Practical strategies for effective risk assessment and management of unexploded ordnance

Dynasafe BACTEC Limited

Philip Norville
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Dynasafe BACTEC Limited

Dynasafe BACTEC - the UK’s leading Unexploded Ordnance Risk Mitigation provider

26 years experience in commercial UXO support

Over 6000 projects delivered to date in over 50 countries

Widest range of UXO services offered to the Construction & Development Industries

Unrivalled International Land & Marine Capabilities

Part of the Dynasafe Group
Munitions and Ordnance are designed with one objective – to explode

Intended purpose can be to Kill, Maim, Destroy, Damage, Disable, Immobilise, Ignite, Burn………..

Accidental detonation of UXO item is typically low

Consequences should detonation occur can be very serious

….Potential for UXO should be considered on all projects and the risk managed and mitigated
UXO Legacy

Heavily Bombed UK Cities – WW2
(This list is not exhaustive)

- London
- Liverpool
- Hull
- Plymouth
- Bristol
- Southampton
- Portsmouth
- Birmingham
- Sheffield
- Coventry
- Norwich
- Cardiff
- Newport
- Bradford
- Glasgow
- Belfast
- Nottingham
- Wrexham
- Manchester
- Barrow
- Swansea

WWII Bombing Densities – Source BombRisk.com
Why is UXO risk still significant to the Construction Industry in 2017?
2017 Finds / Near Misses

- Found on ‘Low Risk’ site in Birmingham
  Destroyed In Situ by Army EOD Team

- Found on ‘Cleared’ site in London
  Outside zone ‘Cleared’
  Defused and removed by Army
Limited amount of UXO guidance for UK Construction Industry
Preliminary Risk Assessment

Doesn't need to be completed by a UXO specialist

Commenced at an early stage – before intrusive groundwork including SI / GI

Purpose is to assess the likely potential for UXO hazard (qualitative screening exercise)

Desktop review of historical use and information of site

- Previous site use
- Post war redevelopment
- Wartime bombing records
  - Abandoned bomb register
  - ARP bomb census maps
- Military records
  - Former MoD use
  - Training facility
  - Home Guard
- OS Mapping
- Local open source records

Written report – clearly referenced
## Preliminary Risk Assessment

### Indicative British / Allied UXO Risk

- **Risk Level:** MEDIUM

### Indicative German UXO Risk

- **Risk Level:** HIGH

### Source

<table>
<thead>
<tr>
<th>Source</th>
<th>Number within 10km</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bombing Decoy Sites</td>
<td>1</td>
</tr>
<tr>
<td>Abandoned Bombs</td>
<td>16</td>
</tr>
<tr>
<td>Press Articles regarding UXO Finds</td>
<td>8</td>
</tr>
<tr>
<td>WWII Defence Related Positions &amp; Pillboxes</td>
<td>79</td>
</tr>
<tr>
<td>Historic Army Camps</td>
<td>2</td>
</tr>
<tr>
<td>Prisoner of War Camps</td>
<td>3</td>
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<tr>
<td>Military Training Areas and Firing Ranges</td>
<td>1</td>
</tr>
<tr>
<td>Heavy Anti-Aircraft Batteries</td>
<td>14</td>
</tr>
<tr>
<td>Army Explosive Ordnance Clearance Tasks/Recces</td>
<td>31</td>
</tr>
<tr>
<td>Sites Related to the Manufacture of Explosives and Explosive Ordnance</td>
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</tr>
<tr>
<td>Dynasafe BACTEC Desk-top Threat Assessments</td>
<td>364</td>
</tr>
</tbody>
</table>

### Abandoned Bombs

<table>
<thead>
<tr>
<th>Description</th>
<th>Approximate distance (km) from site</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 x 250kg, Front of 72/74 Warwick Gardens, Kensington</td>
<td></td>
</tr>
</tbody>
</table>

### Army Explosive Ordnance Clearance Tasks/Recces

<table>
<thead>
<tr>
<th>Location</th>
<th>Approximate distance (km) from site</th>
</tr>
</thead>
<tbody>
<tr>
<td>WWII British Anti-Aircraft Shell 12/3/56</td>
<td>0.9</td>
</tr>
</tbody>
</table>
Ordnance Size and Penetration Depth

- Made ground 1m bgl
  - 50kg
  - Incendiary bomb
  - Mortar round
  - AAA projectiles

- 3m bgl
  - 50kg
  - 18" Naval projectile

- 15m bgl
  - 250kg
  - 500kg

- Dumped / cached munitions in former military premises
- Buried munitions cache
- Small Arms Ammunition (SSA)
- Low angle penetration

Area Clearance Protection Demilitarisation
Detailed Risk Assessment

Detailed risk assessments should only be carried out by a UXO Specialist

Builds on the UXO preliminary risk assessment

Site scope / Construction methods

Ground conditions

History & past use

WWII bomb / UXO records*
  - MoD records
  - Bombing density records
  - Local Authority records
  - Aerial photography
  - Anecdotal records

UXO Bomb Penetration Depth (BPD) assessment (based on historic ground level and soil data)

* Regional availability / variance in quality
Detailed Risk Assessment

Points to consider in a DRA

Regional variances in information
  - Bomb Maps
  - Photos
  - Other sources

Accuracy of information
  - Estimation of impact
  - Plotting on maps / drawings

Censorship

Resources
  - Heavy Raids
  - Infrastructure
  - Backlogs
HSE guidance recommends proactive risk mitigation measures in accordance with ALARP approach

Non-Intrusive Surveys

Sensitive CV sensors
Typically 1m swath width per sensor

Proprietary AGS software
Logs coordinates, mass and depth of ferrous anomalies

Typical survey depth
  LSA up to 1m
  50kg bomb up to 4m

Fast & cost effective
HSE guidance recommends proactive risk mitigation measures in accordance with ALARP approach

On Site Risk Mitigation Measures

Non-Intrusive Surveys

Limitations
Depths
Non-Ferrous items
Brownfield sites

If in doubt ask for a trial
Seek independent advice
HSE guidance recommends proactive risk mitigation measures in accordance with ALARP approach

Intrusive Surveys

Variety of platforms
Proprietary probe
2m radius and < 1m look ahead facility
20m+ depth
Fast and cost effective
Data is logged at
AGS software and interpretation
HSE guidance recommends proactive risk mitigation measures in accordance with ALARP approach

**Intrusive Surveys**
- Variety of platforms
- Proprietary probe
- 2m radius and < 1m look ahead facility
- 20m+ depth
- Fast and cost effective
- Data is logged for full depth of survey
- AGS software and interpretation
On Site Risk Mitigation Measures

HSE guidance recommends proactive risk mitigation measures in accordance with ALARP approach

Site UXO Supervision & Monitoring

UXO specialist Banksman (Qualified EOD Engineer)

Provision of tool box talks for specific works

Ensure safety of excavation works

Real-time identification of suspect items

Recording of all potential ordnance items

Instigate emergency response if appropriate

Remove any UXO if appropriate
UXO Risk Mitigation and Implementation

HSE guidance recommends proactive risk mitigation measures in accordance with ALARP approach

Site Investigation / GeoEnvironmental Work

Same potential UXO risk present on site

Typically supported by EOD Engineer UXO

Supervision and Monitoring

Trial pits / trenches

Boreholes – sampling

Well installation

‘Down Hole’ surveying to provide drilling clearance or detection of ferrous anomaly (non-ferrous casing / removal of casing)

This approach is not suitable for clearance ahead of piling or other intrusive techniques
Local Community Communication and Engagement

'Bomb found in Peacehaven'
A suspected wartime bomb has been discovered at a building site in East Sussex.
Sussex Police said it could contain up to 1,000lbs (450kg) of high explosive.
A 200m exclusion zone has been set up and nearby buildings evacuated. The A259 South Coast Road is closed between Rottingdean and Newhaven.

'Bath WW2 bomb scare: Hundreds of homes evacuated'

'WW2 bomb found on Brondesbury Park building site'
All homes within a 200m radius and a nearby nursery school were evacuated after police and fire crews were called to the scene.

'Frankfurt WW2 bomb defused after mass evacuation'

Area Clearance Protection Demilitarisation
Case Study – Royal High Junior School, Bath

Residential redevelopment of historic former school and construction of new build residential units

Client was aware of Luftwaffe Bombing in 1940-41 and 1942

Bombing records of the surrounding area confirmed medium bombing density

5 recorded HE Bombs on site plus incendiary bomb showers

Significant damage to buildings on site in period including one totally destroyed and one requiring demolition

Anecdotal evidence suggests Baths Civil Defence Association frequently did not carry out post raid checks
Case Study – Royal High Junior School, Bath

Residential redevelopment of historic former school and construction of new build residential units

Risk of shallow incendiaries and UXO largely mitigated due to post war construction activities

Bomb Penetration depth of 6-8m based on site geology

Recommendations

- Safety and Awareness Briefings to all Staff
- Intrusive Magnetometer Surveys
- EOD Engineer Watching Brief
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Case Study – Royal High Junior School, Bath

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Bath WW2 bomb scare: Hundreds of homes evacuated

© Avon & Somerset Police

227kg
0.4 Metres

1.42 Metres
© Avon & Somerset Police

@MurrayKenneth

Area Clearance | Protection | Demilitarisation