1st Line Defence

Unexploded Ordnance Risk in the UK

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“1st Line Defence are UXO Specialists and Consultants dedicated to providing bespoke solutions to the UXO risk for our clients”
Who Are We?

- Company formed July 2011 from extensive commercial and military background
- Head office Hoddesdon, Herts – work across whole UK
- Now one of the UK’s Leading UXO Specialists
- Professional and highly competent
- All operatives and senior management ex-military RAF/Navy/Army
Who are our clients?

• UK Construction Industry
• Councils and Government Agencies
• Ground Investigation Companies
• Archaeologists
• Piling Companies
• Consultants
• Land Remediation Companies
What services do we provide?

• *Express Preliminary UXO Threat Assessments*
• Detailed UXO Threat Assessments
• UXO Specialist On-site Support
• Intrusive UXO Surveys
• Non-intrusive UXO Surveys
• UXO Safety & Awareness Training
• Marine Ordnance Services
• Quality Assurance & Consultancy
• On-Call/Rapid Response

“Our expertise lies in dealing with historic unexploded ordnance contamination throughout the UK and abroad”
Background to UXO Threat in UK

- RAF / USAAF Sites
- Home Guard Activities
- Land Service Ammunition / Small Arms Ammunition Contamination
- German Air-Delivered Ordnance
- Allied Air-Delivered Ordnance
- Aircraft Activity and Crashes
- Explosive ordnance manufacturing, storage and disposal

- Usage of decoy sites
- Training and staging areas
- Defensive Positions
- Firing Ranges
- Army Camps
- Anti-aircraft Batteries
- Prisoner of War Camps
- Military Training Areas

ARP Record, Nottingham
Historical Records, Manchester
Major Target, Pembroke Dock
Major Target, Rail Infrastructure
Recent UXO Finds
Recent UXO Discoveries

Live 500kg German HE Bomb found, Bermondsey
March 2015
Recent UXO Discoveries

Live 50kg German HE Bomb found, Wembley, May 2015
Recent UXO Discoveries 2015

Live 250kg German HE Bomb found, Bethnal Green, August 2015
1000kg UXB, former Armstrong Siddeley works, Coventry, September 2015
Recent UXO Discoveries

50kg bomb found during works on Thames embankment, January 2017
250kg German HE Bomb found Brondesbury Park, London. March 2017
• WWII bomb blast kills digger driver in Germany
• Eight others injured
• Blast impact felt 1km away
• Nearby cars and office buildings damaged

3rd January 2014
Express Preliminary Threat Assessment

- Three to four page report
- Reports produced within 1 day
- Accurate, valuable information
- Clear and concise
- Impartial conclusions
- Produced by specialist graduate researchers
- Conforms directly to CIRIA C681
Express Preliminary Threat Assessment

- Basic Site Data
- Previous Military Use
- Indicators of potential aerial delivered UXO threat
- Consideration of any Mitigating Factors
- Extent of Proposed Intrusive Works
- Requirement for Additional Research or Risk Mitigation Works
Express Preliminary Threat Assessment
Detailed Threat Assessment

- 7-10 Day Turnaround with Competitive Pricing
- WWII-era Aerial Photography Standard
- Includes visits to Local and National Archives as Standard
- Risk Fully Qualified with Transparent Risk Assessment
- Clear, Concise, Common Sense
Five Key Considerations

1. The risk that the site was contaminated with UXO
   - Bomb Density
   - Bomb Damage
   - Frequency of Access
   - Ground Cover
   - Bomb Failure Rate
2. The risk that UXO remains
3. The risk of encountering UXO
4. The risk that UXO might be initiated
5. The consequences of initiation and/or encounter
These are the most common types of high explosive bombs dropped over the UK
WWII Bombing
London Bomb Density Map

Examples of Bomb Census Mapping
## WWII Bombing

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Event Description</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>2/3/43</td>
<td>11:33</td>
<td>Minor Bombing, N.S. Wavell, J. B. Junction, Florey,</td>
<td>Damage</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>from Field</td>
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</table>
WWII Bombing
Example of Blast Effect
J-Curve Effect

Lateral offset from point of entry
Detailed Threat Assessment
Risk Levels

Detailed UXO Risk Assessments
- High Risk: 27%
- Medium Risk: 61%
- Medium-High Risk: 9%
- Low Risk: 3%
- No Further Action: 0%

Preliminary UXO Risk Assessments
- No Further Action: 48%
- Detailed Threat Assessment: 52%

607 Express Preliminary Assessments
386 Detailed Assessments
ALARP Principle
Non-Intrusive Survey

- Sensitive one, three or four sensors
- Data2line UXO software
- 0.5 m swath width per sensor
- Survey depth typically: grenade up to 1m & 50kg bomb up to 4m
- Fast & cost effective
- Target mass & polar coordinates
## Non-Intrusive Survey

**Survey**
- Date of Survey: 26th July 2011
- Surveyor: Mark Watson
- No. Of Sensors: 1
- Line Spacing: 0.5m
- Sensor Elevations: 0.10m

**Interpretation**
- Date of Interpretation: 26th July 2011
- Interpretation By: Brett Kinsman
- Area: Turbine 8
- Noise Threshold: 250 nanoWebers
- Depth To: Below Ground

**Anomaly Investigation**
- Date of investigation: 15 Jul 12
- TDO Supervisor: P. HENY

<table>
<thead>
<tr>
<th>Number</th>
<th>Coordinates</th>
<th>Depth (m)</th>
<th>Volume (m³)</th>
<th>Date</th>
<th>Excavation</th>
<th>Findings</th>
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<tbody>
<tr>
<td>Turbine 8</td>
<td>1</td>
<td>55°41'06&quot;.79&quot;</td>
<td>300'55.39.19&quot;</td>
<td>0.1</td>
<td>1.0</td>
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<tr>
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<td>0.6</td>
<td>0.6</td>
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<tr>
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<td>55°41'04&quot;.83&quot;</td>
<td>300'55.33.95&quot;</td>
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<td>300'55.33.95&quot;</td>
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**Survey Overlay of False colour Anomaly Maps**

- **Approximate Site Boundary:**
- **Owner:** Balfour Beatty
- **Project:** Highams Park Lake
- **Reference:** OPN5870
- **Source:** DP Line Defence Limited
### Target Investigation

<table>
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<th>OPN</th>
<th>Site</th>
<th>Item Found</th>
<th>Modelled Information</th>
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<tbody>
<tr>
<td>2925</td>
<td>Icknield Way, Norfolk (Field 1 Box 4) (Target 4)</td>
<td>Smoke Phosphorus 4.2&quot; Mortar</td>
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<td></td>
<td></td>
<td></td>
<td>Volume [l]</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Inclination [°]</td>
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<td></td>
<td></td>
<td></td>
<td>Local X [m]</td>
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<tr>
<td></td>
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<td>Local Y [m]</td>
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<td></td>
<td></td>
<td></td>
<td>Latitude [°]</td>
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<td></td>
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<td>Min. Value [nT]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Max. Value [nT]</td>
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</tbody>
</table>

**TI Information**

- Depth$_{low}$ [m]: 1
- Depth$_{high}$ [m]: 0.5
- Inclination [°]: 40

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**DIAGRAMS**

1. **Red ring:**
   - Painted green.

2. **SMOKE PHOSPHORUS:**
   - Fuze 162.
   - Tracing cloth discs.
   - Glassboard discs.
   - Exploder pellets.
   - Filled F.M. or CSAM.
   - Tail unit.

3. **Data Plots:**
   - NI Data -5 to +5 nT Range
   - NI Data -15 to +15 nT Range
   - NI Data -50 to +50 nT Range

*Note: Grid lines are 1m x 1m.*
- Intrusive Survey
- Variety of platforms
- Combined Geotechnical CPT
- 2m radius and 0.50m look ahead
- Proprietary software and interpretation
- Fast and cost effective
- 20m+ depth
<table>
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<tr>
<th>Section of site</th>
<th>Survey reference</th>
<th>Co-ordinates</th>
<th>Date of Survey</th>
<th>Depth of survey (m)</th>
<th>File (or borehole) not encompassed by clearance radius</th>
<th>Actual Clearance radius (m)</th>
<th>Clearance</th>
<th>All piles cleared? (Y/N)</th>
<th>Interpretation</th>
<th>Comments / Notes</th>
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<td>435135.276</td>
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<td>DW</td>
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Intrusive Survey
Intrusive Survey
UXO Specialist On-site Support

• Immediate specialist response to Unexploded Ordnance (UXO) or any suspicious items.
• Immediate safety evaluation of any items of UXO found.
• On-site incident control and advice in the event of an ordnance find.
• On-site Ordnance Awareness Safety briefings to project personnel.
UXO Specialist On-site Support
UXO Investigation
Examples of Recent Projects

Case Studies
• Area of works adjacent to former WWII high-altitude practice bombing range
• Area used by the military for training up until 1950
• Non-intrusive UXO Magnetometer Survey carried out
• Practice bombs and live mortar rounds found during Target Investigation
• 1st Line Defence were commission to undertake Detailed UXO Risk Assessment
• Site comprised open area of marsh adjacent to major industrial targets
• 2 x 250kg bombs removed from site during war and incendiary bombing recorded over area
• Non-intrusive UXO magnetometer survey undertaken
• 1kg incendiary bombs and base of AA projectile recovered
Royal Wharf, London

- Risk Assessment undertaken – risk identified from German UXBs
- Over 1000 intrusive UXO magnetometer surveys undertaken to date
- Several phases of works over last two years
Loch Rannoch, Scotland

• 1st Line Defence were commissioned to undertake UXO ‘Watch & Brief’ Support during the planned removal of tree stumps
• Research identified that area used for training by Norwegian forces during WWII
• Numerous live mortar rounds were identified and safely dealt with
- UXO Awareness Briefings to project personnel
- “Watch and Brief” shallow excavation support
• Intrusive UXO Survey
• 691 Surveys across three site areas
Shoeburyness Northern Sea Wall

- Non-intrusive survey followed by 100% target investigation
- Over 600 items of ordnance found
The Moor, Sheffield

- 961 Pile Locations Cleared
Our competitive edge
What we do better than others?

- Professional & Friendly
- Expert
- Honesty and integrity
- Employ only the highest quality specialists
- Attention to detail
- Take the good, discard the bad
- Reasonable and appropriate advice

A Common Sense Approach to UXO Risk Management
Questions?