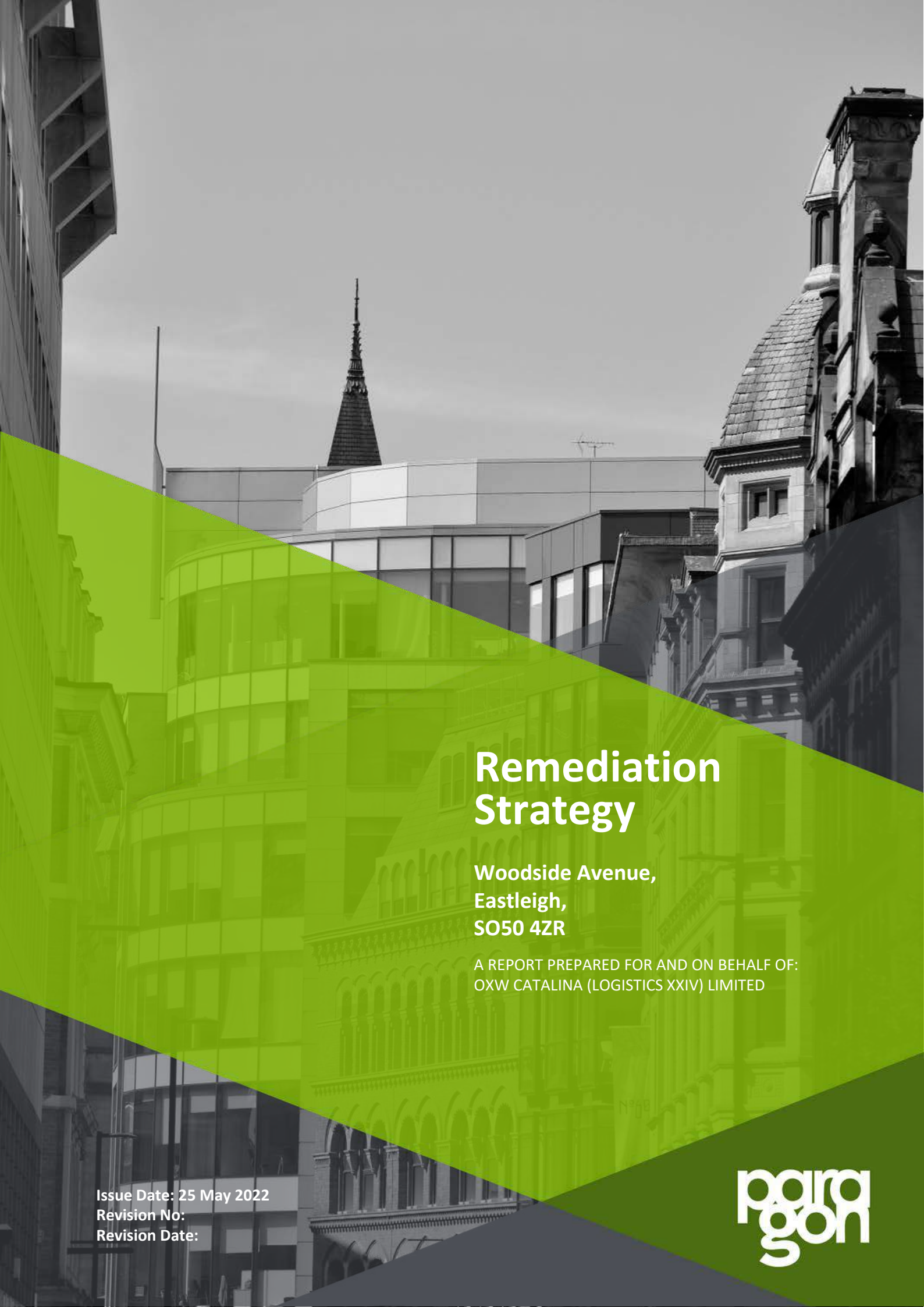




Remediation Strategy

Woodside Avenue,
Eastleigh,
SO50 4ZR

A REPORT PREPARED FOR AND ON BEHALF OF:
OXW CATALINA (LOGISTICS XXIV) LIMITED

Issue Date: 25 May 2022
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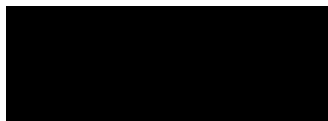
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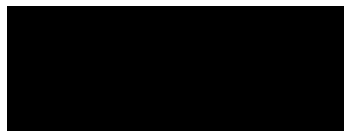
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For and on behalf of
Paragon Building Consultancy Limited

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REMEDIATION STRATEGY

CLIENT NAME: OXW CATALINA (LOGISTICS XXIV) LIMITED

PROPERTY ADDRESS: Woodside Avenue,
Eastleigh,
SO50 4ZR

INSPECTION DATE: N/A



1.0 INSTRUCTION AND SCOPE OF WORKS

- | | |
|-----|---|
| 1.1 | Paragon Building Consultancy Limited were instructed by OXW CATALINA (LOGISTICS XXIV) LIMITED to prepare a Remediation Strategy for a site referred to as Woodside Avenue, Eastleigh, SO50 4ZR. The Remediation Strategy has been completed in connection with redevelopment of the site. |
| 1.2 | This report has been prepared to support the discharge of Planning Condition 6 of application: F/21/91183. This report should be submitted to the Local Authority. |

2.0 INTRODUCTION

- | | |
|-------|---|
| 2.1 | Site Location and Description |
| 2.1.1 | The site is located off Woodside Avenue in Eastleigh, Southampton and is centred around National Grid Reference 444608, 119741. The site is approximately 1.6 hectares in size and a site location plan is provided in Appendix 1. |
| 2.1.2 | The site is located within a commercial and industrial area and the property is surrounded on all sides by buildings of this type. There is a railway line immediately adjacent to the south and Woodside Avenue is immediately east of the site. |
| 2.2 | Proposed Development |
| 2.2.1 | The client is proposing to demolish the existing structures on the site and redevelop the plot with commercial / light industrial warehousing. The development proposal is presented in Figure 2, Appendix 1. |

2.3	Planning Conditions
2.3.1	The proposed development was granted by the Local Authority on 4 February 2022 under Planning Application Reference: F/21/91183. A number of planning conditions were stipulated in the decision notice, including the following, which are relevant to this report:
2.3.2	Condition 4: Prior to the removal of the fuel tanks on the site, a method statement setting out how the tanks will be removed from the site and how the land beneath the tanks will be investigated for contaminants shall be submitted to and approved in writing by the Local Planning Authority. The removal of the fuel tanks and site investigation works in this area shall be then undertaken in accordance with the approved details and a report documenting the ground conditions and results of the site investigation shall then be submitted to and approved in writing by the Local Planning Authority prior to any further development works (excluding demolition works) being undertaken on site. Reason: To ensure that the development does not contribute to or is not put at unacceptable risk from contamination.
2.3.3	Condition 5: No work shall commence on site (other than demolition, excluding the removal of the fuel tanks unless otherwise approved by Condition 4) until a detailed site-specific scheme for remedial works and measures to be undertaken to avoid the risk from contaminants and/or gases when the site is developed and proposals for future maintenance and monitoring, has been submitted to and approved in writing by the Local Planning Authority. Such a scheme shall include nomination of a competent person to oversee the implementation of the works. Reason: To ensure that the development does not contribute to or is not put at unacceptable risk from contamination.
2.3.4	Condition 6: The development hereby permitted shall not be occupied/brought into use until there has been submitted to the Local Planning Authority (LPA) verification by the competent person approved under the provisions of condition 5 that any remediation scheme required and approved under the provisions of condition 5 has been implemented fully in accordance with the approved details (unless varied with the written permission of the LPA in advance of implementation). Unless agreed in writing with the LPA such verification shall comply with UK Land contamination risk management (LCRM) and the guidance contained in EA Guidance for the Safe Development of Housing on Land Affected by Contamination - R&D Publication 66: 2008. Typically such a report would comprise: a. A description of the site and its background, and summary of relevant site information; b. A description of the remediation objectives and remedial works carried out; c. Verification data, including - data (sample locations/analytical results, as built drawings of the implemented scheme, photographs of the remediation works in progress, etc., and d. Certificates demonstrating that imported and / or material left in situ is free from contamination, gas / vapour membranes have been installed correctly.
2.3.5	Thereafter the scheme shall be monitored and maintained in accordance with the scheme approved under condition 5. Reason: To ensure that the site does not pose any further risk to human health by demonstrating that the requirements of the approved verification plan have been met and that remediation of the site is complete.

2.3.6	Condition 7: In the event that any evidence of potential contamination is found at any time when carrying out the approved development that was not previously identified in the approved Phase 2 report, it must be reported in writing immediately to the Local Planning Authority. An investigation and risk assessment must then be undertaken in accordance with a methodology previously approved by the Local Planning Authority. Following completion of the measures identified in the approved remediation scheme, a verification report must be prepared, which is subject to the approval in writing of the Local Planning Authority in accordance with the immediately above condition. Reason: To ensure that the development is not put at unacceptable risk from, or adversely affected by, unacceptable levels of pollution from previously unidentified contamination sources.
2.4	Previous Reports
2.4.1	Paragon previously completed a Combined Phase 1 and Phase 2 Environmental Risk Assessment and Ground Investigation Report, dated 3 June 2021, reference: 21,0084/CB/ED. The information presented in this report is a summary of that report.

3.0 BACKGROUND INFORMATION

3.1	Background
3.1.1	The following information is summarised from the original Phase 1 and 2 assessment listed above. The full document should be read in conjunction with this report.
3.2	General Description and Current Site Use
3.2.1	The site is currently vacant, however it was previously occupied by Lambert Brothers Haulage who operated a haulage company. The operations onsite included storage and distribution of goods, office accommodation, Heavy Goods Vehicle (HGV) lorry movements, refuelling activities and maintenance / workshops.
3.2.2	At the time of the inspection there were several Above-ground Storage Tanks (ASTs) at the site. The largest was a 52,383 litre diesel AST for HGV refuelling. The AST was understood to be double skinned and formed of steel with an integral bund. Whilst there is no automated leak detection, the pipes and gauges are understood to be checked daily. It should be noted that pipework does run underground between the tank and the fuel pumps.
3.2.3	The second largest tank is a 35,000 litre diesel AST of steel construction. It was not known whether the tank is double or single skinned. There is a fuel delivery hose attached to the tank and the pipework is above ground. It is understood from the site representative that the hose and delivery pump were relocated from one side to another of the AST because lorries kept driving over the hose and dislodging it. The other ASTs on site are smaller capacity waste oil tanks and so on associated with the workshop / vehicle maintenance activities referred to above.
3.2.4	There are also smaller drums and volumes of substances such as paints and lubricating oils in the area of the workshops. There are also oil-powered heaters, a heating oil tank and a small diesel-powered generator.

3.2.5 The tenant provided the following details on the tanks:

Location	Installation	Capacity	Tank contents	Tank construction	Overspill secondary containment	Tank leak detection system
Main site (Tank 1)	Not known	52,383 litres	Road Diesel	Steel double skin construction bund integral.	No	Visual
Palletline yard (Tank 2)	Not known	35,000 litres	Road Diesel	Steel	No	Visual
Main site Fork lift tank	Not Known	2,500 litres	Red Diesel (gas oil)	Plastic-composite double skin integral bund.	Yes, external concrete bund wall to full height.	Visual
Workshop	Not Known	1,225 litres	Red Diesel (gas oil)	Plastic-composite integral bund.	No	Visual

Table 1. On site tank details

3.2.6 No obvious evidence or equipment was noted on the surface that indicates the presence of any Underground Storage Tanks (USTs). Furthermore, the site representatives have not revealed such storage tanks to be present.

3.3 Historical Land Use

3.3.1 Paragon completed a review of historical map records from 1868 to the date of the report. Mapping dated 1868 indicated that the site was undeveloped land adjacent to an off-site railway. Despite some slight layout changes, the sites remained relatively unchanged until the 1960s when the site was developed for industrial use. Specifically, there was a structural metal works, joinery works and substation on site. By the late 1970s onwards, the industrial / commercial properties on the site changed layout slightly, with additional buildings being added over time; they were recorded as warehouses and depots and were representative of the current site layout.

3.3.2 The off-site historical land uses included an engineering works, a sheet metal works, a paper warehouse and other works / warehouses. These land uses were developed from a similar period as the industrial buildings on the subject site.

3.4 Geology

3.4.1 A review of the British Geological Survey (BGS) mapping indicates that the site is underlain by Made Ground over River Terrace Deposits. The River Terrace Deposits are underlain by the Wittering Formation.

3.4.2 Following the earlier phase of intrusive investigation across the site, the geological sequence can be summarised as hardstanding over Made Ground to a maximum depth of 1.20mbgl, over River Terrace Deposits to 3.70mbgl, over the Wittering Formation to 5.00mbgl, over the London Clay Formation to 10.50mbgl, over the Bagshot Formation at 15.00mbgl where the investigation terminated. A summary of the ground conditions is presented in Table 2.

3.4.3

Depth From (min/max) (mbgl)	Depth To (min/max) (mbgl)	Soil Type	Description
GL [15.97]	0.10 – 0.30 [15.87 – 15.67]	Hardstanding	Concrete / Brick Paving
0.10 – 0.30 [15.87 – 15.67]	0.20 – 0.50 [15.77 – 15.47]	Made Ground	Made Ground. Red and brown clayey GRAVEL. Gravel is angular to subangular fine to coarse roadstone, brick and flint. [Sub-Base]
0.35 – 0.50 [15.62 – 15.47]	0.70 – 1.10 [15.27 – 14.87]	Made Ground	Made Ground. Soft to firm grey and brown gravelly CLAY. Gravel is angular, fine brick and flint.
0.70 – 1.00 [15.27 – 14.97]	1.10 – 1.20 [14.87 – 14.77]	Made Ground	Made Ground. Soft to firm, brown CLAY, with occasional gravel and rare roots. Gravel is angular, fine brick and flint. [Suspected Reworked Natural Deposits]
1.00 – 1.20 [14.97 – 14.77]	1.50 – 3.70 [14.47 – 12.27]	Gravel	Medium dense, brown, clayey GRAVEL with occasional cobbles. Cobbles are angular to subangular flint. Gravel is angular to subrounded, fine to coarse flint. [River Terrace Deposits]
3.20 – 3.50 [12.77 – 12.47]	5.00 [10.97]	Clay	Firm to stiff, dark grey, silty CLAY. [Wittering Formation]
3.70 [12.27]	10.50 [5.47]	Clay	Soft to firm, bluish grey, silty CLAY. [London Clay Formation]
10.50 [5.47]	15.00 [0.97]	Sand	Very dense, coarse black SAND with black grains (suspected glauconite). [Bagshot Formation]

Table 2: Ground Conditions**3.5 Hydrogeology**

3.5.1 The River Terrace Deposits and the Wittering Formation are classified by the Environment Agency (EA) as Secondary (A) Aquifers. There are no groundwater abstractions within a 1km radius and the site is not located within a Source Protection Zone.

3.6 Hydrology

3.6.1 There are no surface water features within the vicinity of the site. However, there is a culverted water feature circa 10m to the northwest of the site.

3.6.2 There are no surface water abstractions within a 1km radius of the site.

3.7 Regulatory Enquiries

3.7.1 The Contaminated Land Officer at Eastleigh Council has provided comment on the previous report and confirmed that the assessment is sufficient and noted the Contaminated Land planning conditions listed earlier in this report.

3.7.2 The EA was consulted as part of the planning submission. No comments were made by the EA relating to Land Contamination and Controlled Waters.

3.8	Ground Investigation Results
3.8.1	A Geoenvironmental Risk Assessment was carried out on the chemical laboratory test data and a revised Conceptual Site Model was presented. Chemical test data found that the concentrations of the majority of contaminants tested within the Made Ground and natural soil were below the Generic Assessment Criteria (GAC) for a commercial land use. As such, the risk to human health is considered to be low to moderate. However, a single asbestos cement fragment was identified within the Made Ground of a borehole situated within the building.
3.8.2	The groundwater analysis identified marginal exceedances of heavy metals (cadmium, copper and zinc). However, the remaining contaminants were below the Environmental Quality Standard (EQS) or below the limit of detection. The results were compared to the EQS as a conservative assessment. This is because there are no surface water features within the vicinity of the site. In addition, the nearest inland surface water feature is culverted thus reducing the potential for migration to this receptor. Furthermore, there are no groundwater abstractions within the vicinity of the site and the site is not situated within a Source Protection Zone, as such, the risk to Controlled Waters is considered to be low.
3.8.3	Three rounds of gas monitoring were completed as part of the ground investigation over a range of atmospheric pressures (1010mb to 1031mb). The results identified a moderate concentration of carbon dioxide (15.2%v/v), and the concentration of methane was below the limit of detection. Based on a preliminary assessment using BS 8485:2015+A1:2019 ' <i>Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings</i> ', the site falls within Characteristic Situation 2 (CS2), whereby gas protection measures are likely to be required.
3.9	Limitations of Previous Work
3.9.1	The ground investigation was completed whilst the site was still occupied by a storage and distribution company. There were frequent and numerous HGV and forklift movements all around the site throughout the day meaning that there were a limited number of locations where boreholes could be set up and completed safely.
3.9.2	A representative spread of exploratory locations was completed across the site. However, there are several areas below buildings and structures that were not investigated. One window sample location was completed internally (WS05). However, during hand digging of the starter pit a solid concrete obstruction was encountered. Upon further assessment, this appeared to be in line with a surface drain, which appeared to possibly run under the building. Furthermore, in the base of the pit a solid piece of suspect ACM was observed and so the position was terminated.
3.9.3	WS02 also had to be terminated at shallow depth due to concerns over drainage. During the hand excavation of the starter pit, pea shingle was observed and water with an oily sheen came into the excavation. No pipe had been struck but there was a solid obstruction below and so it seemed possible that this could be an old drainage feature. The tenant indicated that if old drains collapsed from HGV movements, they would often get infilled with concrete historically. Whilst this information is anecdotal, it may mean that there are other obstructions around the site that may be encountered during groundworks of the development. As the site is still operational, a cautious approach to services had to be adopted.

3.9.4	Window sampling would have ideally been completed closer to the tanks in particular the two largest ones. However, there were restrictions with utilities and access. There were frequent HGV movements around the refuelling area and it was not possible to get very close to the pump island in the south east of the site. Additionally, the risk of sparks from metal equipment was a consideration. Furthermore, no clear information on the location of underground pipes was provided and so the positions were placed a safe distance from the tank. There were residual spills on the surface near to damaged brick pavements and so the potential for residual impacts, closer to the tank, that have not been directly investigated cannot be discounted. WS06 is the closest position.
3.9.5	It was not possible to drill close to the AST with refuelling pump attached, in the central area of the site, because it is positioned on a main access route for HGVs, which is quite narrow. As such, it was not safe to drill near to the tank. The closest position was WS04.
3.10	Conclusions and Recommendations from the Ground Investigation
3.10.1	No significant levels of contamination were identified within soil and groundwater and therefore no significant remediation is required. However, due to the presence of Made Ground and ASTs onsite, the removal of the ASTs and placement of imported topsoil would be required. Furthermore, there is the potential for contamination to exist beneath the tanks.
3.10.2	In areas of soft landscaping, a suitable growth medium is recommended. As such topsoil and subsoil should be imported with a minimum thickness of 150mm and should meet the requirements of BS3882, Specification for topsoil. The supplier should provide a test certificate to confirm the composition prior to purchase. It is then recommended to test the soils once they arrive onsite to ensure they meet the requirements for a commercial land use based on S4ULs and C4SLs.
3.10.3	The onsite ASTs will require emptying, degassing and removal as part of the proposed development. Additionally, associated below ground pipework and refuelling pumps will need to be removed. Recommendations included a watching brief to assess the localised tank / refuelling areas for hydrocarbon impacts. If impacts (identified by staining or odours) are observed, a suitably qualified Environmental Consultant will need to be contacted to test the area and establish a suitable management approach.
3.10.4	From a preliminary risk assessment of the results to thresholds set in the UK Water Industry Research (2010) <i>'Guidance for the selection of water supply pipes to be used in brownfield sites'</i> , it is possible that barrier water pipes may be required for drinking water supply pipework. The exceedances were identified for TPH C10-16 and TPH C16-40 within samples WS01, WS02 and WS06. However, the majority of samples passed, therefore it may be possible to discuss the findings with the local water provider to discuss their requirements.

4.0 REMEDIATION STRATEGY

4.1	Proposed Strategy
4.1.1	The following measures have been selected to offer the most cost effective and sustainable remediation solution: • Enabling works and demolition of existing structures; • Emptying, degassing and removal of all ASTs and associated pipework; • Removal of sub-surface structures, redundant services and obstructions and preparation of the formation level; • Construction of the new buildings with Gas Protection Measures; • Completion of a discovery strategy throughout the construction works; • Installation of clean cover (subsoil and topsoil) across specific regions of the site; • Validation of clean cover including final topsoil capping; • Preparation of Validation Report.
4.1.2	The objectives of the remediation works are to provide a site that is suitable for the proposed end use. This involves removing the potential risk pathways between contamination beneath the ASTs (if present) and site users, the potential for ground gas to impact site users and the potential for site users to come into contact with Made Ground within areas of soft landscaping.
4.2	Enabling Works
4.2.1	As part of the enabling works the existing buildings and hardstanding will need to be demolished. This phase of works will include the emptying, degassing and removal of ASTs.
4.2.2	The appointed contractor(s) would be required to develop detailed method statements, and management plans with reference to currently available Health and Safety guidelines as set out by the Health and Safety Executive. These plans would define how works would be undertaken but as a minimum it is expected that the following would be considered: • Welfare and decontamination facilities, together with PPE (including that suitable for asbestos in accordance with CAR-SOIL) such as face fitted masks; • Measures to mitigate the potential for generation of dust and nuisance odours such as misting at the site boundary and air monitoring if deemed appropriate by the Main Contractor's risk assessment; • Covering and / damping down of stockpiles; • Regular cleaning of site roads and public highways and covering materials being transported off site to minimise the release of dust and fibres; • Keeping windows and doors to the existing commercial properties closed, as far as is reasonably practicable, during the development; and • Monitoring site security to restrict third-party access into the site.

4.2.3	Paragon has been provided with a Method Statement by the remediation contractor for the removal of the ASTs. This is presented in Appendix 2.
4.2.4	Paragon has previously commissioned a Stage 2 UXO Assessment for the site, which identified a low to moderate risk associated with the development. As such, UXO Safety Awareness Briefings will be required for all site personnel. The UXO report is presented in Appendix 3.
4.3	Discovery Strategy
4.3.1	Based on the results of investigations to date, the likelihood for encountering unforeseen contamination is possible. As such, a watching brief should be maintained by the Main Contractor(s) at all times during groundworks. Care must be taken during excavation works to inspect soils as the site preparation works progress to identify areas of unforeseen contamination. Such contamination would be identified by means of visual and olfactory appraisal by the main contractor(s) in the first instance. For example, this might mean: • Soil or groundwater (if encountered) which appears by eye to have an unusual appearance, such as fibrous materials, Asbestos Containing Materials (ACMs), ash, oil or tar and any unusual discolouration. • Soil or groundwater that presents an odour such as fuel, oil and chemical / solvent type odours or unusual odours such as sweet or rotten egg odours. • Soil or groundwater that, when encountered affects the wellbeing of ground workers, for example reports of personnel feeling light headed, nausea, complaining of stinging eyes or nasal passages and blistering or other forms of skin irritation.
4.3.2	Should areas of unexpected contamination be encountered, an environmental consultant should be informed and the risk associated with the contamination assessed. To address such areas of concern the following methodology is recommended: 1. Stop works in the area immediately, note the location and cordon off the area if safe to do so. 2. Notify a suitably qualified environmental consultant who will attend site (if not already present) within a reasonable timeframe to sample the identified area. 3. Notify statutory regulators, if required. 4. In order to allow works to progress, an environmental consultant will supervise the excavation of contaminated material, which should be placed in a dedicated bunded area and covered to prevent rainwater infiltration from spreading the contamination. 5. Excavations should be progressed outwards from the obviously impacted (discoloured / odorous) material until no further evidence of impact is observed. Soil samples will be obtained by a suitably qualified environmental consultant from both the excavated material and the soils in the sides and base of the excavation to demonstrate that the full area of contamination has been excavated. If appropriate, in-situ testing can be undertaken for verification purposes also, for example for asbestos fibres which cannot be seen by eye. Soil sampling of asbestos will subsequently be carried out using a Hand Auger to obtain a sample of the soil, in concentric circles around known areas of impact, which will be submitted for asbestos identification and quantification by an independently accredited soils testing laboratory. 6. Contamination testing will be scheduled that is commensurate with the visual / olfactory observations made about the possible type of contamination encountered at the time. However, as a minimum a suite of contamination (heavy metals, asbestos, TPH CWG, speciated PAH, pH, SOM) will be completed on all samples.

4.3.3	Upon receipt of the chemical test results, the soils can be dealt with accordingly i.e. treatment, disposal or re-use.
4.3.4	Records, photographs and chemical test certificates will need to be maintained for inclusion into a verification report. The Main Contractor should provide their daily records / log books for the watching brief.
4.4	Asbestos in Soil
4.4.1	As part of the investigations completed to date, Asbestos has been identified in one location onsite.
4.4.2	The protection of workers from exposure to asbestos is regulated by the Control of Asbestos Regulations (HSE, 2012). As such, appropriate Risk Assessments and Method Statements should be put in place to ensure the risks are minimised. This should include, but not be limited to, Personal Protective Equipment (PPE) and Respiratory Protective Equipment (RPE) (depending on the outcome of the Main Contractor's risk assessments), segregation of stockpiles, dust suppression by damping down stockpiles, and / or covering stockpiles with sheeting.
4.4.3	The appointed contractor(s) would be responsible for producing detailed method statements and a management plan based upon the presence of asbestos. They would also be responsible for notifying the Health and Safety Executive and obtaining relevant licenses to undertake any notifiable works, if required.
4.4.4	Details of the controls put in place should be provided by the Main Contractor for inclusion into a final verification report.
4.5	Waste Management
4.5.1	Whilst a waste assessment has not been completed as part of the ground investigation, the chemical analysis completed indicated that the natural soils are likely to be classified as inert and the Made Ground is likely to be classified as non-hazardous, with the exception of the Made Ground in WS05, which would be classified as hazardous due to the visible asbestos fragment.
4.5.2	The Main Contractor should provide the borehole logs and chemical data to a waste receiver to confirm an acceptable end point for disposal of surplus materials. Re-use of materials on site is possible, however this may require further assessment to establish what is to be reused. WAC testing may also be required as part of the ongoing works depending on the nature of materials to be removed and disposed from site.
4.5.3	It should be noted that the Hazardous Waste (England and Wales) Regulations 2005 requires that any waste having an asbestos (ACM) content greater than 0.1% by weight/weight be classified as hazardous waste. Waste with an asbestos content of less than 0.1% w/w can be classified as non-hazardous waste, unless there are other contaminants present which would make the waste hazardous.
4.5.4	It is the waste producer's responsibility to classify and appropriately manage waste under duty of care (section 34 of the Environmental Protection Act 1990) and the Waste Framework Directive 2014. All waste tickets should be maintained for inclusion into final verification report.

4.6	During Construction
	Gas Mitigation Measures
4.6.1	The ground investigation identified that the site falls within CS2. As such, gas protection measures are required as part of the construction of the buildings. At this stage it is considered that the installation of a gas resistant membrane would be sufficient. This is based on elevated carbon dioxide levels and an evaluation against BS8485:2015+A1:2019.
4.6.2	Based on an industrial building type (Type D) and a conservative CS score of 2, the total number of points required in line with BS8485:2015+A1:2019 would be 1.5. A potential measure to meet this score could involve installing a gas membrane that meets the following criteria: 1. Sufficiently impervious to the gases with a methane gas transmission rate <40.0 ml/day/m²/atm (average) for sheet and joints (tested in accordance with BS ISO 15105-1 manometric method); 2. Sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions; 3. Sufficiently strong to withstand in-service stresses e.g. settlement if placed below a floor slab); 4. Sufficiently strong to withstand the installation process and following trades until covered (e.g. penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, dropping tools, etc); and 5. Capable, after installation, of providing a complete barrier to the entry of the relevant gas; and Verified in accordance with CIRIA C735. Capping Layer
4.6.3	Due to the presence of Made Ground, it is considered that subsoil and topsoil would need to be imported to site for areas of soft landscaping. A thickness of 300mm is considered sufficient. The topsoil is required meet the requirements of BS3882, 'Specification for Topsoil'. It is recommended that the supplier should provide a test certificate of all imported material prior to purchase. It is then recommended to test the soils once they arrive onsite to ensure they meet the requirements for a commercial land use based on S4ULs and C4SLs. The importation criteria are included in Appendix 4.
4.6.4	Once the soil has been approved for importation, it should be subjected to onsite inspection and verification testing. This should be completed by an Environmental Consultant and the test frequency will be as follows: • Topsoil – 1 sample per 100-150m³ (approx. 10 lorry loads) • Subsoil – 1 sample per 150-300m³ (approx. 20 lorry loads)
4.6.5	The source of any imported material and test results should be presented within the verification report.

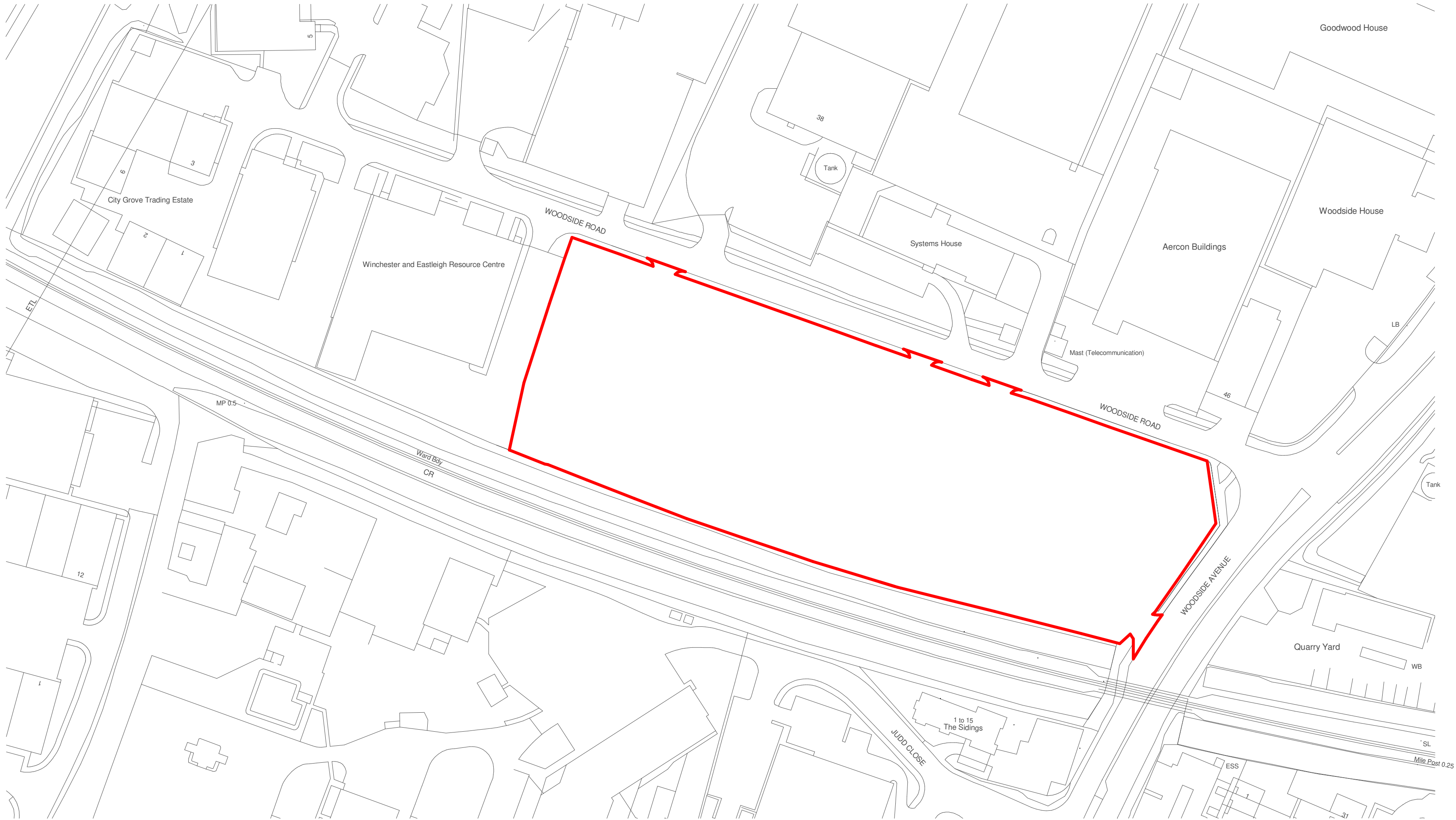
4.6.6	Material Management The potential requirement for imported soils and hardcore to raise levels e.g. 6F2, cannot be discounted at this stage. As such, a Materials Management Plan (MMP) may be required. The source and quality of all imported material will need to be evaluated to ensure contaminated material is not brought to site. The Main Contractor should request chemical test certificates prior to purchase. Additional testing onsite should then be completed when the materials are received. At this stage a frequency of 1 sample per 150-300m³ should be used. Water Supply Pipes 4.6.7 From a preliminary risk assessment of the results of the ground investigation against the thresholds set in the UK Water Industry Research (2010) '<i>Guidance for the selection of water supply pipes to be used in brownfield sites</i>', it is likely that barrier water pipes would be required for drinking water supply pipework. The results of the ground investigation should be provided to the local water provider to discuss their requirements.
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5.0 VERIFICATION STRATEGY

5.1	Verification Strategy 5.1.1 Based on the Stage 3 requirements of Land Contamination: Risk Management (2020), the remediation works require verification to demonstrate that the remediation has worked. The Verification Strategy must make sure that: • Unacceptable risks have been satisfactorily mitigated; • The remedial works do not cause harm to human health or the environment; and • There is an accurate final record of the land quality. 5.1.2 The following strategy sets out the requirements of the Main Contractor in terms of collating information during development and the responsibilities of an environmental consultant in reporting on the findings of third-party verification activities. 5.1.3 Periodic site audits would be required to ensure adequate site records and documentation are being maintained during demolition and construction works. There would need to be regular communication between the environmental consultant and the main contractor(s). The purpose of the verification strategy is to provide a final Verification Report, which provides an accurate record of the final land quality as per the requirements of statutory guidance. The report would seek to demonstrate that remediation is successful in addressing the risks raised by the Conceptual Site Model.
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5.1.4	The purpose of the verification strategy is to obtain essential 'lines of evidence' that remediation has been satisfactorily completed and will involve: • Agreement by regulators to the proposed Remediation Strategy and details of associated permits or exemptions required for the remediation works (if any); • Records from the watching brief and outcomes of any areas of unexpected contamination and the actions undertaken; • Plan showing location of any additional samples obtained if any unforeseen contamination is identified; • Results of any additional chemical / Waste Acceptance Criteria (WAC) testing including details of laboratory quality assurance and accreditation; • Details of material (solid / liquid) disposed off-site including waste classification, details of the receiving site(s) and hauliers and copies of all Duty of Care records; • Records of the installation of the clean capping layers including a layout plan, demonstration of chemical compliance (via review of provenance data prior to importing material and subsequent chemical testing of material on-site), records of the thickness placed and the presence a demarcation layer (including photographs); and • Quantities of materials imported to site and chemical testing results and information on the source of any imported material and plans showing where this material has been used.
5.2	Regulatory
5.2.1	In the first instance, this Remediation Method Statement should be submitted to the Local Planning Authority.
5.2.2	On completion of the above, the verification report would be submitted to the Local Planning Authority for their approval. A copy of the report would need to be retained within the health and safety file for the scheme.

APPENDIX 1: FIGURES



Location Plan
1 : 1000

 Planning application boundary -
1.61Ha / 3.98 Acres



P2: Amended redline up to highway 19.05.2021. JCL
P1: First Issue 27.04.21. PB.

Rev.	Date/Checked
------	--------------

The Old Rectory	Rectory Lane	Milton Malsor
NORTHAMPTON		NN7 3AQ
t: +44 (0)1604 858916	f: +44 (0)1604 859123	
www.peter-haddon.com		



Proposed Logistics / Industrial Development
Oxenwood Real Estate
Woodside Road, Eastleigh South

Location Plan

Status	Planning Issue
--------	----------------

Drawn	PB	Checked	JCL
-------	----	---------	-----

Date	April 2021
------	------------

Project Number:

Project Code	Originator	Zone	Level	Type	Rule	Dwg No.	Revision
SES-	pHp-	XX-	XX-	DR-	A-	4467-	A100 P2

Scale@ A1

0	25m	50m	As indicated
SCALE 1:1000			SCALE 1:1000

Copyright reserved. Dimensions to be checked on site.
Discrepancies to be reported before proceeding.





Proposed Detail Site Plan
1 : 250

External Finishes Legend

- Concrete service yard and parking bays**
Concrete slab on sub-base/capping designed to suit ground conditions to Engineers specification.
- Landscape areas**
Refer to landscape architect's information for details
- Pedestrian Paving**
60mm thick colour: Charcoal concrete block paving will be laid on a 50mm bed of sand, well vibrated, with joints filled with dry wash sand
- Gravel**
To align pedestrian footpaths around perimeter of building where shown. 150mm width. Also aligning RMU and metering cabinets, sprinkler tanks etc.

- New Security Fencing:**
Paladin 2.4m high weldmesh V-mex Fencing to perimeter of service yard & 2.4m high to the outer Northern (Site entrance) perimeter where shown by thick dotted line (as below) and marked 'secure fence line'
Colour: Dark Green RAL 6005
- Planning / Demise boundary**
- Indicative existing soft planting areas**

Drainage Proposals
For drainage details please refer to RPS drawing

External Lighting Proposals
For external lighting levels please refer to CPW drawings

Site and Building Levels
For site levels please refer to RPS Drawing

Structural Columns
All column sizes and locations shown are subject to confirmation by the appointed structural engineer / specialist steel frame sub-contractor and coordination with occupiers internal layout.

BUILDING AREA SCHEDULE

Unit 01 - 13,303sqft (1,234sqm)
Unit 02 - 13,270sqft (1,232sqm)
Unit 03 - 13,277sqft (1,234sqm)
Unit 04 - 14,686sqft (1,363sqm)
Unit 05 - 16,339sqft (1,518sqm)

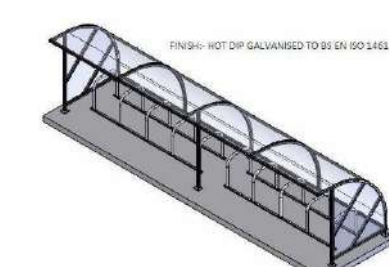
Total - 70,875 sqft (6,581sqm)

Ring Main Unit (RMU)
GRP enclosure for incoming electrical services
Frame Colour: RAL dark green 14-C-39

Dimensions (upto):
Width: 4000 mm
Depth: 4000 mm
Height: 2400 mm
Area: 16sqm



Pedestrian footpaths
Concrete block paving to pedestrian footpaths within site boundary
Colour: Charcoal

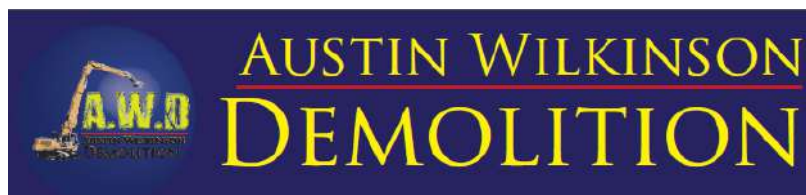


Cycle Shelter:
Cycle shelter and cycle hoops.
Frame Colour: PPC finish. Colour RAL 7016



Rev.	11.05.2021	JCL
P3:	Total unit area amended	29.04.21
P2:	Unit 04 footprint increased / Unit 5 revised site area.	27.04.21
P1:	First Issue	PB
Rev.	Date	Checked
The Old Rectory	Rectory Lane	Milton Watton
NORTHAMPTON	N 7 7 3 A Q	
T: +44 (0)1604 859916	F: +44 (0)1604 859123	
www.peter-haddon.com		
Proposed Logistics / Industrial Development		
Oxenwood Real Estate		
Woodside Road, Eastleigh South		
Proposed Detail Site Plan		
Status	Planning Issue	JCL
Drawn	PB	Checked
Date	April 2021	
Project Number:	SES- pHp- XX- XX- DR- A- 4467- A102	P3
Scale @ A0	1:250	As indicated
Copyright reserved. Dimensions to be checked on site. Discrepancies to be reported before proceeding.		

APPENDIX 2: CONTRACTOR INFORMATION



Demolition Method Statement

Client:

Oxenwood Real Estate LLP.

Site:

Former Lambert Bros Depot, Eastleigh, Southampton, SO50 4RZ.

Scope:

Tank Removal

Document Ref: AWD MS/3183 - 01 Rev.0

Revision	Prepared By:	Date Prepared	Reviewed By:
0	Austin Wilkinson	13/12/2021	Tom Sloyan
1			
2			
3			

I confirm that I have read, understood and agreed the contents of this Method Statement

Revision	Signed Contracts manager	Date	Signed Site Manager	Date
0				
1				
2				
3				

DOCUMENT CONTROL & HISTORY

No changes are allowed without permission from the Contracts Manager.

Minor amendments allowed are to be recorded below and detailed against the amended description / diagram, such changes include re-positioning of welfare due to a change in circumstances.

Major changes required will result in the preparation of a revised RAMS which will be recorded below, such changes include changes in demolition methods and additional works.

Details of amendments are to be communicated to all employees and others affected by our works.

	SUMMARY OF MINOR SITE MADE AMENDMENTS (BY SUPERVISOR)			
	Ref.	Date	Details	By
	A			

	SUMMARY OF MAJOR REVISIONS (ISSUE OF NEW RAMS)			
	Ref.	Date	Details	By
	1			

CONTENTS

- 1.0 Introduction**
- 2.0 Scope of Works**
- 3.0 Project Duration**
- 4.0 Key Personnel**
- 5.0 Sequence & Method**
- 6.0 Competency of Those Involved**
- 7.0 Plant, Equipment & Information Provision**
- 8.0 General Arrangements**
- 9.0 Emergency Procedures**
- 10.0 Environmental Impacts**
- 11.0 Document Approval, Review and Briefing**
- 12.0 Monitoring & Review of Work**
- 13.0 Appendices**
 - A Risk Assessment
 - B RAMS Briefing Form
 - C Machinery Safe Working Zones
 - D Photographs
 - E Site Plans

1.0 INTRODUCTION

This document details the methodology for removal of the over ground tanks at the former Lambert Bros Haulage Depot.

In this instance we are acting as Principal Contractor in accordance with the CDM Regulations 2015. A separate Construction Phase Health & Safety Plan will supplement this document to ensure our compliance with the regulations.

Further in-depth standard procedures are detailed within our Health & Safety Policy and Safe Systems of Work which are referenced to.

2.0 SCOPE OF THE WORKS

The works involves full removal of two over ground tanks off site.

3.0 PROJECT DURATION

Project lead-in period: 1 Week
Start Date: 13th December 2021
Expected Finish Date: 17th August 2021
Max Personnel: 8
Sub-contractors: N/A
Site Hours: 7.30am -5.00pm

4.0 KEY PERSONNEL

AWD Contracts Manager: Tom Sloyan
AWD Site Supervisor: Melvyn Hall
Client Contact: Simon Hobson
Client Supervisor: Simon Hobson
Principal Designer: N/A

5.0 METHOD

Sequence of activities

1. Lift Tanks on to awaiting trailers (AWD)

Pre-task

Upon arrival to site all operatives are to sign in/out of the site register and are to attend site induction including familiarisation with emergency procedures and results of the asbestos survey etc.

All operatives are to be inducted into the method statement and risk assessments accordingly by the site manager / their nominee. Only when they fully understand the scope of works will they be required to sign the document prior to commencing any works.

All AWD Ltd personnel will be given a detailed briefing on the sequence and methodology of the deconstruction of the works and a briefing record kept as per Appendix B.

As per SSOW 21 & 23, the following PPE & RPE which is to conform to current British Standards is required on this contract. Some is mandatory and other is to be worn at appropriate times as per RA:

Lifting Operations:

The removal of two above ground, bunded tanks. The tanks will be removed using AW Demolition's two machines that are currently on site, ranging from 45ton and 30ton in weight. The tanks are to be checked and proved empty, with a dry weight of 7tons. Both tanks have lifting eyes, one in each corner. When machines are in position, with certified chains, both machines will lift one tank at a time, lifting from either end equally to a height where the flat bed trailer can reverse underneath safely with a banks-men in position at all times. When the trailer is in position, the tanks in turn will be lowered equally on to the flat bed trailer, where they can be safely secured to the trailer by the person responsible for the trailer and its load. During and at the end of the task, the tanks will be inspected for any type of leaks. During our site visit, on visual inspection, the tanks and the surrounding area shown no sign of leaks or contamination anywhere.



Appendix A

Demolition Risk Assessment

Risk ratings from potential hazards are calculated on the 'likelihood of occurrence' multiplied by the 'severity of outcome', both rated out of 5 (5 being likely and the worst outcome) as shown below:

	LIKELIHOOD		SEVERITY
1	Very Unlikely	1	Minor injury, no lost time, no damage
2	Unlikely	2	Minor injury, less than or equal to 3 days lost time, minor damage
3	Likely	3	Reportable Injury, 3 days+ lost time, temporary disruptions to operations
4	Very Likely	4	Major Injury, damage, theft
5	Certain	5	Fatality, major damage, industry disruption

The overall risk will be calculated out of 25 as shown below:

		Likelihood				
		1	2	3	4	5
Severity	1	1	2	3	4	5
	2	2	4	6	8	10
	3	3	6	9	12	15
	4	4	8	12	16	20
	5	5	10	15	20	25

Control measures will be implemented to prevent or reduce the potential outcome as far as reasonably practicable and the residual risk will be reassessed accordingly.

Item	Activity	Hazards Identified	Risk Rating			Control Measures	Residual Risk			Persons @ Risk	Monitoring Responsibility
			S	L	RR		S	L	RR		
1.	Deconstruction of buildings	Public interface & Unauthorised entry into works area Trespass	4	2	8	- See SSOW33 - Demolition site fenced / hoarded off by the client - Heras fenced exclusion zone within the site hoarding to be securely fenced off and safety signage to be established, secured and maintained throughout duration of works - AWD Banksman to maintain, monitor and marshal the demolition exclusion zone to ensure there is no unauthorised access. - A Gateman is to be in attendance to control access onto the site. - The access points are to be secured when there are no vehicular movement or left unattended. - Site vehicles to check for pedestrians and traffic before driving out of and on to site. - All operatives to be vigilant for members of the public and third parties at all times - Supervisors to coordinate works with other trades in the area if any. - No reversing movements without a Banksman.	4	1	4	Demolition Operatives General Public	AWD Supervision
2.	Access to work Areas	Slips, Trips & Falls	3	3	9	- Segregated access and egress routes to be clearly marked and signed on site - All operatives to be briefed on & use of designated access & egress routes that are clearly marked and defined - Maintain good levels of housekeeping at all times. - Keep designated access routes clear at all times. - Excavations to be suitably protected and signposted - Areas to be suitably lit	3	1	3	All site Operatives	AWD Supervision

Item	Activity	Hazards Identified	Risk Rating			Control Measures	Residual Risk			Persons @ Risk	Monitoring Responsibility
			S	L	RR		S	L	RR		
3.	Site Traffic Management	Operatives being struck by vehicles using vehicle routes and access/egress from works area.	4	2	8	• See SSOW33 • Ensure vehicle routes and site access and egress are clearly defined and maintained • Site supervisors to monitor • TM Rules to be broadcast and enforced • High visibility clothing to be worn • Operative to attract driver's/operator's attention before approaching vehicles/plant • All reversing vehicles & plant movements to be controlled by a designated Banksman • Where possible pedestrian / vehicle routes to be established and clearly signed posted • Operatives to use pedestrian routes where available • Speed limits to be adhered to	4	1	4	All site Operatives General Public	AWD Supervision – Plant Operators Banksmen
4.	Demolition, Loading etc	Operatives struck by working excavator or similar machine	5	3	15	• All personnel to keep out of demolition zones etc • Where unavoidable operatives to be in contact with machine operator and have adequate communication system	5	1	5	All site operatives	AWD Supervisor

Item	Activity	Hazards Identified	Risk Rating			Control Measures	Residual Risk			Persons @ Risk	Monitoring Responsibility
			S	L	RR		S	L	RR		
5.	General operations throughout the site	Sharps - Stick Injuries - Diseases including, Hepatitis, HIV, AIDS, Radiation Sources, Toxins	5	2	10	- All Operatives to receive instruction and information in the form of a toolbox talk on this subject, due to the possibility of serious / fatal infection from used sharps. - Sharps must not be handled the Site supervisor to Isolate area and summon the AWD sharps remover - Should any person on site be accidentally struck by a needle and it is bleeding they should allow the injury to bleed while washing under water for 10 - 15 mins then report immediately to the Supervisor. - The Supervisor shall then arrange for the person in question to attend a Doctor / Hospital immediately. - The needle should be brought to the casualty / Doctor as it will be required for identification of possible Blood Pathogens etc.	5	1	5	ALL site Operatives	AWD Supervision
6.	Strip out & Demolition	Exposure to Pigeon Guano	4	4	16	- Wear RPE and waterproof type PPE as required - Wet the materials lightly (not power wash) with a detergent type liquid - Wash and maintain high standard of hygiene - Do not eat or drink in local vicinity	4	1	1	Demolition operatives	AWD Supervision
7.	Strip out & Demolition	Exposure to Weils disease / leptospirosis (rat urine)	5	2	10	- Wear RPE and waterproof type PPE as required where rats may be present - Wash cuts & grazes without delay - Wash and maintain high standard of hygiene - Do not eat or drink in local vicinity	5	1	5	Demolition operatives	AWD Supervision

Item	Activity	Hazards Identified	Risk Rating			Control Measures	Residual Risk			Persons @ Risk	Monitoring Responsibility
			S	L	RR		S	L	RR		
8.	Strip out & demolition	Accidental Asbestos Exposure - Inhalation - Ingestion - Penetrate the skin - Penetrate through cuts and scratches	5	2	10	- See SSOW38 - Supervisor to be in possession of survey and clearance paperwork - Areas of known /potential asbestos to be identified before works commence - AWD Operatives are trained in asbestos awareness. - Works to stop and made safe in the event of materials being suspected to contain ACM's that have not previously been identified and recorded in the issued R & D survey - Operatives to emergency decontaminate as per SSOW38. - CS to be informed immediately who will nominate a trained competent person to sample the material - All results to be communicated to AWD site supervision and certificates of analysis to be issued - Exclusion zones to be in place to prevent unauthorised access. - All works to be undertaken in accordance with the Control of Asbestos Regulations 2012 and HSE Guidance Notes.	5	1	5	All Operatives	AWD supervision

Item	Activity	Hazards Identified	Risk Rating			Control Measures	Residual Risk			Persons @ Risk	Monitoring Responsibility
			S	L	RR		S	L	RR		
9.	Strip Out & Demolition – Asbestos Removal Works	Planned Asbestos Exposure - Inhalation - Ingestion - Penetrate the skin - Penetrate through cuts and scratches	5	5	25	- Operatives to be appropriately trained, medical & face fit - Operatives to wear P3 filtered RPE, Type 5 coveralls etc in addition to mandatory PPE - Areas to be segregated to prevent spread prior to commencing - Works to be carried out with minimal fibre disturbance wetting where possible - Operatives to decontaminate and remove PPE & RPE before leaving work area - All works to be carried out in accordance with RAMS, Asbestos Procedures, Training & CAR2012 - Operation to be closely monitored by supervisor - Personnel air monitoring to new employees / techniques to ensure effectiveness of control measures - Waste to be disposed of regularly and in accordance with regulations - Area to be checked for cleanliness by supervisor or analytical company on completion	5	1	5	All Operatives Public	AWD supervision

Item	Activity	Hazards Identified	Risk Rating			Control Measures	Residual Risk			Persons @ Risk	Monitoring Responsibility
			S	L	RR		S	L	RR		
10.	Strip Out & Demolition	Lead Exposure during cutting and burning etc - Inhalation - Ingestion - Penetrate the skin - Penetrate through cuts and scratches	5	3	15	- Unless proven otherwise by means of lead survey, all burning and cutting of painted steels to be assumed as lead containing paint - Operatives to wear appropriately filtered RPE, Type 5 coveralls etc in addition to PPE for cutting, burning etc - Areas to be segregated - Areas to be ventilated appropriately - Localised Extract Ventilation to be introduced where not sufficiently ventilated - Operatives to maintain high levels of hygiene - Burning operatives to be under medical surveillance where works are not sporadic	5	1	5	All Operatives Public	AWD supervision

Item	Activity	Hazards Identified	Risk Rating			Control Measures	Residual Risk			Persons @ Risk	Monitoring Responsibility
			S	L	RR		S	L	RR		
11.	Manual Handling	Personal Injury • Back Strain • Slipped Disc • Hernias • Lacerations • Crushing of hands or fingers • Bruised or broken toes or feet • Various sprains, strains, etc.	3	3	9	• See SSOW13 • Always use mechanical devices wherever possible, • Reduce risk of injury to lowest level reasonably practicable by use of slings, hand grips. • Where the use of a machine is impracticable, sufficient labour must be available to handle any heavy or awkward loads and instructions must be issued to site on the handling of these loads. • All operatives will be given training in the correct methods of handling and lifting loads as part of their normal site safety training. • Maintain High levels of housekeeping at all times • Access & material transfer routes to be kept clear. • Supervisors will ensure that a supply of suitable gloves is available from issue as required for the handling of materials which could cause injuries to the hands. • All lifting devices required are to have correct certification	3	1	3	All site Operatives	AWD Supervision
12.	Strip out & demolition works	Existing Services within building • Personal Injury • Electrocution • Fire –Explosion- Burns • Flooding	4	3	12	• Client to arrange for the disconnection / Isolation of existing services at the entry points into the building prior to any works commencing • Client to provide isolation certificates to AWD	4	1	4	Demolition Operatives	AWD Supervision – Plant Operators Banksmen

Item	Activity	Hazards Identified	Risk Rating			Control Measures	Residual Risk			Persons @ Risk	Monitoring Responsibility
			S	L	RR		S	L	RR		
13.	Demolition works (inch transportation to/from site)	Overhead cables, lines & services - Electrocution thru cable strike - Electrocution through arc when in close proximity - Fire explosion, burns	5	3	15	- See SSOW40 - Isolate and ensure isolation wherever possible - Ensure there is clear, firm and level access beneath for delivery of plant / equipment - Ensure adequate warning measures are in place for passing beneath cables etc on site - Specific RAMS required for work in close proximity / beneath cables	5	1	5	Wagon Drivers Demolition operatives	AWD Supervision – Plant Operators Banksmen
14.	Strip out & demolition	Generation of dust & debris - Inhalation - Irritation to eyes, skin and respiratory system - Nuisance to neighbours etc	4	4	16	- All reasonable measures will be taken to minimise the creation of dust and debris - Wear suitable RPE & glasses - Dust suppression to be used if required. - Assess weather conditions - Tippers to be sheeted - Road sweeper to be called in as and when required	3	2	6	All site personnel General Public	AWD Supervision
15.	Strip out & demolition	Fall from height	5	3	15	- See SSOW29 - Unsecured edges to be protected before and during works as created - Wear necessary fall prevention / arrest equipment as required	5	1	1	All site personnel General Public	AWD Supervision
16.	Strip out & demolition	Minor cuts & bruises	3	4	12	- Use the correct tools for the job - Wear suitable PPE including gloves and eye protection	2	2	4	All site personnel	AWD Supervision

Item	Activity	Hazards Identified	Risk Rating			Control Measures	Residual Risk			Persons @ Risk	Monitoring Responsibility
			S	L	RR		S	L	RR		
17.	Demolition High Noise Activities	Noise High noise levels over a prolonged period of time or very high levels for short durations can lead to Loss of hearing tinnitus [ringing in the ear] Loss of concentration Raised blood pressure.	4	3	12	- See SSOW18 - All plant provided is to be fitted with silencers, mufflers, doors, canopies, etc. And that all equipment and noise reducing doors are used. - Supplies of ear defenders or other hearing protection will be made available on the site or for any operations where it is not practicable to reduce the noise levels to a safe limit. - No unauthorised access to exclusion zone. - Hearing protection to be made available at 80dBA - Hearing protection is mandatory when noise reaches 85dBA - Noise monitoring will be conducted at exclusion zone boundaries - Noise will be limited to acceptable levels at exclusion zone boundaries	4	1	4	Operatives	AWD Supervision
18.	Demolition	Premature / un-controlled collapse	5	4	20	- All works to be conducted in strict accordance with the structural engineers reports and demolition sequence in this method statement - Pre-demolition assessment of structures prior to commencement to determine if site condition have changed - Demarcation zones set up prior to demolition and adequate warning signage in place - Restriction of all non-operational personnel from demolition exclusion zone - Banks's man/ Supervisor to control demarcation zones and also to be in visual / phone radio contact - Do not overload floors etc	5	1	5	All site personnel General Public	AWD Contracts management

Item	Activity	Hazards Identified	Risk Rating			Control Measures	Residual Risk			Persons @ Risk	Monitoring Responsibility
			S	L	RR		S	L	RR		
19.	Demolition, loading & Earthworks	Operating Excavators & Machinery - Overturned machine - Fall into basement etc - Collisions - Machine / attachment failure	5	3	15	- See SSOW 34,35& 41 - Machines to be operated by competent personnel only (CPCS / NPORS) - Wear the seatbelt and any restraint systems fitted at all times - Do not override any safety systems fitted - Machines to be inspected as appropriate and daily by operator - Do not use defective equipment - Machines to maintained appropriately - Machines only to be used for intended use within their limitations - Ensure suitable ground, check for and be vigilant in case of unknown basements, voids, ducts etc - Operator to be aware of surroundings and use banksman where appropriate - Exclusion zones & warning signage	4	1	4	Operator All site personnel General Public	AWD Supervision
20.	Demolition and pulverising of concrete & hardcore materials	Projectiles - Personal injury - Damaged to adjacent properties	5	3	15	- Breaking out will be undertaken by excavators fitted with cab protection - Exclusion zones set up - Operatives to wear PPE - Don not undertakes in windy and storm type conditions	5	2	10	General Public Site personnel	AWD Supervision

Item	Activity	Hazards Identified	Risk Rating			Control Measures	Residual Risk			Persons @ Risk	Monitoring Responsibility
			S	L	RR		S	L	RR		
21.	Demolition / Intrusive Works	Hazardous Materials exposure	4	3	12	• See SSOW04 • Known hazardous materials to be removed by competent personnel prior to works commencing where possible • COSHH assessments to be made available for materials to be used / that may be present during works and made known at induction stage etc • Suitable PPE & RPE to be provided in accordance with COSHH assessments • All Operatives are to be vigilant in their works • AWD Operatives are trained in Asbestos Awareness and Demolition Awareness • If Hazardous materials are suspected or identified all works will be made safe & stopped. Works will not commence until materials are identified and all risk controlled • Hazardous materials to be disposed of accordingly in accordance with current regulations	4	2	8	Demolition Operatives	AWD Supervision

Item	Activity	Hazards Identified	Risk Rating			Control Measures	Residual Risk			Persons @ Risk	Monitoring Responsibility
			S	L	RR		S	L	RR		
22.	Use of abrasive wheels	- Bursting of the wheel or disc causing injuries from flying particles. - Dusts from certain types of materials. - Loose clothing tangled in disc. - Noise. - Fire and explosion.	4	3	12	- See SSOW36 - Hot works permit shall be obtained from AWD Site manager on a daily basis and a suitable fire extinguisher is on hand. - All Operatives are to be trained and competent in the use of abrasive wheels - Equipment to be inspected by a competent person before use. - Defective equipment is to be removed from service - Operative to wear high impact safety goggles, ear defenders & RPE - Safety glasses are not adequate and operatives must have covered arms and legs! - Where necessary, solid fire-retardant screens are to be used to prevent the spread of sparks/projectiles - Dust suppression to be implemented as required.	4	1	4	Operatives	AWD Supervision
23.	Use of breakers and vibrating tools	Hand Arm Vibration Syndrome	4	3	12	- See SSOW10 & Toolbox Talk Nr30 - Follow guidance provided with RAMS on usage and exposure times - Supervisor to monitor and record HAVS exposure and rotate operatives accordingly - High exposure tools such as reciprocating saw to be used as last resort - An on-line HSE reckoner is available in case of doubt - It is recommended that operatives are comfortably warm when carrying out such works therefore gloves etc are recommended	4	1	4	Operatives	AWD Supervision

Item	Activity	Hazards Identified	Risk Rating			Control Measures	Residual Risk			Persons @ Risk	Monitoring Responsibility
			S	L	RR		S	L	RR		
24.	Working @ Height – use of mobile scaffold tower	- Fall of persons working from platform - Falling Debris / Materials Over turning platform	5	3	15	- See SSOW31 - Area around tower to be cordoned off - Towers to be erected, altered, dismantled and inspected daily when in use by competent persons with PASMA (or equivalent) training - Towers to be erected in accordance with manufacturers instruction and best industry practice. - Towers must be erected on suitable and stable ground with outriggers and ties as necessary - Operatives to stay within confines and firmly footed on deck levels - Towers must not be used in lightning or windy conditions	5	1	5	Demolition operatives	AWD Supervision
25.	Working @ Height - operation of MEWP	- Fall of persons working from platform - Falling Debris / Materials - Over turning platform	5	3	15	- See SSOW32 - Operate in accordance with supplier's instruction and good practice as per training (ideally IPAF) - Supervisor to assess competence of new / temporary operatives - Operatives to wear appropriate harness to suit type of MEWP - Approved and certificated safety harness to be worn and clipped to cage by operative at all times whilst. Operative shall not unclip until lowered to ground level. - Boom is dual controlled with emergency descent system. - Demolition operatives to work from above or from the side when removing materials – never below! - Always check that the ground is stable and level and not liable to localised settlement below stabilisers and during location / movement - Cordon off work area - Ensure an emergency rescue plan is in place and practice it before work commences	5	1	5	Demolition operatives	AWD Supervision

Item	Activity	Hazards Identified	Risk Rating			Control Measures	Residual Risk			Persons @ Risk	Monitoring Responsibility
			S	L	RR		S	L	RR		
26.	Working near water	Persons falling into water - Drowning - Hyperthermia - Cold shock	5	3	15	- Signage to be placed along banking / waters' edge - Fencing / barriers to be placed when working near banking's / water - Watcher to be in attendance throughout - Lifejackets, belts etc to be provided as required - Mobile phone required to contact emergency services - Blankets, dry clothing required	5	1	5	General Public Site personnel	AWD Supervision
27.	External Works	UV Irradiation (Sunburn)	4	2	8	- Exposure will be minimal due to the wearing of hard hats and long sleeve garments such as overalls (shorts are not permitted) - In extreme circumstances where shorts etc are allowed then protective sunblock will be provided as appropriate	3	1	3	Site personnel	AWD Supervision

Item	Activity	Hazards Identified	Risk Rating			Control Measures	Residual Risk			Persons @ Risk	Monitoring Responsibility
			S	L	RR		S	L	RR		
28.	Hot Works	- Fire - Explosion - Burns	4	3	12	- See SSOW 39. - Check atmospheres for flammability - A Hot Work Permit is to be issued prior to work starting. All works to be conducted in accordance with Hot Works Permit. - Cut into open ends only, not sealed systems - Hot works to stop 1 hour before end of shift and fire watch to be undertaken. - Only trained, certified & experienced operatives are permitted to carry out work with cutting equipment and burning equipment. - Ensure that all necessary protective clothing, ventilation equipment, respirators or breathing apparatus, fire blankets, extinguishers, comply with the relevant standards are on site prior to cutting or burning. - Ensure that adequate fire precautions and first aid provision have been put in place prior to work commencing. - All equipment to be in good condition. Defective equipment to be removed from service.	4	1	4	Operatives	AWD Supervision
29.	Earthworks	- Disturbing unexploded ordnance - Fire explosion, burns	5	2	10	- Be vigilant – stop works immediately if any suspect items are seen. - Shut down machinery. - Clear the surrounding area of all personnel without delay. - Report to site supervisor for further investigation.	5	1	5	All site personnel	AWD Supervision – Plant Operators Banksmen

Item	Activity	Hazards Identified	Risk Rating			Control Measures	Residual Risk			Persons @ Risk	Monitoring Responsibility
			S	L	RR		S	L	RR		
30.	Earthworks	Underground cables & services - Electrocution thru cable strike - Fire explosion, burns - Flooding	5	2	10	- The location of all services is to be investigated prior to works - Where possible services to be isolated - Live services to indicated at ground level with markers inch safe distance either side - Services to be protected where possible with road plates etc - All to be made known at site induction and daily briefings etc	5	1	5	All site personnel	AWD Supervision – Plant Operators Banksmen
31.	Foundation removal	Falling into deep excavations - Injury - Entrapment - Drowning	5	2	10	- See SSOW29 - Excavations to be signposted and guarded with barriers / battered back to 45° - Backfill at earliest opportunity - No persons to enter excavations unless sufficient supports such as trench boxes in place	5	1	5	All site personnel Public	AWD Supervision
32.	Crushing operations	Lack of Machine Guarding - Fall from Height - Entrapment - Injury	5	4	20	- See SSOW37 - All manufacturer installed guards; rails and protection systems must be securely in place prior to operating the machine. - Under no circumstances should the machine be operated without these guards in place. - The crusher operator is vulnerable to falls from height when climbing to and from the operating platform, or gaining access to the conveyors, and for general maintenance and greasing operations. - Care must be taken when using the ladder access onto the working platform and once on the platform the operator will have a body harness, which is clipped onto a secure part of the structure at all times	5	1	5	Crusher Operator	AWD Supervision

Item	Activity	Hazards Identified	Risk Rating			Control Measures	Residual Risk			Persons @ Risk	Monitoring Responsibility
			S	L	RR		S	L	RR		
33.	Crusher Operation Continued	Injury caused by other working plant – collision between loading equipment and the crusher	5	4	20	• SeeSSOW37 • Ensure that the designated work area for the proposed crushing operation is sufficiently set out to allow adequate space at one end for the loading of the crusher hopper and equally at the other end for the clearing of crushed aggregate from below the discharge belt. • Ensure that the ground conditions are firm enough to support the proposed operation, and to allow the safe level access for loading and removal operations. • Ensure that the crushing operation is being carried out as far away as possible from other on-site activities in order to avoid conflicts between other plant and equipment. • Ensure that material stockpiles at either end of the crusher are not piled so as to obscure the visibility of either the crusher operator; the loading operator, or the machine operator removing the crushed aggregate. • Ensure that all drivers and operatives are fully trained in the use of all Plant & Equipment, and that all such equipment is certified, tested and in good working order.	5	1	5	All Site Operatives Crusher Operator	AWD Supervision

Item	Activity	Hazards Identified	Risk Rating			Control Measures	Residual Risk			Persons @ Risk	Monitoring Responsibility
			S	L	RR		S	L	RR		
34.	Crushing Operations Continued	Clearing Blocked or Stalled Jaws, Moving Parts etc	4	3	12	- See SSOW37 - Prior to removing any blockage or trapped material make sure that THE MACHINE IS STOPPED and that all machine components, which can be 'locked off' are, in order to prevent any 'stored energy' or latent flywheel pressure from causing components to move or material to dislodge and spring free. - Blocked materials should be removed as much as possible using mechanical means and only after all excess materials have been removed, and the machine and components have been isolated, will it then be safe for the crusher operator to enter the crushing chamber to remove and dislodge blocked material by hand, and using bars. - Under NO CIRCUMSTANCES should WEDGES or a 'MOUSE' be used to try and unblock the material, as these can be ejected out of the crushing chamber under pressure and injuring the operator	4	2	8	Crusher Operator	AWD Supervision
35.	Crushing Operations continued	- Slips - Trips - Falls	4	2	8	- See SSOW37 - Ensure that the working platform is free from obstructions and that all guard rails, handrails and access ladders are in position and firmly secured. - Keep the foot well of the working platform clear of any spilt material or loose aggregate - Do not use the working platform as a temporary storage area for foreign bodies and unsuitable materials, which have been hand-picked from the feeding hopper. - Ensure that the access and egress to and from the machine is clear and unobstructed.	4	1	4	Crusher Operator	AWD Supervision

Item	Activity	Hazards Identified	Risk Rating			Control Measures	Residual Risk			Persons @ Risk	Monitoring Responsibility
			S	L	RR		S	L	RR		
36.	Crushing Operations continued	Whole Body Vibration Syndrome	4	4	16	- See SSOW37 - Crusher to be operated remotely wherever possible by operator at ground level - Access on to the crusher platform to be minimal and short duration during operation for periodic inspections as and when necessary	4	1	4	Crusher Operator	AWD Supervision
37.	Storage of fuel Re-fuelling of plant	- Explosion - Fire - Burns - Dermatitis - General Skin Irritation - Ingress into waterways	5	2	10	- See SSOW04 - All refuelling will be carried out in a designated area at least 10 metres away from any known water course - Fuel will be stored in a double bunded fuel tank - Emergency spill kits will be on hand at each refuelling point - Refuelling must take place in a well-ventilated area. - Ensure that there are No Naked Flames in the area - DO NOT SMOKE	5	1	5	All Site Personnel	AWD Supervision – Plant Operators

Assessed By: Austin Wilkinson

Date: 13/12/2021 Austin Wilkinson

Reviewed By: Tom Sloyan

Date: 13/12/2021 Tom Sloyan



Appendix B

Method Statement & Risk Assessment Briefing Form

Project: Lambert Bros Haulage Depot

Company Name: AWD

Activity: Tank Removal

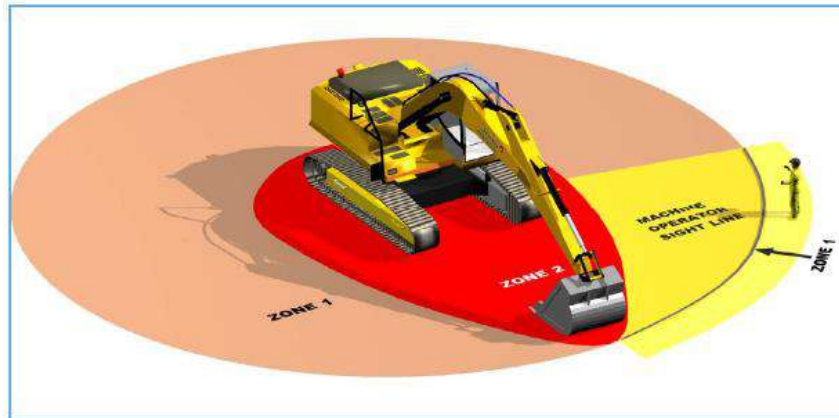
Method Statement Ref No: AWD MS – 3183-01

Revision: 0

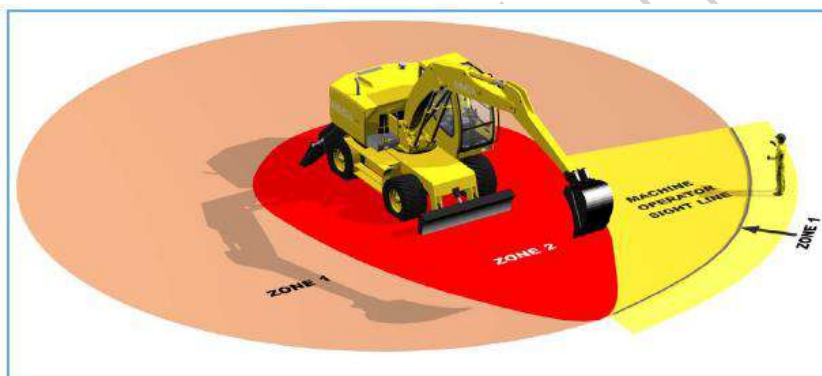
I confirm that I have read / been inducted into these RAMS and made aware of the asbestos survey, I am fully conversant with the scope of works and risks highlighted risks detailed within it, and that I will conform to the methods detailed:

Nos	Name(print)	Employer (print)	Signature*	Date
1				
2				
3				
4				
5				
6				
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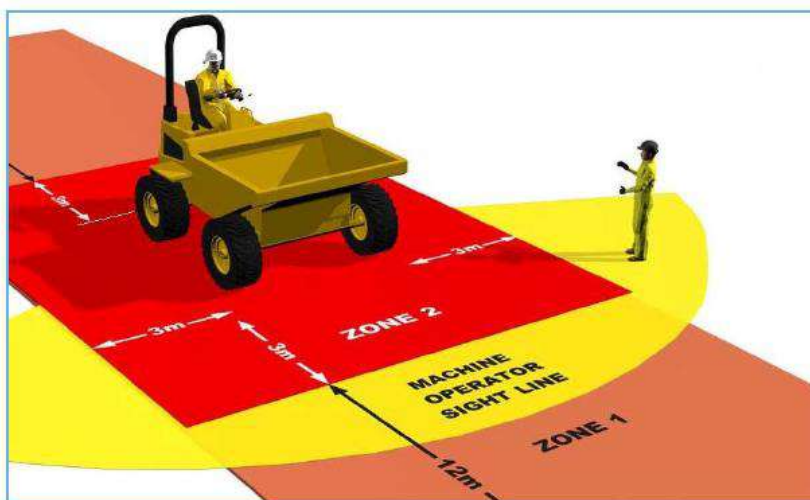
Appendix C



360° tracked excavator



360° wheeled excavator



Forward tipping dumper

APPENDIX 3: STAGE 2 UXO RISK ASSESSMENT



BRIMSTONE
SITE INVESTIGATION

**DETAILED
UXO RISK ASSESSMENT**

INTEGRITY



PROFESSIONALISM



KNOWLEDGE



STAGE 2 DETAILED UXO RISK ASSESSMENT

Client:	Paragon Building Consultancy Limited		
Project Ref:	PARA10R		
Site:	Woodside Road, Eastleigh		
Report Ref:	DRA-20-1191-PARA10R-Woodside Road, Eastleigh		
Revision:	0		
Status:	Final		
Release Date:	31 st July 2020		
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Authorised By:	Aaron Florence	Managing Director	

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D.O.R.	31.07.2021

EXECUTIVE SUMMARY

RESULT: Brimstone Site Investigation concludes that UXO poses a **Low-to-Moderate Risk** to the proposed works.

THE SITE: The Site (centred on the National Grid Ref: SU 44439 19692) is located in Eastleigh (Hampshire), approximately 7km north of Southampton city centre. Situated within the City Grove Industrial Estate, it is bound to the north by Woodside Road, to the east by Woodside Avenue, to the south by a railway line, and to the west by neighbouring commercial property. The Site comprises several warehouse type buildings with adjoining offices. Service yard / forecourt / loading bay areas, as well as car parking make up the remainder of the Site area.

THE PROPOSED WORKS: The proposed redevelopment will see demolition of the existing buildings and construction of five replacement light industrial units with associated offices and yard areas. No details relating to the extent of the required excavations were available at the time of writing.

UXO RISK ASSESSMENT:

German UXO:

- The Site was undeveloped and situated within an agricultural area on the edge of Eastleigh town during WWII. Eastleigh was home to known Luftwaffe bombing targets, however the most significant (and most frequently attacked) were >1km to the south-east of the Site. A secondary target (cable factory >530m from the Site) was attacked at least twice. However, the town was never subjected to a large or even medium scale raid.
- A collection of original written incident reports for the borough was reviewed. The town appears to have experienced a low to moderate bombing density. Between five and nine individual (small scale) raids resulted in bombing incidents within 1km of the Site, however no confirmed bomb strikes within 500m of the Site were identified. The closest confirmed bombing incidents occurred within the cable factory, between 530 and 970m to the south-east of the Site. NB: it is conceivable (although unlikely) that bomb strikes occurred closer to the Site during three further raids, for which precise location details are unavailable.
- Although it is conceivable that an aircraft responsible for one of the more distant bombing incidents flew over the Site, the significant distances between the Site and the bomb strike locations suggests this is unlikely to have occurred. Analysis of the known positions of bomb strikes and two air raid flight path orientations, indicates a low likelihood that a German bomber flew over or immediately adjacent to the Site. Therefore, the likelihood of a UXB release over the Site is very low.
- An aerial photograph of the study area, taken during WWII and after the final raid on the town, does not exhibit any evidence of HE bombing (bomb craters, in-filled crater marks or demolished buildings) in the immediate vicinity.
- The study area was sparsely populated during WWII. This increases the risk that any UXB fall on Site could have occurred unobserved and gone unreported. As an agricultural field, the Site would not have been frequently accessed and any evidence of a UXB could have remained unseen for a significant period of time or could have been overlooked, obscured by crop growth or long grass. However, such a scenario is considered a remote possibility as there is a low likelihood of a UXB actually striking the Site.

British / Allied UXO:

- 14 HAA gun batteries and at least two LAA gun batteries were present within range of the Site during WWII. The Luftwaffe were active over the town and therefore these guns would have expended ammunition. For the same reasons as above, any unexploded AA shell strike to the Site could have easily occurred unobserved and remained undetected, becoming shallow buried in soft ground. NB: five unexploded AA shell strikes were reported and dealt with in the borough during WWII.
- A second potential source of British UXO (Home Guard activity) has been identified in the wider area. However, no specific evidence of military activity within the Site boundary has been found, and as an

agricultural field, it is unlikely that any occurred historically. Consequently, the risk from associated UXO is low.

Likelihood of UXO Remaining and UXO Encounter:

- The risk from very shallow buried UXO (German 1kg / 2kg IBs and British LAA shells, SAA and some LSA) will have been largely mitigated on Site. The risk from shallow buried UXO (HAA shells, some LSA and lighter German 'iron' UXBs) will have been mitigated within the volume of soil excavated during foundation construction. Such UXO could remain in-situ, beneath existing buildings, in between their foundations. The risk from deep buried German UXBs will not have been mitigated to any significant degree.
- The lack of details relating to the proposed intrusive ground works limits the analysis of the likelihood of a UXO encounter. There is a slightly elevated likelihood that an unexploded British HAA shell remains shallow buried on Site. There is no variation in this contamination risk across the Site and consequently all the proposed ground works will be exposed to such a UXO encounter.

RECOMMENDED RISK MITIGATION MEASURE(S): Brimstone recommends that the minimum risk mitigation measure be put in place prior to ground works commencing: **UXO Safety Awareness Briefings** to all Site personnel.

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FIGURE 6:	Luftwaffe Target Reconnaissance Photograph - July 1940

APPENDICES

APPENDIX 1:	Recent UXO Incidents and Historical Analysis
APPENDIX 2:	Data Sheets - German WWII Air-Delivered Munitions
APPENDIX 3:	Data Sheet - British WWII Anti-Aircraft Munitions
APPENDIX 4:	Data Sheet - British / Allied WWII Land Service Ammunition
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BRIMSTONE SITE INVESTIGATION LTD

Brimstone Site Investigation is committed to delivering bespoke UXO-risk mitigation strategies to a range of clients across a range of industries.

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

- **Integrity** in advice, information and the manner in which we conduct ourselves and our operations.
- **Professionalism** in the way we handle our operations, people, and processes.
- **Knowledge** in new skills and information, to ensure we remain at the forefront of innovation and strategy.

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This report has been prepared with consideration to the site conditions at the time of report order confirmation. BSI Ltd cannot accept liability for any subsequent changes to the conditions on site which may influence the UXO risk. The report has been prepared in line with the relevant CIRIA guidance and UK legislation current at the time of report order confirmation. Changes to official guidance, legislation or technical risk assessment improvements could render parts of this assessment obsolete.

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1 INTRODUCTION

1.1 Background

Paragon Building Consultancy Limited (the Client) has commissioned BSI to carry out a Stage 2 Detailed Unexploded Ordnance Risk Assessment (DRA) of the proposed works at the Woodside Road, Eastleigh site (the Site).

1.2 Legislation

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

1.2.1 Construction Design and Management Regulations (CDM) 2015

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

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

1.2.2 The Health and Safety at Work Act 1974

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

1.3 Commercial Contractor and the Authorities

1.3.1 Commercial Contractors

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

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

Our UXO Engineers can assess suspicious items on site when they are found. This will avoid unnecessary site evacuations. If our engineer(s) decide the item is UXO, they will coordinate with the authorities, manage

disruptions, and advise on control measures, such as evacuations and a cordon.

1.3.2 UK Authorities

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

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

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

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

1.4 UXO Risk in the UK

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

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

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

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

1.5 UXO Detonations

A detonation is a violent chemical reaction which creates a huge volume of gas. This reaction appears to happen instantaneously – the velocity of the shockwave moving is up to 9000m per second. This chemical reaction is started using a small amount of very sensitive explosives called primary explosives. These types of explosives are highly sensitive to shock, friction, heat, and spark. As the explosive charge undergoes high order decomposition (detonation), the brisance, or shattering effect, causes the casing to splinter, projecting razor-sharp shrapnel across long distances.

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

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

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

2 ASSESSMENT METHODOLOGY

2.1 Introduction

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

2.2 SPRC Risk Model

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

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

2.3 Assessment Structure

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

- The likelihood that the site was contaminated with UXO.
- The type of UXO that could have contaminated the site, and their associated hazards.
- The likelihood that UXO remains on the site.
- Theoretical bomb penetration depths.
- The likelihood that UXO will be uncovered during the proposed works.
- Risk rating and risk mapping (as appropriate).
- Risk mitigation recommendations.

2.4 Information Sources

To complete this risk assessment BSI has gathered information from a wide range of sources. BSI's research team has completed detailed historical research, including access of original archived records. The following is a general list of information sources that are consulted during the research process:

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

2.5 ALARP Principle

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

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

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

2.6 Risk Tolerances

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

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

2.7 Reliance and Limitations

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

3 THE PROJECT

3.1 The Site

The Site (centred on the National Grid Ref: SU 44439 19692) is located in Eastleigh (Hampshire), approximately 7km north of Southampton city centre. Situated within the City Grove Industrial Estate, it is bound to the north by Woodside Road, to the east by Woodside Avenue, to the south by a railway line, and to the west by neighbouring commercial property.

The Site comprises several warehouse type buildings with adjoining offices. Service yard / forecourt / loading bay areas, as well as car parking make up the remainder of the Site area.

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

3.2 The Proposed Works

The proposed redevelopment will see demolition of the existing buildings and construction of five replacement light industrial units with associated offices and yard areas. No details relating to the extent of the required excavations were available at the time of writing.

FIGURE 3: Proposed Development Plan

4 SITE HISTORY

4.1 Introduction

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

4.2 OS Mapping

Period	Map Date	Map Scale	Review
Pre-WWI	1897	1:2,500	The Site is exclusively occupied by a single (likely agricultural) field, associated with Woodside Farm, a farmstead immediately north-east. Like today, the Site is bound to the north and east by roads and to the south by a railway line.
	1909	1:2,500	No changes on or adjacent to the Site observed.
Pre-WWII	1933	1:2,500	No changes on or adjacent to the Site observed.
	1939	1:2,500	FIGURE 4.1: No changes on Site observed. Woodside Road is now labelled. The immediate surrounding area is agricultural in nature. The Site is positioned just beyond the western extent of Eastleigh town.
Post-WWII	1947	1:25,000	No changes on or adjacent to the Site observed.
	1950	1:2,500	FIGURE 4.2: No changes on or adjacent to the Site observed. No evidence of potential severe bomb damage (demolished pre-war buildings or buildings labelled 'ruin') in the vicinity.
	1963	1:10,560	No changes on or adjacent to the Site observed.

	1974	1:1,250	In the east half two light industrial buildings (one small and one large) are present. The latter is a Structural Metal Works. Both appear to be the present-day structures. In the west half, three light industrial buildings are present. The two in the east (including a Joinery Works) appear to be the present-day structures. The one in the west may be the present-day structure.
	1991	1:1,250	Additional buildings have been constructed in the east half. This area is now labelled Depot and appears as it does today. The building at the western extent of the Site has been extended. This is likely the majority of the present-day structure.

4.3 Aerial Photography

Period	Photo Date	Review
WWII	Aug 1944	FIGURE 5.1: This small-scale photograph was taken within the final year of WWII. The Site appears as it does on the historic OS maps, occupying one single field. The appearance of the field indicates it is either a meadow with no use, or in use as pasture for livestock. No evidence of German bombing (demolished buildings or HE blast craters in open ground) visible in the vicinity. NB: many bomb craters only persisted temporarily during WWII, particularly on worked ground. Craters were often in-filled and ploughed prior to the available aerial photography.
Post-WWII	Sep 1949	FIGURE 5.2: This oblique view photograph was taken approximately four years after the end of WWII (in Europe). No changes to the Site visible. No evidence of German bombing visible in the vicinity. The buildings of Woodside Farm appear to have survived the war intact.
	Dec 2000	This vertical view image shows a number of adjoining light industrial units (since demolished) in the central southern location. These single-storey buildings have since been demolished and replaced with the large warehouse type building that exists on Site today.

4.4 Additional Site-Specific History

Some sites will have been occupied by landmarks or significant buildings historically and in such cases specific written histories including significant wartime details are occasionally available in the public domain. Research has not located any relevant information relating to the Site.

5 UXO RISK – GERMAN BOMBING

5.1 WWII Bombing History of the Site

5.1.1 The Wider Southampton Region

Southampton was an important port city during WWII. It was also home to one of the Luftwaffe's most high priority targets, the Supermarine (aircraft) Works at Woolston. Mostly minor air raids were conducted during the summer and autumn of 1940, with the exception of two medium and one medium to large scale attacks in September. Then in November the city experienced its first large-scale 'Blitz' raid.

Of Southampton's 57 air raids, by far the most destructive occurred on the nights of 23rd November, 30th November, 1st December 1940, a period referred to as the 'Southampton's Blitz'. During these attacks, much of the city centre was destroyed.

A few medium scale raids were mounted during the spring of 1941, with small scale attacks in May and July 1941. The last significant raid (involving over 50 bombers) was carried out in June 1942. A few solitary aircraft raids occurred during 1943 and 1944.

By the end of the war nearly 45,000 buildings had been damaged or destroyed. The city experienced four major raids. NB: 'major' was a Luftwaffe designation describing a raid that delivered >100 tonnes of HE (in addition to incendiaries) to a target area.

Many of the surrounding towns (including Eastleigh), suffered from inaccurate overspill bombing and 'Tip and Run' incidents. The latter occurred when enemy pilots, harassed by RAF fighters or AA fire, jettisoned their bomb loads prematurely / indiscriminately in order to escape the combat zone.

5.1.2 Site Specific

Eastleigh was never subjected to a large-scale targeted air raid, instead experiencing at least 16 smaller scale attacks. Luftwaffe activity to the south of the town was high and therefore Eastleigh was vulnerable to random 'Tip and Run' bombing incidents. However, a Luftwaffe reconnaissance photograph (displayed at **FIGURE 6**) highlights targets within Eastleigh.

A military airfield (RAF Eastleigh / RAF Southampton / HMS Raven) is highlighted approximately 1.8km to the south-east and the Southern Railway Locomotive Works (the Eastleigh Works) is highlighted approximately 1.3km to the east. NB: the boundary of the former target encompasses two aircraft factories, also earmarked for attack.

No further Luftwaffe target records covering the study area were available. Further research has identified an unconfirmed but viable facility that may have been known to the Luftwaffe. Pirelli-General Cable Works (a large factory) was located >530m south-east of the Site. This vital war industry would have represented a profitable target for Germany. NB: the cable works was given a camouflage paint scheme at the beginning of the war, indicating that the authorities considered it a likely bombing target.

5.1.3 Bombing Decoy Sites

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

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

792 static decoy sites were built at 593 locations in Britain. They were estimated to have drawn at least 5% of the total weight of bombs away from their intended targets. No decoys were operational within a significant radius of the Site during WWII. The closest was approximately 5.3km to the south-west.

5.2 WWII Bombing Records

5.2.1 Introduction

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

The bomb census was unreliable in the early stages of the war, though by 1941 procedures had been standardised. The quality of the census records also depended on where in the UK the records were produced.

5.2.2 Bombing Statistics

The table below records the Ministry of Home Security's bombing density calculation for the Municipal Borough of Eastleigh. It gives a breakdown of the types of large German bombs reported. NB: 1kg / 2kg IBs and 2kg AP bombs were often too numerous to record accurately and therefore are not included. These figures were sourced from the National Archives, London.

Area Acreage	6,269
High Explosive Bombs (all types/weights)	160
High Explosive Parachute Mines	10
Flam (Oil) Bombs	3
40kg Phosphorus Incendiary Bombs (IBs)	0
40kg 'Fire Pot' IBs	0
V1 Flying Bomb	5
V2 Long Range Rocket	0
Total (excluding V-Weapons and 1kg / 2kg IBs)	173
Bombs Per 1,000 Acres	27.5

In addition, the Eastleigh's Civil Defence organisation recorded 100 x 1kg / 2kg IBs and 5 x unexploded AA shells within the borough.

5.2.3 Eastleigh ARP Bombing Incident Reports

An original borough war diary compiled from ARP bombing incident reports is held at Hampshire Record Office. All bombing incidents identified within approximately 2km of the Site are detailed in the table below. NB: some entries lacked a specific address and some entries (hand-written) were partly illegible. Therefore, the list below cannot be considered a complete picture of all local bombing incidents.

Date	Bomb(s)	Location (relative to the Site)	Remarks
22/08/40 17:25hrs	8 x HE bombs	On Eastleigh Aerodrome (>1.8km south-east of the Site). Police report of suspect UXB.	No damage, no casualties.
11/09/40	2 x HE Bombs	Cunliffe Owen's factory at Eastleigh Aerodrome (>1.8km south-east of the Site).	None.
08/10/40	8 x HE UXBs	High Street, Market Street, Desborough Road (>1km south-east of the Site).	Three Ju 88 bombers flew low over the town bombing and machine gunning.
	3 x HE bombs (inc 1 x UXB)	Pirelli cable works. Canteen demolished (>530m south-east of the Site).	
	4 x HE bomb (inc. 3 x UXBs)	On sheds within the locomotive works (~1.3km to the east of the Site).	
	1 x HE bomb	8 Grantham Road (~1.4km south-east of the Site).	
	7 x HE UXBs	Eastleigh Aerodrome (>1.8km south-east of the Site).	
01/11/40	1 x HE bomb	Southern area of Chandlers Ford (precise location not given, likely >800m west of the Site).	No damage or casualties.
19/11/40	1 x unexploded parachute mine	In nurseries at Twyford Road within 80 yards of the railway line (~1.4km north-east of the Site).	None.
23/11/40 18:38hrs	6 x HE UXBs	Sewage Farm. Believed to have sunk to great depth in water (>2km south-east of the Site).	None.
	11 x HE bombs	On Eastleigh Aerodrome (>1.9km south-east of the Site).	No damage or casualties.
	1 x HE bomb	Doncaster Drive (~1.9km south of the Site).	None.
	1 x HE UXB	On admiralty ground near Eastleigh Aerodrome (>2km south-east of the Site).	None.

24/11/40	1 x HE bomb	Shaftesbury Avenue, Chandlers Ford (~750m west of the Site).	None.
	1 x HE bomb	Hursley Road, Chandlers Ford (>1.4m north-west of the Site).	No casualties.
02/12/40	4 x HE bombs	In open countryside, away from the town centre (location not given).	None.
09/01/41 23:05hrs	3 x HE bombs	55 and 57 Chamberlayne Road and 55 Cranbury Road (1km south-east of the Site).	Five houses badly damaged, six slightly damaged. Four injuries and one fatality.
18/01/41	1 x HE bomb	Eastleigh (location not given).	None.
25/02/41	3 x HE bombs	Thornbury, Chandlers Ford (>1.9km north of the Site).	Direct hit on one house. Two injuries, two fatalities.
03/03/41	5 x HE bombs	Kingsway and Boyott Lane (>1.6km north-west and north of the Site).	Two houses destroyed. Gas and water service pipes damaged.
10/03/41	Multiple 1kg / 2kg IBs	Passfield Avenue (320m to 1.4km south of the Site) and Chandler's Ford (>500m west of the Site).	None.
22/06/41	1 x parachute mine	Locksley Road (>1km south of the Site).	Multiple houses damaged.
22/06/42 01:16hrs	5 x HE bombs + several IBs	Pirelli cable works (>530m south-east of the Site).	Rolling drills burnt out. Telecom cable factory badly damaged. Seven fatalities, 12 injured.
	2 x HE UXBs	Power cable factory and in the road outside the turning shop (>530m south-east of the Site).	Entry hole diameters of 36" (fins visible) and 27". 2 x 250kg UXBs removed by BDU the next day.
24/06/42	2 x HE bombs	Toynbee Road School and No.6 Regional Reception Camp (~670m south-east of the Site).	Camp partly destroyed.

5.2.4 Bomb Plot Mapping

From late 1941 onwards the national Bomb Census organisation began creating bomb plot maps. These maps often plotted several air raids, however are not true consolidated bomb plot maps as any bombing between 1940 and early 1941 would not have been included. The maps recorded HE bomb strikes only, not IBs.

Eastleigh experienced air raids during 1942, however the National Archives' collection does not include a map plotting these raids.

Individual boroughs often used their ARP incident reports to produce bomb plot maps. No such map for Eastleigh was produced by the borough's Civil Defence organisation.

5.2.5 Secondary Source and Anecdotal Evidence

A search of online resources and historical publications was conducted with the intention of locating any eyewitness accounts of local bombing incidents. Eyewitness accounts referencing bombing in the local area were located:

'the night that the [Eastleigh Pirelli cable] factory was bombed is quite unforgettable [>530m south-east of the

Site]. *There was so much noise, thick smoke, roaring flames and people shouting and screaming*¹.

*'Lots of bombs were dropped on Eastleigh, because of the Carriage Works, Pirelli and Cunliffe Owens at the airport, who made parts for machinery for the army'. 'I was at school in Toynbee Road, Eastleigh [approximately 670m south-east of the Site]. I remember the school being bombed in about 1941, and we were evacuated out to Barton Peveril School for a few months'*².

5.2.6 Abandoned Bomb Register

Due to the overstretched bomb disposal units during WW2, many bombs were intentionally left undisturbed. UXBs were triaged based on where they were and how big they were. If they didn't pose a significant risk they were 'abandoned'. The locations of these bombs were recorded on the abandoned bomb register.

The abandoned bomb register is a public record document held at the Parliamentary Archives of the House of Commons, from which BSI has obtained a copy. The register should not be relied on for completeness or accuracy. No abandoned bombs are recorded on or near the Site.

5.3 Likelihood of UXB Contamination

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

Density of Bombing	
Number of Air Raids in the Vicinity:	Between five and nine individual air raids affected a 1km radius around the Site.
Intensity of these Air Raids:	All small scale raids. Most were executed by solitary aircraft (likely 'Tip and Run'). At least one raid involved three aircraft.
Bomb Strike Positions	
Closest Bomb Strikes to the site:	The closest confirmed bombing incidents occurred within the cable factory, between 530 and 970m south-east of the Site. It is conceivable that bomb strikes occurred closer to the Site during three further raids, for which precise location details are unavailable.
Alignment of recorded Bomb Strikes:	Most of the bombing records do not contain the level of detail required to confirm the flight path orientations of the aircraft responsible. One of the most significant raids (three aircraft on the 08/10/40) occurred just south of the Site and resulted in bomb strikes in a generally east / west orientation across the town. Therefore, none of these aircraft likely flew over the Site. Another raid (likely one aircraft on the 10/03/41) resulted in bombing incidents to the south and west of the Site. Therefore, this aircraft likely did not fly over the Site. Although it is conceivable that an aircraft responsible for one of the more distant bombing incidents flew over the Site, the significant distances between the Site and the bomb strike locations suggests this is unlikely.
Bomb Failure Rate	
Evidence to suggest that the generally accepted failure rate of 10% differs in the vicinity of the site:	No evidence.

¹<https://www.bbc.co.uk/history/ww2peopleswar/stories/43/a2907443.shtml>

²<https://www.bbc.co.uk/history/ww2peopleswar/stories/52/a4212352.shtml>

UXBs recorded in close proximity to the site:	None confirmed within close proximity.
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5.4 Likelihood of Subsequent UXB Detection

A range of circumstances determine whether a UXB strike location would have been identified, during and after the war. This is discussed in the following table.

Historic Access
A UXB falling on a site which was frequently accessed would have had a better chance of being found. ARP Wardens actively searched for UXBs in heavily bombed residential areas. The importance of a site or nearby buildings and infrastructure was also a factor. Many industrial facilities had fire watchers tasked with extinguishing incendiary bombs and reporting UXBs.
The Site was undeveloped, and the local area sparsely populated during WWII. It is conceivable therefore that any UXB dropped on Site could have fallen unnoticed. However, the nearby Pirelli factory likely had fire watchers keeping watch every night and personnel manning at least one LAA gun battery at the factory would have been on alert around the clock. This reduces the likelihood of local air raids occurring unobserved. Any UXBs dropped in the vicinity could have been witnessed and subsequently investigated. The field on Site adjoined a farmstead, indicating that it was likely accessed during the war. There do not appear to have been any significant areas of inaccessible vegetation on Site at the time. The Site was insignificant and therefore is unlikely to have been subject to specific post-raid searches for delayed action (DA) bomb / UXB entry holes, carried out by ARP wardens.

Ground Cover Type
A UXB which falls on open field could easily go unnoticed, whereas a UXB dropped on a hard-surfaced car park would have been easily observed.
WWII aerial photography indicates that the Site was agricultural (likely pasture) during WWII. A large UXB entry hole within a grass field is likely to have been observed and reported. However, if the Site was occupied by tall / unmaintained grass during the war, it is conceivable that evidence of UXO could have been overlooked. NB: the diameter of the smallest German HE bomb (which was also the most commonly deployed over Britain) was 200mm; creating a small, easily obscured entry hole. After a time, environmental conditions would cause the hole to collapse and in-fill, erasing evidence of the UXO strike.

Bomb Damage
As the bombing campaign continued, damaged areas became vulnerable to unreported UXBs. Bombsite wreckage or soil disturbance at a bomb crater could obscure evidence of a subsequent UXB strike.
No evidence of HE bomb cratering was identified on Site.

5.5 Bombing During WWI

During WWI, an estimated 9,000 German bombs were dropped on London, eastern and south-east England during 51 zeppelin airship raids and 52 aeroplane raids. London suffered the worst of the bombing, with an estimated 250 tonnes of HE and incendiary bombs recorded across the capital. However, Eastleigh and wider area were not subjected to any air raids during this conflict and therefore there is no risk from WWI German UXBs.

6 WWII GERMAN BOMBS

6.1 Bombs Dropped on the UK

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

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

- **HE bombs – moderate NEQ (net explosive quantity):** the most common types of HE bombs dropped were the SC (general purpose - GP) and SD (semi-armour piercing - SAP) series of bombs. The NEQ is between 30-50%. SAP bombs are engineered to attack light fortifications, whereas GP bombs are used in a mixed destructive blast and anti-personnel fragmentation role. 70% of bombs dropped on the UK were the 50kg type.
- **HE bombs – high NEQ:** blast bombs and parachute mines have bodies made of thin steel, allowing for larger HE charges. These were designed to detonate above ground, maximising the blast effect. Parachute mines were weapons slowed by parachutes and designed to detonate without penetrating the ground. Although, in some marshland areas, partially buried parachute mines have been observed. Consequently, it is highly unlikely that any unexploded blast bombs remain buried in the UK today.
- **HE bombs – low NEQ:** The PC series were armour piercing bombs used against heavy fortifications and reinforced bunkers. They were not commonly used over the UK.
- **Small incendiary bombs:** The 1kg and 2kg incendiaries were the most dropped bomb. Up to 620 x 1kg incendiaries could be packed into the largest container unit, which opened at a pre-determined height scattering its payload over a wide area. These small bombs could fully penetrate soft ground due to their small diameter. Variants of the 1kg and 2kg incendiary bombs contained a small HE charge designed for an anti-personnel role, and to increase its incendiary effect.
- **Large incendiary bombs - Thick skinned:** The C50 has a thick body and contained a mixture of incendiary liquids and white phosphorus. Another version of the C50 had a white phosphorus fill. The C50 'firepot' contained thermite incendiary containers (aka firepots) and a small HE charge.
- **Large incendiary bombs - Thin skinned:** The Flam 250 and Flam 500 models had thin steel bodies designed to break up on impact, spreading their oil-incendiary mixture, which was ignited by a small HE charge. Consequently, it is highly unlikely that any unexploded Flam bombs remain buried in the UK today. Their unreliability meant withdrawal from frontline use by January 1941.
- **Submunitions:** The SD2 'butterfly' bomb was a 2kg submunition dropped on several British cities and towns. It contained a 225gram HE charge. SD2s had no ground penetration ability so the vast majority were recovered at the time. However, SD2s are still found across Britain today.
- **V1 flying bombs and V2 rockets:** In the final year of WWII Germany began using pilotless weapons against England. Both V Weapons had 1,000kg HE warheads. Due to their light-body construction, they had no penetration ability and any impact left a noticeable debris field. As such, there is negligible risk from unexploded V weapons today.

6.2 Bomb Failures

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

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

Failures can happen for different reasons, including:

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

6.3 Bomb Ground Penetration

6.3.1 Introduction

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

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

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

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

- **Impact velocity:** German bombing raids were carried out at altitudes in excess of 5,000m. The velocity of impact is roughly 313ms^{-1} (not accounting for resistance). It is the same velocity regardless of mass.
- **Impact angle:** strike angles of 10 to 15 degrees to the vertical. It must be assumed that the bomb was stable at the moment of ground penetration.
- **Bomb design:** Some larger German bombs were occasionally fitted with ‘kopfrings’ - a metal ring, triangular in cross section, fitted around the nose of the bomb to help prevent penetration. It must be assumed that no ‘kopfrings’ were fitted.

6.3.2 The J-Curve Effect

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

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

6.3.3 Site Specific Maximum Bomb Penetration Depth

The likelihood of an ‘iron’ UXB strike on Site is low. Therefore, a Site-specific maximum bomb penetration depth calculation is unnecessary.

7 UXO RISK – BRITISH/ALLIED ACTIVITY

7.1 Introduction

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

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

7.2 Potential Sources of UXO

7.2.1 Introduction

Research has not located any evidence of British or Allied army, RAF or Royal Navy activity specifically on Site. Although it is conceivable that the field on Site could have been temporarily requisitioned for wartime (military) use, such WWI or WWII activity is highly unlikely to have occurred.

The most likely potential sources of UXO contamination on Site are WWII Home Guard activity and AA artillery fire. These are discussed below.

7.2.2 WWII Home Guard Activity

The Home Guard was formed in the summer of 1940. It was a volunteer force of men who were either too young, too old, or in key occupations. Battalions were established in most urban areas and some large organisations (such as railway networks) created their own platoons.

Their main purpose was to bolster regular army units in the event of German invasion. By the end of June 1940, over one million had signed up. Initially, weapons were in short supply and some new weapons (and ammunition) were designed specifically for the Home Guard. As the war progressed, conventional weapons became available.

Soldiers of the 11th Hampshire (Eastleigh) Home Guard Battalion would have been active locally during WWII. However, neither the local county archive nor the National Archives hold any original documents detailing the activities of the 11th Battalion.

Although no specific evidence of Home Guard activity on Site has been identified, it is known that troops often carried out manoeuvres in open ground on the outskirts of urban areas and sometimes within close proximity to civilian life. However, as the Site was agricultural during WWII, it is unlikely to have been requisitioned for Home Guard training or as an ad-hoc weapons range. However, it is conceivable that armed Home Guard soldiers accessed the Site whilst on patrol.

Recent UXO finds confirm that Home Guard soldiers purposefully buried caches of ammunition in tactical locations to be used in event of a German invasion. However, such activity is more likely to have occurred within the defended coastal area to the north of the Site. Faulty or partially spent ammunition was sometimes discarded in random locations, often on civilian land. Similarly, there are examples of surplus ammunition buried on civilian land as a hassle-free way of disposal, likely when the Home Guard was disbanded in 1944. Although considered unlikely, the possibility of such activity on Site cannot be ruled out entirely.

7.2.3 WWII Anti-Aircraft Fire

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

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

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

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

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

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

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

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

14 permanent HAA batteries were constructed within range (a 15km radius) of the Site immediately prior to WWII. The Pirelli works and locomotive works were designated Vulnerable Points (VPs) during WWII and consequently were given LAA gun protection. Anecdotal evidence confirms that at least one 40mm Bofors LAA battery was positioned near the Pirelli works in 1943. By July 1942, the 21st Hampshire Home Guard (Southern Railway) Battalion had an LAA gun platoon defending their Eastleigh Works. The LAA guns based at these VPs would have been within firing range of the Site.

Luftwaffe activity was frequent over the wider area and therefore it is quite possible that an unexploded AA shell landed on Site. NB: the bombing records describe an unexploded AA shell strike to No.184 Market Street (1.4km south-east of the Site) on the 20th January 1941 and a second shell strike to the rear of the High Street (~1.2km south-east of the Site) on the 26th October 1942.

7.3 Land Service Ammunition

7.3.1 General

Land Service Ammunition (LSA) is a broad term describing a variety of weapons for use by land forces. LSA encompasses those types of ammunition that can be placed, thrown, launched or projected and is broken down into five main munitions families: grenades, mortars, projectiles, rockets and landmines.

Anti-tank rockets are portable infantry weapons. These types of weapons were not widely used. The US made Bazooka and British made PIAT were deployed in relatively small numbers.

Landmines (anti-personnel and anti-tank) were used by the British to fortify English beaches. Each minefield was well documented and subsequently cleared during the 1940s.

LSA does not necessarily lose its effectiveness with age. Decades of burial can cause ammunition to become less stable and more sensitive. LSA is frequently found on construction projects around the UK and can present a serious hazard to workers.

Data sheets on the most likely types to be encountered today and/or the most hazardous are included at **APPENDIX 4**.

7.3.2 Grenades

A grenade is a catch all term for small items of ordnance, which are thrown, fired from a weapon or launched from a grenade launcher. They can contain high explosives, incendiary mixtures and white phosphorous fills, amongst others. A very wide range of grenades have been used in the UK, the most common being explosive so-called defensive grenades – high explosive fragmentation grenades – designed to detonate on impact, or after time delay. Some grenades are equipped with incredibly sensitive ‘all-ways’ fuzes.

They are divided into three categories: defensive, offensive and carrier. Defensive grenades require the user to take cover after throwing them, due to the fragmentation effect. Blast grenades, or offensive grenades use the blast effect to disorientate or injure enemy without necessitating cover – such as clearing rooms. Carrier describes grenades used for special effects, such as producing smoke, ‘flashbang’ effect or incendiary effect.

The Mills Bomb was the first modern defensive grenade produced for the British Army and was used in the WWI trenches from 1915. Updated Mills models were the mainstay of the Army throughout WWII and into the post-war period.

The No. 36 – a Mills Bomb variant – used a cocked striker retained by the flyoff lever and safety pin. Upon removal of the safety pin the grenade is thrown. The compressed spring is released, forcing the striker onto the percussion cap, igniting the time delay. The time delay burns and initiates the detonator, which in turns causes the main charge to function. This type of mechanism makes unexploded grenades sensitive to shock.

7.3.3 Mortars

A mortar is a simple infantry weapon that fires a munition in a high-arching trajectory, at low velocity, to a relatively short range. It is a compact, easily transportable system used by British and Allied armies since WWI, with the Stokes Mortar.

During WWII British mortars had a rate of fire of 30 bombs per minute with ranges of 2km. The 2” and 3” mortars were the most common types used by the British.

Ammunition for mortars generally comes in two main categories: fin-stabilised and spin-stabilised. Both types can have a variety of fills: high explosive, smoke, parachute illumination, inert practice, propaganda, amongst others.

A mortar is almost always nose fused, with the tail section made of a spigot and stabilisation fins. Mortar fuzes often contain cocked strikers, making unexploded mortars sensitive to shock.

7.3.4 Artillery Projectiles

Anti-tank guns and Howitzers have been in use by the British Army for over a hundred years. The former ranged from the Ordnance QF 2 Pounder (40mm) to the Ordnance QF 17 Pounder (76mm) in calibre. Howitzers ranged from the Ordnance QF 25 Pounder (87.6mm) to the BL 60 Pounder (127mm).

A wide variety of artillery projectiles have been deployed in the UK historically, by British and Allied Armies. There are a very wide range of different projectile categories, ranging from armour-piercing fin-stabilised discarding sabots (APFSDS) to base-bleed and rocket assist high explosive projectiles. Historically, there were three types of WWII-era British artillery shell:

- **Bursting Type:** the filling (or part of it) caused the shell to burst. The most common filling was HE where the shell caused damage to material by the force of the burst or to personnel and aircraft by fragmentation of the shell casing producing shrapnel. NB: bursting shells were also used with chemical fillings.
- **Shrapnel Type:** these usually burst in the air and projected their 'payload' forwards acting like a shotgun. The usual payload was shrapnel bullets however Thermite 'pots' were used during WWI. By the start of WWII shrapnel shells were obsolete for field artillery.
- **Carrier Type:** these also burst in the air, however ejected their payload backwards after blowing the base plate off the shell. The most common fills used were smoke, star and flare shells. The latter two being designed to illuminate an area or target. Smoke shells were used to produce smoke screens and used various fillings (the most common being white Phosphorus).

Artillery projectiles were always painted, this protected the steel from rust but was also used to indicate the nature of the ammunition. Markings include overall body colour, coloured bands, cold markings, stamps and more. Each of these markings carry significance and provides information on the fill, the fuzing, specific hazards and more.

In 1964 NATO standardised these markings and calibres across members of the treaty – for logistical homogenisation in anticipation of multilateral conflict. Markings dating before this standardisation are more complicated to discern. Ordnance from different countries within NATO would use different systems to signify the nature of munitions.

Generally speaking, most artillery projectiles are similar in appearance and feature a nose section, an ogive, a bourrelet, a driving band and a boat tail. Some projectiles, however do not fit these characteristics, and some ordnance which is not classed as a projectile do fit these characteristics, such as certain mortars.

The 3.7" AA projectile shown in APPENDIX 3 is a good example of WWII-era artillery ordnance.

7.3.5 20mm Autocannon Ammunition

During WWII, a number of RAF and USAAF fighters were fitted with 20mm autocannons; manufactured by the Swiss company Oerlikon and the French company Hispano-Suiza. These weapons were also used by UK-based army and navy units in the LAA role. An autocannon is essentially a larger calibre machine gun. Ammunition from these weapons can be either solid shot or fused projectiles containing high explosives, incendiaries, or tracers.

This ammunition can look very similar to SAA. The difference is that they contain a small, simple impact fuse and approximately 4 grams of HE. Although small, they pose a significant hazard, and detonation can cause serious injury or death. The fuses in this type of ammunition can be particularly sensitive.

During WWII, Hispano-Suiza and Oerlikon produced a variety of 20mm ammunition types; high explosive, high explosive tracer, high explosive incendiary, armour piercing, armour piercing incendiary, target practice and target practice tracer. Each type was distinguished by the painted colour of the projectile head and colours varied between the two manufactures.

Some 20mm projectiles featured a self-destruct mechanism in the fusing, causing detonation after 5 seconds if no target was struck. The aim was to reduce the number of unexploded 20mm projectiles falling back to Earth.

A data sheet on 20mm ammunition is included in **APPENDIX 5**.

7.3.6 Small Arms Ammunition

Small arms ammunition is primarily cartridge-based, solid shot ammunition with a calibre <20mm. It covers ammunition used for side arms, rifles and light to heavy machine guns. Each 'round' of ammunition comprises a cartridge case, bullet, propellant and primer.

The most common types of SAA to be encountered in the UK are .303 calibre (the standard British and Commonwealth military cartridge from 1889 until the 1950s), .30 calibre (the standard American cartridge used during WWII) and .50 calibre (used by machine guns on USAAF bombers, based in Britain during WWII).

As solid shot, spent SAA rounds do not pose a hazard. Unspent rounds contain a small propellant charge within the cartridge, however SAA is generally stable and relatively safe to handle. Unspent rounds can function if

subjected to high heat, such as fire. Any detonation in this manner, however, would not be contained within the barrel of a weapon therefore would only result in local, minor overpressure with a minor projection potential.

8 UXO RISK MITIGATING CIRCUMSTANCES

8.1 Introduction

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

8.2 Explosive Ordnance Clearance Tasks

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

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

UXO encounters on civilian land are often reported in the media and therefore a web search of local media outlets was also carried out. No recent incidents within close proximity to the Site were identified.

8.3 Ground Works

Post-war, the Site will likely have remained agricultural and no evidence of any substantial non-construction related earthworks on Site has been found.

Most of the existing buildings represent the only phase of post-war development within their structural footprint. The footprint of the large southerly building has experienced two phases of post-war development. These developments likely required shallow (likely traditional) footings and none are likely to incorporate basement levels. Therefore, associated ground works probably disturbed shallow soil depths only.

8.4 Deductions

It is considered highly unlikely that the Site was ever searched for UXO, as part of an EOC task. The risk from very shallow buried UXO (German 1kg / 2kg IBs and British LAA shells, SAA and some LSA) will have been largely mitigated on Site.

The risk from shallow buried UXO (HAA shells, some LSA and lighter German 'iron' UXBs) will have been mitigated within the volume of soil excavated during foundation construction. Such UXO could remain in-situ, beneath existing buildings, in between their foundations. The risk from deep buried German UXBs will not have been mitigated to any significant degree.

9 CONCLUSION

9.1 Accuracy of Historical Records

Occasionally, the accuracy of some historical records can prove to be poor when compared with other sources of information. One significant consequence of this can be the possibility of unrecorded German bomb strikes in the study area. A review of the records gathered for this assessment has not highlighted any significant inconsistencies, although the historic bombing records is likely incomplete.

9.2 The Risk of UXO Contamination on Site

9.2.1 Key Findings - German UXO Risk

- The Site was undeveloped and situated within an agricultural area on the edge of Eastleigh town during WWII. Eastleigh was home to known Luftwaffe bombing targets, however the most significant (and most frequently attacked) were >1km to the south-east of the Site. A secondary target (cable factory >530m from the Site) was attacked at least twice. However, the town was never subjected to a large or even medium scale raid.
- A collection of original written incident reports for the borough was reviewed. The town appears to have experienced a low to moderate bombing density. Between five and nine individual (small scale) raids resulted in bombing incidents within 1km of the Site, however no confirmed bomb strikes within 500m of the Site were identified. The closest confirmed bombing incidents occurred within the cable factory, between 530 and 970m to the south-east of the Site. NB: it is conceivable (although unlikely) that bomb strikes occurred closer to the Site during three further raids, for which precise location details are unavailable.
- Although it is conceivable that an aircraft responsible for one of the more distant bombing incidents flew over the Site, the significant distances between the Site and the bomb strike locations suggests this is unlikely to have occurred. Analysis of the known positions of bomb strikes and two air raid flight path orientations, indicates a low likelihood that a German bomber flew over or immediately adjacent to the Site. Therefore, the likelihood of a UXB release over the Site is very low.
- An aerial photograph of the study area, taken during WWII and after the final raid on the town, does not exhibit any evidence of HE bombing (bomb craters, in-filled crater marks or demolished buildings) in the immediate vicinity.
- The study area was sparsely populated during WWII. This increases the risk that any UXB fall on Site could have occurred unobserved and gone unreported. As an agricultural field, the Site would not have been frequently accessed and any evidence of a UXB could have remained unseen for a significant period of time or could have been overlooked, obscured by crop growth or long grass. However, such a scenario is considered a remote possibility as there is a low likelihood of a UXB actually striking the Site.

9.2.2 Key Findings - British UXO Risk

- 14 HAA gun batteries and at least two LAA gun batteries were present within range of the Site during WWII. The Luftwaffe were active over the town and therefore these guns would have expended ammunition. For the same reasons as above, any unexploded AA shell strike to the Site could have easily occurred unobserved and remained undetected, becoming shallow buried in soft ground. NB: five unexploded AA shell strikes were reported and dealt with in the borough during WWII.
- A second potential source of British UXO (Home Guard activity) has been identified in the wider area. However, no specific evidence of military activity within the Site boundary has been found, and as an agricultural field, it is unlikely that any occurred historically. Consequently, the risk from associated UXO is low.

9.3 Site-Specific UXO Hazards

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

UXO Type	NEQ (NEQ Range)	Likely Burial Depth	Hazard Posed
WWII German General Purpose HE Bombs	25kg - 220kg (most commonly deployed bomb weights)	Likely deep burial (>3m)	HIGH RISK
WWII British Heavy Anti-Aircraft Shells	1.1kg - 1.7kg	Shallow burial (<1.5m)	MODERATE-HIGH RISK

WWII British Land Service Ammunition	<2kg	Shallow burial (<1.5m)	
WWII German 2kg Incendiary / HE Bombs	680g incendiary hazard + ~500g explosive hazard	Shallow burial (<1.5m)	
WWII German 1kg IBs	680g (incendiary, not explosive hazard)	Shallow burial (<1.5m)	MODERATE RISK
WWII British Light Anti-Aircraft Shells	4g - 70g	Very shallow burial (<1m)	LOW-MODERATE RISK

9.4 The Likelihood of UXO Encounter

9.4.1 Introduction

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

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

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

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

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

9.4.2 German UXBs

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

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

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

9.4.3 British / Allied UXO

The nature of British/Allied military activity involving LSA and SAA and the smaller size of these munitions (in relation to German HE bombs) indicates that any resulting UXO contamination on a site will be limited to shallow

depths, usually within 1.5m of the surface, notwithstanding added material to raise the ground level.

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

9.4.4 Deductions

The lack of details relating to the proposed intrusive ground works limits the analysis of the likelihood of a UXO encounter. If a German HE UXB remains buried on Site, it is highly likely to exist at a depth beyond the reach of excavations for shallow foundations. However, there is considered to be a low likelihood that such UXO remains on Site today.

There is a slightly elevated likelihood that an unexploded British HAA shell remains shallow buried on Site. There is no variation in this contamination risk across the Site and consequently all the proposed ground works will be exposed to such a UXO encounter.

10 OVERALL RISK RATING

Ratings for the likelihood of UXO contaminating the site, remaining on site up to the present day and being encountered during the proposed works, inform the overall risk rating. The UXO risk to the proposed works on Site has been assessed as **Low-to-Moderate**.

Risk Table: Low-to-Moderate Risk				
UXO TYPE (ASSOCIATED HAZARD)	LIKELIHOOD OF UXO CONTAMINATION	LIKELIHOOD OF UXO REMAINING	LIKELIHOOD OF ENCOUNTER	OVERALL RISK RATING
WWII German 'Iron' Bombs	Low	n/a		Low
WWII British Heavy Anti-Aircraft Shells	Low-to-Moderate	Moderate	Moderate	Low-to-Moderate
WWII British Land Service Ammunition	Low	n/a		Low
WWII German 2kg Incendiary / HE Bombs	Low	n/a		
WWII German 1kg Incendiary Bombs	Low	n/a		
WWII British Light Anti-Aircraft Shells	Low-to-Moderate	Low	n/a	

11 RISK MITIGATION RECOMMENDATIONS

To reduce the risk to ALARP level, BSI recommends the minimum risk mitigation measure be put in place prior to works commencing:

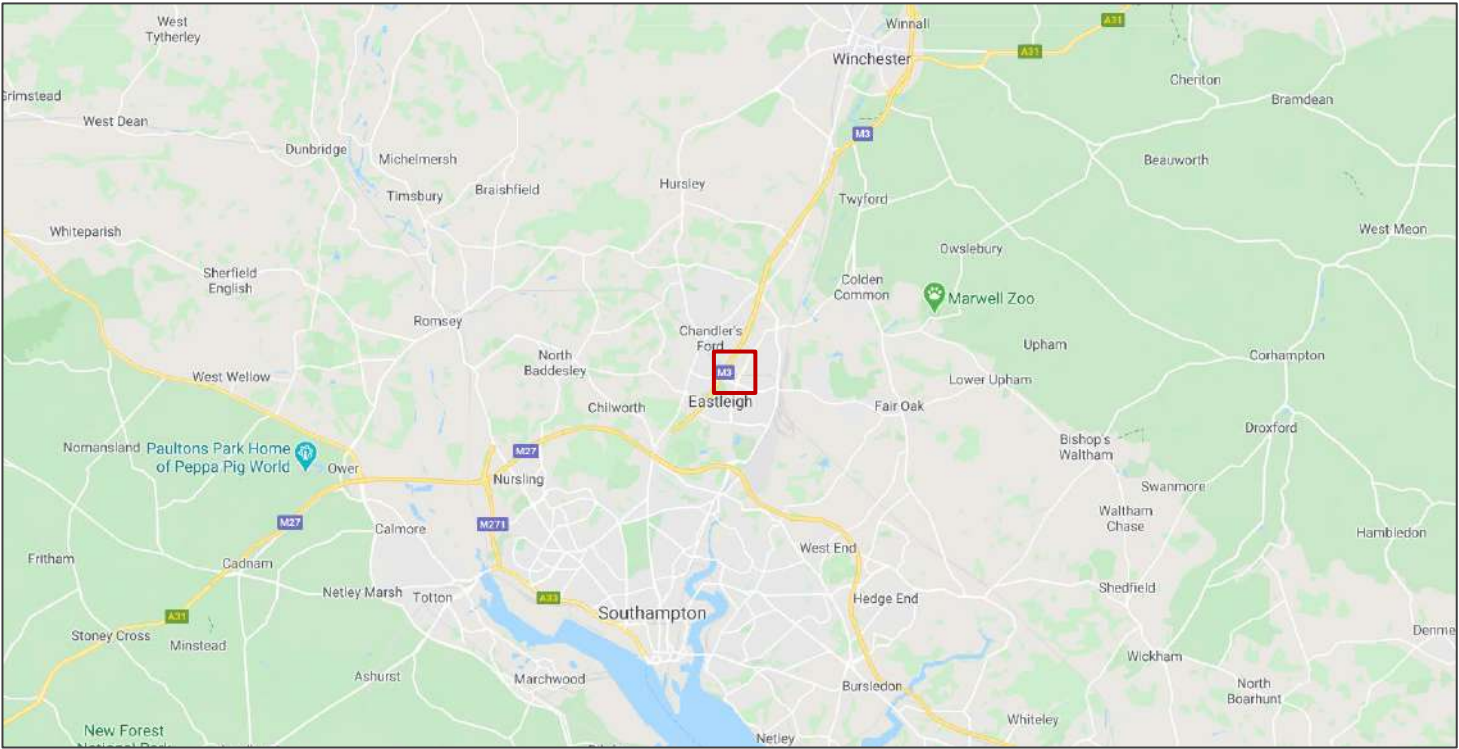
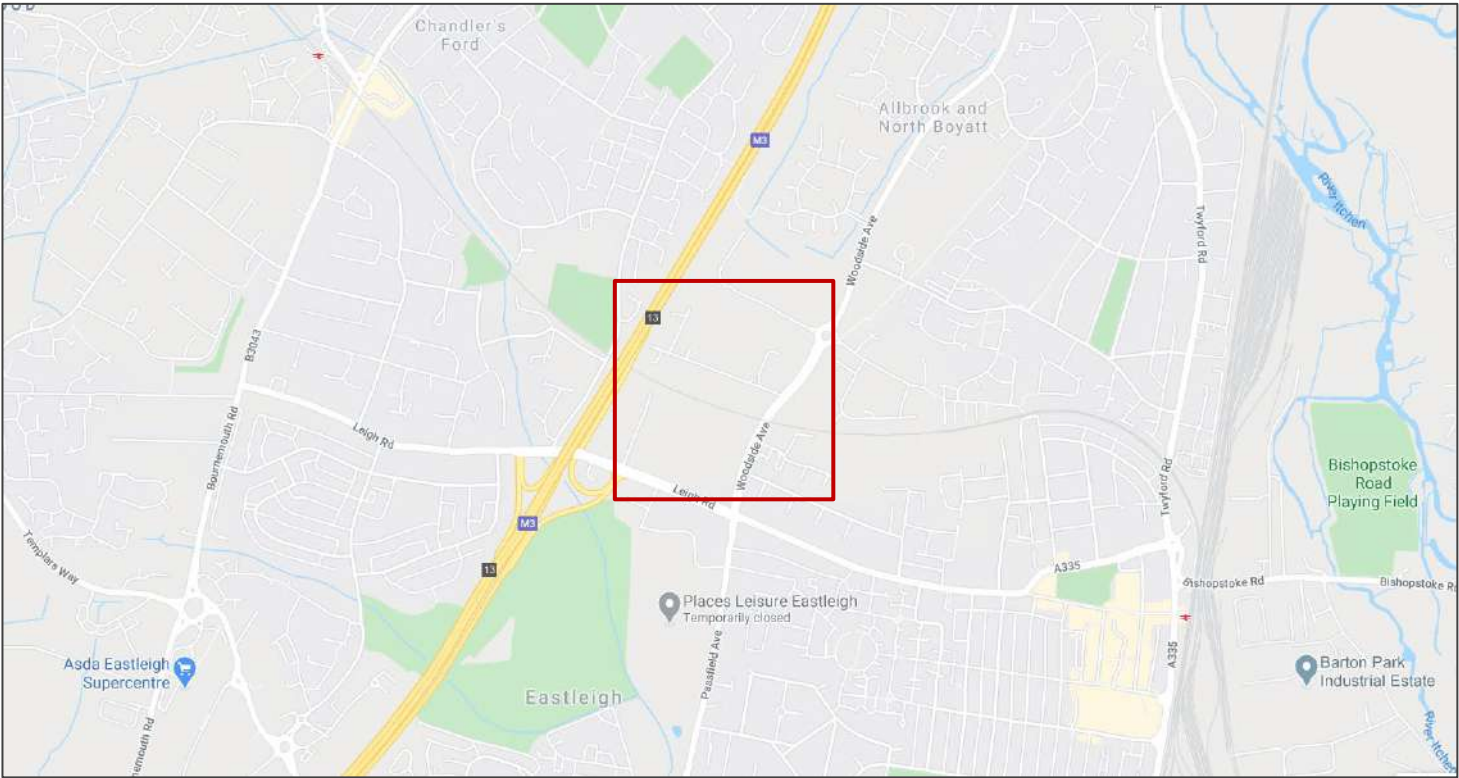
Risk Mitigation Measure	Recommendation
UXO Safety Awareness Briefings: To all personnel conducting intrusive works on Site. An essential part of the Health & Safety Plan for a site. Conforms to the requirements of CDM2015	Prior to all intrusive works commencing.

FIGURES: 1 - 6



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	Project	Woodside Road, Eastleigh	
	Client:	Paragon Building Consultancy Limited	
	Report Ref:	DRA-20-1191	
	 General Site Location	Info Source:	Google (open-source)

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 Approx. Site Boundary

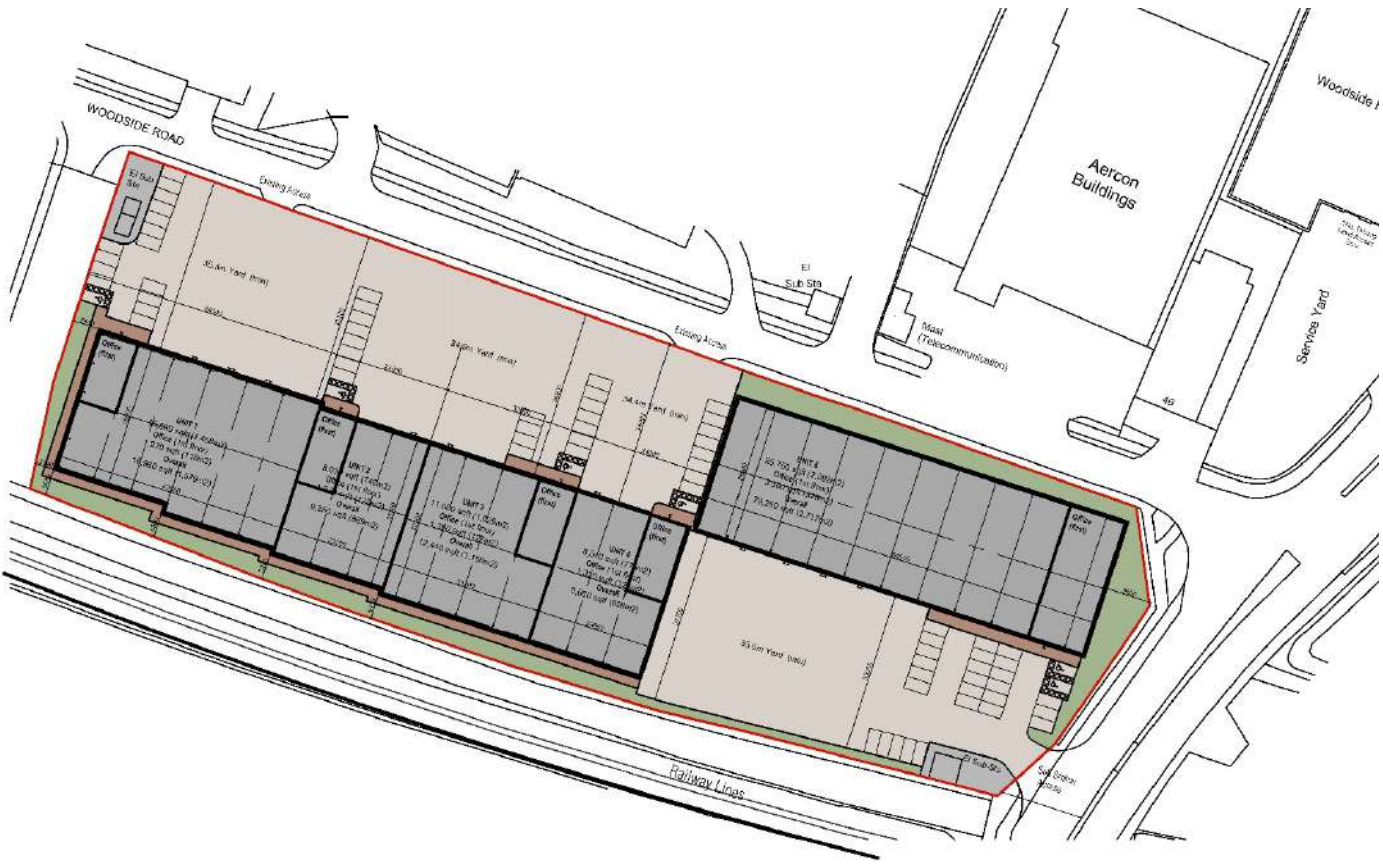
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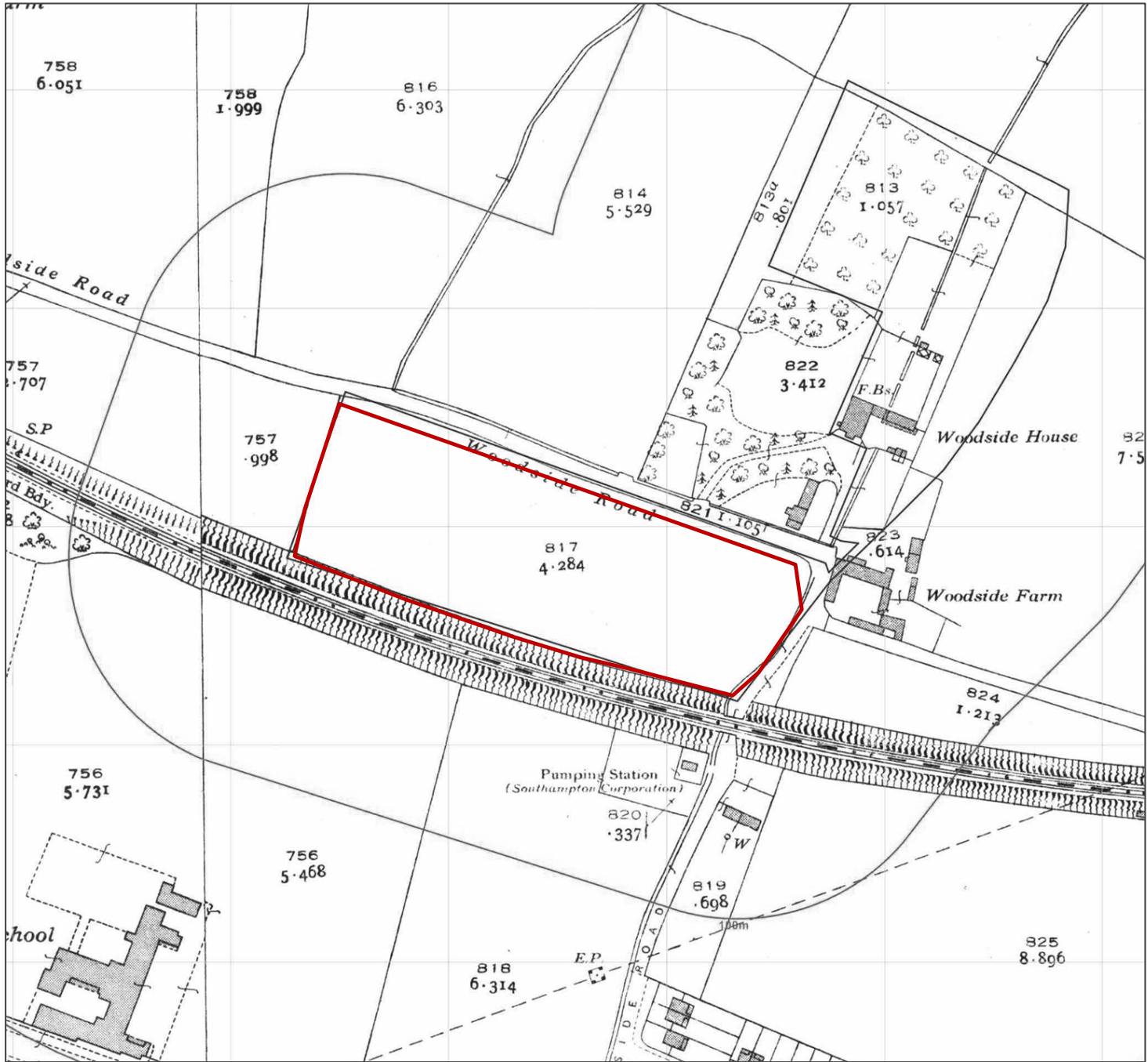
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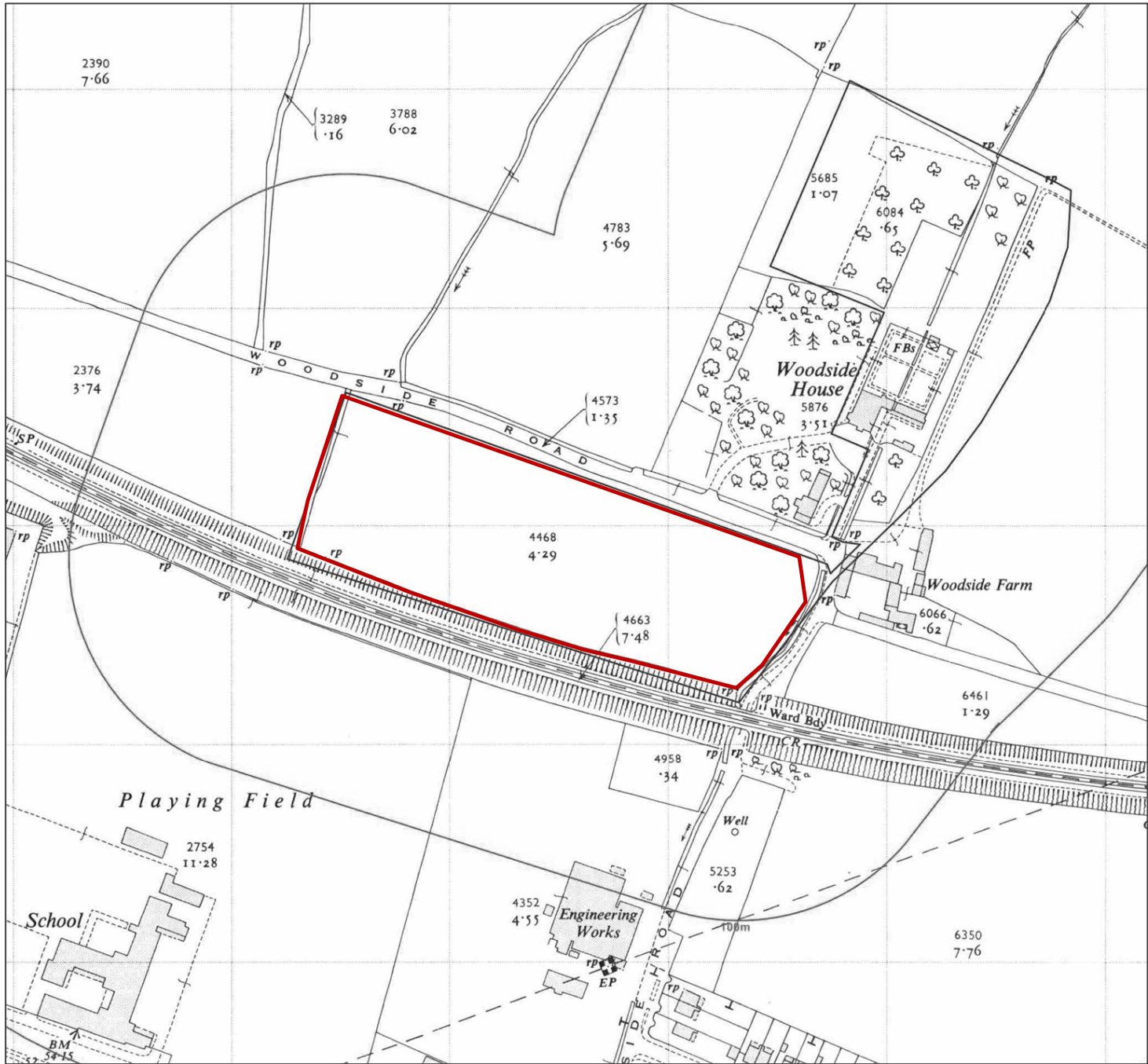
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— Approx. Site Boundary

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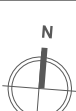
Groundsure



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	 Approx. Site Boundary	Info Source:	Historic England	

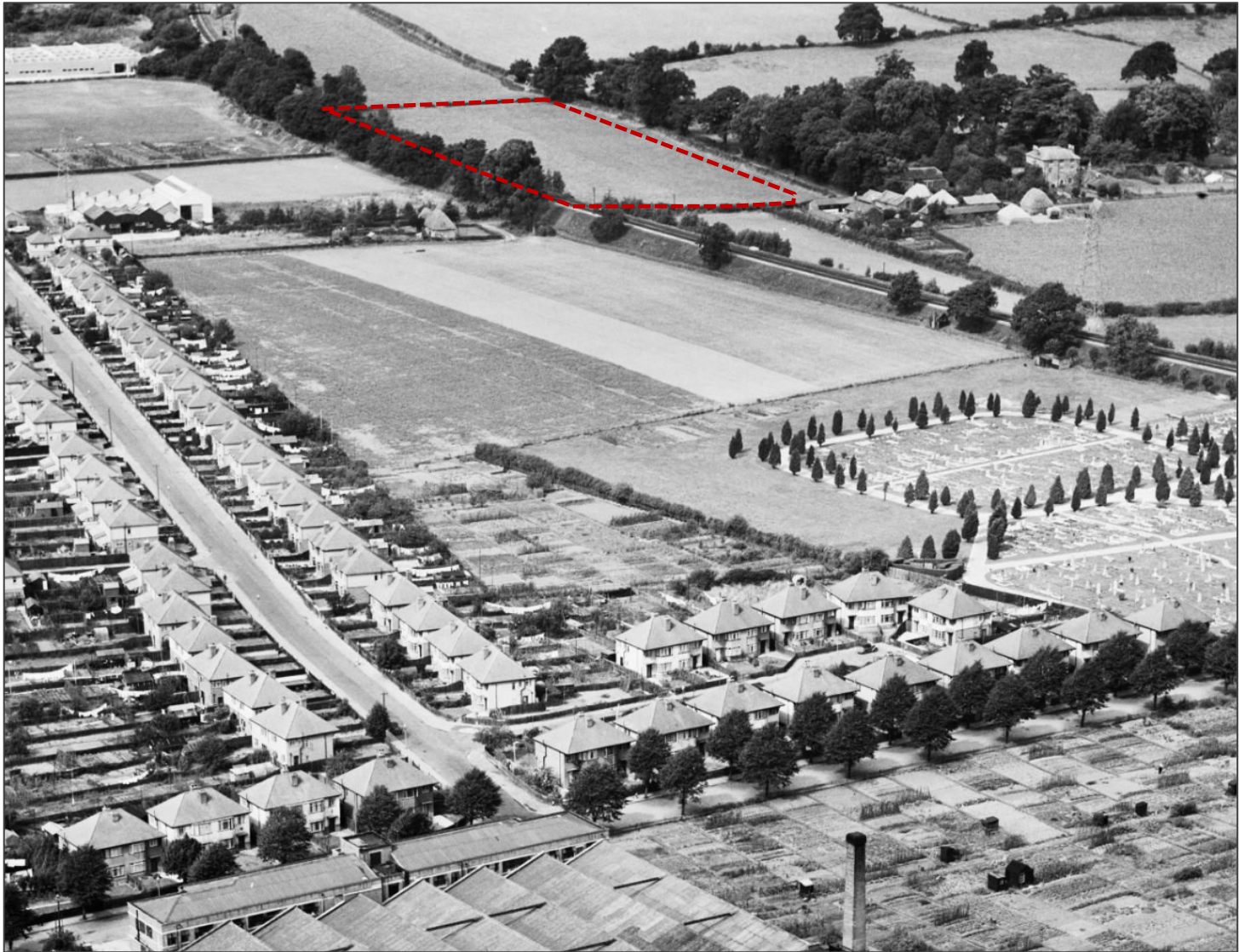


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	Report Ref:		DRA-20-1191	
	Approx. Site Boundary	Info Source:	Historic England	



- Luftwaffe highlighted targets
- Closest highlighted target (~1.2k east of the Site)

APPENDICES: 1 - 7



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Recent German UXB Finds in the UK + Historical Analysis

- **23rd May 2019** - An SC250 (standard 250kg HE bomb) was found during shallow excavations at a building site in Kingston upon Thames, London. *Historical Analysis: The UXB landed in a small residential back garden belonging to an undamaged terraced house. It came to rest approximately 3 to 4m bgl.*
- **15th May 2017** - An SC250 (standard 250kg HE bomb) was found during shallow excavations at a building site in Aston, Birmingham. *Historical Analysis: The UXB landed in a small back garden belonging to a terraced house, part of a row. It J-Curved under a neighbouring garden and came to rest at just 1.4m bgl. NB: These houses had not sustained bomb damage.*
- **2nd March 2017** - A 250kg HE bomb was found during deep excavations at a building site in Brondesbury Park, London. *Historical Analysis: UXB landed in a large residential back garden. A single storey building was built on top of the UXB post-WWII.*
- **19th January 2017** - An SD50 (semi-armour piercing 50kg HE bomb) was dredged from the Thames during barge dredging works near Westminster Bridge, London.
- **12th May 2016** - A 500kg HE bomb was found buried just 1m below the playground of the former Royal High Junior School in Bath. *Historical Analysis: The UXB landed in a plot of neglected, unmaintained vegetation in between the school gym and main school building.*
- **23rd September 2015** - A 1,000kg HE bomb was encountered by a mechanical excavator on a building site in Paradise Street, Coventry. *Historical Analysis: the UXB landed in a large residential back garden occupied by dense vegetation. A two storey building was built on top of the UXB post-WWII.*
- **10th August 2015** - A 250kg HE bomb was found immediately beneath a basement floor during refurbishment works in Temple Street, Bethnal Green (London). *Historical Analysis: The UXB struck a house that had been damaged beyond repair during a previous air raid. The existing house was then built on top of UXB post-WWII.*
- **21st May 2015** - An SC50 (general purpose 50kg HE bomb) was found during deep excavations at a construction site in Wembley, London. *Historical Analysis: UXB landed in a large residential back garden.*
- **23rd March 2015** - A 250kg HE bomb was found during deep excavations at a building site in Grange Walk, Bermondsey (London). *Historical Analysis: inconclusive - reported UXB position is likely inaccurate.*

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

Initiation of WWII Allied Bombs

- **6th January 2014** - Mechanical excavator stuck a WWII bomb in Euskirchen (Germany) causing it to explode, killing the operator and injuring 13 more, two critically. The explosion was so large it damaged buildings 400m away.
- **1st March 2013** - During piling at a construction site in Ludwigshafen (Germany) a small buried WWII bomb exploded, injuring one worker.
- **2nd June 2010** - A British 500kg bomb detonated whilst being defused, killing three EOD engineers in Goettingen, Germany. The bomb was found as builders dug the foundations for a new sports hall. Several houses had their fronts blown off by the blast.
- **19th September 2008** - Seventeen people were injured and buildings were damaged when an excavator apparently drove over and set off a 250kg American bomb at a construction site in Hattingen, Germany.
- **23rd October 2006** - A construction worker breaking up tarmac at the side of a highway near the south-western German town of Aschaffenburg was killed when his machine struck and detonated a WWII bomb. In addition, the blast injured several motorists who were driving past.
- **2006** - A piling rig and dump truck were destroyed when a piling rig struck an Allied bomb on a construction site in Austria.
- **2003** - In the Austrian city of Salzburg, two people were killed while attempting to defuse a 250kg Allied bomb.
- **1994** - At a central Berlin construction site a piling rig struck a large WWII Allied bomb. 3 were killed and 14 more were injured. Dozens of cars in a 250m radius were wrecked, the top 10 floors of neighbouring office building collapsed and human remains were found 100m away.
- **1990** - In Wetzlar (Germany) two EOD engineers were blown up as they removed the detonator of an allied WWII UXB.

Project

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Paragon Building Consultancy Limited

Report Ref:

DRA-20-1191

Info Source:

Various



1-3 Manor Road, Chatham,
Kent, ME4 6AE

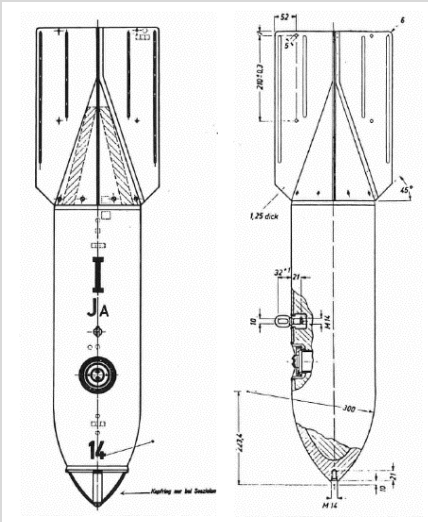
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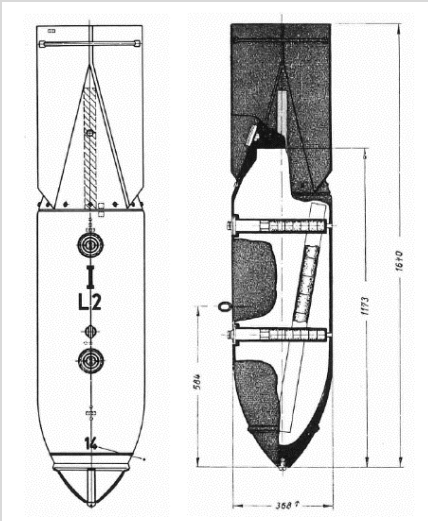
SC 50

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



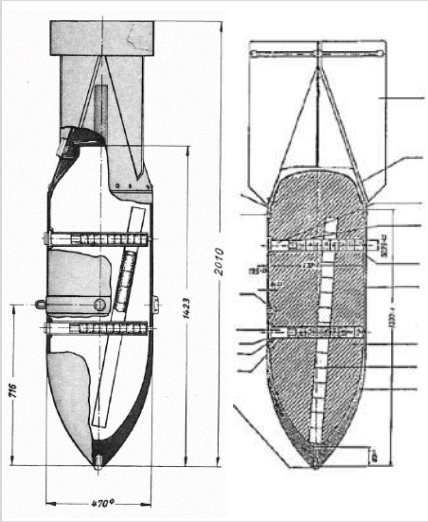
SC 250

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



SC 500

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



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B-1E Sub-Munition

Bomb Weight: 1-1.3kg (2.2-2.87lb)

Incendiary Weight: 680g (1.4lb)

Filling: Thermite

Fuse Type: Simple impact fuse

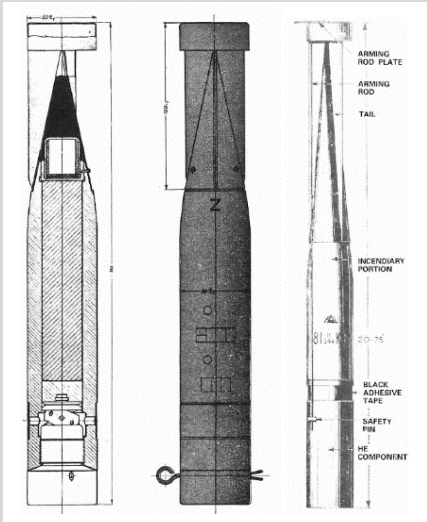
Body Dimensions: 247mm length x 50mm diameter

Appearance: Grey body and dark green painted tail unit. Magnesium alloy case.

Operation: Small percussion charge ignites Thermite (>1,000°C burn).

Variants: Most common variant: B 2EZ (2kg) included a small HE charge

Remarks: Drop containers varied in size. The smallest cluster bomb held 36 x B-1Es and the largest 620 x B-1Es.



Brand C50

Bomb Weight: 41kg (90.4lb)

Incendiary Weight: 13kg (30lb)

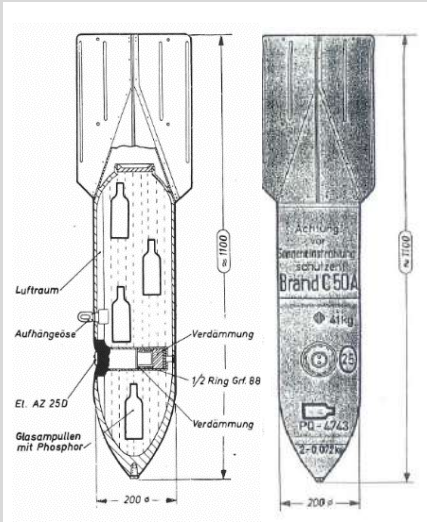
Filling: Main fill (86% Benzine, 10% Rubber) plus 4% Phosphorus in glass bottles

Fuse Type: 1 x electrical impact fuse

Bomb Dimensions: 762mm length x 203mm diameter

Appearance: bomb body and tail painted grey or green with the rear of the bomb painted red and a red band around the centre of the body.

Variants: C 50 B: 77% White Phos fill
C 250 A: 87.7% Petroleum, 11.7% Polystyrene, 0.5% White Phos (185kg version)



Spreng-Brand C50 - Fire Pot

Bomb Weight: 34kg (75lb)

Explosive Weight: 9kg (20lb)

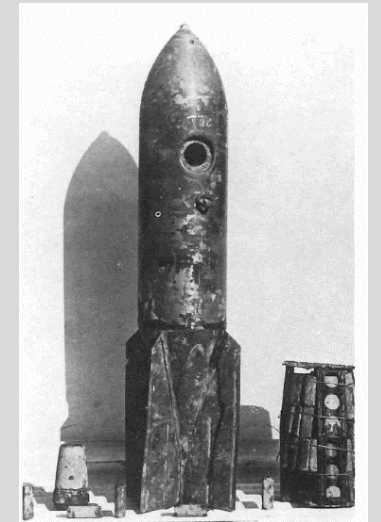
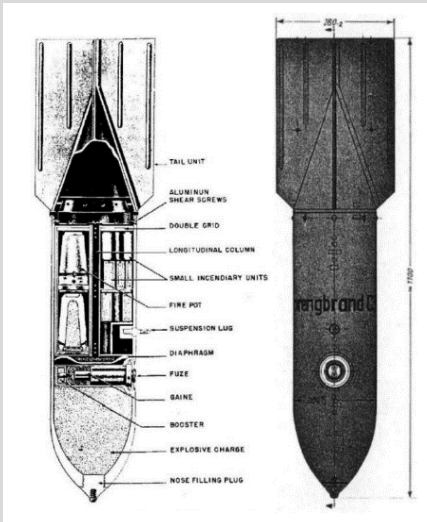
Filling: TNT burster charge, 6 x Thermite containers (fire pots) and 67 x small triangular incendiary elements.

Fuse Type: 1 x electrical impact fuses or aerial burst fuse

Bomb Dimensions: 711mm length x 203mm diameter

Appearance: Bomb body and tail painted grey/green or pale blue with red base plug and red or green incendiary markings. Steel construction.

Operation: A charge blows off the base plate, firing a plume of incendiary mixture 100 yds. Approx 1 second later the HE charge detonates.



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HAA Battery - 3.7" QF Shell

Shell Weight: 12.7kg

Shell Dimensions: 94mm x 438mm

Fill Weight: 1.1kg

Fill Type: TNT

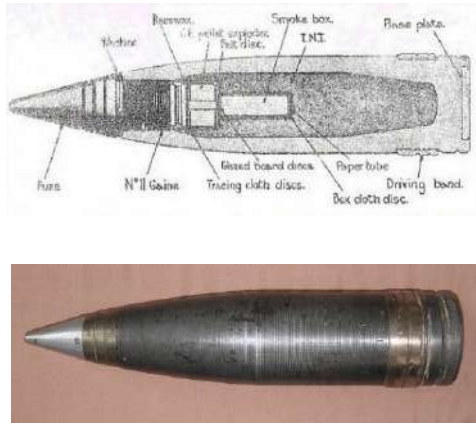
Fuse Type: Mechanical Time Delay fuse

Appearance: Grey body, copper driving bands, brass neck

Rate of Fire: 10 - 20 rpm

Ceiling: 9,000 - 18,000m

Variants: HE or shrapnel shells.
Note, the 4.5" gun was also used in an HAA role throughout the UK.



LAA Battery - 40mm Bofors Shell

Shell Weight: 0.84kg

Shell Dimensions: 40mm x 180mm

Fill Weight: 70g

Fill Type: TNT

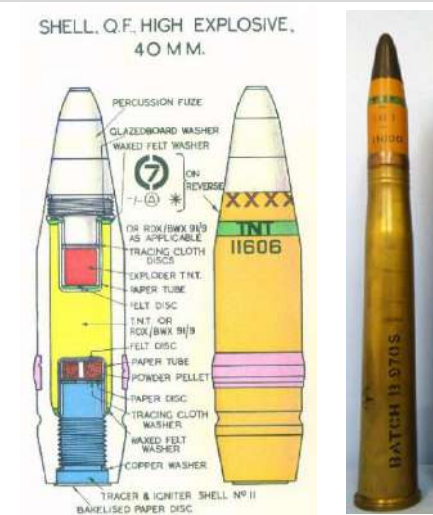
Fuse Type: Impact fuse

Appearance: Grey body, copper driving bands, brass neck

Rate of Fire: 120 rpm

Ceiling: 7,000m

Variants: HE or AP shells. Both with rear tracer compartment



Z Battery - 3" U.P Rocket

Rocket Weight: 24.5kg

Warhead Weight: 1.94kg

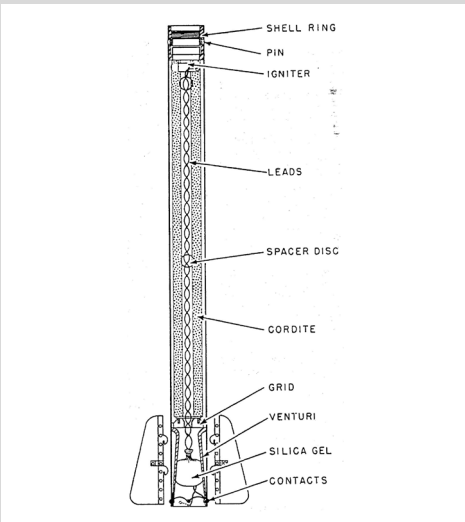
Filling: TNT warhead. Black Powder solid fuel rocket motor.

Fuse Type: Mechanical Time Delay fuse

Rocket Dimensions: 1,930mm x 76mm

Ceiling: 6,770m

Operation: Fired from single, tandem and (later) 36 x rail launchers (Z Batteries). Limited use throughout the UK.



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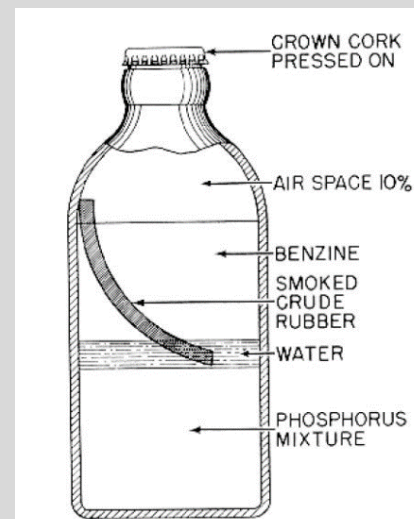
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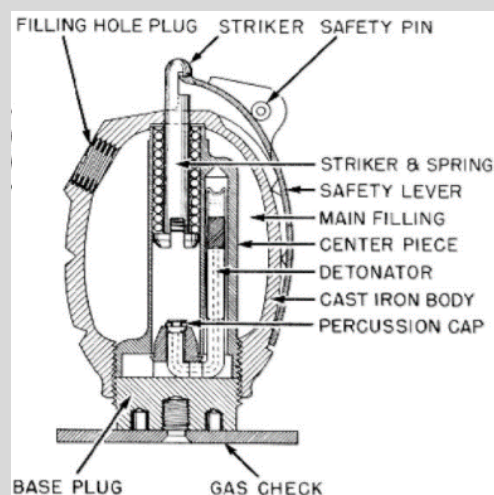
No. 76 Self Igniting Grenade (SIP)

Construction:	Glass bottle and metal stopper
Weight:	0.59kg
Dimensions:	152mm x 63mm
Hazardous Fill:	White Phosphorus and Benzene
Fuse:	n/a
Appearance:	White / off yellow milk bottle
Hazards:	Choking fumes of Phosphorus Pentoxide and Sulphur Dioxide, as well as heat. Severe burns if comes into contact with skin.
Remarks:	By August 1941 well over 6,000,000 of these grenades were available and mainly issued to the Home Guard.



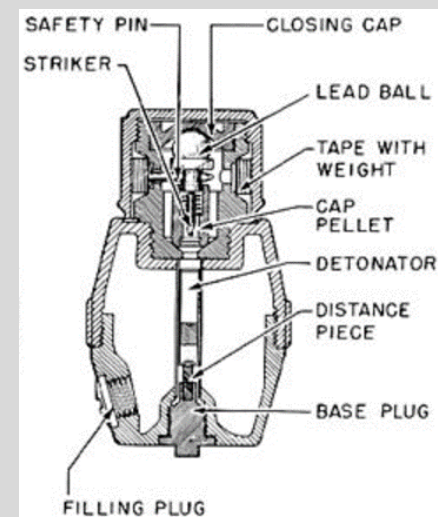
No. 36 Hand Grenade (Mills Bomb)

Construction:	Metal
Dimensions:	95mm x 61mm
Weight:	760g
Fill weight:	71g
Hazardous Fill:	Baratol
Fuse:	Percussion cap and 4 second time delay fuse
Hazards:	Blast, fragmentation. ~30m effective range.
Remarks:	>70 million were produced between 1915 and the 1980s



No. 69 (Blast) Hand Grenade

Construction:	Bakelite (plastic)
Dimensions:	114mm x 60mm
Weight:	383g
Fill weight:	92g
Hazardous Fill:	Baratol, Amatol or Lyddite
Fuse:	'All-Ways' Impact fuse
Hazards:	Blast effect. <20m effective range.
Remarks:	Green bands around the grenade signified a HE fill.



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2" ML Mortar - High Explosive

Weight: 1.02kg

Dimensions: 51mm x 290mm

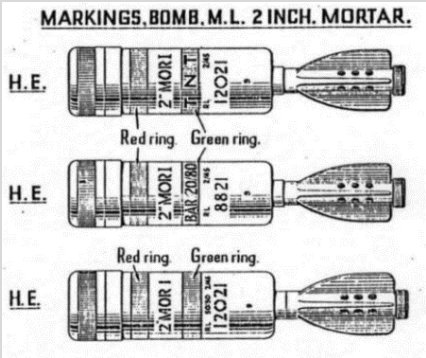
Hazardous Fill: 200g of RDX/TNT

Fuse: Impact fuse

Appearance: Cylindrical shape. Brown body, green and red bands, five finned tail

Variants: Several smoke, inert practice and parachute illumination versions were manufactured

Remarks: Common anti-personnel weapon in use with British Army throughout WWII. >12.5 million HE rounds were produced in 1942 alone



3" ML Mortar - High Explosive

Weight: 4.5kg

Dimensions: 81mm x 490mm

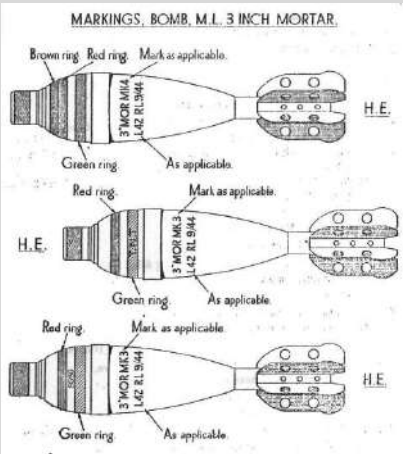
Hazardous Fill: 882g of RDX/TNT

Fuse: Impact fuse

Appearance: Pear-drop shape. Brown body, green and red bands, five finned tail

Variants: Several smoke, white Phosphorus, inert practice and parachute illumination versions were manufactured

Remarks: Common anti-personnel weapon in use with British Army throughout WWII. >6.5 million HE rounds were produced in 1942 alone



PIAT Anti-Tank Weapon

Projectile Type: HEAT - shaped charge

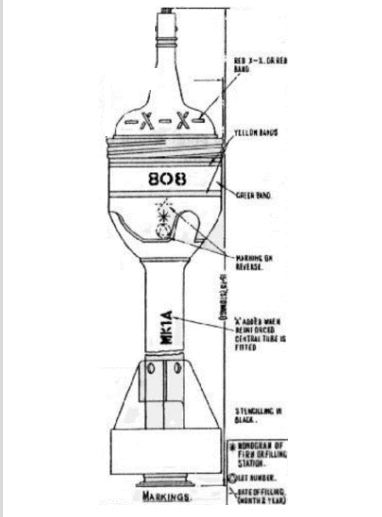
Projectile Dimensions: 400mm x 90mm

Hazardous Fill: Hollow HE charge and small solid propellant charge

Fill Weight: 1.13kg (charge)

Fuse: Impact fuse

Remarks: 115,000 launchers were produced in Britain during WWII and the PIAT was used by most Allied armies during this conflict



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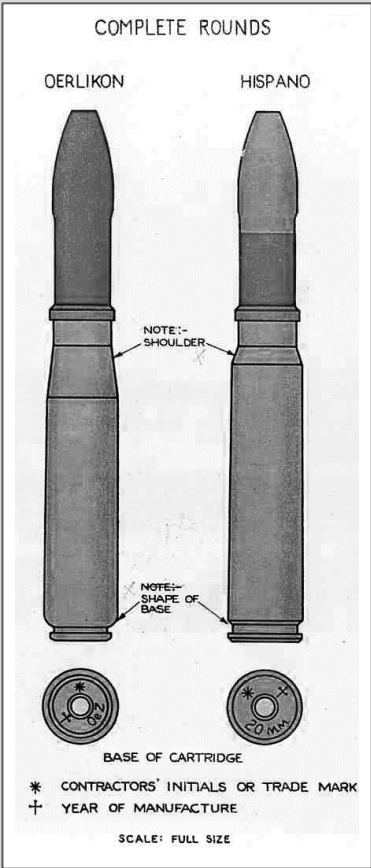


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20mm Cannon Ammunition (various)

Cartridge Weight: 256g (approx.)
Total Cartridge length: 182mm (approx.)
Hazardous Fill: Various HE, incendiary and tracer compositions. Typically TNT, Tetryl and Pentolite.
Fuse: Impact fuse
Appearance: Cylindrical shape. Brown body, green and red bands, five finned tail
Variants: Oerlikon and Hispano 20mm ammunition was deployed in the UK during WWII. These varied slightly in shape and also in the colours used to identify different projectile types.
Remarks: Today, 20mm rounds of WWII vintage may be found unexpended as full single cartridges or in belts of multiple cartridges. Or expended, i.e just the fused projectile without the brass base.



Recent WWII 20mm rounds find

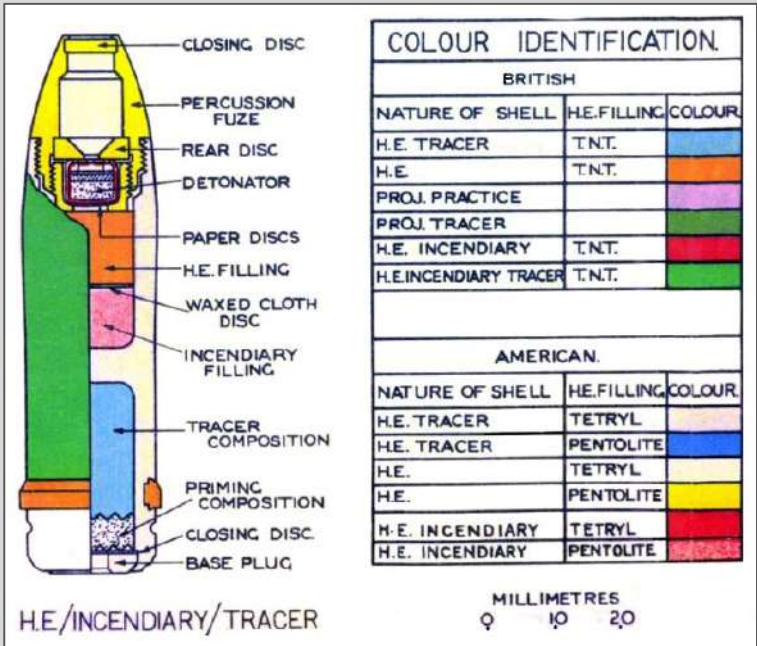


WWII belted 20mm rounds



Bottom Right: Colour identification of Hispano rounds

Bottom Left: Colour identification of Oerlikon rounds



20mm x 110mm Hispano Armour Piercing - 1935 > Present



20mm x 110mm Hispano High Explosive - 1935 > Present



20mm x 110mm Hispano High Explosive Incendiary - 1935 > Present



20mm x 110mm Hispano High Explosive Incendiary Tracer - 1935 > Present



20mm x 110mm Hispano High Explosive Tracer - 1935 > Present

Project

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

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APPENDIX 4: IMPORTATION CRITERIA

IMPORT CRITERIA – COMMERCIAL

CONTAMINANT	RESUSE CRITERIA (1% SOM mg/kg)	SOURCE
NON-METALS		
Asbestos	No detectable fibres	N/A
METALS		
Arsenic	640	C4SL
Cadmium	410	S4UL
Chromium	8600	S4UL
Hexavalent Chromium	49	C4SL
Copper	100	BS3882
Lead	2330	C4SL
Mercury (inorganic)	1100	S4UL
Nickel	60	BS3882
Selenium	12000	S4UL
Zinc	<200	BS3882
POLYAROMATIC HYDROCARBONS		
Naphthalene	190	S4UL
Acenaphthylene	83000	S4UL
Acenaphthene	84000	S4UL
Fluorene	63000	S4UL
Phenanthrene	22000	S4UL
Anthracene	520000	S4UL
Fluoranthene	23000	S4UL
Benzo(a)pyrene	76	C4SL
TPH-CWG - Aliphatic >EC5 - EC6	3200	S4UL
TPH-CWG - Aliphatic >EC6 - EC8	7800	S4UL
TPH-CWG - Aliphatic >EC8 - EC10	2000	S4UL
TPH-CWG - Aliphatic >EC10 - EC12	9700	S4UL
TPH-CWG - Aliphatic >EC12 - EC16	59000	S4UL
TPH-CWG - Aliphatic >EC16 - EC35	1600000	S4UL
TPH-CWG - Aromatic >EC5 - EC7	26000	S4UL
TPH-CWG - Aromatic >EC7 - EC8	56000	S4UL
TPH-CWG - Aromatic >EC8 - EC10	3500	S4UL
TPH-CWG - Aromatic >EC10 - EC12	16000	S4UL
TPH-CWG - Aromatic >EC12 - EC16	36000	S4UL
TPH-CWG - Aromatic >EC16 - EC21	28000	S4UL
TPH-CWG - Aromatic >EC21 - EC35	28000	S4UL

APPENDIX 5: EXTENT OF SURVEY AND LIMITATIONS

EXTENT OF SURVEY AND LIMITATIONS

Paragon has been able to identify perceived risks based on the information reviewed and made available. Where comments are provided based on third party data and or reports provided to Paragon, we cannot be held responsible for the accuracy of the work of others and we assume that all information supplied to us is accurate and representative of the current site conditions.

Environmental risk assessments will be undertaken with due regard to Contaminated Land Guidance documents (available and relevant at the time of issuing our report) issued by (but not limited to) the Environmental Protection Act Part IIA 1990 (and relevant amendments), Department for Environment, Food and Rural Affairs (DEFRA) and its predecessors, the Environment Agency (and its devolved equivalents), British Standards Institute (BSi), the Royal Institution of Chartered Surveyors (RICS) and the American Society for Testing and Materials (ASTM) Standard E 1527-13. No liability can be accepted for the effects of any future changes to such guidelines and legislation. In the event that guidance / legislation changes it may be necessary for Paragon to update or modify reports.

Specific comment is made regarding the site's status under Part 2A of the Environmental Protection Act (EPA) 1990, which provides a statutory definition of Contaminated Land and as revised under The Contaminated Land (England) (Amendment) Regulations 2012 (and relevant amendments, where applicable). Unless specifically stated as relating to this definition, references to 'contamination' and 'contaminants' relate in general terms to the presence of potentially hazardous substances in, on or under the site.

The risk assessment (where included) is dictated by the finite data on which it is based and is relevant only for the purpose of which the report is commissioned. If additional information or data becomes available which may affect the opinions expressed in our report, we reserve the right to review such information and, if warranted, to modify the risk assessment accordingly. We reserve the right to charge an additional fee for un-anticipated second opinion reviewing of previous reports. A site inspection was not carried out within the scope of this assessment.

Where budget costs are included in our report, these costs are for guidance purposes only.

Our report will be for the attention and purposes of the Addressee only and consequently we cannot accept any third party liability for the whole or any part thereof. Neither may the whole nor any part of our report, nor any reference thereto, be published in any way nor included in any published document, circulate or statement without our prior written approval of the form and context in which it may appear.

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