety of responsibilities; road patrols, manning Observation Posts at commanding points, reporting on enemy airborne landings, delaying the enemy at stop-lines / roadblocks / nodal-points, and organising mobile fighting patrols to harry the enemy.

Soldiers of the 7th Kent (Lyminge) HG Battalion will have been active locally during WWII. Due to its entirely undeveloped, open nature, it is considered plausible that the Home Guard accessed the Site and associated ordnance was present. This is heightened by the presence of anti-landing trenches immediately south-east of the Site and in the vicinity in WWII-era aerial photography. An area of ground disturbances, anticipated to be vehicle tracks, are also visible approximately 1km south-west within post-WWII aerial photography; these are potentially indicative of Allied activity in the wider study area, potentially utilising this area for purposes of ad hoc training, although this could not be confirmed.

Recent UXO finds confirm that Home Guard soldiers would bury caches of ammunition in tactical locations to be exhumed and used in the event of a German invasion. Other recent WWII ammunition finds in the England indicate an ill disciplined 'out of sight out of mind' culture in the army during WWII. It would appear that surplus, faulty or partially spent ammunition was sometimes discarded in random locations, often on civilian land. Similarly, there are examples of surplus (boxed) ammunition buried on civilian land as a hassle-free means of disposal, likely when the Home Guard was disbanded in 1944.

However, while the Site comprised entirely undeveloped, open ground and evidence of Allied activity has been identified in the vicinity, no evidence has been identified to suggest that the Site itself was accessed by armed troops on patrol or was utilised in any significant way; although, such a possibility cannot be completely ruled out due to the evidence of Allied activity and defences in close proximity.

[1] https://www.heritagegateway.org.uk/Gateway/Results_Single.aspx?uid=eec383c6-5786-40e3-8ec4-3c8b03cbc3ef&resourceID=19191
[2] https://www.heritagegateway.org.uk/Gateway/Results_Single.aspx?uid=MKE111015&resourceID=1005

7.2.4 WWII Anti-Aircraft Fire

Anti-Aircraft (AA) Command was a British Army command established in 1939 to defend the UK during the anticipated German bombing campaign. It controlled the Territorial Army AA artillery and searchlight units. From 1940 to 1945 BDUs dealt with 7,000 unexploded AA shells in Britain. There were three main types of AA battery used for home defence (see below). Data sheets on these AA defences are included at **APPENDIX 3**.

- **Heavy Anti-Aircraft (HAA):** large-calibre guns (3.7" and 4.5") for engaging high-altitude bomber formations. Hundreds of permanent batteries were constructed in and around major cities and military bases during the 1930s. Some 2,000 of these guns were available during the Blitz. Each gun could fire between 10 and 20 rounds per minute and consequently HAA batteries could expend large quantities of shells during each engagement.

  British time fuses were poorly manufactured during WWII, and this led to high failure rate for HAA shells, up to 30%. Unexploded HAA shells had the potential to land up to 27km from their battery, although more typically landed within a 15km radius.

- **Light Anti-Aircraft (LAA):** smaller calibre guns for engaging dive bombers and low altitude intruders. As such, they were mostly used to defend specific industrial and military targets which were subject to precision bomber attack. LAA guns were either .303" calibre machine guns or 20mm and 40mm calibre cannon. The latter were fitted with simply impact fuses and small incendiary or HE bursting charges.

  The 40mm Bofors gun could fire 120 x HE shells / minute to a ceiling of 1,800m. Each shell was designed to self-destruct if it didn't strike an aircraft, however, inevitably some failed and fell back to earth.

- **Z (Rocket) Batteries**: a Z-Battery comprised a grid formation of 64 rocket projectors which fired 2" and later 3" Unrotated Projectile (UP) rockets to a maximum altitude of 5,800m; a ground range of some 9,000m. They were deployed in cities all around the UK from 1941 and proved to be an effective addition to the existing AA guns.

  The rockets measured 0.9m (2") and 1.8m (3") in length with four stabilising fins at the base and were fitted with 3.5kg or 8.2kg HE warheads. The larger warhead had an effective airborne blast radius of up to 20m. Some variants deployed a form of aerial mine described as a "small yellow bomb" which was designed to detach from the rocket at height and descend on a parachute with the objective of becoming snagged on target aircraft and then detonating.

Unlike bombs which were designed to strike the ground, AA projectiles and rockets were designed to function in the air. Due to their shape, and centre of gravity they would often not strike the ground nose first. This coupled with the lower mass of AA UXO resulted in shallower ground penetration depths, compared to UXBs. Although, in very soft conditions, unexploded AA projectiles have been found deeper than 1.5m bgl.

10 permanent HAA batteries were active within range of the Site during WWII. LAA guns likely defended vulnerable points within the borough. Luftwaffe activity was somewhat frequent over the wider area and therefore these guns may have expended a reasonable quantity of ammunition. Consequently, the possibility of unexploded AA shells striking the Site and penetrating to a shallow depth cannot be ruled out; indeed, one such incident is recorded in the vicinity, approximately 465m south-east.

8 UXO RISK MITIGATING CIRCUMSTANCES

8.1 Introduction

Works on a UXO contaminated site could result in the partial or complete removal of UXO risk. Construction or earthworks may have uncovered any UXO contamination, which would then have been reported and removed by the authorities. A site may have been subject to an explosive ordnance clearance (EOC) task conducted by the armed forces. EOC tasks involve surveying, subsequent target investigation and removal of UXO. Although the effectiveness of historic EOC tasks will have often been unsatisfactory.

8.2 Explosive Ordnance Clearance Tasks

The division of EOC tasks has been complex throughout British military history. It used to be the case that anything under the water level would be dealt with by navy units, and anything on land would be dealt with by army units. In recent years, RAF Explosive Ordnance Disposal (EOD) capability has been discontinued, and now only the Royal Navy and the British Army have EOD units. In the army, the Royal Logistics Corps and Royal Engineer EOD units have been amalgamated to form 29 EOD & Search Group. Often taskings are assigned to either the naval or army elements based on where in the country the threat is and the nature of the threat.

Brimstone has access to a database of historic EOC tasks. This database is only complete up until the early 2000s and therefore does not include recent EOC tasks. No such database for the RAF and Royal Navy EOD units is easily accessible. A search of this database has not resulted in any Army EOC tasks in the vicinity of the Site.

UXO encounters on civilian land are often reported in the media and therefore a web search of local media outlets was also carried out. One such incident occurred on 14th September 2020, in which an unspecified item of UXO was identified at a hotel within Port Lympne Wildlife Park, approximately 3.7km south-east of the Site.[3] The item was deemed to be inert by an EOD team and was safely removed from the scene. Due to its distance from the Site, this incident is not considered significant regarding UXO contamination on Site.

8.3 Ground Works

No significant post-conflict ground works are anticipated to have taken place across the Site boundary. Post-WWII, general maintenance / agricultural ploughing may have disturbance WWII-era soil to very shallow (<1m bgl) depths across the Site. However, no shallow (1-2m bgl) or deep (>2m bgl) intrusions are anticipated to have taken place across the Site.

8.4 Deductions

The risk associated with any very shallow buried UXO may have been largely mitigated across the Site. The risk associated with any shallow to deep buried UXO almost certainly remains unmitigated.

Please note, the risk of a UXO encounter can be considered mitigated in the exact locations and down to the exact depths of any post-WWII intrusive works.

[3] https://www.kentonline.co.uk/hythe/news/bomb-discovered-at-animal-park-233743/

9 CONCLUSION

9.1 Accuracy of Historical Records

Occasionally, the accuracy of some historical records can prove to be poor when compared with other sources of information. One significant consequence of this can be the possibility of unrecorded German bomb strikes in the study area. No such inconsistencies were noted within the records consulted for this report.

9.2 The Risk of UXO Contamination on Site

9.2.1 Key Findings – German UXO Risk

- During WWII, the Site was situated within the Rural District of Elham, which experienced 24.2 bombs / 1,000 acres, a low-to-moderate bombing density, according to official Home Office statistics. The Site was situated approximately 2.1km north-west of RAF Lympne and associated radio stations, which were identified as primary bombing targets in the region within Luftwaffe target photography.
- Kent daily bomb and shell plot mapping records approximately five HE bomb strikes, one IB strike and two machine gunning incidents as occurring within an approximate 1km radius of the Site; one bomb stick has been identified that appears to straddle the Site area, with one HE bomb strike appearing to be plotted over the Site / in the immediate vicinity. However, due to the large scale of these maps and the large plot points, the precise locations of the Site and of these incidents could not be confirmed.
- Furthermore, a collection of written ARP war diaries and a bomb and shell register for the Elham Rural District were assessed; collectively, 17 HE bomb strikes are recorded within an approximate 1km radius of the Site, as well as an unknown number of IBs, one AA shell, two UXHEs, one UXAA shell, and two V1 bomb strikes. The closest strike, an IB strike, is recorded approximately 280m north-west of the Site. However, no bombing incidents are recorded on Site or in the immediate surrounds.
- Note, the map references within these records use the Modified British System based on a Cassini use of a grid reference of the United Kingdom, which has an approximate 300m margin for error; therefore, it would be possible for recorded incidents to have occurred closer to the Site, potentially within its boundary, as well as further away.
- Post-WWII aerial photography dated 1945 identifies a potential ground disturbance in the western extent of the Site boundary, as well as additional potential cratering approximately 95m south within an adjacent area of open ground. An area of ground disturbances is also visible immediately south of the Site in the surrounds of the aforementioned crater. Furthermore, a potential crater is also visible approximately 550m south-west of the Site within this imagery, as well as approximately 820m north-west within post-WWII aerial photography dated 1946. However, no immediately obvious evidence of bomb damage is visible on Site or in the vicinity within WWII-era aerial photography dated 1940.
- The entirety of the Site comprised undeveloped, open ground, likely of an agricultural nature, during WWII. It is therefore anticipated that access may have been infrequent throughout WWII; although this would have depended on the landowner(s) and seasonal agricultural activity. Infrequent access reduces the likelihood that evidence of a UXB strike would have been observed and reported; however, the undamaged residential structures present adjacent to the eastern extent of the Site may have added a degree of access to / monitor over areas of the Site in close proximity. Furthermore, any evidence of a UXB strike, such as a small entry hole, could feasibly have become obscured within vegetation, especially if it became overgrown at any point during WWII. Any such UXB could feasibly remain in-situ, given the lack of significant post-conflict redevelopment across the Site.

- In conclusion, while no bombing incidents are recorded on Site, numerous bomb strikes are recorded in the vicinity, with a potential bomb stick appearing to straddle the Site. Although no immediately obvious evidence of bomb damage is visible within the Site boundary itself, ground disturbances potentially indicative of German bomb damage are visible immediately south of the Site within an area of open ground. Given this, coupled with the margin of error associated with Cassini grid references, the Site's entirely undeveloped nature creating conditions unconducive to the detection of UXO, and an anticipated lack of frequent access, it cannot be ruled out that a UXB strike could have occurred within the Site boundary unnoticed and unrecorded, becoming obscured within vegetation, could have come to rest within the Site boundary. As such, a **Moderate Risk** for German UXO has been assessed across the Site.

9.2.2 Key Findings - British UXO Risk

- Sellindge was designated as a 'Category A' Nodal Point during WWII, and defensive features were erected across the town. Indeed, anti-landing trenches are visible immediately south-west of the Site within WWII-era aerial photography dated 1940, as well as approximately 225m north-west.
- Multiple defensive emplacements have been identified within an in-house geodata set and on Heritage Gateway within an approximate 1km radius of the Site boundary. A searchlight battery is recorded approximately 300m south-east of the Site, while a railway gun is recorded approximately 685m south-east. Given the heightened military presence in the vicinity, it is considered possible that the Site was further utilised for ad hoc training purposes or for the erection of additional temporary defensive emplacements, and associated ordnance may have come to contaminate the Site through failing to explode during training exercises or being disposed of through improper means; although, no evidence of the Site being requisitioned in any significant way has been identified.
- In conclusion, although the Site comprised undeveloped, open ground and was situated immediately adjacent to an area of anti-landing trenches, no evidence of the Site being utilised for defensive / training purposes has been identified. However, given the Site's open nature and situation within a Nodal Point, with associated defences identified in the vicinity, it cannot be completely ruled out that the Site was accessed by armed troops stationed in the wider study area. Therefore, a **Low-Moderate Risk** of encountering Allied UXO has been assessed across the Site.
- 10 permanent HAA batteries were active within range of the Site during WWII. LAA guns likely defended vulnerable points within the borough also. Luftwaffe activity was somewhat frequent over the wider area and therefore these guns may have expended a reasonable quantity of ammunition. Consequently, there is an elevated likelihood of unexploded AA shells striking the Site; one such incident is recorded in the vicinity, approximately 465m north-east. As such, the risk of an unexploded AA shell striking the Site is considered to be analogous to German UXBs; a **Moderate Risk** has been assessed across the Site.

9.3 Site-Specific UXO Hazards

Different types of UXO pose differing types of hazard, depending on their structural design, Net Explosive Quantity (NEQ), fill type and likely contamination depth. The table below lists the main types of UXO most often encountered on urban UK sites and their relative hazard levels.

UXO Type	NEQ (NEQ Range)	Likely Burial Depth	Hazard Posed
WWII German General Purpose HE Bombs	25kg - 220kg (most commonly deployed bomb weights)	Deep burial (>2m)	HIGH
WWII British Heavy Anti-Aircraft Shells (HAA Shells)	1.1kg - 1.7kg	Shallow burial (1-2m)	MODERATE-HIGH
WWII British Land Service Ammunition (LSA)	<2kg	Shallow burial (1-2m)	
WWII German 2kg Incendiary / HE Bombs (IBs)	680g incendiary hazard + ~500g explosive hazard	Shallow burial (1-2m)	
WWII German 1kg IBs	680g (incendiary, not explosive hazard)	Shallow burial (1-2m)	MODERATE
WWII British Light Anti-Aircraft Shells (LAA Shells)	4g - 70g	Very shallow burial (<1m)	LOW-MODERATE
Small Arms Ammunition (SAA)	<1g	Very shallow burial (<1m)	LOW
Inert/Practice Item	0g	Very shallow burial (<1m)	

9.4 The Likelihood of UXO Encounter

9.4.1 Introduction

This report assesses the risk of UXO in relation to the proposed works, not simply the risk that UXO remains buried on Site. The likelihood of UXO encounter during intrusive ground works will vary depending on the type of UXO and the type of construction methods employed during the project. With increased soil disturbance i.e. more excavations, the likelihood of encountering UXO increases.

Within an area of elevated UXO contamination likelihood, the sub-surface volume of potential UXO contamination will comprise the natural soil / geology in between WWII ground level and the maximum bomb penetration depth. Therefore, any intrusions into this layer will be at risk of UXO encounter.

Any post-WWII fill material deposited on a site is unlikely to be contaminated with UXO and therefore the risk of encountering UXO on such a site could vary with depth.

In the wake of the initial nine-month Blitz, many cities and towns were left with vast quantities of bomb site rubble that required removal and relocation. This material was put to use for in a variety of ways, for example >750,000 tons of London's rubble was used to build runways for new RAF and USAAF airfields and much of Liverpool's rubble was used to create and maintain sea / flood defences throughout Merseyside.

It is quite possible that unexploded British AA projectiles and German 1kg incendiaries were overlooked during removal, resulting in UXO contaminated fill material ending up on otherwise low UXO risk sites, possibly many miles from any high bombing density areas.

9.4.2 German UXBs

Although most German UXBs came to rest several metres below WWII ground level, these weapons can be found at any level between just below WWII ground level and the maximum bomb penetration depth. There are a number of reasons why these heavy bombs might be found at surprisingly shallow depths.

- **Tip and run:** When enemy aircraft had to take evasive action to escape RAF fighter intercepts or AA defences, they often dropped their bomb loads from a reduced height, potentially resulting in extreme J-curve effect.
- **Deflection:** the shape of German bomb nose sections meant they were susceptible to deflection when striking surface or shallow sub-surface obstacles, occasionally resulting in shallow burial or even UXBs skidding across hardstanding.
- **Aircraft Crash Site:** if an aircraft was unable to dump its bomb load before impacting the ground, due to mechanical fault, any externally fitted bombs could have become buried on impact.

German 1kg / 2kg incendiaries were cylindrical and approximately 50mm in diameter. They had tail sections, and so landed nose first. Within soft ground this could result in full penetration of the bomb below the surface. Such UXBs are usually found close to the surface.

9.4.3 British / Allied UXO

The nature of British/Allied military activity involving LSA and SAA and the smaller size of these munitions (in relation to German HE bombs) indicates that any resulting UXO contamination on a site will be limited to shallow depths, usually within 1.5m of the surface, notwithstanding added material to raise the ground level.

Domestic military LSA and SAA contamination will either be the result of expending blinds (dud ammunition) which bury into the ground on impact or munitions purposefully buried, for a number of reasons. Either way, these types of UXO are all found at shallow depth.

9.4.4 Deductions

An elevated likelihood of UXO contamination (German) and likelihood of that UXO remaining up to the present day has been identified across the Site. Additionally, a slightly elevated likelihood of UXO contamination (British) and likelihood of that UXO remaining up to the present day has been identified across the Site. Therefore, all the proposed works are considered to be exposed to a UXO encounter.

10 OVERALL RISK RATING

Ratings for the likelihood of UXO contaminating the Site, remaining within the Site up to the present day and being encountered during the proposed works, inform the overall risk rating. Please refer to the UXO hazard table presented in ***Section 9.3*** for a breakdown of the most common hazards and their associated risk. The colour of each respective type of hazard indicates the associated risk, as defined within the aforementioned table. The UXO risk to the proposed works has been assessed as **Moderate**.

Risk Table					
Risk Zone	**UXO Type (Hazard)**	**Likelihood of UXO Contamination**	**Likelihood of UXO Remaining**	**Likelihood of UXO Encounter**	**Overall Risk Rating**
Moderate Risk	**WWII German GP HE Bombs**	Moderate	Moderate-High	Moderate	**MODERATE**
	HAA Shells	Moderate	Moderate	Moderate-High	
	LSA	Low-Moderate	Moderate	Moderate-High	**LOW-MODERATE**
	German 2kg IBs	Low	n/a		**LOW**
	German 1kg IBs	Low	n/a		
	LAA Shells	Low	n/a		
	SAA	Low-Moderate	Moderate	Moderate-High	**LOW-MODERATE**

11 RISK MITIGATION RECOMMENDATIONS

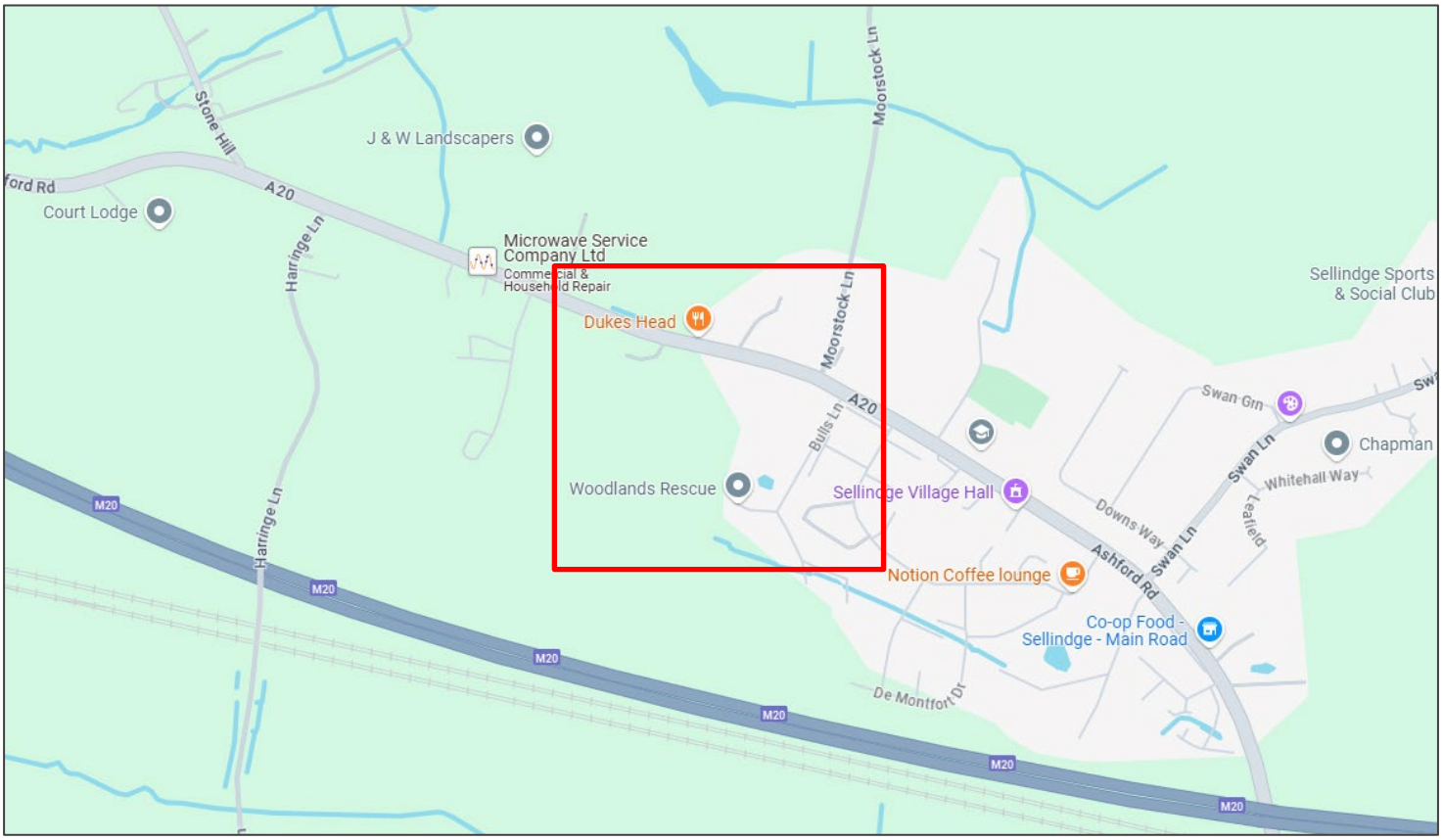
Brimstone has identified an elevated UXO risk to the proposed works. The measures detailed below are recommended to mitigate the risk to ALARP level.

Risk Mitigation Measure	Recommendation
UXO Safety Awareness Briefings: To all personnel conducting intrusive works on Site. An essential part of the Health & Safety Plan for a site. Conforms to the requirements of CDM2015.	Prior to all intrusive works commencing.
EOD Engineer - On Site Supervision: Watching brief for open excavations below WWII ground level. Portable magnetometer instruments for clearing ground ahead of borehole positions and shallow excavations (where / when appropriate). Positive identification of suspicious (non UXO) objects. Liaison during confirmed UXO incidents. Provision of additional UXO Safety Awareness Briefings.	Watching brief of all open excavations and magnetometer survey of borehole locations.
Intrusive Magnetometer Probe Survey: A range of intrusive magnetometer methodologies can be deployed to survey the ground (down to the maximum bomb penetration depth) prior to deep intrusive works; pile foundations. The appropriate technique is governed by a number of factors, the most important being the site-specific ground conditions.	Of all / any pile positions.
Non-Intrusive Magnetometer Survey: A range of non-intrusive magnetometer methodologies can be deployed to survey large areas of land to a limited depth. Such surveys can typically detect a 50kg WWII bomb at a depth of 4.5m, in “clean” ground. This survey is only appropriate for greenfield land where “magnetic noise” is negligible. To extend survey range, a reduced dig and secondary survey can be carried out.	Open excavations on greenfield land.

FIGURES: 1 - 8

BRIMSTONE
Innovation Centre Medway
Maidstone Road
Chatham
ME5 9FD
+44 (0) 207 117 2492
www.brimstoneuxo.com
enquire@brimstoneuxo.com

N	Title:	Site Location Maps	FIGURE: 1



Project:	**Land to the South of Ashford Road, Sellindge, Kent**
Client:	**IDOM**
Report Ref:	**DRA-24-1799**
General Site Location:	Info Source: Google (open-source)

BRIMSTONE
Innovation Centre Medway
Maidstone Road
Chatham
ME5 9FD
+44 (0) 207 117 2492
www.brimstoneuxo.com
enquire@brimstoneuxo.com

N

Title: Recent Aerial Photograph

FIGURE: 2

Project:	Land to the South of Ashford Road, Sellindge, Kent
Client:	IDOM
Report Ref:	DRA-24-1799
Approx. Site Boundary:	Info Source: Google (open-source)

BRIMSTONE

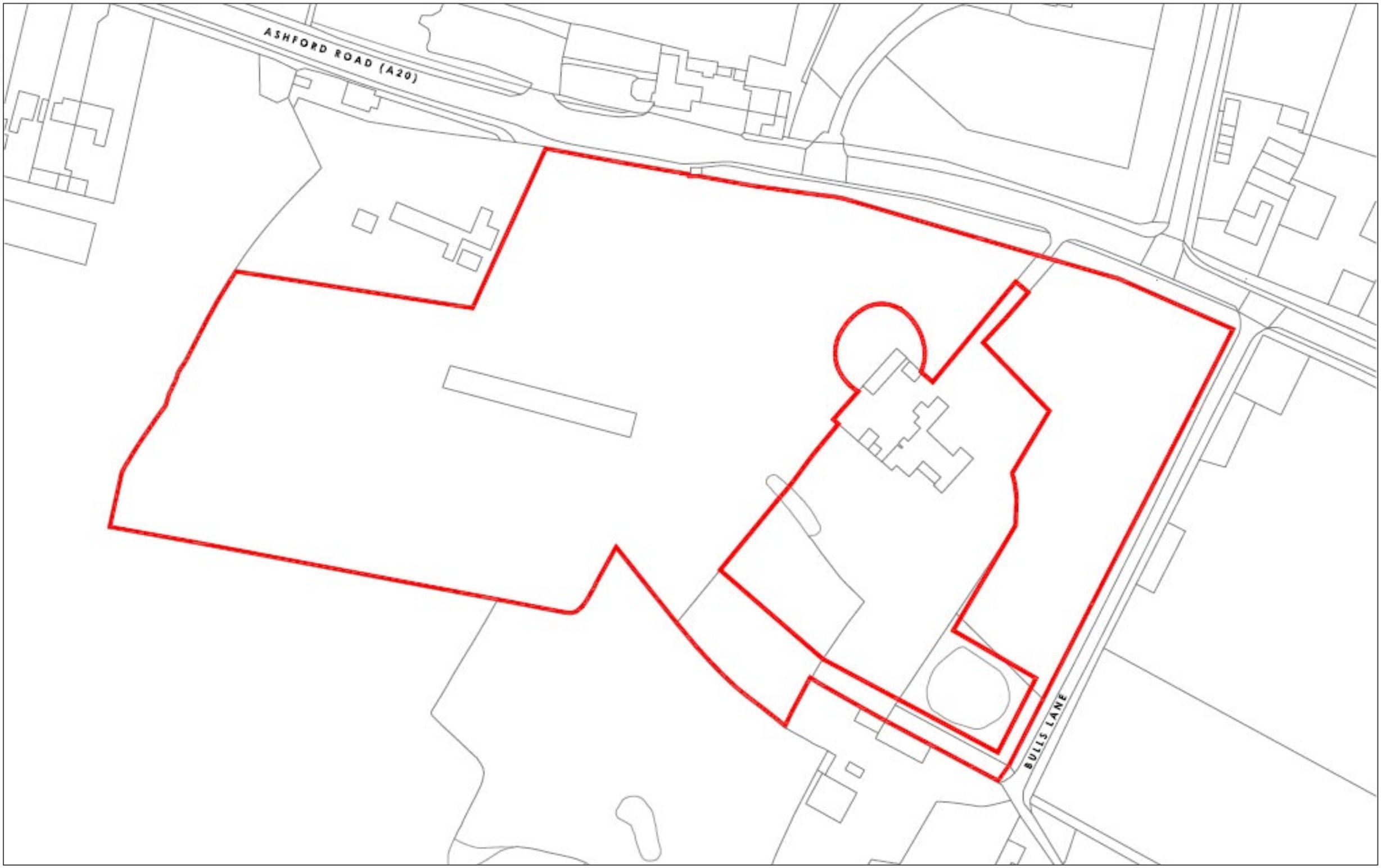
Innovation Centre Medway
Maidstone Road
Chatham
ME5 9FD

+44 (0) 207 117 2492
www.brimstoneuxo.com
enquire@brimstoneuxo.com

N

Title: Existing Site Plan

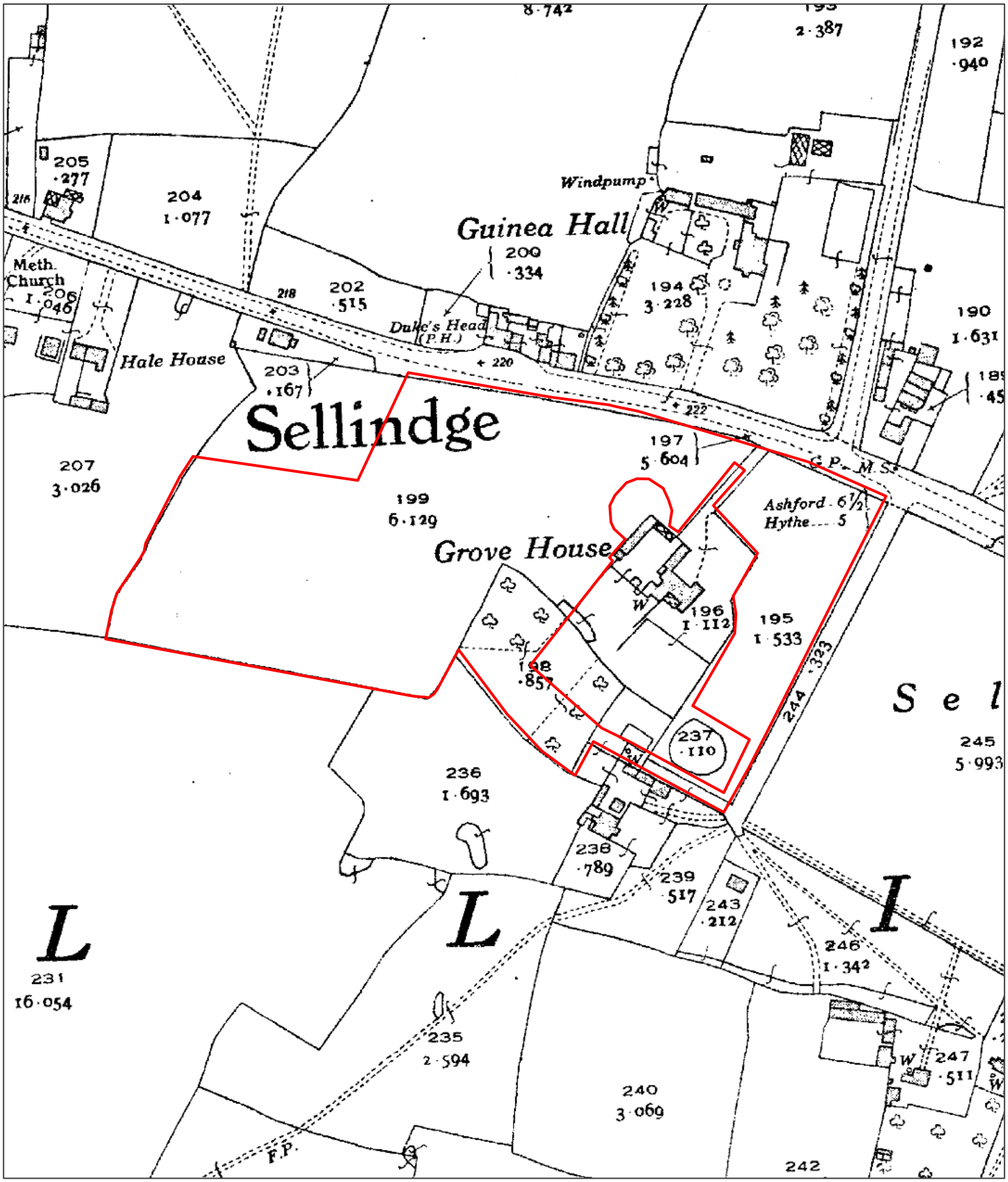
FIGURE: 3



Project:	**Land to the South of Ashford Road, Sellindge, Kent**	Report Ref:	**IDOM121R**	Site Boundary	
Client:	**IDOM**	Info Source:	IDOM		

BRIMSTONE
Innovation Centre Medway
Maidstone Road
Chatham
ME5 9FD
+44 (0) 207 117 2492
www.brimstoneuxo.com
enquire@brimstoneuxo.com

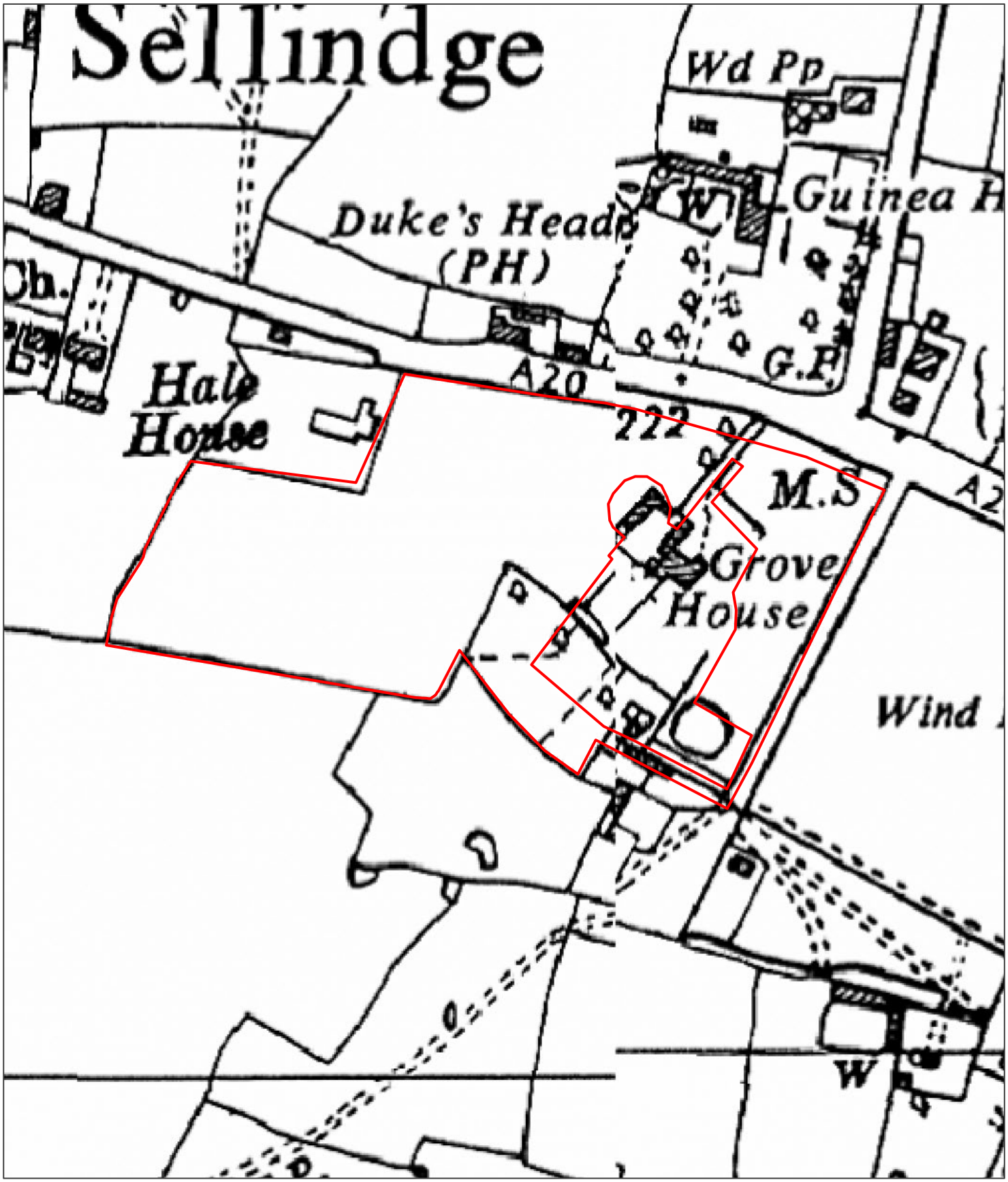
Title:	Historical OS Mapping – 1939	FIGURE: 4.1



Project:	Land to the South of Ashford Road, Sellindge, Kent		
Client:	IDOM		
Report Ref:	DRA-24-1799		
Approx. Site Boundary:		Info Source:	Promap

BRIMSTONE
Innovation Centre Medway
Maidstone Road
Chatham
ME5 9FD
+44 (0) 207 117 2492
www.brimstoneuxo.com
enquire@brimstoneuxo.com

Title:	Historical OS Mapping – 1961	FIGURE: 4.2



Project:	Land to the South of Ashford Road, Sellindge, Kent
Client:	IDOM
Report Ref:	DRA-24-1799
Approx. Site Boundary:	Info Source: Promap

BRIMSTONE
Innovation Centre Medway
Maidstone Road
Chatham
ME5 9FD
+44 (0) 207 117 2492
www.brimstoneuxo.com
enquire@brimstoneuxo.com

Title:	Historical Aerial Photography – 15th August 1940	FIGURE: 5.1

Project:	Land to the South of Ashford Road, Sellindge, Kent
Client:	IDOM
Report Ref:	DRA-24-1799
Approx. Site Boundary:	Info Source: NCAP

BRIMSTONE
Innovation Centre Medway
Maidstone Road
Chatham
ME5 9FD
+44 (0) 207 117 2492
www.brimstoneuxo.com
enquire@brimstoneuxo.com

Title:	Historical Aerial Photography – 15th August 1940	FIGURE: 5.2

Project:	Land to the South of Ashford Road, Sellindge, Kent
Client:	IDOM
Report Ref:	DRA-24-1799
Approx. Site Boundary:	Info Source: NCAP

BRIMSTONE
Innovation Centre Medway
Maidstone Road
Chatham
ME5 9FD
+44 (0) 207 117 2492
www.brimstoneuxo.com
enquire@brimstoneuxo.com

N	**Title:** Historical Aerial Photography – July 1945	**FIGURE: 5.3**

Project:	**Land to the South of Ashford Road, Sellindge, Kent**
Client:	**IDOM**
Report Ref:	**DRA-24-1799**
Approx. Site Boundary:	Info Source: NLS

BRIMSTONE
Innovation Centre Medway
Maidstone Road
Chatham
ME5 9FD
+44 (0) 207 117 2492
www.brimstoneuxo.com
enquire@brimstoneuxo.com

Title: Historical Aerial Photography – July 1945 FIGURE: 5.4

Project:	Land to the South of Ashford Road, Sellindge, Kent
Client:	IDOM
Report Ref:	DRA-24-1799
Approx. Site Boundary:	Info Source: NLS

BRIMSTONE
Innovation Centre Medway
Maidstone Road
Chatham
ME5 9FD
+44 (0) 207 117 2492
www.brimstoneuxo.com
enquire@brimstoneuxo.com

Title:	Historical Aerial Photography – July 1945	FIGURE: 5.5

Project:	Land to the South of Ashford Road, Sellindge, Kent
Client:	IDOM
Report Ref:	DRA-24-1799
Approx. Site Boundary:	Info Source: NLS

BRIMSTONE
Innovation Centre Medway
Maidstone Road
Chatham
ME5 9FD
+44 (0) 207 117 2492
www.brimstoneuxo.com
enquire@brimstoneuxo.com

Title:	Historical Aerial Photography – July 1945	FIGURE: 5.6

Project:	Land to the South of Ashford Road, Sellindge, Kent
Client:	IDOM
Report Ref:	DRA-24-1799
Approx. Site Boundary:	Info Source: NLS

BRIMSTONE
Innovation Centre Medway
Maidstone Road
Chatham
ME5 9FD
+44 (0) 207 117 2492
www.brimstoneuxo.com
enquire@brimstoneuxo.com

Title:	Historical Aerial Photography – 12th January 1946	FIGURE: 5.7

Project:	Land to the South of Ashford Road, Sellindge, Kent
Client:	IDOM
Report Ref:	DRA-24-1799
Approx. Site Boundary:	Info Source: Historic England

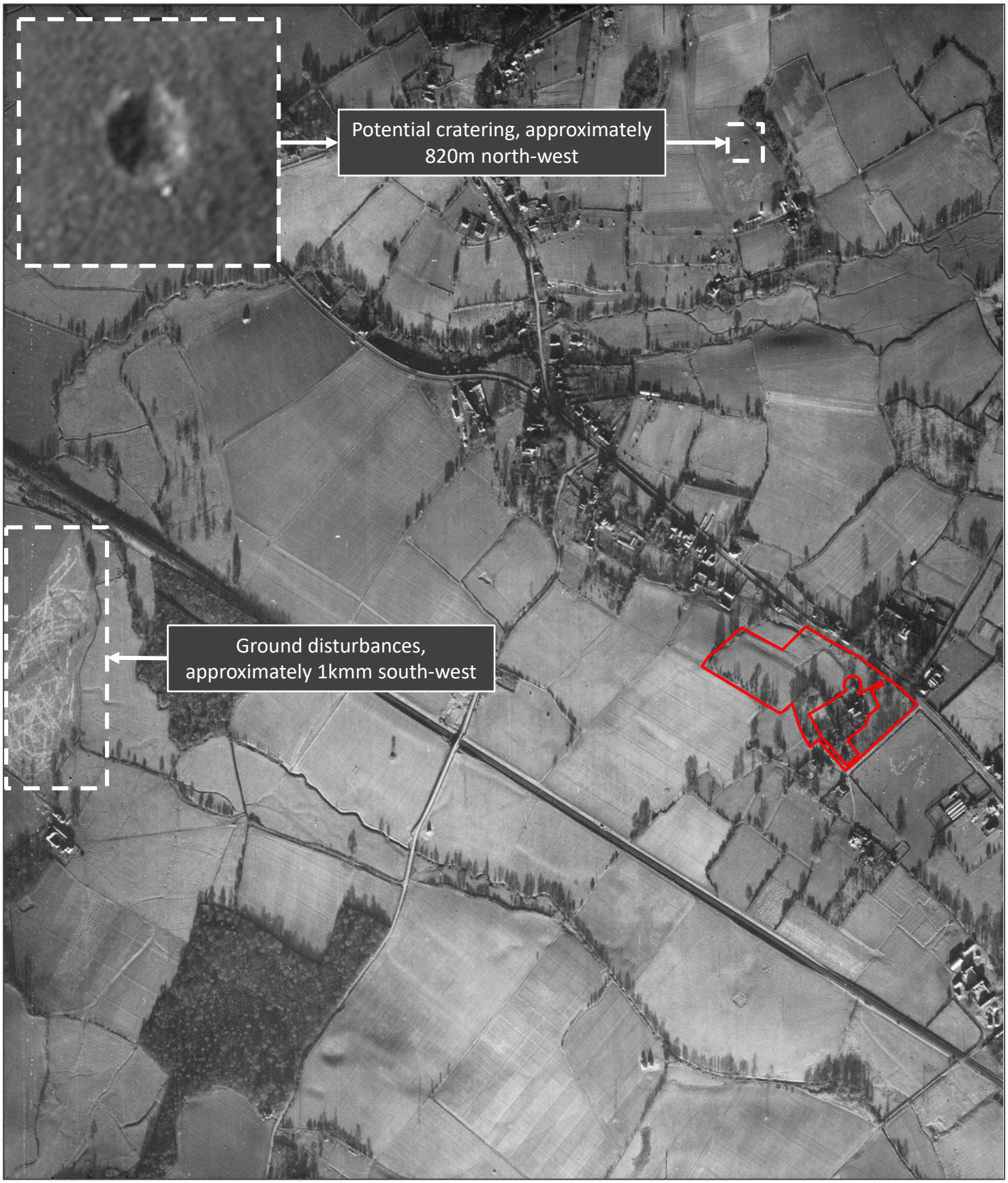
BRIMSTONE
Innovation Centre Medway
Maidstone Road
Chatham
ME5 9FD
+44 (0) 207 117 2492
www.brimstoneuxo.com
enquire@brimstoneuxo.com

Title:	Historical Aerial Photography – 12th January 1946	FIGURE: 5.8

Project:	Land to the South of Ashford Road, Sellindge, Kent
Client:	IDOM
Report Ref:	DRA-24-1799
Approx. Site Boundary:	Info Source: Historic England

BRIMSTONE
Innovation Centre Medway
Maidstone Road
Chatham
ME5 9FD
+44 (0) 207 117 2492
www.brimstoneuxo.com
enquire@brimstoneuxo.com

Title:	Historical Aerial Photography – 12th January 1946	FIGURE: 5.9



Project:	Land to the South of Ashford Road, Sellindge, Kent
Client:	IDOM
Report Ref:	DRA-24-1799
Approx. Site Boundary:	Info Source: Historic England

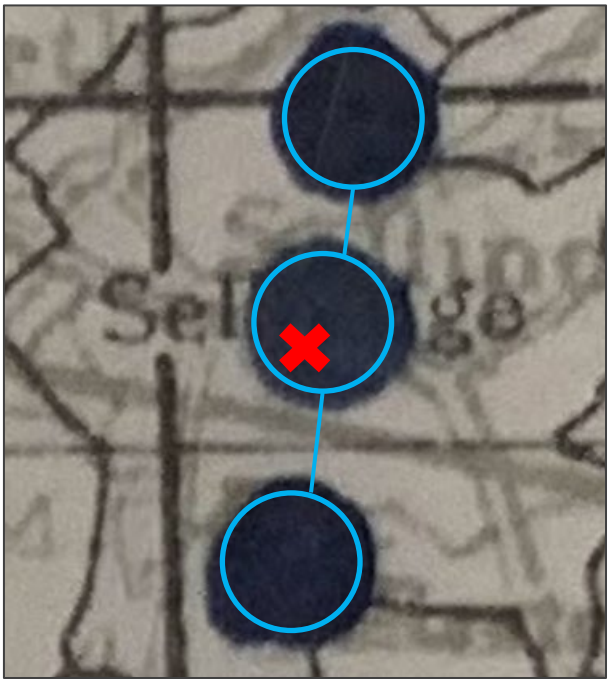
BRIMSTONE
Innovation Centre Medway
Maidstone Road
Chatham
ME5 9FD
+44 (0) 207 117 2492
www.brimstoneuxo.com
enquire@brimstoneuxo.com

N	Title:	Kent Daily Bomb and Shell Plot Maps	FIGURE: 6.1

08/10/1940

02/11/1940

28/11/1940



12/11/1942 – 04/12/1942

Key: HE Bomb | Incendiary Bomb | Machine Gunning | Potential Bomb Stick

Project:	Land to the South of Ashford Road, Sellindge, Kent
Client:	IDOM
Report Ref:	DRA-24-1799
Approx. Site Location: ✖	Info Source: Kent History and Library Centre

BRIMSTONE
Innovation Centre Medway
Maidstone Road
Chatham
ME5 9FD
+44 (0) 207 117 2492
www.brimstoneuxo.com
enquire@brimstoneuxo.com

N	Title:	Kent Daily Bomb and Shell Plot Maps	FIGURE: 6.2

10/11/1942 – 09/12/1942

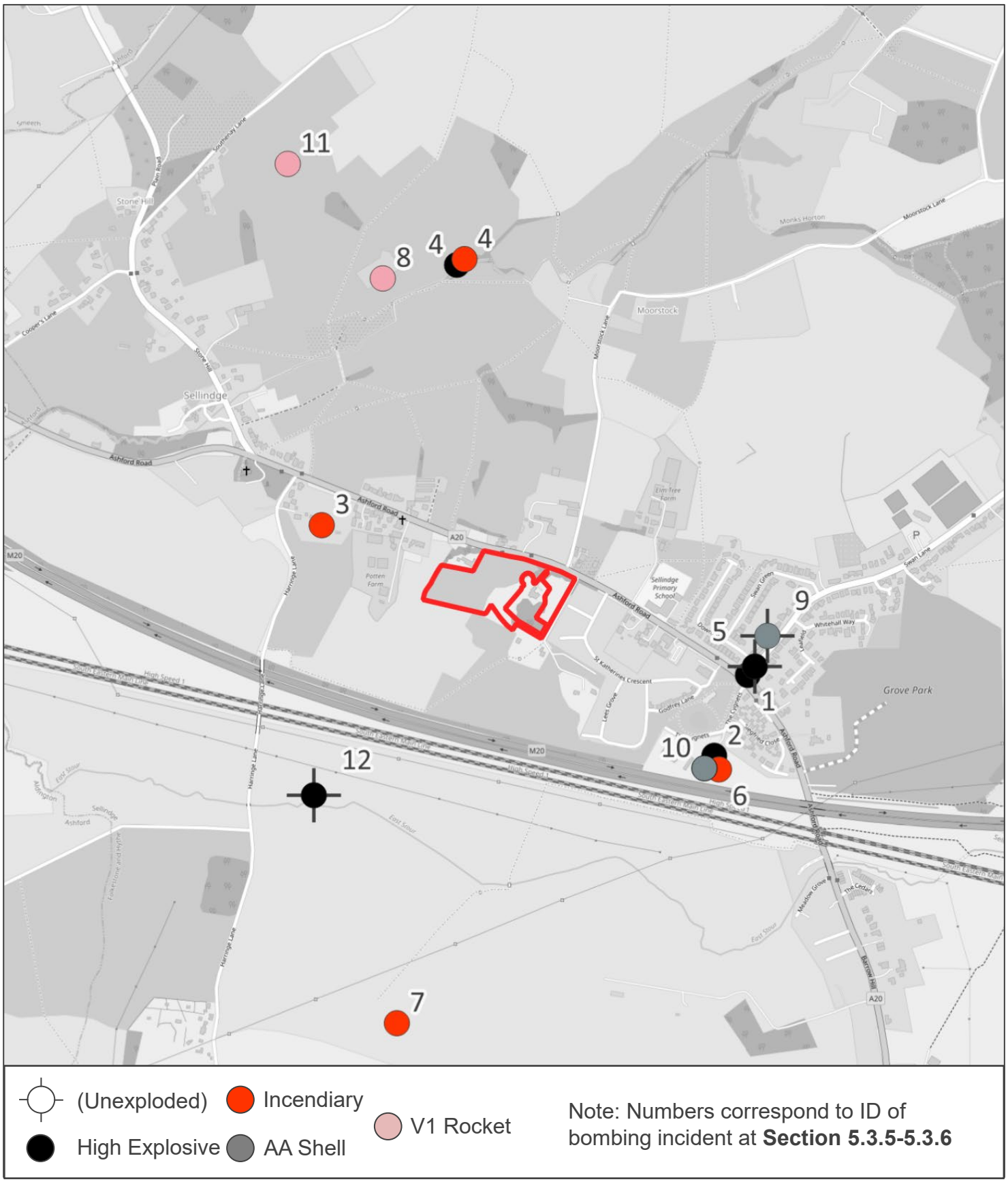
21/01/1944

Key: HE Bomb Machine Gunning

Project:	**Land to the South of Ashford Road, Sellindge, Kent**
Client:	**IDOM**
Report Ref:	**DRA-24-1799**
Approx. Site Location: ✖	Info Source: Kent History and Library Centre

BRIMSTONE
Innovation Centre Medway
Maidstone Road
Chatham
ME5 9FD
+44 (0) 207 117 2492
www.brimstoneuxo.com
enquire@brimstoneuxo.com

N	Title:	Bombing Overlay	FIGURE: 7



Project:	**Land to the South of Ashford Road, Sellindge, Kent**
Client:	**IDOM**
Report Ref:	**DRA-24-1799**
Approx. Site Boundary:	Info Source: Brimstone / OpenStreetMaps

BRIMSTONE
Innovation Centre Medway
Maidstone Road
Chatham
ME5 9FD
+44 (0) 207 117 2492
www.brimstoneuxo.com
enquire@brimstoneuxo.com

Title:	‘Where the “Doodlebugs” Crashed in Kent’	FIGURE: 8

Project:	Land to the South of Ashford Road, Sellindge, Kent
Client:	IDOM
Report Ref:	DRA-24-1799
Approx. Site Location: ✖	Info Source: The Kent Messenger

BRIMSTONE
Innovation Centre Medway
Maidstone Road
Chatham
ME5 9FD
+44 (0) 207 117 2492
www.brimstoneuxo.com
enquire@brimstoneuxo.com

APPENDICES: 1 - 5

BRIMSTONE
Innovation Centre Medway
Maidstone Road
Chatham
ME5 9FD
+44 (0) 207 117 2492
www.brimstoneuxo.com
enquire@brimstoneuxo.com

Recent German UXB Finds in the UK + Historical Analysis

The Ministry of Defence (MOD) says that bomb disposal teams around the UK deal with approximately 60 German WWII-era UXBs per year.

- ***20th February 2024*** – An SC500 (standard 500kg HE bomb) was found during shallow excavations in a residential garden in Keyham, Plymouth. *Historical Analysis: The UXB landed in a small residential back garden belonging to an undamaged terraced house. It came to rest at approximately 1 to 2m bgl.*
- ***10th February 2023 –*** An SC250 (standard 250kg HE bomb) was dredged out of the River Yare in Great Yarmouth. The UXB detonated unexpectedly in situ during an attempt to disarm it. *Historical Analysis: The UXB landed in the River Yare; the precise location of its initial impact is unknown. UXBs in water are often affected by migration, whereby the item can travel along the riverbed.*
- ***26th February 2021 –*** An SC1000 (standard 1,000kg HE bomb) was discovered during shallow excavations in Exeter, adjacent to the University of Exeter. The item was detonated in situ and caused structural damage to nearby properties, leaving some inhabitable. *Historical Analysis: The UXB landed in undeveloped land of no obvious significance. It came to rest at approximately 2 to 3m bgl with its nose facing upwards, highlighting the potential of J-curve occurring.*
- ***23rd May 2019*** - An SC250 (standard 250kg HE bomb) was found during shallow excavations at a building site in Kingston upon Thames, London. *Historical Analysis: The UXB landed in a small residential back garden belonging to an undamaged terraced house. It came to rest approximately 3 to 4m bgl.*
- ***11th February 2018*** – An SC500 (standard 500kg bomb) was discovered in George V Dock in London during planned work at London City Airport. *Historical Analysis*: *George V Dock was identified as a primary target by the Luftwaffe during WWII and was bombed on multiple occasions.*
- ***15th May 2017 -*** An SC250 (standard 250kg HE bomb) was found during shallow excavations at a building site in Aston, Birmingham. *Historical Analysis: The UXB landed in a small back garden belonging to a terraced house, part of a row. It J-Curved under a neighbouring garden and came to rest at just 1.4m bgl. NB: These houses had not sustained bomb damage.*
- ***2nd March 2017 -*** A 250kg HE bomb was found during deep excavations at a building site in Brondesbury Park, London. *Historical Analysis: UXB landed in a large residential back garden. A single storey building was built on top of the UXB post-WWII.*

Recent Allied UXB finds in Europe

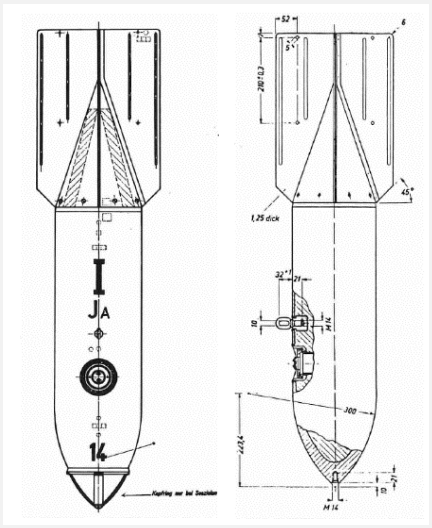
- ***27th June 2024*** – A 250kg HE UXB of Allied origin was discovered in a wooded area in Gruenheide (Germany).
- ***26th April 2024*** – A 500kg American HE UXB was discovered during construction work in Mainz (Germany), nearby the MEWA Arena stadium.
- ***3rd April 2024 –*** A 500kg UXB of Allied origin was discovered during construction work on a shipping channel in Deutz, Cologne (Germany). The device was defused in situ.
- ***28th March 2024*** – A 500lb American HE UXB was discovered during construction work in Aachen (Germany). The device was defused in situ.
- ***11th August 2023 –*** A 250kg HE UXB of Allied origin was discovered in Lublin (Poland). The device was discovered in an area where an aircraft factory had been located prior to WWII.
- ***8th August 2023*** – An unexploded "one-tonne shell" (1000kg HE UXB) of anticipated Allied origin was discovered near Dusseldorf city zoo (Germany).
- ***5th July 2023*** – A UXB of unspecified origin and calibre (alleged to have been Russian but no confirmation) was discovered on a construction site in Hohenschönhausen, Berlin (Germany). The device was defused in situ.
- ***17th March 2022*** – A farmer ploughing a field discovered a British INC30 (incendiary) bomb, which contained phosphorous, in Viersen (Germany). The plough became embedded in the device, which did not explode.

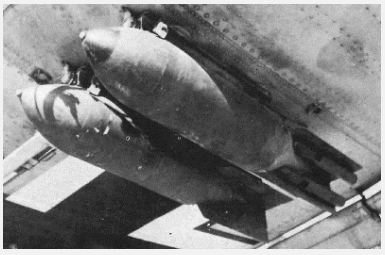
NB: Domestic UXO finds in the UK are too numerous to list. Between 2006 and 2009, over 15,000 items of British / Allied UXO (excluding small arms ammunition) were found on UK construction sites (CIRIA).

BRIMSTONE
Innovation Centre Medway
Maidstone Road
Chatham
ME5 9FD
+44 (0) 207 117 2492
www.brimstoneuxo.com
enquire@brimstoneuxo.com

SC 50

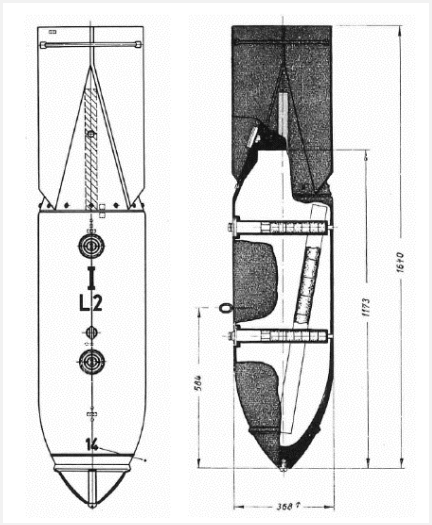
Bomb Weight:	40-54kg (110-119lb)
Explosive Weight:	25kg (55lb)
Filling:	TNT, Amatol or Trialen
Charge/Weight Ratio:	46%
Fuse Type:	Electrical impact fuse or mechanical delayed action fuse
Body Dimensions:	1,100mm length x 200mm diameter
Appearance:	Bomb body and tail painted grey/green with a yellow stripe on the tail unit. Steel construction.
Variants:	8 x variants. Additional fittings: Kopfring nose for limited penetration and Stabbo nose for dive-bombing.





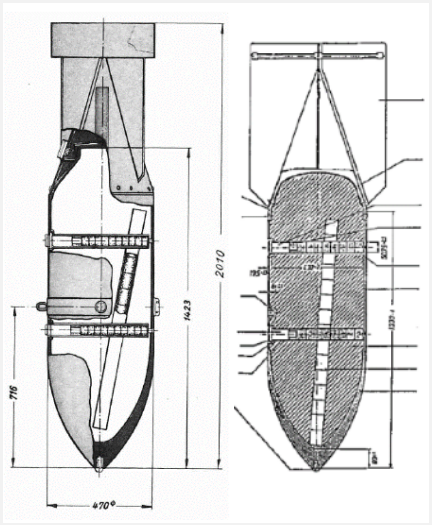
SC 250

Bomb Weight:	245-256kg (540-564lb)
Explosive Weight:	125-130kg (276-287lb)
Filling:	TNT, Amatol and Trialen mix
Charge/Weight Ratio:	44%
Fuse Type:	1 or 2 electrical impact fuse(s) or mechanical delayed action fuse(s)
Body Dimensions:	1,173mm length x 368mm diameter
Appearance:	Bomb body and tail painted grey/green with a yellow stripe on the tail unit. Steel construction.
Variants:	8 x variants. Kopfring nose for limited penetration. Stabbo nose for dive-bombing.



SC 500

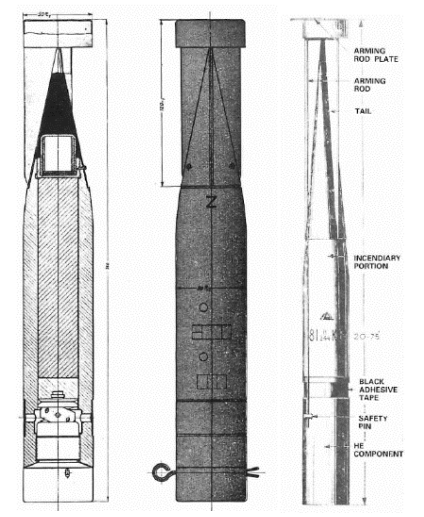
Bomb Weight:	480-520kg (1,058-1,146lb)
Explosive Weight:	220kg (485lb)
Filling:	TNT, Amatol and Trialen mix
Charge/Weight Ratio:	44%
Fuse Type:	2 electrical impact fuses or mechanical delayed action fuses
Body Dimensions:	1,423mm length x 470mm diameter
Appearance:	Bomb body and tail painted grey/green or buff with a yellow stripe on the tail unit. Steel construction.
Variants:	3 x variants. Kopfring nose for limited penetration.



BRIMSTONE
Innovation Centre Medway
Maidstone Road
Chatham
ME5 9FD
+44 (0) 207 117 2492
www.brimstoneuxo.com
enquire@brimstoneuxo.com

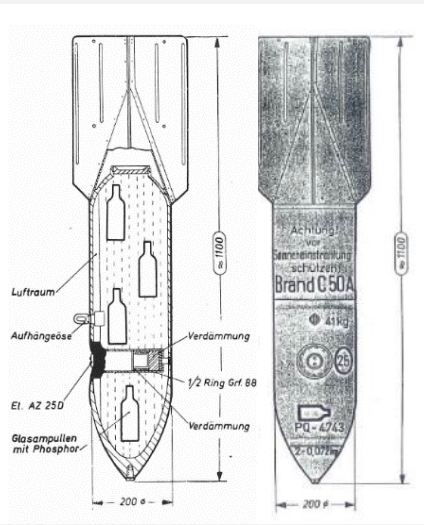
B-1E Sub-Munition

Bomb Weight:	1-1.3kg (2.2-2.87lb)
Incendiary Weight:	680g (1.4lb)
Filling:	Thermite
Fuse Type:	Simple impact fuse
Body Dimensions:	247mm length x 50mm diameter
Appearance:	Grey body and dark green painted tail unit. Magnesium alloy case.
Operation:	Small percussion charge ignites Thermite (>1,000°C burn).
Variants:	Most common variant: B 2EZ (2kg) included a small HE charge
Remarks:	Drop containers varied in size. The smallest cluster bomb held 36 x B-1Es and the largest 620 x B-1Es.



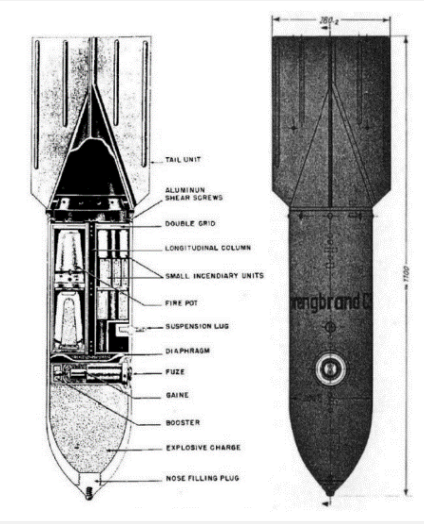
Brand C50

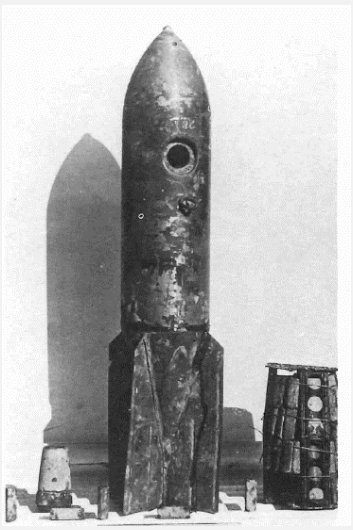
Bomb Weight:	41kg (90.4lb)
Incendiary Weight:	13kg (30lb)
Filling:	Main fill (86% Benzine, 10% Rubber) plus 4% Phosphorus in glass bottles
Fuse Type:	1 x electrical impact fuse
Bomb Dimensions:	762mm length x 203mm diameter
Appearance:	bomb body and tail painted grey or green with the rear of the bomb painted red and a red band around the centre of the body.
Variants:	C 50 B: 77% White Phos fill C 250 A: 87.7% Petroleum, 11.7% Polystyrene, 0.5% White Phos (185kg version)



Spreng-Brand C50 - *Fire Pot*

Bomb Weight:	34kg (75lb)
Explosive Weight:	9kg (20lb)
Filling:	TNT burster charge, 6 x Thermite containers (fire pots) and 67 x small triangular incendiary elements.
Fuse Type:	1 x electrical impact fuses or aerial burst fuse
Bomb Dimensions:	711mm length x 203mm diameter
Appearance:	Bomb body and tail painted grey/green or pale blue with red base plug and red or green incendiary markings. Steel construction.
Operation:	A charge blows off the base plate, firing a plume of incendiary mixture 100 yds. Approx 1 second later the HE charge detonates.

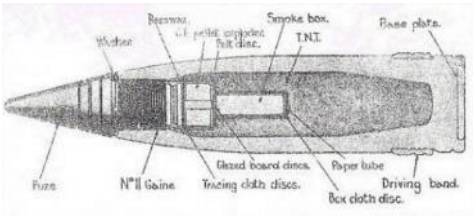




BRIMSTONE
Innovation Centre Medway
Maidstone Road
Chatham
ME5 9FD
+44 (0) 207 117 2492
www.brimstoneuxo.com
enquire@brimstoneuxo.com

HAA Battery - 3.7" QF Shell

Shell Weight:	12.7kg
Shell Dimensions:	94mm x 438mm
Fill Weight:	1.1kg
Fill Type:	TNT
Fuse Type:	Mechanical Time Delay fuse
Appearance:	Grey body, copper driving bands, brass neck
Rate of Fire:	10 - 20 rpm
Ceiling:	9,000 - 18,000m
Variants:	HE or shrapnel shells. Note, the 4.5" gun was also used in an HAA role throughout the UK.

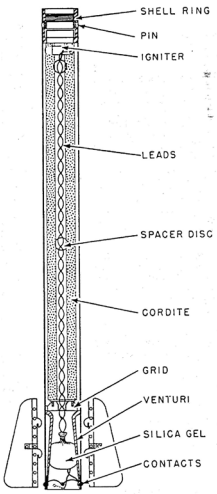


LAA Battery - 40mm Bofors Shell

Shell Weight:	0.84kg
Shell Dimensions:	40mm x 180mm
Fill Weight:	70g
Fill Type:	TNT
Fuse Type:	Impact fuse
Appearance:	Grey body, copper driving bands, brass neck
Rate of Fire:	120 rpm
Ceiling:	7,000m
Variants:	HE or AP shells. Both with rear tracer compartment

Z Battery - 3" U.P Rocket

Rocket Weight:	24.5kg
Warhead Weight:	1.94kg
Filling:	TNT warhead. Black Powder solid fuel rocket motor.
Fuse Type:	Mechanical Time Delay fuse
Rocket Dimensions:	1,930mm x 76mm
Ceiling:	6,770m
Operation:	Fired from single, tandem and (later) 36 x rail launchers (Z Batteries). Limited use throughout the UK.



Project:	**Land to the South of Ashford Road, Sellindge, Kent**
Client:	**IDOM**
Report Ref:	**DRA-24-1799**
Info Source:	*W, Ramsey.1988 / various news sources*

BRIMSTONE
Innovation Centre Medway
Maidstone Road
Chatham
ME5 9FD
+44 (0) 207 117 2492
www.brimstoneuxo.com
enquire@brimstoneuxo.com

AA	*Anti-Aircraft (defences)*
AFS	*Auxiliary Fire Service*
AP	*Anti-Personnel*
ARP	*Air Raid Precautions*
ASW	*Anti-Submarine Warfare*
BDU	*Bomb Disposal Unit (historic term for EOD)*
Bgl	*Below Ground Level*
EOC	*Explosive Ordnance Clearance*
EOD	*Explosive Ordnance Disposal*
FP	*Fire Pot (German bomb)*
GI	*Ground Investigation*
HAA	*Heavy Anti-Air (gun battery)*
Ha	*Hectare (10,000m2)*
HE	*High Explosive*
IB	*Incendiary Bomb*
Kg	*Kilogram*
LAA	*Light Anti Air (gun battery)*
LCC	*London County Council*
LRRB	*Long Range Rocket Bomb (V2)*
LSA	*Land Service Ammunition*
Luftwaffe	*German Air Force*
OB	*Oil Bomb (German bomb)*
PM	*Parachute Mine (German bomb)*
RAF	*Royal Air Force*
RFC	*Royal Flying Corps*
RN	*Royal Navy (British)*
RNAS	*Royal Naval Air Service*
ROF	*Royal Ordnance Factory*
SAA	*Small Arms Ammunition*
SD2	*2kg AP bomb (German bomb)*
SI	*Site Investigation*
U/C	*Unclassified (German) bomb*
UP	*Unrotating Projectile (British 3" AA rocket)*
USAAF	*United States Army Air Force*
UX	*Unexploded*
UXB	*Unexploded Bomb*
UXO	*Unexploded Ordnance*
V1	*German Flying (pilotless) bomb - "Doodlebug"*
V2	*German LRRB - "Big Ben"*
WAAF	*Women's Auxiliary Air Force*
WWI	*World War One*
WWII	*World War Two*

BRIMSTONE
Innovation Centre Medway
Maidstone Road
Chatham
ME5 9FD
+44 (0) 207 117 2492
www.brimstoneuxo.com
enquire@brimstoneuxo.com

- ***Bates. H. E***, Flying Bombs Over England, Frogletts Publications Ltd, 1994.
- ***Bulloch. G***, Steeds J E, Green K, Sainsbury M G, Brockwell J S & Slade N J, Land Contamination: Technical Guidance on Special Sites: MoD Land, Environment Agency, 2001.
- ***Castle. I,*** London 1914-17: The Zeppelin Menace, Osprey Publishing Ltd, 2008.
- ***Castle. I,*** London 1917-18: The Bomber Blitz, Osprey Publishing Ltd, 2010.
- ***CIRIA***, C681: Unexploded Ordnance (UXO), A Guide for the Construction Industry, 2009.
- ***Clarke. N. J***, Luftwaffe Target Reconnaissance, German Aerial Photography 1939-1942, 1996.
- ***Clarke. N. J***, Adolf's British Holiday Snaps: Luftwaffe Aerial Reconnaissance Photographs of England, Scotland and Wales, 2012.
- ***Cocroft. W. D***, Dangerous Energy, Historic England, 2000.
- ***Dobinson. C. S,*** AA Command: Britain's Anti-Aircraft Defences of the Second World War, Methuen Publishing Ltd, 2001.
- ***Dobinson. C. S***, Fields of Deception - Britain's Bombing Decoys of World War II, Methuen Publishing Ltd, 2013.
- ***Fleischer. W***, German Air-Dropped Weapons to 1945, Midland Publishing, 2004.
- ***Heritage Gateway,*** Former sidings for a Second World War railway gun, https://www.heritagegateway.org.uk/Gateway/Results_Single.aspx?uid=MKE111015&resourceID=1005
- ***Heritage Gateway***, Searchlight Battery, https://www.heritagegateway.org.uk/Gateway/Results_Single.aspx?uid=eec383c6-5786-40e3-8ec4-3c8b03cbc3ef&resourceID=19191.
- ***Jappy. M. J,*** Danger UXB: The Remarkable Story of the Disposal of Unexploded Bombs during the Second World War. Channel 4 Books, 2001.
- ***Morris. J***, German Air Raids on Britain: 1914-1918, Nonsuch Publishing, 2007.
- ***Price. A***, Blitz on Britain 1939-45, Sutton Publishing Ltd, 2000.
- ***Ramsey. W,*** The Blitz Then and Now: Vol 1, Battle of Britain Prints International Limited, 1987.
- ***Ramsey. W,*** The Blitz Then and Now: Vol 2, Battle of Britain Prints International Limited, 1988.
- ***Ramsey. W,*** The Blitz Then and Now: Vol 3, Battle of Britain Prints International Limited, 1990.
- ***Whiting. C***, Britain Under Fire: The Bombing of Britain's Cities 1940-1945, Pen & Sword Books Ltd, 1999.

BRIMSTONE
Innovation Centre Medway
Maidstone Road
Chatham
ME5 9FD
+44 (0) 207 117 2492
www.brimstoneuxo.com
enquire@brimstoneuxo.com

The National Archives

- **HO 196/10/112**: D. Christopherson. (1941-1942) *Penetration of unexploded bombs in earth,* Ministry of Home Security

Kent History and Library Centre

- **C/Ad1/1-13:** County Control (1940-1945), *War Diary – Kent Region*
- **C/Ad1/21:** County Control (1940), *Daily incident maps*
- **C/Ad1/22:** County Control (1941-1944), *Daily incident maps*
- **RD/EL/AR3/1:** (1940-1945), *Register of Bombs and Shells dropped in the Elham Rural District*
- **WU21/P28:** Kent Messenger (1944), *'Where the Doodle Bugs crashed in Kent'*

BRIMSTONE
Innovation Centre Medway
Maidstone Road
Chatham
ME5 9FD
+44 (0) 207 117 2492
www.brimstoneuxo.com
enquire@brimstoneuxo.com

BRIMSTONE

Innovation Centre Medway, Maidstone Road, Chatham, ME5 9FD

Brimstone Site Investigations Ltd, Registered in England and Wales under company number 10253758

www.brimstoneuxo.com 0207 117 2492 enquire@brimstoneuxo.com