



1ST LINE DEFENCE



Detailed Unexploded Ordnance (UXO) Risk Assessment

Project Name	Southleigh Park, Havant
Client	Ground Conditions Consultants Ltd
Site Address	Southleigh Park, Havant, PO9 2PE
Report Reference	DA12228-00
Date	20/11/20
Originator	SB



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Executive Summary

Site Location and Description

The site is located on the outskirts of the town of Havant, within south-east Hampshire. The site is bordered to the north by Spire Portsmouth Hospital along Bartons Road and to the east by both forested land along Comley Hill and Emsworth Common Road. The site is bordered to the south by open land, with Southleigh Road and its associated farming grounds situated further south of the site boundary. The west of the site boundary is bordered by further agricultural land along Eastleigh Road.

The site is currently occupied by Southleigh Park House and its associated grounds, which is understood to be currently in commercial use. Open land occupies the site's southern section, as well as a small pond in the south-western section of the site boundary. The central section of the site is occupied by the Grade II Listed Southleigh Park House structure and the northern section by an attached 'U-shaped' office building built c.1983. Forested areas border the structures to the north, east and west. Intersecting roadways and car-parking facilities are also located in the northern section of the site boundary.

The site is approximately centred on the OS grid reference: **SU 73719 07980**.

Proposed Works

Whilst the exact scope of proposed works was not available at the time of writing this report, it is understood that the Southleigh Park Manor House and Estate will be developed for residential usage. This will include the development of a number of new build residential properties across the estate and the conversion of Southleigh Park House into apartments, as well as proposed mews house conversions in the estate's stables, west wing and coach house.

Information provided by the client suggests that one of the first phases of works will be to demolish the 1980s office building located in the northern section of the site boundary.

Geology and Bomb Penetration Depth

The British Geological Survey (BGS) map shows to varying formations for the north and south of the site boundary. The north of the site boundary shows London Clay Formation - clay, silt and sand of the Palaeogene Period. Local environment was previously dominated by deep seas. Superficial deposits shows Head - clay and gravel, of the Quaternary Period. Local environment was previously dominated by subaerial slopes. The southern section of the site boundary shows London Clay Formation - clay, silt and sand of the Palaeogene Period. Local environment was previously dominated by deep seas. There are no superficial deposits recorded for this area of the site boundary.

Site specific geotechnical information was not available to 1st Line Defence at the time of the production of this report. An assessment of maximum bomb penetration depth can be made once such data becomes available, or by a UXO specialist during on-site support.

It should be noted that the maximum depth that a bomb could reach may vary across a site and will be largely dependent on the specific underlying geological strata and its density.

UXO Risk Assessment

1st Line Defence has assessed that there is an overall **Low-Medium Risk** from both German and Allied unexploded ordnance at the site of proposed works. This assessment is based on the following factors:

The Risk from German Aerial Delivered UXO

- During WWII, the site was situated in the Urban District of Havant and Waterloo was subject to an overall low-moderate density of bombing, with an average of 35 bombs recorded per 1,000 acres according to Home Office statistics. The majority of bombing in the district is attributed to its proximity in relation to significant Luftwaffe targets across Portsmouth.
- As today, the site was occupied by Southleigh Park Manor House and its associated grounds during WWII. Open land and forested areas comprised the remainder of the site boundary with a small pond located in the south-western section of the site.
- Multiple references of UXB bombs located along Eastleigh Road and Southleigh Road are corroborated through anecdotal references and war diaries for Havant and Waterloo. The cause for this concentration of UXB's in the site

**UXO Risk Assessment**

locality is not clear. However, no positive evidence could be found to suggest that the structures or grounds within Southleigh Park House were affected by a bomb incident.

- Post-war aerial photography dated 1946, shows the structures within the site boundary to have remained externally intact. No obvious signs of damage such as rubble, debris and white tiling, which can often be indicative of repair works, is visible to Southleigh Park House or its external buildings. The open natured areas of the site also appear undamaged, with no signs of ground disturbance or cratering visible. This is reinforced through post-war OS mapping, as the site boundary and surrounding area appear to have remained in its pre-war composition.
- The site was occupied by Southleigh Park House and its associated grounds, with neighbouring roadways. It is therefore anticipated that these areas of the site boundary occupied by structures and their immediate environs would have been subject to fairly regular access. The open land areas of the site boundary would have experienced more intermittent access, although the neighbouring roadways should have still given these areas some degree of monitor.
- In summary, the records highlighting bombing along Eastleigh Road fail to pinpoint the exact location of the strikes, however, it is anticipated that due to the prominence of Southleigh Park House in the area, it is thought that should bombing have fallen in this vicinity it would have likely been noted and recorded. However due to the , the aforementioned UXB strikes along Eastleigh Road the risk from German aerial delivered ordnance is considered to be slightly elevated, as the possibility of an item falling within open areas of the site cannot be completely discounted. The risk from German aerial UXO has therefore been assessed at **Low-Medium**.

The Risk from Allied UXO

- Anecdotal information indicates pillboxes in the form of concrete bunkers were located within 100 yards of Southleigh Park House, as well as further ones in neighbouring roadways. Reference has also been to an anti-aircraft gun site at Southleigh Farm, situated approximately 800m south of the site.
- In addition, a number of WWII-era military camps are recorded in the site vicinity across the wooded and open areas of Emsworth and Rowland Castle, including camps used for D-Day Marshalling. The closest of the camps is understood to be a Free French camp named Bir Hakeim Barracks. This camp is understood to have been situated off Allendale Avenue, in Greville Green, approximately 600-700m south-east of the site.
- The concentration of these camps suggests that the rural areas surrounding Havant were heavily used by the military in the run up to D-Day. Indeed, anecdotal evidence has been found to suggest that a layby was constructed opposite the entrance to Southleigh House to accommodate additional camps, but was never needed.
- Due to this concentration of WWII-era Allied activity in the surrounding site area the risk from Allied UXO has also been slightly elevated to Low-Medium Risk, as a precaution. However, no evidence has been found to suggest that Southleigh Park House or its grounds were ever directly requisitioned by the military.

Post War Development

- The site boundary has experienced some development post-war. An office building in the northern section of the site boundary was developed in the 1980s, which included the associated access ways and car-parking facilities. The remainder of the site boundary has seen no more than perceived maintenance works, rather than significant structural changes.

Recommended Risk Mitigation Measures

The following risk mitigation measures are recommended to support the proposed works at the Southleigh Park, Havant site:

All Works

- UXO Risk Management Plan
- Site Specific UXO Awareness Briefings to all personnel conducting intrusive works.



Glossary

Abbreviation	Definition
AA	Anti-Aircraft
AFS	Auxiliary Fire Service
AP	Anti-Personnel
ARP	Air Raid Precautions
DA	Delay-action
EOC	Explosive Ordnance Clearance
EOD	Explosive Ordnance Disposal
FP	Fire Pot
GM	G Mine (Parachute mine)
HAA	Heavy Anti-Aircraft
HE	High Explosive
IB	Incendiary Bomb
JSEODOC	Joint Services Explosive Ordnance Disposal Operation Centre
LAA	Light Anti-Aircraft
LCC	London County Council
LRRB	Long Range Rocket Bomb (V-2)
LSA	Land Service Ammunition
NFF	National Filling Factory
OB	Oil Bomb
PAC	Pilotless Aircraft (V-1)
PB	Phosphorous Bomb
PM	Parachute Mine
POW	Prisoner Of War
RAF	Royal Air Force
RCAF	Royal Canadian Air Force
RFC	Royal Flying Corps
RNAS	Royal Naval Air Service
ROF	Royal Ordnance Factory
SA	Small Arms
SAA	Small Arms Ammunition
SD2	Anti-personnel "Butterfly Bomb"
SIP	Self-Igniting Phosphorous
U/C	Unclassified bomb
UP	Unrotated Projectile (rocket)
USAAF	United States Army Air Force
UX	Unexploded
UXAA	Unexploded Anti-Aircraft
UXB	Unexploded Bomb
UXO	Unexploded Ordnance
V-1	Flying Bomb (Doodlebug)
V-2	Long Range Rocket
WAAF	Women's Auxiliary Air Force
X	Exploded



Contents

Executive Summary	II
Glossary	IV
Contents.....	V
Annexes	VII
1. Introduction	1
1.1. Background.....	1
2. Method Statement	2
2.1. Report Objectives.....	2
2.2. Risk Assessment Process.....	2
2.3. Sources of Information	2
3. Background to Bombing Records	3
3.1. General Considerations of Historical Research	3
3.2. German Bombing Records	3
3.3. Allied Records	3
4. UK Regulatory Environment and Guidelines	4
4.1. General	4
4.2. CDM Regulations 2015	4
4.3. The 1974 Health and Safety at Work etc. Act.....	4
4.4. CIRIA C681	4
4.5. Additional Legislation	5
5. The Role of Commercial UXO Contractors and The Authorities	6
5.1. Commercial UXO Specialists	6
5.2. The Authorities	6
6. The Site	7
6.1. Site Location	7
6.2. Site Description.....	7
7. Scope of the Proposed Works.....	7
7.1. General	7
8. Ground Conditions	8
8.1. General Geology	8
8.2. Site Specific Geology.....	8
9. Site History.....	8
9.1. Introduction	8
9.2. Summary of the Historical Background of the Site	8
9.3. Ordnance Survey Historical Maps.....	9
10. Introduction to German Aerial Delivered Ordnance	10
10.1. General	10
10.2. Generic Types of WWII German Aerial Delivered Ordnance.....	10
10.3. Failure Rate of German Aerial Delivered Ordnance.....	11
10.4. UXB Ground Penetration	11
10.4.1. The J-Curve Effect	11
10.4.2. WWII UXB Ground Penetration Studies	11
10.4.3. Site Specific Bomb Penetration Considerations	12



10.5.	V-Weapons	12
11.	The Likelihood of Contamination from German Aerial Delivered UXBs	13
11.1.	World War I	13
11.2.	World War II Bombing of the Urban District of Havant and Waterloo.....	13
11.3.	WWII Home Office Bombing Statistics	14
11.5.	Childhood Memories of Havant in the Second World War	15
11.6.	WWII-Era Aerial Photography	15
11.7.	Abandoned Bombs.....	16
11.8.	Bomb Disposal Tasks	16
11.9.	Evaluation of German Aerial Delivered UXO Records.....	16
12.	Introduction to Allied Explosive Ordnance	18
12.1.	General	18
12.2.	Land Service Ammunition	18
12.3.	Small Arms Ammunition	19
12.4.	Anti-Aircraft Ammunition (AAA).....	19
13.	The Likelihood of Contamination from Allied Ordnance	20
13.1.	Introduction	20
13.2.	Military History of the Site Locality.....	20
13.3.	Childhood Memories of Havant in the Second World War	21
13.4.	Evaluation of Contamination Risk from Allied UXO	22
14.	The Likelihood of UXO Contamination Summary	24
15.	The Likelihood that UXO Remains	26
15.1.	Introduction	26
15.2.	UXO Clearance	26
15.3.	Post-War Redevelopment.....	26
16.	The Likelihood of UXO Encounter	27
16.1.	Introduction	27
16.2.	Land Service/Small Arms Ammunition Encounter	27
17.	The Likelihood of UXO Initiation	28
17.1.	Introduction	28
17.2.	Initiating Aerial Delivered Ordnance	28
17.3.	Land Service /Small Arms Ammunition Initiation	28
18.	Consequences of Initiation/Encounter	30
18.1.	Introduction	30
18.2.	Consequences of Detonation	30
19.	1st Line Defence Risk Assessment	31
19.1.	Risk Assessment Stages	31
19.2.	Assessed Risk Level	31
20.	Proposed Risk Mitigation Methodology	32
20.1.	General	32
	Bibliography	33



Annexes

List of Report Annexes	
Annex A	Site Location Maps
Annex B	Recent Aerial Photography
Annex C	Client Provided Site Plan
Annex D	Pre and Post-WWII Historical Maps
Annex E	Examples of German Aerial Delivered Ordnance
Annex F	Example of UXO Entry Holes / The 'J-curve' Effect Principle
Annex G	Examples of UXO Incidents
Annex H	WWI Map of Air Raids and Naval Bombardments
Annex I	Luftwaffe Reconnaissance Imagery
Annex J	Havant and Waterloo Air Raids 1939-1944 War Diary
Annex K	Childhood Memories of Havant in the Second World War
Annex L	WWII-era RAF Aerial Photography of the Site
Annex M	Examples of LSA
Annex N	Examples of SAA
Annex O	Examples of Anti-Aircraft Projectiles

1st Line Defence Limited

Detailed Unexploded Ordnance (UXO) Risk Assessment

Site: Southleigh Park, Havant
Client: Ground Conditions Consultants Ltd

1. Introduction

1.1. Background

1st Line Defence has been commissioned by Ground Conditions Consultants Ltd to conduct a Detailed Unexploded Ordnance (UXO) Risk Assessment for the works proposed at the Southleigh Park, Havant site.

Buried UXO can present a significant risk to construction works and development projects. The discovery of a suspect device during works can cause considerable disruption to operations as well as cause unwanted delays and expense.

UXO in the UK can originate from three principal sources:

1. Munitions resulting from wartime activities including German bombing in WWI and WWII, long range shelling, and defensive activities.
2. Munitions deposited as a result of military training and exercises.
3. Munitions lost, burnt, buried or otherwise discarded either deliberately, accidentally, or ineffectively.

This report will assess the potential factors that may contribute to the risk of UXO contamination. If an elevated risk is identified at the site, this report will recommend appropriate mitigation measures, in order to reduce the risk to as low as is reasonably practicable. Detailed analysis and evidence will be provided to ensure an understanding of the basis for the assessed risk level and any recommendations.

This report complies with the guidelines outlined in *CIRIA C681*, 'Unexploded Ordnance (UXO) A Guide for the Construction Industry.'



2. Method Statement

2.1. Report Objectives

The aim of this report is to conduct a comprehensive assessment of the potential risk from UXO at the Southleigh Park site, Havant. The report will also recommend appropriate site and work-specific risk mitigation measures to reduce the risk from explosive ordnance during the envisaged works to a level that is as low as reasonably practicable.

2.2. Risk Assessment Process

1st Line Defence has undertaken a five-step process for assessing the risk of UXO contamination:

1. The likelihood that the site was contaminated with UXO.
2. The likelihood that UXO remains on the site.
3. The likelihood that UXO may be encountered during the proposed works.
4. The likelihood that UXO may be initiated.
5. The consequences of initiating or encountering UXO.

In order to address the above, 1st Line Defence has taken into consideration the following factors:

- Evidence of WWI and WWII German aerial delivered bombing as well as the legacy of Allied occupation.
- The nature and conditions of the site during WWII.
- The extent of post-war development and UXO clearance operations on site.
- The scope and nature of the proposed works and the maximum assessed bomb penetration depth.
- The nature of ordnance that may have contaminated the proposed site area.

2.3. Sources of Information

Every reasonable effort has been made to ensure that relevant evidence has been consulted and presented in order to produce a thorough and comprehensible report for the client. To achieve this the following, which includes military records and archive material held in the public domain, have been accessed:

- The National Archives and Hampshire Archives.
- Historical mapping datasets.
- Historic England National Monuments Record.
- Relevant information supplied by Ground Conditions Consultants Ltd.
- Available material from 33 Engineer Regiment (EOD) Archive (now 28 Regt).
- 1st Line Defence's extensive historical archives, library and UXO geo-datasets.
- Open sources such as published books and internet resources.

Research involved a visit to The National Archives and Hampshire Archives.

3. Background to Bombing Records

3.1. General Considerations of Historical Research

This desktop assessment is based largely upon analysis of historical evidence. Every reasonable effort has been made to locate and present significant and pertinent information. 1st Line Defence cannot be held accountable for any changes to the assessed risk level or risk mitigation measures, based on documentation or other data that may come to light at a later date, or which was not available to 1st Line Defence during the production of this report.

It is often problematic and sometimes impossible to verify the completeness and accuracy of WWII-era records. As a consequence, conclusions as to the exact location and nature of a UXO risk can rarely be quantified and are, to a degree, subjective. To counter this, a range of sources have been consulted, presented and analysed. The same methodology is applied to each report during the risk assessment process. 1st Line Defence cannot be held responsible for any inaccuracies or the incompleteness in available historical information.

3.2. German Bombing Records

During WWII, bombing records were generally gathered locally by the police, Air Raid Precaution (ARP) wardens and military personnel. These records typically contained information such as the date, the location, the amount of damage caused and the types of bombs that had fallen during an air raid. This information was made either through direct observation or post-raid surveys. The Ministry of Home Security Bomb Census Organisation would then receive this information, which was plotted onto maps, charts, and tracing sheets by regional technical officers. The collective record set (regional bomb census mapping and locally gathered incidents records) would then be processed and summarised into reports by the Ministry of Home Security Research and Experiments Branch. The latter were tasked with providing the government 'a complete picture of air raid patterns, types of weapons used and damage caused- in particular to strategic services and installations such as railways, shipyards, factories and public utilities.'¹

The quality, detail and nature of record keeping could vary considerably between provincial towns, boroughs and cities. No two areas identically collated or recorded data. While some local authorities maintained records with a methodical approach, sources in certain areas can be considerably more vague, dispersed, and narrower in scope. In addition, the immediate priority was mostly focused on assisting casualties and minimising damage at the time. As a result, some records can be incomplete and contradictory. Furthermore, many records were even damaged or destroyed in subsequent air raids. Records of raids that took place on sparsely or uninhabited areas were often based upon third party or hearsay information and are therefore not always reliable. Whereas records of attacks on military or strategic targets were often maintained separately and have not always survived.

3.3. Allied Records

During WWII, considerable areas of land were requisitioned by the War Office for the purpose of defence, training, munitions production and the construction of airfields. Records relating to military features vary and some may remain censored. Within urban environments datasets will be consulted detailing the location of munition production as well as wartime air and land defences. In rural locations it may be possible to obtain plans of military establishments, such as airfields, as well as training logs, record books, plans and personal memoirs. As with bombing records, every reasonable effort will be made to access records of, and ascertain any evidence of, military land use. However, there are occasions where such evidence is not available, as records may not be accessible, have been lost/destroyed, or simply were not kept in the first place.

¹ <http://www.nationalarchives.gov.uk/help-with-your-research/research-guides/bomb-census-survey-records-1940-1945/>.

4. UK Regulatory Environment and Guidelines

4.1. General

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

4.2. CDM Regulations 2015

The Construction (Design and Management) Regulations 2015 (CDM 2015) define the responsibilities of parties involved in the construction of temporary or permanent structures.

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

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

- Provide an appropriate assessment of potential UXO risks at the site (or ensure such an assessment is completed by others).
- Put in place appropriate risk mitigation measures if necessary.
- Supply all parties with information relevant to the risks presented by the project.
- Ensure the preparation of a suitably robust emergency response plan.

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

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

4.4. CIRIA C681

In 2009, the Construction Industry Research and Information Association (CIRIA) produced a guide to the risk posed by UXO to the UK construction industry (CIRIA C681). CIRIA is a neutral, independent and not-for-profit body, linking organisations with common interests and facilitating a range of collaborative activities that help improve the industry.

The publication provides the UK construction industry with a defined process for the management of risks associated with UXO from WWI and WWII aerial bombardment. It is also broadly applicable to the risks from other forms of UXO that might be encountered. It focuses on construction professionals' needs, particularly if there is a suspected item of UXO on site, and covers issues such as what to expect from a UXO specialist. The guidance also helps clients to fulfil their legal duty under CDM 2015 to provide designers and contractors with project specific health and safety information needed to identify hazards and risks associated with the design and construction work. This report conforms to this CIRIA guidance and to the various recommendations for good practice referenced therein. It is



recommended that this document is acquired and studied where possible to allow a better understanding of the background to both the risk assessment process and the UXO issue in the UK in general.

4.5. Additional Legislation

In the event of a casualty resulting from the failure of an employer/client to address the risks relating to UXO, the organisation may be criminally liable under the Corporate Manslaughter and Corporate Homicide Act 2007.

5. The Role of Commercial UXO Contractors and The Authorities

5.1. Commercial UXO Specialists

The role of a UXO Specialist (often referred to as UXO Consultant or UXO Contractor) such as 1st Line Defence, is defined in CIRIA C681 as the provision of expert knowledge and guidance to the client on the most appropriate and cost-effective approach to UXO risk management at a site.

The principal role of UXO Specialists is to provide the client with an appropriate assessment of the risk posed by UXO for a specific project, and identify and carry out suitable methodology for the mitigation of any identified risks to reduce them to an acceptable level.

The requirement for a UXO Specialist should ideally be identified in the initial stages of a project, and it is recommended that this occur prior to the start of any detailed design. This will enable the client to budget for expenditure that may be required to address the risks from UXO, and may enable the project team to identify appropriate techniques to eliminate or reduce potential risks through considered design, without the need for UXO specific mitigation measures. The UXO Specialist should have suitable qualifications, levels of competency and insurances.

Please note 1st Line Defence has the capability to provide a complete range of required UXO risk mitigation services, in order to reduce a risk to as low as reasonably practicable. This can involve the provision of both ground investigation, and where appropriate, UXO clearance services.

5.2. The Authorities

The police have a responsibility to co-ordinate the emergency services in the event of an ordnance-related incident at a construction site. Upon inspection they may impose a safety cordon, order an evacuation, and call the military authorities Joint Services Explosive Ordnance Disposal Operation Centre (JSEODOC) to arrange for investigation and/or disposal. Within the Metropolitan Police Operational Area, SO15 EOD will be tasked to any discovery of suspected UXO. The request for Explosive Officer (Expo) support is well understood and practiced by all Metropolitan Boroughs. The requirement for any additional assets will then be coordinated by the Expo if required.

In the absence of a UXO specialist, police officers will usually employ such precautionary safety measures, thereby causing works to cease, and possibly requiring the evacuation of neighbouring businesses and properties.

The priority given to the police request will depend on the EOD teams judgement of the nature of the UXO risk, the location, people and assets at risk, as well as the availability of resources. The speed of response varies; authorities may respond immediately or in some cases it may take several days for the item of ordnance to be dealt with. Depending on the on-site risk assessment the item of ordnance may be removed from the site and/or destroyed by a controlled explosion.

Following the removal of an item of UXO, the military authorities will only undertake further investigations or clearances in high-risk situations. If there are regular UXO finds on a site the JSEODOC may not treat each occurrence as an emergency and will recommend the construction company puts in place alternative procedures, such as the appointment of a commercial contractor to manage the situation.

6. The Site

6.1. Site Location

The site is located on the outskirts of the town of Havant, within south-east Hampshire. The site is bordered to the north by Spire Portsmouth Hospital along Bartons Road and to the east by both forested land along Comley Hill and Emsworth Common Road. The site is bordered to the south by open land, with Southleigh Road and its associated farming grounds situated further south of the site boundary. The west of the site boundary is bordered by further agricultural land along Eastleigh Road.

The site is approximately centred on the OS grid reference: **SU 73719 07980**.

Site location maps are presented in **Annex A**.

6.2. Site Description

The site is currently occupied by Southleigh Park House and its associated grounds, which is understood to be currently in commercial use. Open land occupies the site's southern section, as well as a small pond in the south-western section of the site boundary. The central section of the site is occupied by the Grade II Listed Southleigh Park House structure and the northern section by an attached 'U-shaped' office building built c.1983. Forested areas border the structures to the north, east and west. Intersecting roadways and car-parking facilities are also located in the northern section of the site boundary.

A recent aerial photograph and site plan are presented in **Annex B** and **Annex C** respectively.

7. Scope of the Proposed Works

7.1. General

Whilst the exact scope of proposed works was not available at the time of writing this report, it is understood that the Southleigh Park Manor House and Estate will be developed for residential usage. This will include the development of a number of new build residential properties across the estate and the conversion of Southleigh Park House into apartments, as well as proposed mews house conversions in the estate's stables, west wing and coach house.

Information provided by the client suggests that one of the first phases of works will be to demolish the 1980s office building located in the northern section of the site boundary.

8. Ground Conditions

8.1. General Geology

The British Geological Survey (BGS) map shows to varying formations for the north and south of the site boundary. The north of the site boundary shows London Clay Formation - clay, silt and sand of the Palaeogene Period. Local environment was previously dominated by deep seas. Superficial deposits shows Head – clay and gravel, of the Quaternary Period. Local environment was previously dominated by subaerial slopes.

The southern section of the site boundary shows London Clay Formation - clay, silt and sand of the Palaeogene Period. Local environment was previously dominated by deep seas. There are no superficial deposits recorded for this area of the site boundary.

8.2. Site Specific Geology

Site-specific geotechnical data was not available during the production of this report.

9. Site History

9.1. Introduction

The purpose of this section is to identify the composition of the site pre and post-WWII. It is important to establish the historical use of the site, as this may indicate the site's relation to potential sources of UXO as well as help with determining factors such as the land use, groundcover, likely frequency of access and signs of bomb damage.

9.2. Summary of the Historical Background of the Site

Southleigh Park House was built in the 1850s and the interior was remodelled in the 1930s in Art Deco style. The previous owners substantially restored the property in the post war period to make it suitable for office use.²

The Southleigh Park Estate was established as the mansion house and gardens of a mid-Victorian gentleman's estate. The manor is now contained within an area between Horndean Road to the east, Bartons Road to the north, and Eastleigh Road to the west, overlooking its former parkland to the south. Today, Southleigh Park House and its grounds are approximately 3.16 ha in area.³

² <https://www.lsh.ie/explore/research-and-views/news/2019/nov/lsh-sells-historical-southleigh-park-with-consent-for-90-homes#:~:text=Southleigh%20Park%20House%20was%20built,it%20suitable%20for%20office%20use>.

³ <https://www.havant.gov.uk/sites/default/files/documents/Developer%27s%20briefing.pdf>

9.3. Ordnance Survey Historical Maps

Relevant historical maps were obtained for this report and are presented in **Annex D**. See below for a summary of the site history shown on acquired mapping.

Pre-WWII		
Date	Scale	Description
1934	1:2,500	Pre-war OS mapping dated 1934, appears to show the site to consist of Southleigh Park, with the Manor House and associated structures located in the centre of the site boundary and additional structures located in the northern section of the site boundary. The rest of the site boundary is made up of open forested land with a pond located in the south-western section of the site. The site is bordered by roadways to the north-east and west with Southleigh Cottage and Parkside Cottage located further south of the boundary.

Post-WWII		
Date	Scale	Description
1946	1:10,560	Post-war OS mapping dated 1946, appears to show no significant and visible change to the site boundary and the wider area. However, it should be noted that the poor quality of this map would in turn make it more difficult to notify any potential changes to the site boundary.
1952-1972	1:2,500	Post-war OS mapping dated 1952-1972, again appears to show little visible structural changes to the site boundary, with the site area maintaining much of its pre-war composition. Three small rectangular structures are however now present in the north-west corner of the site area.

10. Introduction to German Aerial Delivered Ordnance

10.1. General

During WWI and WWII, the UK was subjected to bombing which often resulted in extensive damage to city centres, docks, rail infrastructure and industrial areas. The poor accuracy of WWII targeting technology and the nature of bombing techniques often resulted in neighbouring areas to targets sustaining collateral damage.

In addition to raids which concentrated on specific targets, indiscriminate bombing of large areas also took place. This occurred most prominently in the London 'Blitz', though affected many other towns and cities. As discussed in the following sections, a proportion of the bombs dropped on the UK did not detonate as designed. Although extensive efforts were made to locate and deal with these UXBs at the time, many still remain buried and can present a potential risk to construction projects.

The main focus of research for this section of the report will concern German aerial delivered ordnance dropped during WWII, although WWI bombing will also be considered.

10.2. Generic Types of WWII German Aerial Delivered Ordnance

To provide an informed assessment of the hazards posed by any items of unexploded ordnance that may remain in situ on site, the table below provides information on the types of German aerial delivered ordnance most commonly used by the Luftwaffe during WWII. Images and brief summaries of the characteristics of these items of ordnance are listed in **Annex E**.

Generic Types of WWII German Aerial Delivered Ordnance		
Type	Frequency	Likelihood of detection
High Explosive (HE) bombs	In terms of weight of ordnance dropped, HE bombs were the most frequently deployed by the Luftwaffe during WWII.	Although efforts were made to identify the presence of unexploded ordnance following an air raid, often the damage and destruction caused by detonated bombs made observation of UXB entry holes impossible. The entry hole of an unexploded bomb can be as little as 20cm in diameter and was easily overlooked in certain ground conditions (see Annex E1). Furthermore, ARP documents describe the danger of assuming that damage, actually caused by a large UXB, was due to an exploded smaller bomb. UXBs therefore present the greatest risk to present-day intrusive works.
1kg Incendiary bombs (IB)	In terms of the number of weapons dropped, small IBs were the most numerous. Millions of these were dropped throughout WWII.	IBs had very limited penetration capability and in urban areas would often have been located in post-raid surveys. If they failed to initiate and fell in water, on soft vegetated ground, or bombed rubble, they could easily go unnoticed.
Large Incendiary bombs (IB)	These were not as common as the 1kg IBs, although they were more frequently deployed than PMs and AP bomblets.	If large IBs did penetrate the ground, complete combustion did not always occur and in such cases they could remain a risk to intrusive works.
Aerial or Parachute mines (PM)	These were deployed less frequently than HE and IBs due to size, cost and the difficulty of deployment.	If functioning correctly, PMs would generally have had a slow rate of descent and were very unlikely to have penetrated the ground. Where the parachute failed, mines would have simply shattered on impact if the main charge failed to explode. There have been extreme cases when these items have been found unexploded. However, in these scenarios, the ground was either extremely soft or the munition fell into water.
Anti-personnel (AP) bomblets	These were not commonly used and are generally considered to pose a low risk to most works in the UK.	SD2 bomblets were packed into containers holding between 6 and 108 submunitions. They had little ground penetration ability and should have been located by the post-raid survey unless they fell into water, dense vegetation or bomb rubble.

10.3. Failure Rate of German Aerial Delivered Ordnance

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

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

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

10.4. UXB Ground Penetration

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

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

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

10.4.1. The J-Curve Effect

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

10.4.2. WWII UXB Ground Penetration Studies

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

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

10.4.3. Site Specific Bomb Penetration Considerations

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

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

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

10.5. V-Weapons

Hitler's 'V-weapon' campaign began from mid-1944. It used newly developed unmanned cruise missiles and rockets. The V-1, known as the *flying bomb* or *pilotless aircraft*, and the V-2, a long range rocket, were launched from bases in Germany and occupied Europe. A total of 9,251 V-1s and 1,115 V-2s were recorded in the United Kingdom.

Although these weapons caused considerable damage, their relatively low numbers allowed accurate records of strikes to be maintained. These records have mostly survived. There is a negligible risk from unexploded V-weapons on land today. Even if the 1000kg warhead failed to explode, the weapons are so large that they would have been observed and dealt with at the time. The risk from V-weapons is therefore considered negligible and will not be further addressed in this report.

11. The Likelihood of Contamination from German Aerial Delivered UXBs

11.1. World War I

During WWI Britain was targeted and bombed by Zeppelin Airships, as well as Gotha and Giant fixed-wing aircraft. A WWI map of air raids and naval bombardments across England is presented in **Annex H**. This source does not record any WWI bombing incidents to have affected the site.

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

11.2. World War II Bombing of the Urban District of Havant and Waterloo

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

During WWII the site was located within the Urban District of Havant and Waterloo, which sustained a low-medium density of bombing. Any bombing can be attributed in part to the proximity of Havant to Portsmouth, which became a strategic target for the Luftwaffe, due its position as the foremost port of the Royal Navy. Portsmouth was not only the home of many of the battleships of the Royal Navy, such as HMS Iron Duke and the destroyer flotilla, but also was headquarters for several operations throughout the war such as Operation Dynamo, the evacuation of Dunkirk and Operation Overlord, the Normandy invasion.

Portsmouth endured a particularly heavy bombing campaign, with especially heavy raids taking place on 10th January, 10th March and 27th April 1941. Accordingly, Portsmouth Airport, approximately 8km to the south-west of the site, is highlighted on Luftwaffe reconnaissance photography (see **Annex I**) which confirms its status as a target. Wider surrounding areas would often be affected by the presence of such targets, largely due to the inaccuracy of aerial bombing on adjacent areas to avoid having to return to base with ordnance still on board – known as 'tip and run' raids. Much of the bombing on the region can be attributed to these potential targets and any bombing inflicted upon the civilian population.

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

Records of bombing incidents are presented in the following sections.

11.3. WWII Home Office Bombing Statistics

The following table summarises the quantity of German aerial delivered bombs (excluding 1kg incendiaries and anti-personnel bombs) dropped on the Urban District of Havant and Waterloo between 1940 and 1945.

Record of German Ordnance Dropped on the Urban District of Havant and Waterloo		
Area Acreage		12.074
Weapons	High Explosive bombs (all types)	375
	Parachute mines	39
	Oil bombs	9
	Phosphorus bombs	4
	Fire pots	0
	Pilotless aircraft (V-1)	1
	Long range rocket bombs (V-2)	0
Total		428
Number of Items per 1,000 acres		35.4

Source: Home Office Statistics

This table does not include UXO found during or after WWII.

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

11.4. Havant and Waterloo District Air Raids 1939-1944 War Diary

A diary of Air Raid incidents compiled by Havant authorities during WWII were consulted at Hampshire Record Office, Winchester. These reports recorded information such as the date, time, type and damage caused by major bomb incidents in Havant and are therefore not often comprehensive. Recorded incidents in proximity to the site have been transcribed in the table below and are presented in **Annex J**.

Ministry of Home Security Bomb Census Reports – Annex J1		
Date	Incident Type	Comments
19 th March 1941	UXB	At 0320 fifteen UXB's were dropped near the junction of Southleigh Road and Eastleigh Road, Havant – one of them cracking a gas main, another damaging the roof of a cart shed.
18 th April 1941	HE, IB, Para Mines	Parachute mines, HE and incendiary bombs – Incidents occurred at Emsworth, East of Denvilles and Eastleigh Havant...
21 st August 1942	UXB	2 HE bombs at Southleigh Farm, Southleigh Road, Block by debris.

Ministry of Home Security Bomb Census Reports – Incident Reports to Group Control – Annex J2		
Date	Incident Type	Comments
12 th May 1940	UXB	Eastleigh Road, Havant
5 th October 1940	UXB	Eastleigh Road, Havant
8 th October 1940	HE	No UXB's reported – 1 bomb Eastleigh Road to be dealt with
9 th October 1940	UXB	Removal of UXB 4 th Avenue – 1 bomb Eastleigh Road
18 th March 1941	UXB	UXB Southleigh and Eastleigh Road, Havant
19 th March 1941	UXB	UXB Southleigh and Eastleigh Road, Havant
25 th March 1941	UXB	UXB Southleigh Road, Havant - removed
20 th June 1942	UX.A.A Shell	UX.A.A shell reported Southleigh Poultry Farm, Havant

11.5. Childhood Memories of Havant in the Second World War

An article named *Childhood Memories of Havant in the Second War* compiled by Ralph Cousins for The Spring Arts & Heritage Centre, provides anecdotal accounts of Havant during WWII. References found to bombing in the site locality and the wider vicinity are transcribed in the table below and presented in **Annex K1**.

Childhood Memories of Havant in the Second World War	
Date Range	Comments
19 th March 1941	At 03.20 15 UXBs dropped near junction of Southleigh Road and Eastleigh Road one of them cracking a gas main another damaging the roof of a cart shed.
18 th April 1941	At 00.20 One HE bomb and 200 IBs In open field junction of Southleigh Road and Westbourne Road one mile north of Emsworth Police Station. No Damage. No casualties.
20 th August 1942	Four HE bombs. House in Ranelagh Road, hit, some damage two slight casualties. Two HE bombs Southleigh Farm, Southleigh Road, blocked by debris.

11.6. WWII-Era Aerial Photography

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

WWII-Era Aerial Photography	
Date	Description
19 th April 1946	Post-war aerial photography dated 1946, appears to show the structures within the site boundary to have remained externally intact. No obvious signs of damage such as rubble, debris and white tiling, which can often be indicative of repair works, is visible Southleigh Park House or its external buildings. . The open natured areas of the site also appear undamaged, with no signs of ground disturbance or cratering visible.

	An area of prefabricated housing is located south of the site boundary along Southleigh Road, see the wider view presented in Annex X2 . However, their appearance is not believed to have been the result of bomb damage in this area.
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11.7. Abandoned Bombs

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

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

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

11.8. Bomb Disposal Tasks

The information service from the Explosive Ordnance Disposal (EOD) Archive Information Office at 33 Engineer Regiment (EOD) (now 29 Regt) is currently facing considerable delay. It has therefore not been possible to include any updated official information regarding bomb disposal/clearance tasks with regards to this site. A database of known disposal/clearance tasks has been referred to which does not make reference to such instances occurring within the site of proposed works. If any relevant information is received at a later date Ground Conditions Consultants Ltd will be advised.

11.9. Evaluation of German Aerial Delivered UXO Records

Factors	Conclusion
Density of Bombing <i>It is important to consider the bombing density when assessing the possibility that UXBs remain in an area. High bombing density could allow for error in record keeping due to extreme damage caused to the area.</i>	The Urban District of Havant and Waterloo was subject to an overall low-moderate density of bombing, with an average of 35 bombs recorded per 1,000 acres according to Home Office statistics. Available records indicate numerous bomb incidents to have affected the general area of Havant, which can likely be attributed to the proximity of Havant to Portsmouth, which Luftwaffe target photography confirms was a strategic target for bombing. No positive evidence could be found to suggest that structures concerning Southleigh Park House was affected by a bomb incident. However, multiple references of UXB bombs located along nearby Eastleigh Road and Southleigh Road are corroborated through anecdotal references and war diaries for Havant and Waterloo. The cause for this concentration of UXB's in the area could not be confirmed.



Damage <i>If buildings or structures on a site sustained bomb or fire damage, any resulting rubble and debris could have obscured the entry holes of unexploded bombs dropped during the same or later raids. Similarly, a high explosive bomb strike in an area of open agricultural land will have caused soil disturbance, increasing the risk that a UXB entry hole would be overlooked.</i>	Post-war aerial photography dated 1946, appears to show the structures within the site boundary to have remained externally intact. No obvious signs of damage such as rubble, debris and white tiling, which can often be indicative of repair works, is visible to Southleigh Park House or its external structures. . The open natured areas of the site also appear undamaged, with no signs of ground disturbance or cratering visible. This is reinforced through post-war OS mapping as the site boundary and surrounding area appear to have remained in its pre-war composition. An area of potential pre-fabricated or temporary shelters is located approximately 550m south of the site boundary in the vicinity of Southleigh Farm. However, the presence of these structures is not believed to have been the result of bomb damage in this area.
Ground Cover <i>The nature of the ground cover present during WWII would have a substantial influence on any visual indication that may indicate UXO being present.</i>	Due to the site consisting of Southleigh Park House and its associated grounds, as well as its close proximity to neighbouring roadways, it is anticipated that this ground cover be largely conducive to the detection of UXO. However, the open forested areas of the site boundary, as well as the pond in the south-western corner, is considered less conducive to the detection of UXO due to the potential of bombing being lost in shrubbery and vegetation.
Access Frequency <i>UXO in locations where access was irregular would have a greater chance of passing unnoticed than at those that were regularly occupied. The importance of a site to the war effort is also an important consideration as such sites are likely to have been both frequently visited and subject to post-raid checks for evidence of UXO.</i>	The site was occupied by Southleigh Park House and its associated grounds, with neighbouring roadways. It is anticipated that these areas of the site boundary would have been subject to fairly regular access. In addition, anecdotal evidence (see Section 13.2) suggests that offices were operational within the manor house during wartime. The open land areas of the site boundary would have experienced intermittent access, although the neighbouring roadways would have given these areas some degree of monitor. Generally, frequent access may increase the likelihood that obvious signs of UXO would have been noticed and reported.
Bomb Failure Rate	There is no evidence to suggest that the bomb failure rate in the locality of the site would have been dissimilar to the 10% normally used.
Abandoned Bombs	1st Line Defence holds no records of abandoned bombs at or within the site vicinity.
Bombing Decoy sites	1st Line Defence could find no evidence of bombing decoy sites within the site vicinity.
Bomb Disposal Tasks	1st Line Defence could find no evidence of bomb disposal tasks within the site boundary and immediate area.

12. Introduction to Allied Explosive Ordnance

12.1. General

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

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

This section of the report discusses the generic types of Allied ordnance typically encountered on or near areas associated with former military activity. Areas such as the location of the site can also be at risk from buried unexploded anti-aircraft projectiles fired during WWII – as addressed below.

12.2. Land Service Ammunition

A number of WWII-era camps, including D-Day marshalling camps are recorded in the site vicinity, within the forested and open areas of Emsworth and Rowland Castle (see [Section 13.2](#)). Soldiers based at these camps would likely have been equipped with a range of LSA.

The term LSA covers items of ordnance that are propelled, placed, or thrown during land warfare. These items may be filled or charged with explosives, smoke, incendiary, or pyrotechnics and can be divided into five main groups:

Land Service Ammunition	
Item	Description
Mortar Rounds	A mortar round is normally nosed-fused and fitted with its own propelling charge. Its flight is stabilised by the use of a fin. They are usually tear-drop shaped (though older variants are parallel sided), with a finned 'spigot tube' screwed or welded to the rear end of the body which houses the propellant charge. Mortars are either High Explosive or Carrier (i.e. smoke, incendiary, or pyrotechnic).
Grenades	A grenade is a short range weapon designed to kill or injure people. It can be hand thrown or fired from a rifle or a grenade launcher. Grenades either contain high explosive or smoke producing pyrotechnic compounds. The common variants have a classic 'pineapple' shape.
Projectiles	A projectile (or shell) is propelled by force, normally from a gun, and continues in motion using its kinetic energy. The gun a projectile is fired from usually determines its size. A projectile contains a fuzing mechanism and a filling. Projectiles can be high explosive, carrier or Shot (a solid projectile).
Rockets	Rockets were commonly designed to destroy heavily armoured military vehicles (anti-tank weapon). The device contains an explosive head (warhead) that can be accelerated using internal propellants to an intended target. Anti-aircraft rocket batteries were also utilised as part of air defence measures.
Landmines	A landmine is designed to be laid on or just below the ground to be exploded by the proximity or contact of a person or vehicle. Landmines were often placed in defensive areas of the UK to obstruct potential invading adversaries.

In the UK unexploded or partially exploded mortars and grenades are the most common items of LSA encountered, as they could be transported and utilised anywhere. They are mostly encountered in areas used for military training and are often found discarded on or near historical military bases.

Images of the most commonly found items of LSA are presented in **Annex M**.

12.3. Small Arms Ammunition

The most common type of ordnance encountered on land used by the military are items of Small Arms Ammunition (SAA). SAA refers to the complete round or cartridge designed to be discharged from varying sized hand-held weapons such as rifles, machine guns and pistols. SAA can include bullets, cartridge cases and primers/caps.

12.4. Anti-Aircraft Ammunition (AAA)

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

Anti-Aircraft Artillery				
Item	Description			
HAA	These large calibre guns such as the 3.7" QF (Quick Firing) were used to engage high flying enemy bombers. They often fired large HE projectiles, which were usually initiated by integral fuzes, triggered by impact, area, time delay or a combination of aforementioned mechanisms.			
LAA	These mobile guns were intended to engage fast, low flying aircraft. They were typically rotated between locations on the perimeters of towns and strategically important industrial works. As they could be moved to new positions with relative ease when required, records of their locations are limited. The most numerous of these were the 40mm Bofors gun which could fire up to 120 x 40mm HE projectiles per minute to over 1,800m.			
Variations in HAA and LSA Ammunition	Gun type	Calibre	Shell Weight	Shell Dimensions
	3.0 Inch	76mm	7.3kg	76mm x 356mm
	3.7 Inch	94mm	12.7kg	94mm x 438mm
	4.5 Inch	114mm	24.7kg	114mm x 578mm
	40mm	40mm	0.9kg	40mm x 311mm
Z-AA	The three inch unrotated rocket/projectile known as the UP-3 had initially been developed for the Royal Navy. The UP-3 was also used in ground-based single and 128-round launchers known as "Z" batteries. The rocket, containing a high explosive warhead was often propelled by cordite.			

The closest recorded anti-aircraft gun site was located approximately 0.8km south of the site at Southleigh Farm. A second gun site (a HAA battery) is recorded approximately 1.3km north-west of the site, at Prospect Farm. The range of a AA projectile can be up to 15km.

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

Illustrations of Anti-Aircraft artillery, projectiles and rockets are presented at **Annex O**.

13. **The Likelihood of Contamination from Allied Ordnance**

13.1. **Introduction**

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

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

13.2. **Military History of the Site Locality**

A number of WWII-era military camps are recorded in the site vicinity across the wooded and open areas of Emsworth and Rowland Castle, including camps used for D-Day Marshalling. This was most likely due to the position of the Portsmouth Dock's nearby, which served as a key embarkation point for Allied troops. A list of recorded camps, showing their names and location in relation to the site area is presented below:

Second World War Military Camps in Havant	
Location	Name and Description
Bir Hakeim Barracks – 700m south-east of the site.	Bir Hakeim Barracks - Free French camp
Emsworth Common Road – 710m north-east of the site boundary	Emsworth Camp (A2) – D-day marshalling camp & The Oaks Camp
Hollybank Lane – 880m south-east of the site boundary	Emsworth Common, Hollybank Woods and the nearby Hollybank House was one of the camps in Marshalling Area 'A', used by Allied forces before D-Day. British, Canadian and, Free French troops were based here, including Canadians of the North Shore Regiment (March 1944), the headquarters of British 8th Infantry Brigade, and 5th Beach Group. The camp could hold 2,100 men and 210 vehicles.

The closest of the camps listed above is understood to be the Free French camp named Bir Hakeim Barracks (after an oasis in Libya, which was the scene of a famous battle between Erwin Rommel and Free French forces). This camp is understood to have been situated off Allendale Avenue, in Greville Green, approximately 600-700m south-east of the site.

The concentration of these camps suggests that the rural areas surrounding Havant were heavily used by the military in the run up to D-Day. Anecdotal evidence has been found to suggest that the 'throughout April and May (1944)...the woods to the north of Havant, Southleigh Forest, The Thicket and The Holt between Rowlands Castle and Finchdean, began to fill up with troops, with guns and tanks. There are still laybys, for instance opposite the entrance to Southleigh House in Eastleigh Road, that were built to accommodate just two or three more⁴.' However no evidence has been found to suggest that Southleigh Park house or its grounds were ever requisitioned by the military during the war.

⁴ <http://thespring.co.uk/media/3005/33-childhood-memories-of-havant-in-the-second-world-war-2.pdf> (p61)

13.3. Childhood Memories of Havant in the Second World War

As introduced in [Section 11.5](#), an article named *Childhood Memories of Havant in the Second War* compiled by Ralph Cousins for The Spring Arts & Heritage Centre, provides anecdotal accounts of Havant during WWII. References found to Allied activity in the site vicinity are transcribed in the table below and presented in **Annex K2**.

Childhood Memories of Havant in the Second World War	
Date Range	Comments
1939	<i>'I was amazed by the speed with which the area was being prepared for resistance to invasion. Concrete bunkers at strategic points in the road system seemed, like mushrooms, to have sprung up overnight. For example three large ones were built within 100 yards (95 metres) of my office in the grounds of Southleigh Park House, two at the junction of Horndean Road with Emsworth Common Road, one is still there, and another in Bartons Road in what are now the grounds of the Spire Hospital, opposite the junction of that road with Eastleigh Road. Each had slits for machine guns and rifles covering all approaches.'</i>
1939	<i>'The defence works which brought home to me most impressively the full horror of what conditions might be like if the invader came, were two hideouts for guerrillas, deep in the estate owned Southleigh Forest. Constructed secretly, they were two holes about 6 feet (2 metres) deep, with boarded walls and a metal roof, which was covered with soil to a depth of not less than 6 inches (15 cm), and a ventilator shaft opening in undergrowth a yard (metre) or so away, all so effectively concealed that one could walk over them without knowing they were there. Each was designed to hold about six men.'</i>
1944	<i>'Hear that Emsworth Common Camp is beginning to fill with troops ready for the invasion. This refers to the large camp in what is now Southleigh Forest made ready for the D-Day invasion.'</i>
1944	The Anti-aircraft Battery and Searchlight Emplacement was cited on Langstone Road, where the Langstone Technology Park now is. The A.A. Battery was bombed on several occasions. There was a Free French Camp, Bir Hakeim Barracks, at Hollybank, Southleigh Road, and also one in Emsworth.

13.4. Evaluation of Contamination Risk from Allied UXO

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

Sources of Allied UXO Contamination	Conclusion
Military Camps <i>Military camps present an elevated risk from ordnance simply due to the large military presence and likelihood of associated live ordnance training.</i>	1 st Line Defence could find no evidence of a military camp within the site, however a number of WWII-era camps (including D-Day marshalling camps) are recorded in the site vicinity, see Section 13.2 .
Anti-Aircraft Defences <i>Anti-Aircraft defences were employed across the country. Proximity to anti-aircraft defences increases the chance of encountering AA projectiles.</i>	1 st Line Defence could find no evidence of Anti-Aircraft defences such as a HAA or LAA gun emplacement occupying or bordering the site. The closest recorded anti-aircraft gun HAA to the site was located approximately 0.8km south of the site at Southleigh Farm. A second gun site (a HAA battery) is recorded approximately 1.3km north-west of the site, at Prospect Farm. The range of an AA projectile can be up to 15km. . The conditions in which HAA or LAA projectiles may have fallen unnoticed within a site footprint are analogous to those regarding German aerial delivered ordnance.
Home Guard Activity <i>The Home Guard regularly undertook training and ordnance practice in open areas, as well as burying ordnance as part of anti-invasion defences.</i>	1 st Line Defence has no evidence of any Home Guard activities on the site.
Defensive Positions <i>Defensive positions suggest the presence of military activity, which is often indicative of ordnance storage, usage or disposal.</i>	There is no evidence of any defensive features formerly located on site. However reference to a number of static defences (anti-invasion positions), such as pillboxes are documented to have been installed in the site vicinity, see Section 11.3 .
Training or firing ranges <i>Areas of ordnance training saw historical ordnance usage in large numbers, often with inadequate disposal of expended and live items. The presence of these ranges significantly impact on the risk of encountering items of ordnance in their vicinity.</i>	There is no evidence of such features affecting the site.
Defensive Minefields <i>Minefields were placed in strategic areas to defend the country in the event of a German invasion. Minefields were not always cleared with an appropriate level of vigilance.</i>	There is no evidence of defensive minefields affecting the site.
Ordnance Manufacture <i>Ordnance manufacture indicates an increased chance that items of ordnance were stored, or disposed of, within a location.</i>	No information of ordnance being stored, produced, or disposed of within the proposed site could be found.



Military Related Airfields

Military airfields present an elevated risk from ordnance simply due to the large military presence and likelihood of associated live ordnance training or bombing practice.

The site was not situated within the perimeters or vicinity of a military airfield.

14. The Likelihood of UXO Contamination Summary

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

UXO Contamination Summary	
Quality of the Historical Record	The research has evaluated pre- and post-WWII Ordnance Survey maps, Luftwaffe reconnaissance imagery, Havant and Waterloo air raid war diaries, RAF WWII-era aerial photography and anecdotal references. The record set is of generally mixed quality, post-war OS mapping and post-war aerial photography largely corroborate with one another and bombing is cross-referenced between anecdotal articles and war diaries for Havant and Waterloo. However, there is no comprehensive bomb mapping or damage mapping for the district, so the accuracy of strikes relies upon incident records and war diaries for the borough.
German Aerial Delivered Ordnance	- During WWII, the site was situated in the Urban District of Havant and Waterloo was subject to an overall low-moderate density of bombing, with an average of 35 bombs recorded per 1,000 acres according to Home Office statistics. The majority of bombing in the district is attributed to its proximity in relation to significant Luftwaffe targets across Portsmouth. - As today, the site was occupied by Southleigh Park Manor House and its associated grounds during WWII. Open land and forested areas comprised the remainder of the site boundary with a small pond located in the south-western section of the site. - Multiple references of UXB bombs located along Eastleigh Road and Southleigh Road are corroborated through anecdotal references and war diaries for Havant and Waterloo. The cause for this concentration of UXB's in the site locality is not clear. However, no positive evidence could be found to suggest that the structures or grounds within Southleigh Park House were affected by a bomb incident. - Post-war aerial photography dated 1946, shows the structures within the site boundary to have remained externally intact. No obvious signs of damage such as rubble, debris and white tiling, which can often be indicative of repair works, is visible to Southleigh Park House or its external buildings. . The open natured areas of the site also appear undamaged, with no signs of ground disturbance or cratering visible. This is reinforced through post-war OS mapping, as the site boundary and surrounding area appear to have remained in its pre-war composition. - The site was occupied by Southleigh Park House and its associated grounds, with neighbouring roadways. It is therefore anticipated that these areas of the site boundary occupied by structures and their immediate environs would have been subject to fairly regular access. The open land areas of the site boundary would have experienced more intermittent access, although the neighbouring roadways should have still given these areas some degree of monitor. - In summary, the records highlighting bombing along Eastleigh Road fail to pinpoint the exact location of the strikes, however, it is anticipated that due to the prominence of Southleigh Park House in the area, it is thought that should bombing have fallen in this vicinity it would have likely been noted and recorded. However due to the , the aforementioned UXB strikes along Eastleigh Road the risk from German aerial delivered ordnance is considered to be slightly elevated, as the possibility of an item falling within open areas of the site cannot be completely discounted. The risk from German aerial UXO has therefore been assessed at Low-Medium.



Allied Ordnance	• Anecdotal information indicates pillboxes in the form of concrete bunkers were located within 100 yards of Southleigh Park House, as well as further ones in neighbouring roadways. Reference has also been to an anti-aircraft gun site at Southleigh Farm, situated approximately 800m south of the site. • In addition, a number of WWII-era military camps are recorded in the site vicinity across the wooded and open areas of Emsworth and Rowland Castle, including camps used for D-Day Marshalling. The closest of the camps is understood to be a Free French camp named Bir Hakeim Barracks. This camp is understood to have been situated off Allendale Avenue, in Greville Green, approximately 600-700m south-east of the site. • The concentration of these camps suggests that the rural areas surrounding Havant were heavily used by the military in the run up to D-Day. Indeed, anecdotal evidence has been found to suggest that a layby was constructed opposite the entrance to Southleigh House to accommodate additional camps, but was never needed. • Due to this concentration of WWII-era Allied activity in the surrounding site area the risk from Allied UXO has also been slightly elevated to Low-Medium Risk, as a precaution. However, no evidence has been found to suggest that Southleigh Park House or its grounds were ever directly requisitioned by the military.
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15. The Likelihood that UXO Remains

15.1. Introduction

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

15.2. UXO Clearance

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

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

15.3. Post-War Redevelopment

The site boundary has experienced some development post-war. An office building in the northern section of the site boundary was developed in the 1980s, which included the associated access ways and car-parking facilities. The remainder of the site boundary has seen no more than perceived maintenance works, rather than significant structural changes.

The risk of UXO remaining is considered to be mitigated at the location of and down to the depth of any post-war redevelopment on site.

Within the footprints of post-WWII redevelopments, the risk from shallow-buried UXO (especially 1kg German incendiaries and British AA projectiles) should have been encountered/removed during initial excavations. However, the risk from deep-buried German UXBs will only have been mitigated within the volumes of any post-war pile foundations or deep excavations for basement levels. The risk will remain within virgin geology below and amongst these post-war works, down to the maximum bomb penetration depth.

16. The Likelihood of UXO Encounter

16.1. Introduction

For UXO to pose a risk at a site, there should be a means by which any potential UXO might be encountered on that site.

The likelihood of encountering UXO on the site of proposed would depend on various factors, such as the type of UXO that might be present and the intrusive works planned on site. In most cases, UXO is more likely to be present below surface (buried) than on surface.

In general, the greater the extent and depth of intrusive works, the greater the risk of encountering. The most likely scenarios under which items of UXO could be encountered during construction works is during piling, drilling operations or bulk excavations for basement levels. The overall risk will depend on the extent of the works, such as the numbers of boreholes/piles (if required) and the volume of the excavations.

Generally speaking, the risk of encountering any type of UXO will be minimal for any works planned within the footprint and down to the depth of post-war foundations and excavations.

16.2. Land Service/Small Arms Ammunition Encounter

Items of LSA and SAA are mostly encountered in areas previously used for military training. Such items could have been lost, burnt, buried or discarded during being in use by the military. Due to this, LSA are most likely to be encountered at relatively shallow depths – generally in the top 1m below ground level. Therefore, such items are most likely to be encountered during open excavation works. In some cases, there is the potential that LSA or SAA may be present on the surface of the ground – especially in areas with active military use or were recently in use by the MoD.

17. The Likelihood of UXO Initiation

17.1. Introduction

UXO does not spontaneously explode. Older UXO devices will require an external event/energy to create the conditions for detonation to occur. The likelihood that a device will function can depend on a number of factors including the type of weaponry, its age and the amount of energy it is struck with.

17.2. Initiating Aerial Delivered Ordnance

Unexploded bombs do not spontaneously explode. All high explosive filling requires significant energy to create the conditions for detonation to occur.

In recent decades, there have been a number of incidents in Europe where Allied UXBs have detonated, and incidents where fatalities have resulted.. There have been several hypotheses as to the reason why the issue is more prevalent in mainland Europe – reasons could include the significantly greater number of bombs dropped by the Allied forces on occupied Europe, the preferred use by the Allies of mechanical rather than electrical fuzes, and perhaps just good fortune. The risk from UXO in the UK is also being treated very seriously in many sectors of the construction industry, and proactive risk mitigation efforts will also have affected the lack of detonations in the UK.

There are certain construction activities which make initiation more likely, and several potential initiation mechanisms must be considered:

UXB Initiation	
Direct Impact	Unless the fuze or fuze pocket is struck, there needs to be a significant impact e.g. from piling or large and violent mechanical excavation, onto the main body of the weapon to initiate a buried iron bomb. Such violent action can cause the bomb to detonate.
Re- starting the Clock	A small proportion of German WWII bombs employed clockwork fuzes. It is probable that significant corrosion would have taken place within the fuze mechanism over the last 70+ years that would prevent clockwork mechanisms from functioning. Nevertheless, it was reported that the clockwork fuze in a UXB dealt with by 33 EOD Regiment in Surrey in 2002 did re-start.
Friction Impact	The most likely scenario resulting in the detonation of a UXB is friction impact initiating the shock-sensitive fuze explosive. The combined effects of seasonal changes in temperature and general degradation over time can cause explosive compounds to crystallise and extrude out from the main body of the bomb. It may only require a limited amount of energy to initiate the extruded explosive which could detonate the main charge.

17.3. Land Service /Small Arms Ammunition Initiation

Items of LSA generally do not become inert or lose their effectiveness with age. Time can cause items to become more sensitive and less stable. This applies equally to items submerged in water or embedded in silts, clays, or similar materials. The greatest risk occurs when an item of ordnance is struck or interfered with. This is likely to occur when mechanical equipment is used or when unqualified personnel pick up munitions.

If left alone, an item of LSA will pose little/no risk of initiation. Therefore, if it is not planned to undertake construction/intrusive works at the site, the risk of initiation of any LSA that may be present would be negligible. Similarly, those accessing a contaminated area would be at minimal risk if they do not interfere with any UXO present on the ground. Clearly for many end uses, however, the presence of UXO anywhere on a site would not be acceptable as it could not be guaranteed that the items will not be handled, struck or otherwise affected, increasing the likelihood of initiation.



Items of SAA are much less likely to detonate than LSA or UXBs, but can be accidentally initiated by striking the casing, coming into contact with fire, or being tampered with/dismantled. It is likely that the detonation of an item of SAA would result in a small explosion, as the pressure would not be contained within a barrel. Detonation would only result in local overpressure and very minor fragmentation from the cartridge case.

18. Consequences of Initiation/Encounter

18.1. Introduction

The repercussions of the inadvertent detonation of UXO during intrusive ground works, or if an item or ordnance is interfered with or disturbed, are potentially profound, both in terms of human and financial cost. A serious risk to life and limb, damage to plant and total site shutdown during follow-up investigations are potential outcomes. However, if appropriate risk mitigation measures are put in place, the chances of initiating an item of UXO during ground works is comparatively low.

The consequences of encountering UXO can be particularly notable in the case of high-profile sites (such as airports and train stations) where it is necessary to evacuate the public from the surrounding area. A site may be closed for anything from a few hours to a week with potentially significant cost in lost time. It should be noted that even the discovery of suspected or possible item of UXO during intrusive works (if handled solely through the authorities), may also involve significant loss of production

18.2. Consequences of Detonation

When considering the potential consequences of a detonation, it is necessary to identify the significant receptors that may be affected. The receptors that may potentially be at risk from a UXO detonation on a construction site will vary depending on the site specific conditions but can be summarised as follows:

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

19. 1st Line Defence Risk Assessment

19.1. Risk Assessment Stages

Taking into account the quality of the historical evidence, the assessment of the overall risk from unexploded ordnance is based on the following five considerations:

1. That the site was contaminated with unexploded ordnance.
2. That unexploded ordnance remains on site.
3. That such items will be encountered during the proposed works.
4. That ordnance may be initiated by the works operations.
5. The consequences of encountering or initiating ordnance.

19.2. Assessed Risk Level

1st Line Defence has assessed that there is an overall **Low-Medium Risk** from both German and Allied unexploded ordnance at the site of proposed works.

Ordnance Type	Risk Level			
	Negligible	Low	Medium	High
German Unexploded HE Bombs		✓		
German 1kg Incendiary Bombs		✓		
Allied Anti-Aircraft Artillery Projectiles		✓		
Allied Land Service and Small Arms Ammunition		✓		

Please note – although the risk from unexploded ordnance on this site has been assessed as ‘Low-Medium’, this does not mean there is ‘no’ risk of encountering UXO. This report has been undertaken with due diligence, and all reasonable care has been taken to access and analyse relevant historical information. By necessity, when dealing historical evidence, and when making assessments of UXO risk, various assumptions have to be made which we have discussed and justified throughout this report. Our reports take a common-sense and practical approach to the assessment of risk, and we strive to be reasonable and pragmatic in our conclusions.

It should however be stressed that if any suspect items are encountered during the proposed works, 1st Line Defence should be contacted for advice/assistance, and to re-assess the risk where necessary. The mitigation measures outlined in the next section are recommended as a minimum precaution to alert ground personnel to the history of the site, what to look out for, and what measures to take in the event that a suspect item is encountered. It should also be noted that the conclusions of this report are based on the scope of works outlined in the ‘Proposed Works’ section of this report. Should the scope of works change or additional works be proposed, 1st Line Defence should be contacted to re-evaluate the risk.

20. **Proposed Risk Mitigation Methodology**

20.1. **General**

The following risk mitigation measures are recommended to support the proposed works at the Southleigh Park site, Havant:

Type of Work	Recommended Mitigation Measure
All Works	• UXO Risk Management Plan It is recommended that a site-specific plan for the management of UXO risk be written for this site. This plan should be kept on site and be referred to in the event that a suspect item of UXO is encountered at any stage of the project. It should detail the steps to be taken in the event of such a discovery, considering elements such as communication, raising the alarm, nominated responsible persons etc. Contact 1st Line Defence for help/more information. • Site Specific UXO Awareness Briefings to all personnel conducting intrusive works. As a minimum precaution, all personnel working on the site should be briefed on the basic identification of UXO and what to do in the event of encountering a suspect item. This should in the first instance be undertaken by a UXO Specialist. Posters and information on the risk of UXO can be held in the site office for reference.

In making this assessment and recommending these risk mitigation measures, if known, the works outlined in the 'Scope of the Proposed Works' section were considered. Should the planned works be modified or additional intrusive engineering works be considered, 1st Line Defence should be consulted to see if a re-assessment of the risk or mitigation recommendations is necessary.

1st Line Defence Limited

20/11/20

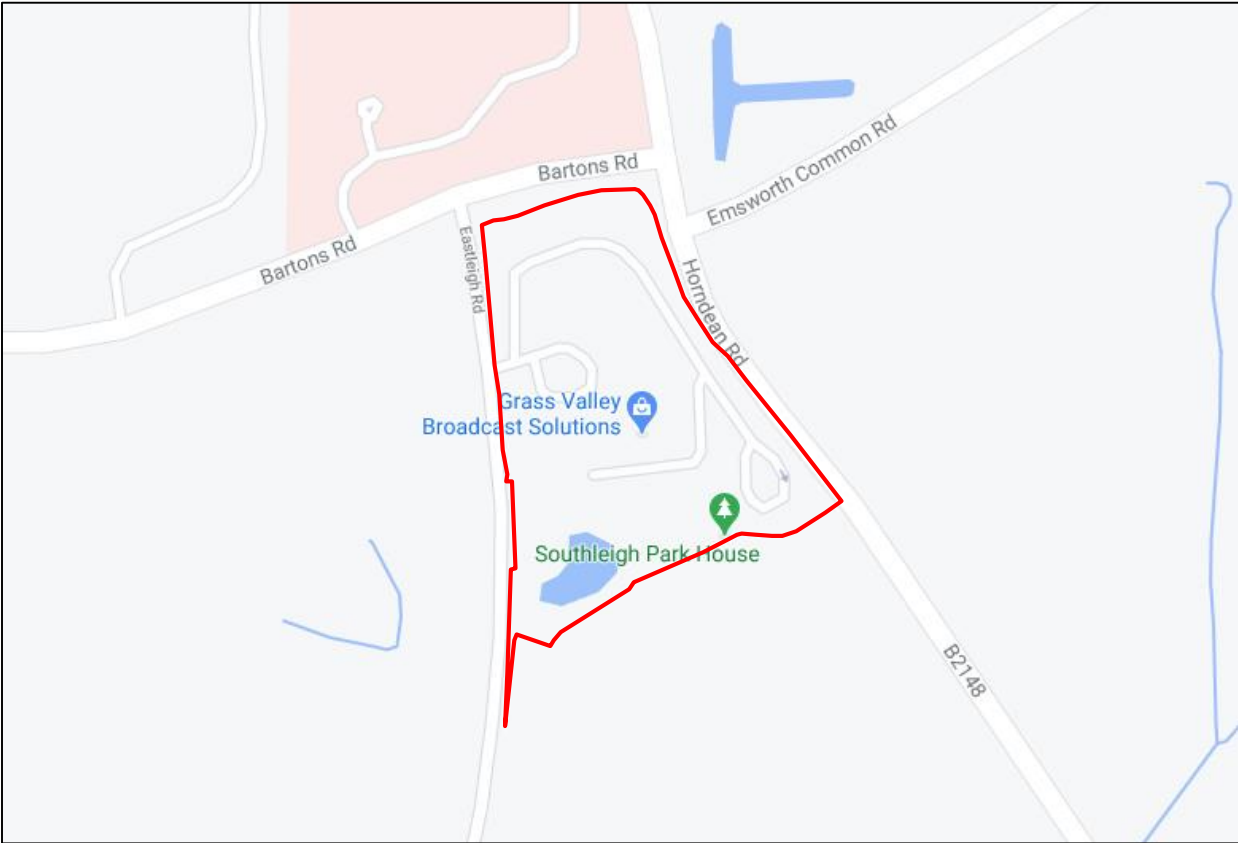
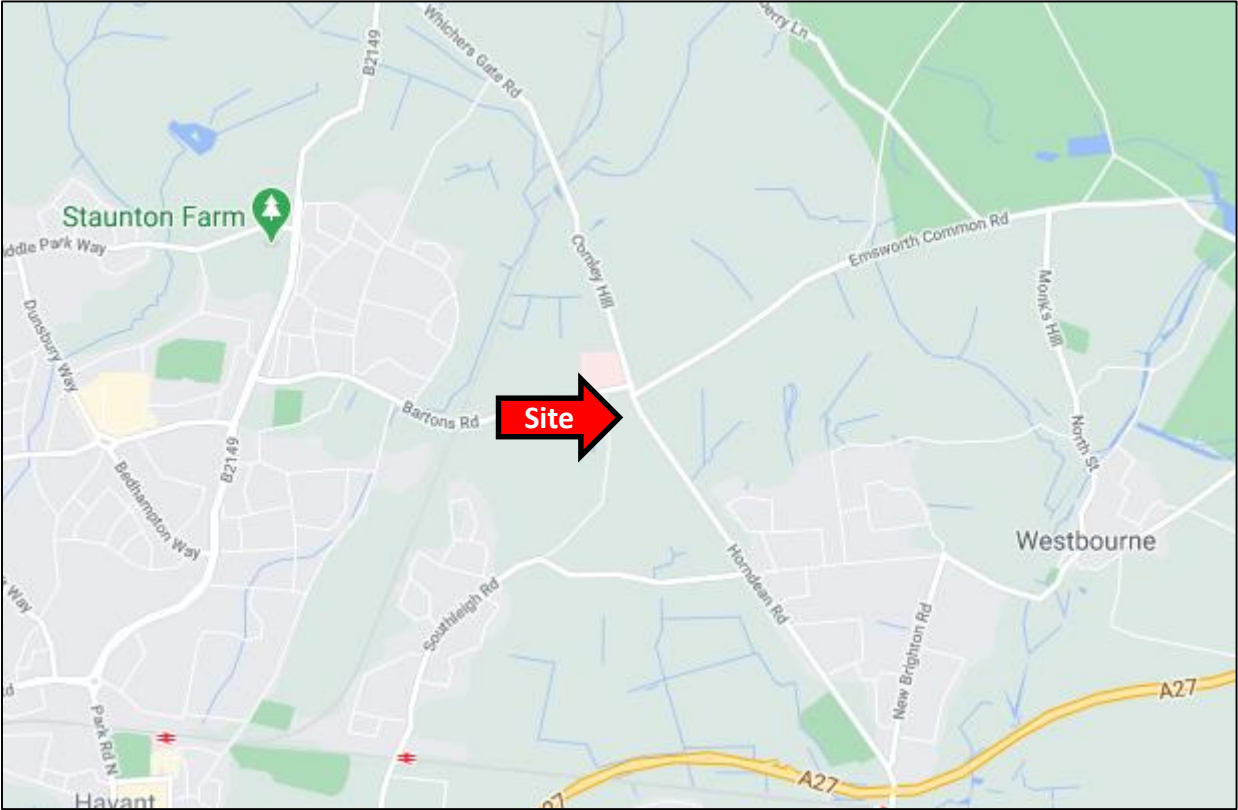
This Report has been produced in compliance with the Construction Industry Research and Information Association (CIRIA) C681 guidelines for the writing of Detailed UXO Risk Assessments.

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Project: **Southleigh Park, Havant**

Ref: **DA12228-00**

Source: Google Maps

— Approximate site boundary





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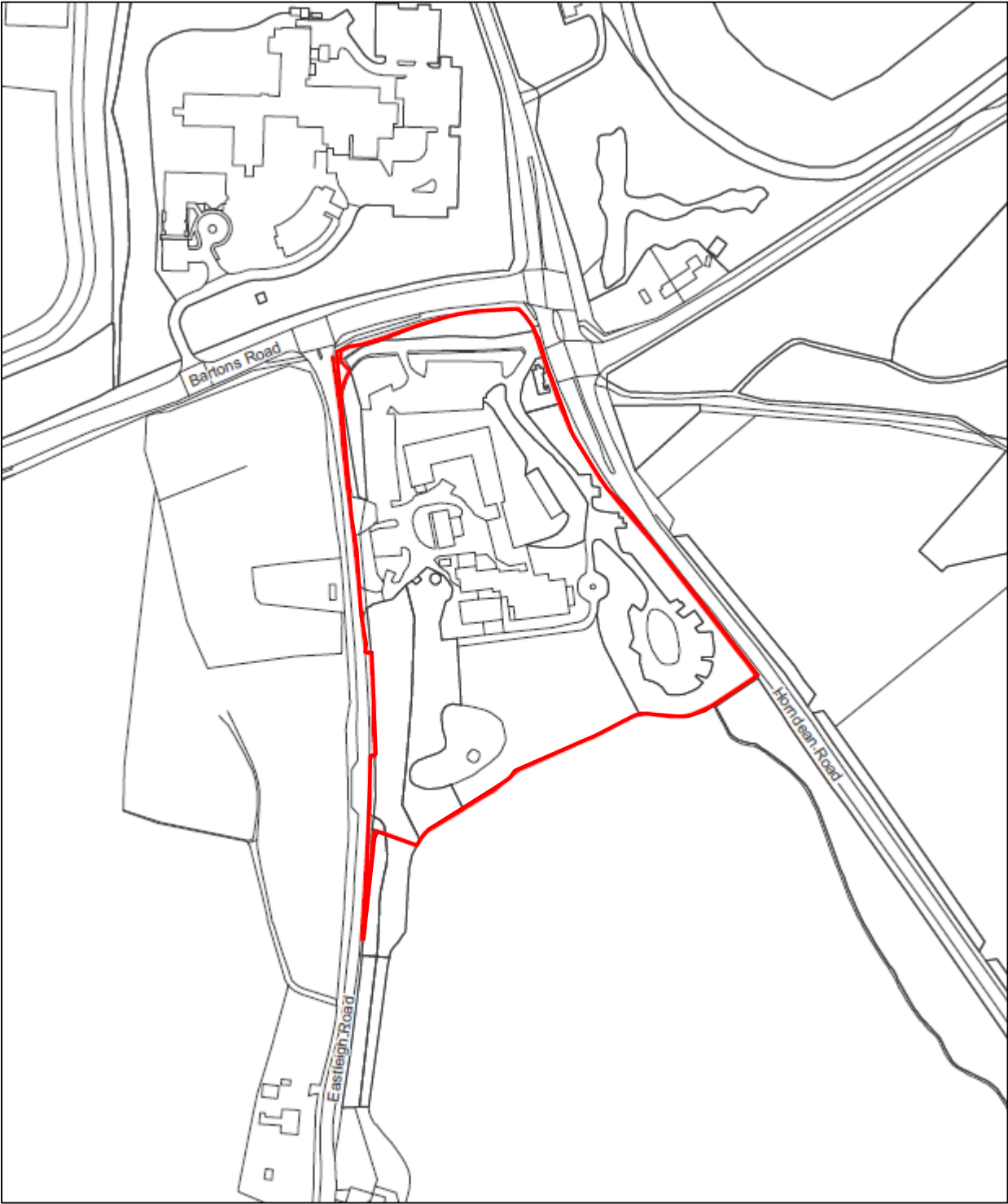
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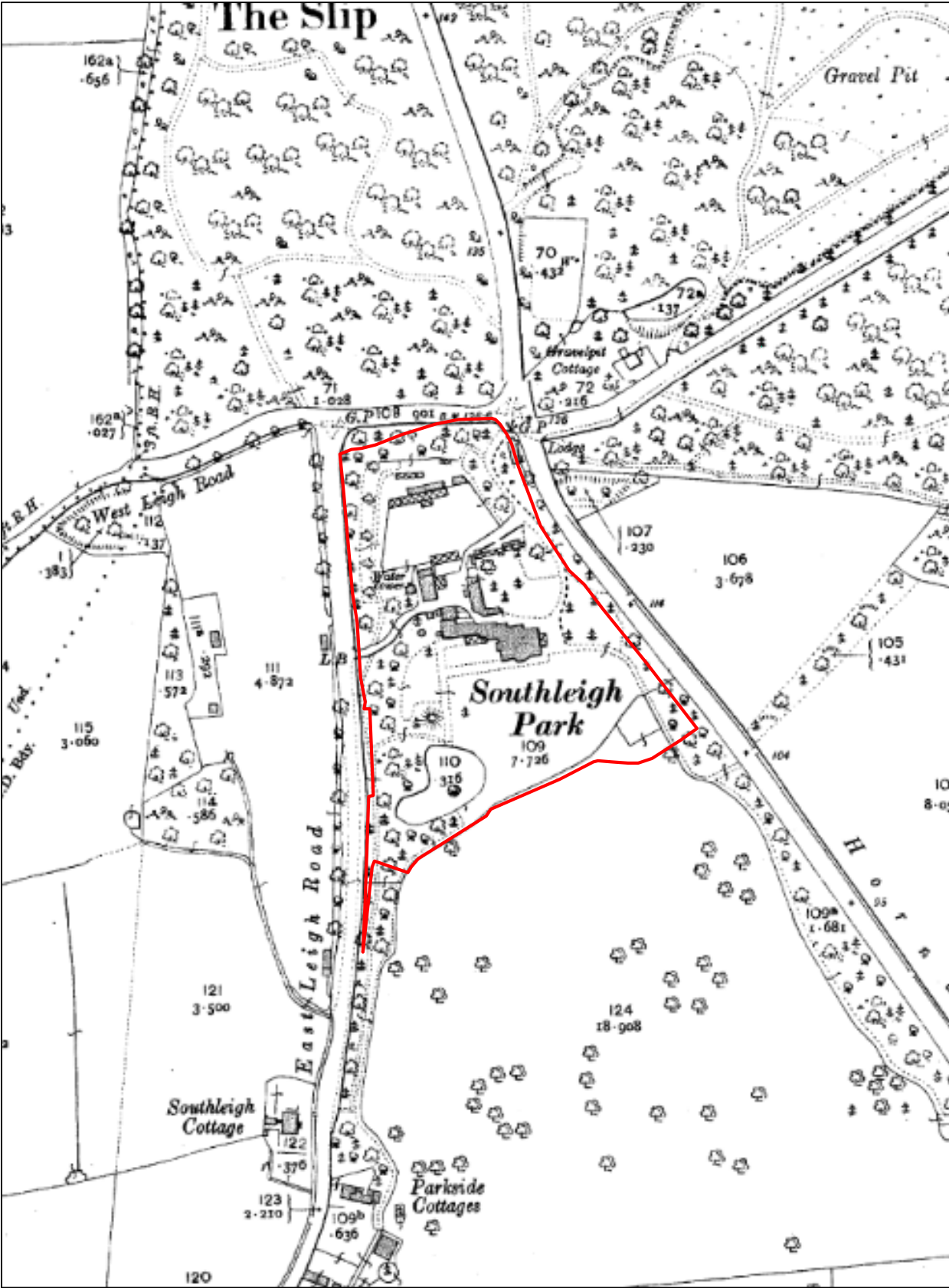
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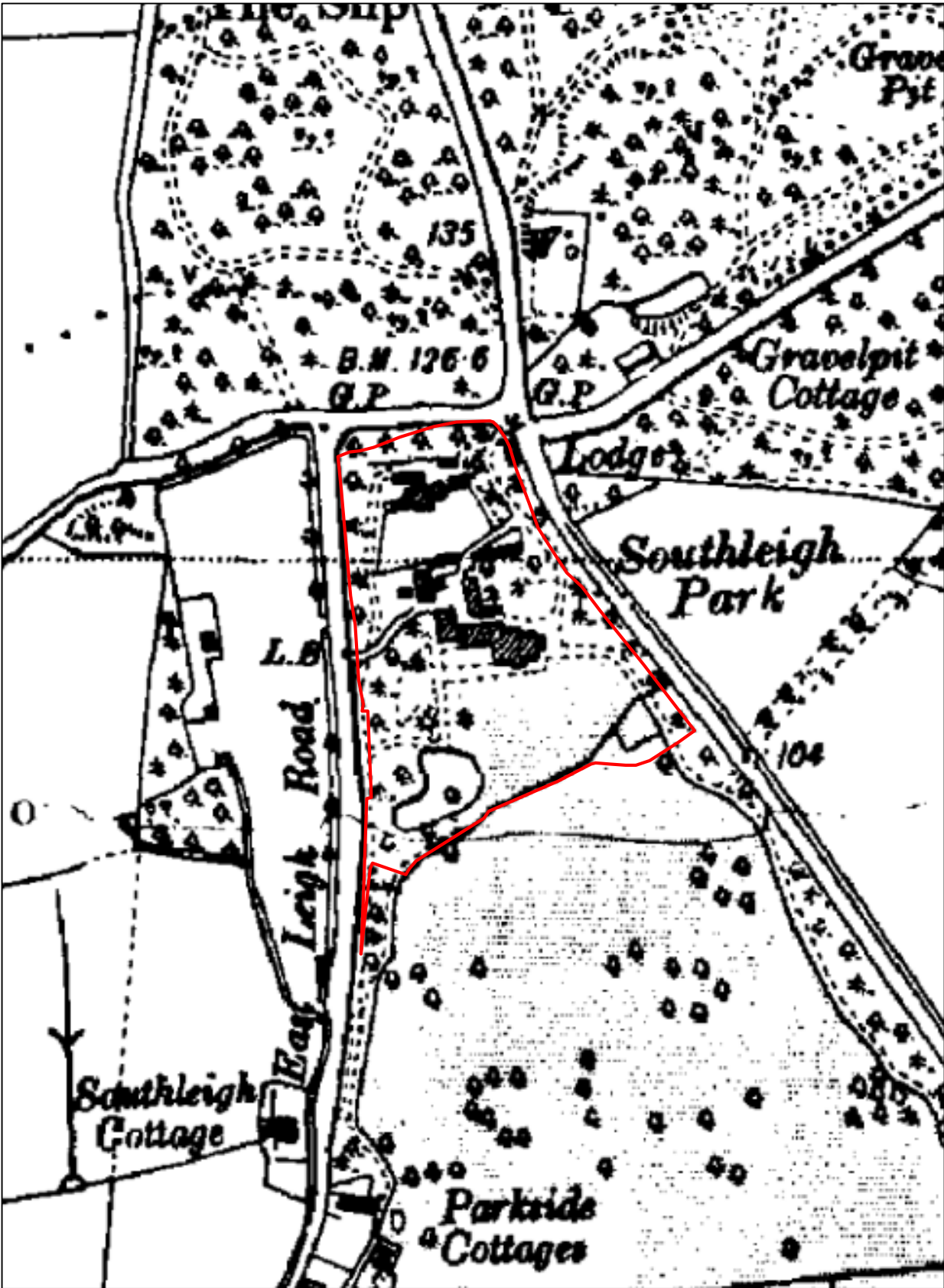
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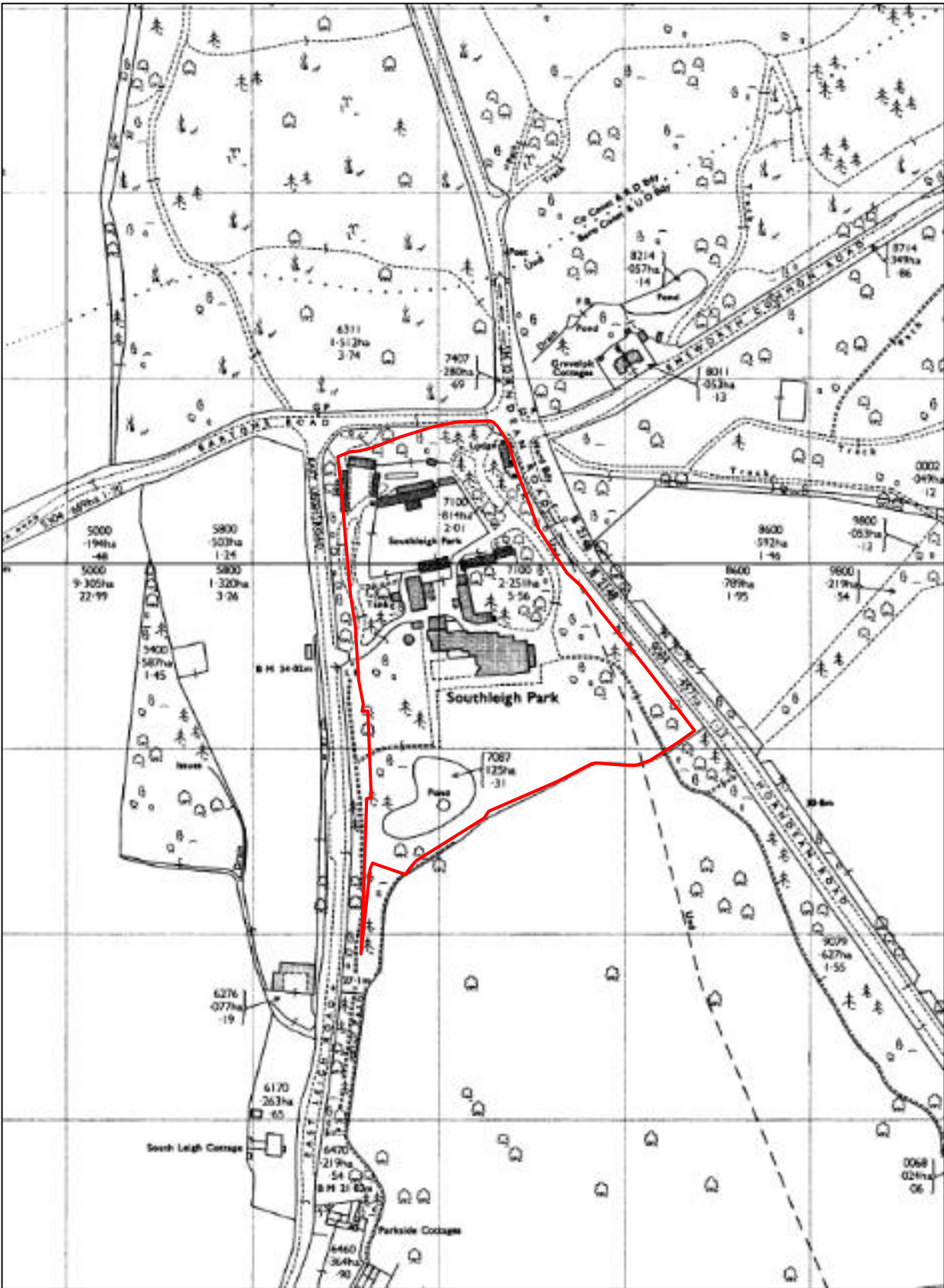
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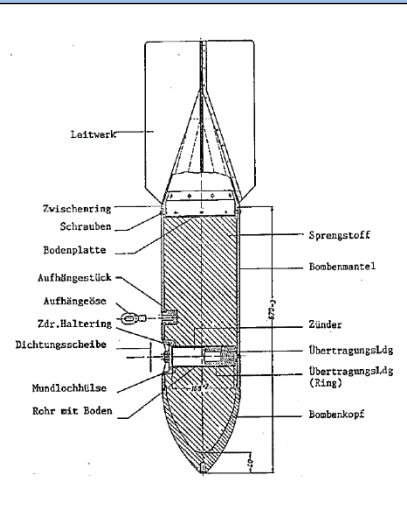
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Examples of German Air-Delivered Ordnance

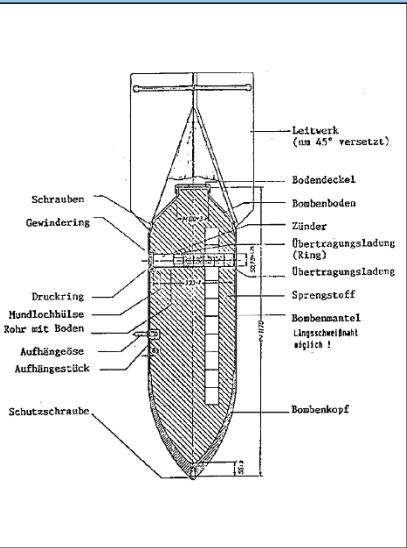
SC 50kg High Explosive Bomb

Bomb Weight	40-54kg (88-119lb)
Explosive Weight	25kg (55lb)
Fuze Type	Impact fuze/electro-mechanical time delay fuze
Bomb Dimensions	1,090 x 280mm (42.9 x 11.0in)
Body Diameter	200mm (7.87in)
Use	Against lightly damageable materials, hangars, railway rolling stock, ammunition depots, light bridges and buildings up to three stories.
Remarks	The smallest and most common conventional German bomb. Nearly 70% of bombs dropped on the UK were 50kg.



SC 250kg High Explosive Bomb

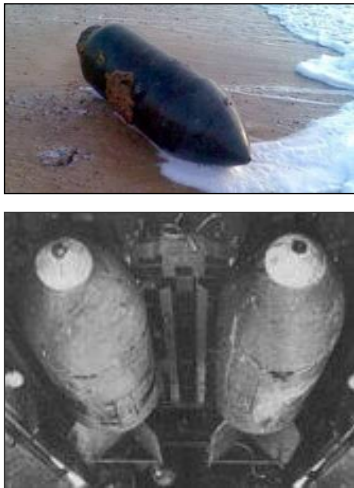
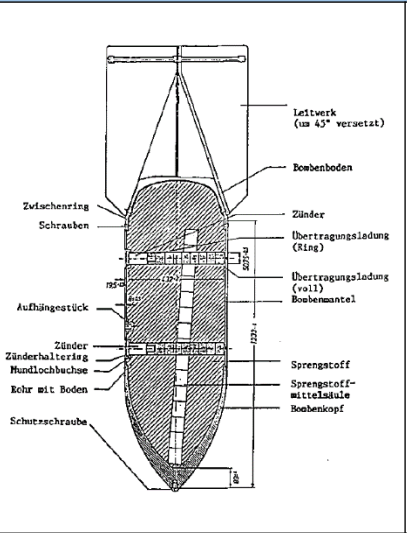
Bomb Weight	245-256kg (540-564lb)
Explosive Weight	125-130kg (276-287lb)
Fuze Type	Electrical impact/mechanical time delay fuze.
Bomb Dimensions	1640 x 512mm (64.57 x 20.16in)
Body Diameter	368mm (14.5in)
Use	Against railway installations, embankments, flyovers, underpasses, large buildings and below-ground installations.
Remarks	It could be carried by almost all German bomber aircraft, and was used to notable effect by the Junkers Ju-87 Stuka (Sturzkampfflugzeug or dive-bomber).



SC250 bomb being loaded onto German bomber

SC 500kg High Explosive Bomb

Bomb Weight	480-520kg (1,058-1,146lb)
Explosive Weight	250-260kg (551-573lb)
Fuze Type	Electrical impact/mechanical time delay fuze.
Bomb Dimensions	1957 x 640mm (77 x 25.2in)
Body Diameter	470mm (18.5in)
Use	Against fixed airfield installations, hangars, assembly halls, flyovers, underpasses, high-rise buildings and below-ground installations.
Remarks	40/60 or 50/50 Amatol TNT, trialene. Bombs recovered with Trialen filling have cylindrical paper wrapped pellets 1-15/16 in. in length and diameter forming



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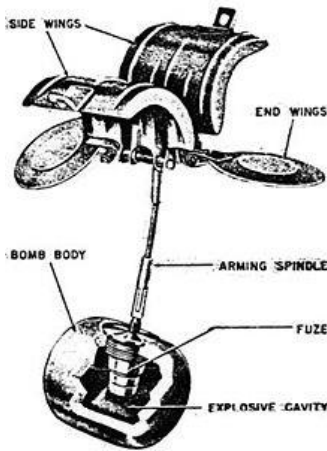
Project: Southleigh Park, Havant

Ref: DA12228-00

Source: Various sources

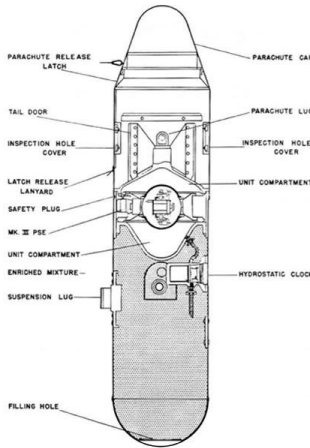
SD2 Anti-Personnel ‘Butterfly Bomb’

Bomb Weight	Approx. 2kg (4.41lb)
Explosive Weight	Approx. 7.5oz (225 grams) of Amatol surrounded by a layer of bituminous composition.
Fuze Type	41 fuze (time) , 67 fuze (clockwork time delay) or 70 fuze (anti-handling device)
Body Diameter	3in (7.62 cm) diameter, 3.1in (7.874) long
Use	Designed as an anti-personnel/ fragmentation weapon. They were delivered by air, being dropped in containers of 23-144 sub-munitions that opened at a predetermined height, thus scattering the bombs.
Remarks	Very rare. First used against Ipswich in 1940, but were also dropped on Kingston upon Hull, Grimsby and Cleethorpes in June 1943, amongst various other targets in UK. As the bombs fell the outer case flicked open by springs which caused four light metal drogues with a protruding 5 inch steel cable to deploy in the form of a parachute & wind vane which armed the device as it span.



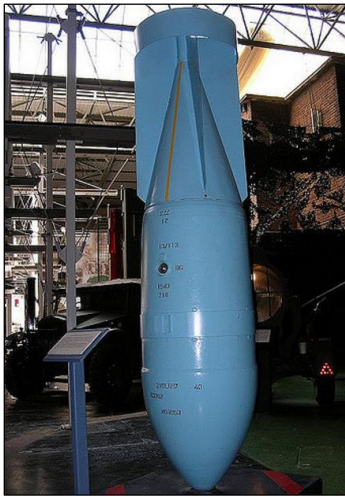
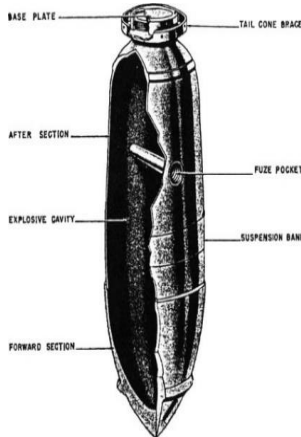
Parachute Mine (Luftmine B / LMB)

Bomb Weight	Approx. 990kg (2176lb)
Explosive Weight	Approx. 705kg (1,554lb)
Fuze Type	Impact/ Time delay / hydrostatic pressure fuze
Dimensions	2.64m x 0.64m (3.04m with parachute housing)
Use	Against civilian, military and industrial targets. Used as blast bombs and designed to detonate above ground level to maximise damage to a wider area.
Remarks	Deployed a parachute when dropped in order to control its descent. Had the potential to cause extensive damage in a 100m radius.



SC 1000kg

Bomb Weight	Approx. 993-1027kg (2,189-2,264lb)
Explosive Weight	Approx. 530-620kg (1168-1367lb)
Fuze Type	Electrical impact/mechanical time delay fuze.
Filling	Mixture of 40% amatol and 60% TNT, but when used as an anti-shipping bomb it was filled with Trialen 105, a mixture of 15% RDX, 70% TNT and 15% aluminium powder.
Bomb Dimensions	2800 x 654mm (110 x 25.8in)
Body Diameter	654mm (18.5in)
Use	SC type bombs are General Purpose Bombs used primarily for general demolition work. Constructed of parallel walls with comparatively heavy noses. They are usually of three piece welded construction



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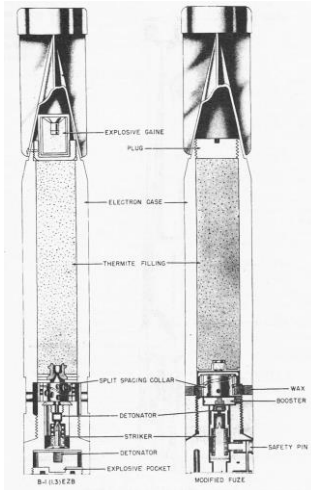
Source: Various sources

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German Incendiary Bombs

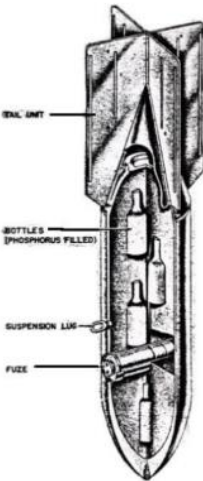
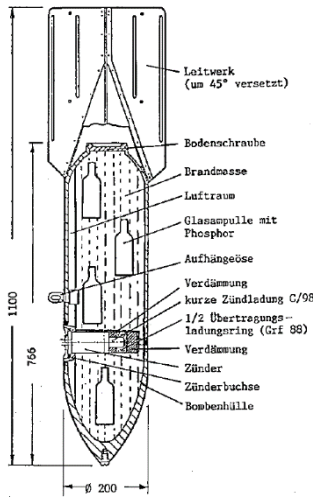
1kg Incendiary Bomb

Bomb Weight	Approx. 1.0 - 1.3kg (2.2 and 2.9lb)
Explosive Weight	Approx. 680g (1.5lb) Thermite 8-15gm Explosive Nitropenta
Fuze Type	Impact fuze
Bomb Dimensions	350 x 50mm (13.8 x 1.97in)
Body Diameter	50mm (1.97in)
Use	As incendiary – dropped in clusters on towns and industrial complexes
Remarks	Magnesium alloy case. Sometimes fitted with high explosive charge. The body is a cylindrical alloy casting threaded internally at the nose to receive the fuze holder and fuze.



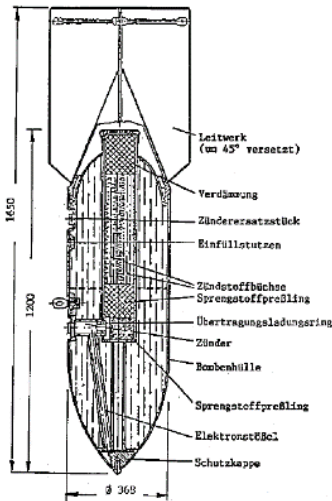
C50 A Incendiary Bomb

Bomb Weight	Approx. 41kg (90.4lb)
Explosive Weight	Approx. 0.03kg (0.066lb)
Incendiary Filling	12kg (25.5lb) liquid filling with phosphor igniters in glass phials. Benzine 85%; Phosphorus 4%; Pure Rubber 10%
Fuze Type	Electrical impact fuze
Bomb Dimensions	1,100 x 280mm (43.2 x 8in)
Use	Against any targets where an incendiary effect is required
Remarks	Early fill was a phosphorous/carbon disulphide incendiary mixture



Flam C-250 Oil Bomb

Bomb Weight	Approx. 125kg (276lb)
Explosive Weight	Approx. 1kg (2.2lb)
Fuze Type	Super-fast electrical impact fuze
Filling	Mixture of 30% petrol and 70% crude oil
Bomb Dimensions	1,650 x 512.2mm (65 x 20.2in)
Body Diameter	368mm (14.5in)
Use	Often used for surprise attacks on ground troops, against troop barracks and industrial installations. Thin casing – not designed for ground penetration



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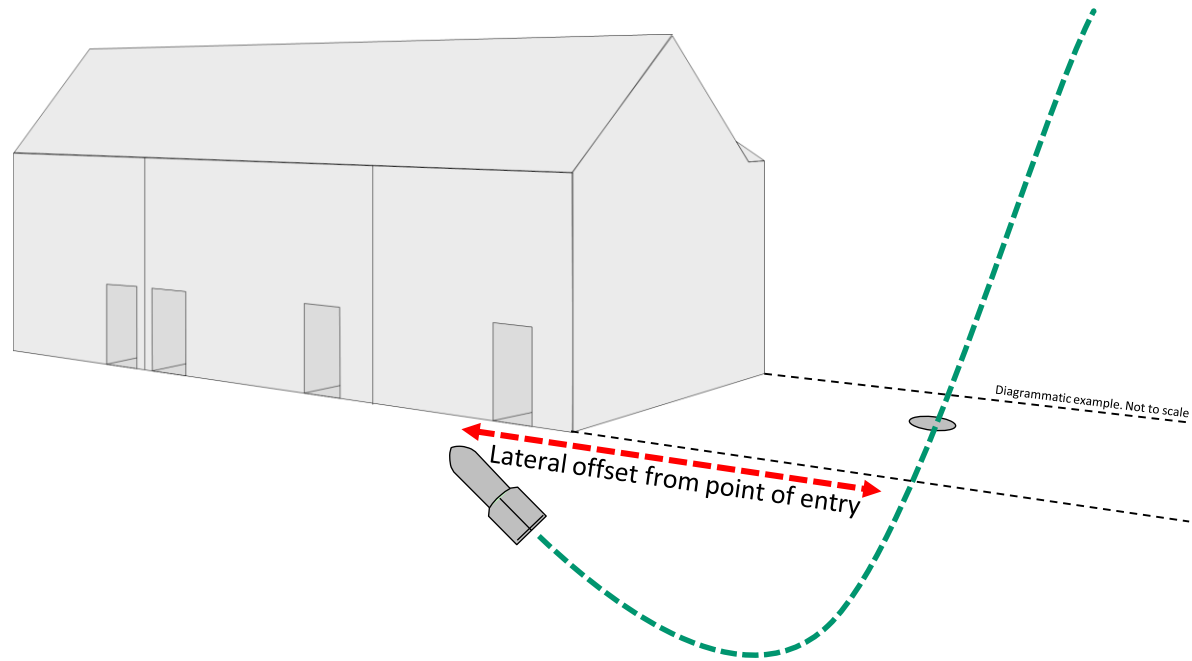
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Project: **Southleigh Park, Havant**

Ref: **DA12228-00**

Source: Various sources

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Top: J-curve Effect - Due to angle of entry, unexploded bombs would often end their trajectory at a lateral offset from point of entry, often ending up beneath adjacent extant structures/sites. The photograph above shows 250kg bomb found in Bermondsey pointing upwards, demonstrating 'J-curve'



One of the most common scenarios for UXO going unnoticed was when a UXB fell into a 'bomb site' (such as the area shown **Top Left**), the entry hole of the bomb obscured by any debris and rubble present. Note that the entry hole of a 50kg UXB could be as little as 20cm in diameter (**Left**).



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Bermondsey bomb: World War Two device safely removed



An unexploded World War Two bomb found in south London has been driven away safely under police and Army escort.

The 500lb (250kg) device was found on a building site in Grange Walk, Bermondsey on Monday.

March 2015



Bethnal Green WW2 bomb: Experts remove unexploded device



An unexploded World War Two bomb that prompted the evacuation of 700 people in east London has been made safe and removed by the military.

Families spent the night in a school hall after the 500lb bomb was found in the basement of a building site on Temple Street, in Bethnal Green, on Monday afternoon.

A 200m (650ft) exclusion zone was set up around the device.

August 2016



Bath WW2 bomb scare: Device defused, police say



A 500lb World War Two bomb found on the site of a former school in Bath has been defused and made safe.

The discovery of the bomb on Thursday led to the evacuation of hundreds of homes and many road closures in the Lansdown area of the city.

A cordon around the site was lifted on Friday evening, more than 24 hours after residents were asked to leave their homes.

May 2016



London City Airport reopens after WW2 bomb moved



London City Airport has reopened after an unexploded 500kg World War Two bomb was safely moved from the area.

The device was discovered at the King George V Dock on Sunday during planned work at the east London airport.

All flights were cancelled on Monday after an exclusion zone was put in place, with the closure affecting up to 16,000 passengers and nearby residents being evacuated from their homes.

May 2015



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Source: BBC News

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BASF has confirmed that an explosive device, most likely a World War II-era bomb, caused the blast that left one person injured Tuesday at a plant construction site in Germany.

The explosion was reported at BASF's Ludwigshafen toluene diisocyanate (TDI) plant, which recently broke ground for a 300,000 metric tons per year TDI production plant and other construction to expand its facilities.



BASF Provides Some Details

Responding to a request from *PaintSquare News* for more information on Wednesday (Feb. 27), BASF's manager of media relations and corporate communications Europe, Ursula von Stetten, wrote in an email, "So here [are] the facts: The detonation took place at 10:00 a.m. One person was injured; the injury is not serious. He will be kept in the hospital for some days."

"Cause of the detonation was an explosive device, presumably a bomb deriving from the Second World War. The device detonated when grounding work was done. No details on [a] delay [are] available. At the moment, the exact circumstances of the incident are [being] evaluated."

1st March 2013

SPIEGEL ONLINE

Blast Kills One
World War II Bomb Explodes on German Motorway

A highway construction worker in Germany accidentally struck an unexploded World War II bomb, causing an explosion which killed him and wrecked several passing cars.



A World War II bomb has exploded during construction work on a German highway, killing one worker and injuring several motorists who were driving past, police said.

The worker had been cutting through the road surface near the south-western town of Aschaffenburg when his machine struck the bomb and triggered it. Police said they weren't sure yet what type of bomb it was. "The explosion seems to have been too small for it to have been an aircraft bomb," a police spokesman said.

23rd October 2006

WWII bomb injures 17 at Hattingen construction site



Seventeen people were injured on Friday when a construction crew unwittingly detonated a buried World War II-era bomb in Hattingen.

An excavator apparently drove over a 250-kilogramme (550 pound) American bomb, damaging surrounding buildings. Most of the injured suffered auditory trauma from the blast, and the excavator operator suffered injuries to his hands, police in the German state of North Rhine-Westphalia said.

"The hole was astoundingly small for such a large bomb full of so many explosives," Armin Gebhard, head of the Arnsberg department for military ordnance removal, told *The Local*. "But of course it damaged all the surrounding buildings too. We are really happy it wasn't worse."

19th September 2013



World War II bomb kills three in Germany



A special commission is investigating the causes of the explosion, while prosecutors are considering whether the team leader should face charges of manslaughter through culpable negligence, the BBC's Oana Lungescu reports from Berlin.

The blast happened an hour before the defusing operation was due to start.

Officials said the three men who died were experienced sappers, or combat engineers, who over 20 years had defused up to 700 bombs.

More than 7,000 people were immediately evacuated when the 500kg bomb was found. Several schools, a kindergarten and local companies remain closed.

2nd June 2010



June 2006



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WW2 bomb found in Portsmouth harbour

🕒 22 February 2017 🇬🇧

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A World War Two bomb containing 290lb (131kg) of "high explosives" has been found in Portsmouth harbour.

The ordnance was discovered by a dredger in the water at about 03:00 GMT, the Royal Navy said.

Specialist divers at the scene said the bomb posed a "very serious threat". It was towed out to sea and detonated.

All ferries were stopped and trains between Portsmouth and Southsea station and Portsmouth Harbour were suspended, but have since started running again.

There were also extensive road closures in the area, affecting access to Gunwharf Quays.



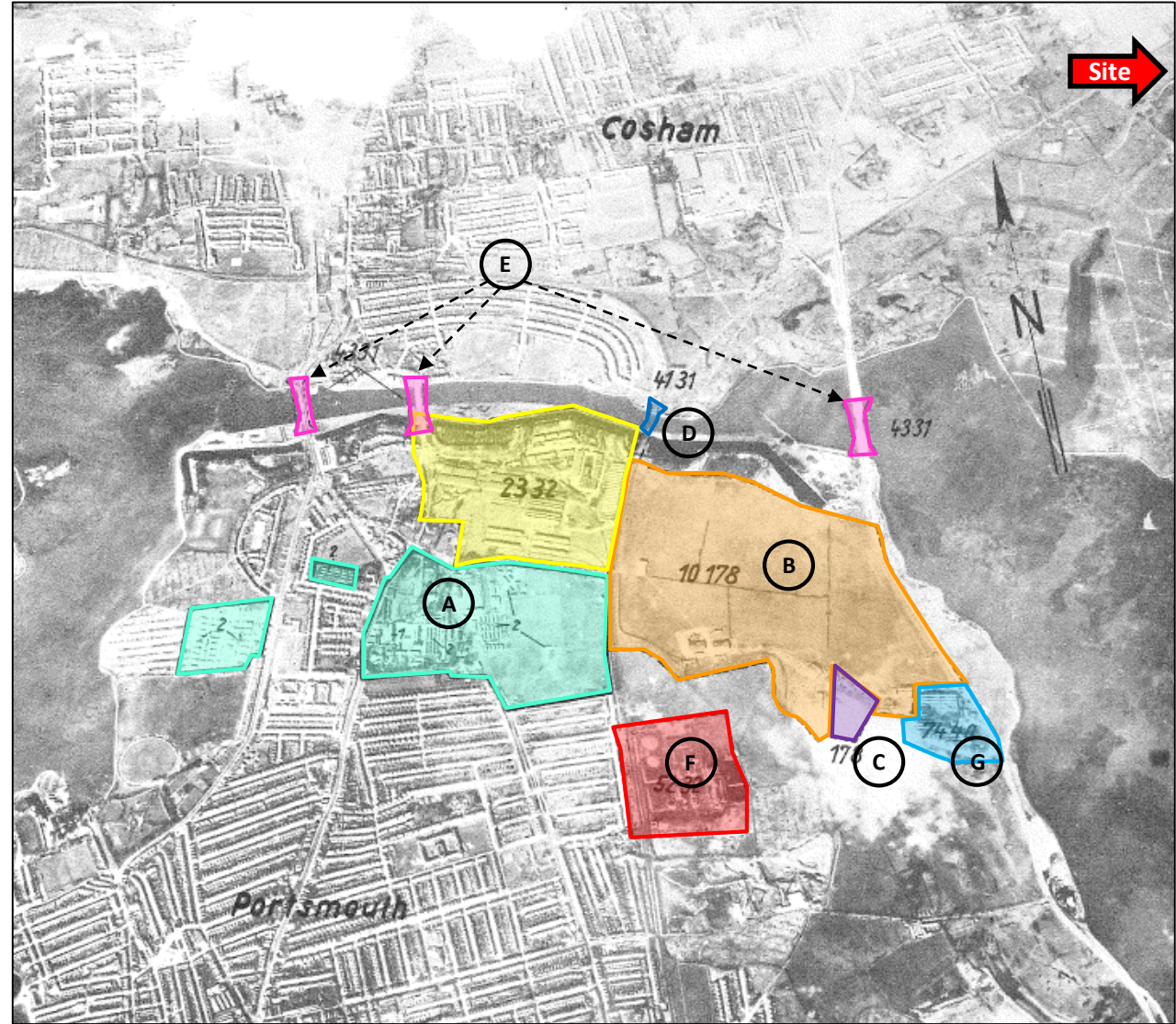
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Ref:	DA12228-00	Source:	BBC News
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Luftwaffe Photograph, 3rd September 1941



Hampshire – Portsmouth, Hilsea and Cosham

- A. GB 138 – Barracks building & total flat area
- B. GB 10 178 – Portsmouth airport
- C. GB 17 8 – Bearing system
- D. GB 41 31 – Railway bump
- E. GB 43 31 – 2 Road bridges & 1 Street embankment
- F. GB 52 32 – Hilsea Gasworks
- G. GB 74 40 – Airframe factory

The site located approximately 5km north-east of the extremity of the photography.



19th March 1941

19th March, 1941.

At 0100 two H.E. bombs were dropped at Hambrook about two miles east of Emsworth causing damage to one house no casualties. At 0320 fifteen U.X.B's were dropped near the junction of South Leigh Road and East Leigh Road, Havant one of them cracking a gas main another damaging the roof of a cart shed. At 0415 one H.E. was dropped on the Golf Links at Hayling and about the same time a string of H.E and incendiary bombs were dropped in the sea off Eastney and Fort Cumberland.

18th April 1941

18th April, 1941, Report No. 155.

During the night 17th/18th Five enemy aircraft were destroyed during an attack on the Portsmouth District with parachute mines, high explosive and incendiary bombs. Incidents occurred at Emsworth, East of Denvilles, Eastleigh Havant, Portsdown Hill Bedhampton, Purbeck, Stokes, Waterlooville, Lovedean, Stoke, North Hayling, and several points in South Hayling causing considerable damage including some houses demolished and a few casualties at most incidents some being fatal. Fire services had to deal with 28 fires and the A.R.P.

21st August 1942

21st August, 1942. Report No. 255.

Between 2300 and 2330 H.E. Bombs were dropped as follows:-

- 4 H.E. Lower Drayton and near Railway some damage slight casualties
- 4 H.E. Ranelagh Road Havant, some damage 2 slight casualties.
- 2 H.E. Southleigh Farm, South Leigh Road, Block by debris.
- 2 H.E. Near Hayling Railway about 1 mile north of South Hayling Station.
- 3 H.E. Jellicoe Avenue, Alverstoke some damage and casualties one fatal.



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Source: Hampshire Archives

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Incident Reports to Group Control

12-5-40	U.x.B.	Elmleigh Rd Havant
1-10-40	Removal of damaged	
5-10-40	U.x.B.	Eastleigh Rd Havant
8-10-40	No UxBs Reported	1 Bomb Eastleigh Rd to be dealt with
9-10-40	Removal of UxB.	4 th Avenue & 1 Bomb Eastleigh Rd
18-3-41	U.x.B.	South Leigh & East Leigh Rd Havant
19-3-41	U.x.Shell	Park Crescent Emsworth
19-3-41	U.x.B.	Southleigh Road Havant
19-3-41	Re to UxB.	Eastleigh & South Leigh Rd Havant
19-3-41	Re to UxB.	Eastleigh & South Leigh Rd Havant
20-3-41	U.x.Shells	Havant & Emsworth
25-3-41	U.x.B.	South Leigh Rd Havant Removed
20-6-42	U.x.H.A. Shell report	South Leigh Poultry Farm Havant



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1941

March 19. At 03.20 15 UXBs dropped near junction of Southleigh Road and Eastleigh Road one of them cracking a gas main another damaging the roof of a cart shed.

April 18. At 00.15 HE bomb at Helmsley House, West Leigh Road [Bartons Road]. Cottage demolished. One male dead. One child missing. Two women and three children slightly injured. At 00.20 One HE bomb and 200 IBs. in open field junction of Southleigh Road and Westbourne Road one mile north of Emsworth Police Station. No Damage. No casualties. 00.30. Bomb dropped

1942

August 20. Four HE bombs. House in Ranelagh Road, hit, some damage two slight casualties. Two HE bombs Southleigh Farm, Southleigh Road, blocked by debris.

1944

March 9. *Hear that Emsworth Common Camp is beginning to fill with troops ready for the invasion. This refers to the large camp in what is now Southleigh Forest made ready for the D-Day invasion.*



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Source: Childhood Memories of Havant in the Second World War

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1939

I was amazed by the speed with which the area was being prepared for resistance to invasion. Concrete bunkers at strategic points in the road system seemed, like mushrooms, to have sprung up overnight. For example, three large ones were built within 100 yards (95 metres) of my office in the grounds of Southleigh Park House, two at the junction of Horndean Road with Emsworth Common Road, one is still there, and another in Bartons Road in what are now the grounds of the Spire Hospital, opposite the

20

The defence works which brought home to me most impressively the full horror of what conditions might be like if the invader came, were two hide-outs for guerrillas, deep in the estate owned Southleigh Forest. Constructed secretly, they were two holes about 6 feet (2 metres) deep, with boarded walls and a metal roof, which was covered with soil to a depth of not less than 6 inches (15 cm), and a ventilator shaft opening in undergrowth a yard (metre) or so away, all so effectively concealed that one could walk over them without knowing they were there. Each was designed to hold about six men.

1944

The Anti-aircraft Battery and Searchlight Emplacement was sited on the Langstone Road, where the Langstone Technology Park now is. The A.A. Battery was bombed on several occasions. There was a Free French Camp, Bir Hakeim Barracks, at Hollybank, Southleigh Road, and also one in Emsworth.

Post-WWII



After the war the army camp and gun site in Southleigh Road was occupied by squatters. Havant council later converted the huts for living accommodation and rented them out 10s (50p) per week for 2 bedrooms and 7s 6d (37½p) for 1 bedroom. It was named Southleigh Close.



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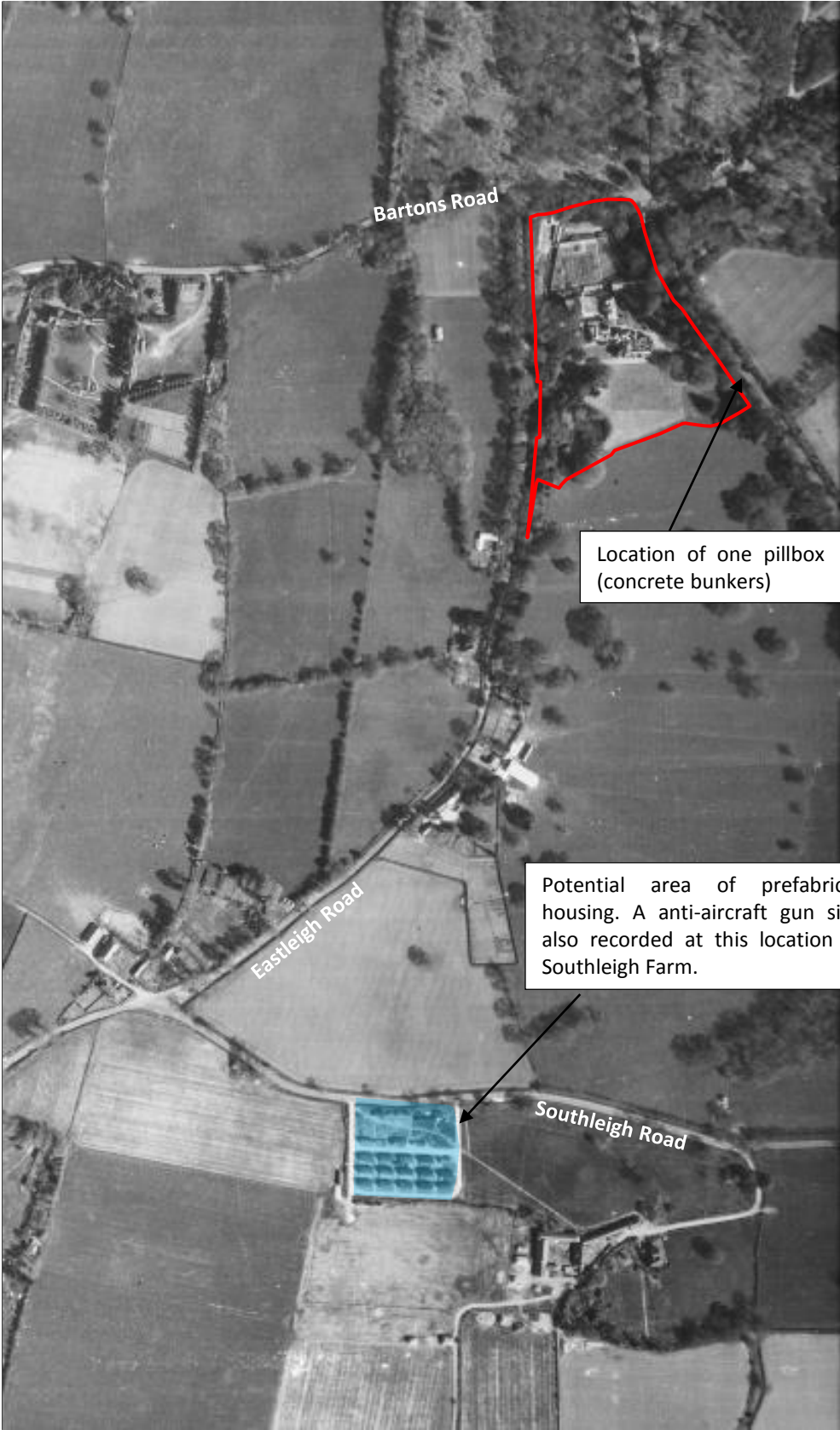
— Approximate site boundary

Project: **Southleigh Park, Havant**

Ref: **DA12228-00**

Source: National Monuments Record Office (Historic England)





Location of one pillbox
(concrete bunkers)

Potential area of prefabricated
housing. A anti-aircraft gun site is
also recorded at this location near
Southleigh Farm.



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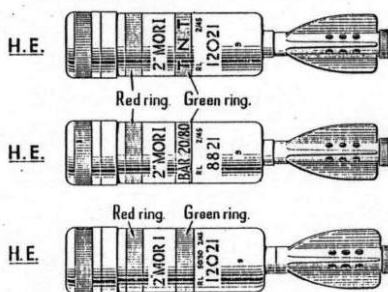
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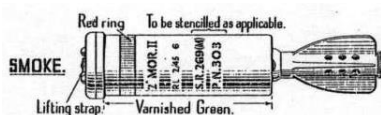
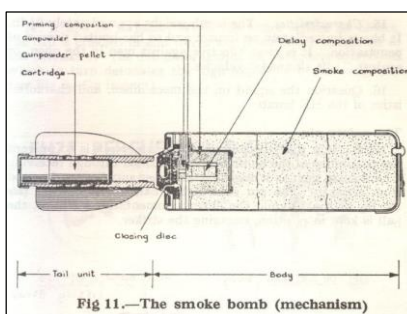


2 inch Mortar High Explosive

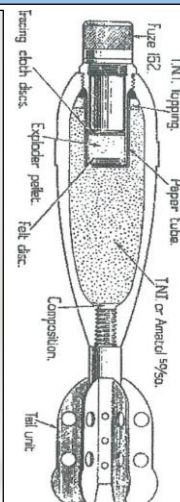
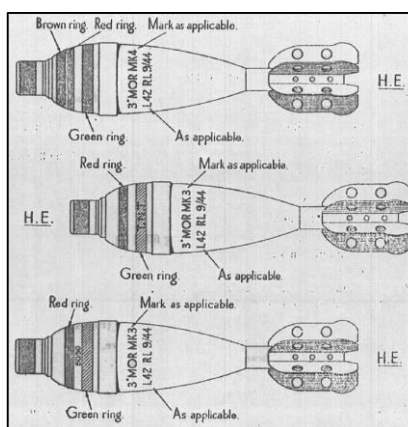
Weight	Approx. 1.02kg (2.25lb)
Maximum Range	460m (500yards)
Filling	200g RDX/TNT
Dimensions	51 x 290mm (2in x 11.4 in)
Fuze Type	An impact fuze which detonates the fuze booster charge and in turn the high explosive charge.
Use	It had greater range and firepower over hand and rifle grenades, and was used to attack targets behind cover with high explosive rounds.
Identification	HE has a rounded edge to a flat back. Can either be a black body colour with red and yellow band or dark green with yellow band. Brass cap on top. Practice will have hole all the way through the top.

MARKINGS, BOMB, M.L. 2 INCH. MORTAR.**2 inch Mortar Smoke**

Weight	Approx. 910g (2lb)
Maximum Range	460m (500yards)
Filling	White phosphorus and smoke fill
Dimensions	51 x 290mm (2in x 11.4 in)
Fuze Type	An impact fuze which initiates a bursting charge. This ruptures the mortar bomb's body and disperses the phosphorus filler
Identification	Smoke mortars have a recess and emission holes. May still see light green body paint. Look for stained ground around munition.
Use	As a screening devices for unit movement or to impair enemy field of vision.

**3 inch Mortar High Explosive**

Weight	Approx. 4.5kg (10lb)
Maximum Range	1,460 (Mk1) – 2,560m (Mk2) (1,600 – 2,800yds)
Dimensions	81mm (3in)
Filling	Amatol
Firing Mechanism	Drop, fixed striker
Remarks	Fin-stabilised bomb fired by means of a charge consisting of a primary cartridge in the tail and four secondary cartridges
Identification	An old style mortar. No way of telling if HE or practice so treat as HE

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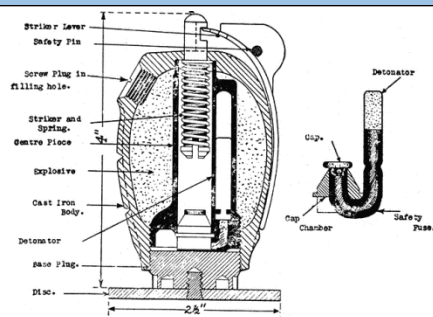
Client: **Ground Conditions Consultants Ltd**Project: **Southleigh Park, Havant**Ref: **DA12228-00**

Source: Various sources

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No. 36 'Mills' Grenade

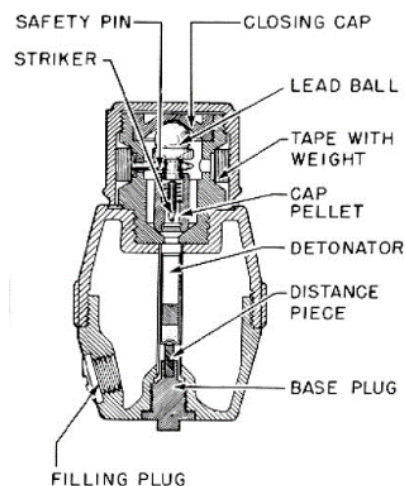
Weight	Approx. 765g filled (1lb 11.25oz)
Explosive Weight	71g (2oz) filling.
Fuze Type	4-7 second delay hand-throwing fuze. No. 6 Detonator
Dimensions	95 x 61mm (4 x 2.4in)
Use	Fragmentation explosive at approx. 30m range 100m range of damage.
Remarks	First introduced in 1915 its classic grooved, cast-iron 'pineapple' design was designed to provide uniform fragmentation. The detonator is inserted before use after removing the base plug.



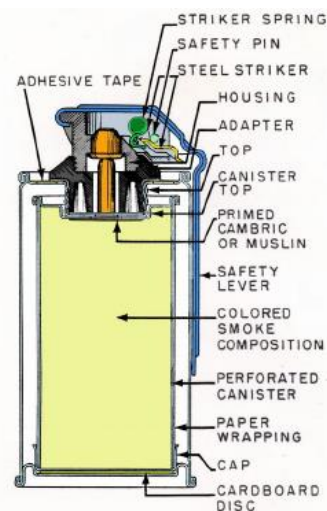
Left: baseplate and detonator removed

No. 69 Grenade

Weight	Approx. 383g (13.5oz)
Fill Weight	93g (3.25 oz) of either Amatol, Baratol or Lyddite
Fuze Type	'All-ways' Fuze. Comprised of a safety cap, a weighted streamer attached to a steel ball bearing and a safety bolt designed to detonate from any point of impact.
Dimensions	115 x 60mm (4.5 x 2.4 in)
Use	A blast grenade for use as an offensive weapon. Detonator was inserted before use.
Remarks	Introduced December 1940 and made from the plastic Bakelite as opposed to conventional metals. Detection is difficult due to this low metal content.

**No. 83 Smoke Grenade**

Weight	Approx. 680g (1.5lb)
Explosive Weight	Approx. 170-200g. (6-7 oz)
Fuze Type	Originally used a friction system using a match head composition. Later developed to a striker lever ignition system.
Dimensions	Approx. 62 x 140mm (2.44 x 5.5 in)
Use	Use as a target or landing zone marking device and as a screening method for troop / unit movement.
Remarks	This basic design stayed relatively unchanged up to the 1980's. The letters CCC were often etched into the body of the grenade in the colour of the smoke.

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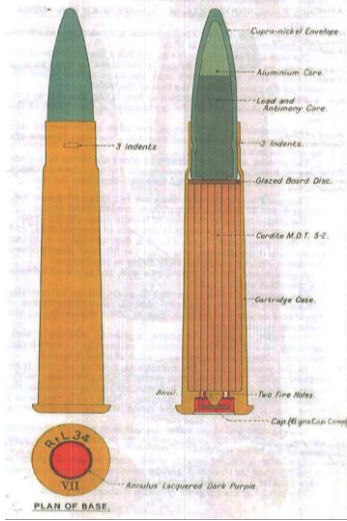
Examples of British Small Arms Ammunition



.303 Rifle

Bullet Diameter	7.92mm
Case length	56.44mm
Overall length	78.11mm
Type	Rifle Ammunition
Propellant	Originally black powder. Later Cordite followed by Nitrocellulose
Remarks	First produced in 1889 and still in use today, the .303inch cartridge has progressed through ten 'marks' which eventually extended to a total of around 26 variations.

Bullet Type	Colour of tip	Colour of Annulus
Armour Piercing	Green	Green
Ball	None	Purple
Incendiary	Blue	Blue
Observing	Black	Black
Proof	None	Yellow
Tracer Short Range	White	Red
Tracer Dark Ignition	Grey	Red
		



Buried and Decayed Ammunition



1ST LINE DEFENCE

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Client: **Ground Conditions Consultants Ltd**

Project: **Southleigh Park, Havant**

Ref: **DA12228-00**

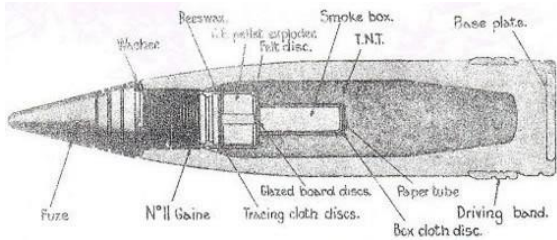
Source: Various sources

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Examples of Anti-Aircraft Projectiles

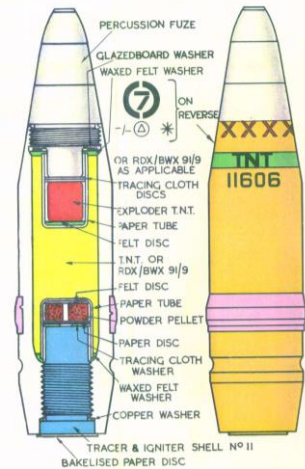
3.7 Inch QF Anti-Aircraft Projectile

Projectile Weight	28lb (12.6 kg)
Explosive Weight	2.52lbs
Fuze Type	Mechanical Time Fuze
Dimensions	3.7in x 14.7in (94mm x 360mm)
Rate of Fire	10 to 20 rounds per minute
Use	The 3.7in AA Mks 1-3 were the standard Heavy Anti-Aircraft guns of the British Army.
Ceiling	30,000ft to 59,000ft



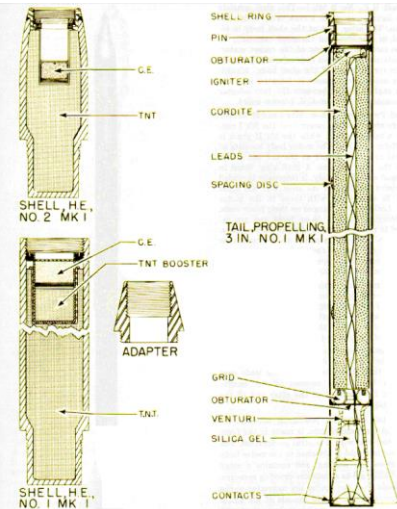
40mm Bofors Projectile

Projectile Weight	1.96lb (0.86kg)
Explosive Weight	300g (0.6lb)
Fuze Type	Impact Fuze
Rate of Fire	120 rounds per minute
Projectile Dimensions	40 x 180mm
Ceiling	23,000ft (7000m)
Remarks	Light quick fire high explosive anti-aircraft projectile. Each projectile fitted with small tracer element. If no target hit, shell would explode when tracer burnt out. Designed to engage aircraft flying below 2,000ft



3in Unrotated Projectile (UP) Anti-Aircraft Rocket ("Z" Battery)

HE Projectile Weight	3.4kg (7.6lb)
Explosive Weight	0.96kg (2.13lb)
Filling	High Explosive – TNT. Fitted with aerial burst fuzing
Dimensions of projectile	236 x 83mm (9.29 x 3.25in)
Remarks	As a short range rocket-firing anti-aircraft weapon developed for the Royal Navy. It was used extensively by British ships during the early days of World War II. The UP was also used in ground-based single and 128-round launchers known as Z Batteries. Shell consists of a steel cylinder reduced in diameter at the base and threaded externally to screw into the shell ring of the rocket motor



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