1ST LINE DEFENCE

UXO SOLUTIONS

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UNEXPLODED ORDNANCE

1ST Line Defence will assess, manage and mitigate the risk posed by unexploded ordnance (UXO)

Investigation, Disposal and Certification

Once 1ST Line Defence has completed a non-intrusive or intrusive survey, the data is processed and analysed. Any item identified that corresponds with the mass and dimension range of UXO are designated as targets requiring follow up action. The client will be consulted throughout this process and the intended works and end use of the site will be taken into consideration.

1ST Line Defence will arrange for a UXO Specialist team to expose the target to enable a positive identification to be made.

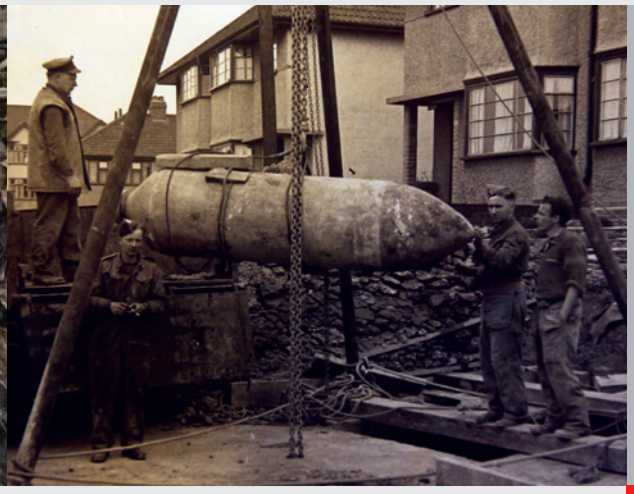
The procedure will be determined by the ground conditions, location, depth and nature of the suspect item but may include:

- Open cast excavations
- Vertical and horizontal shafting
- Other specialist temporary works

If a target is identified as an item of ordnance by the UXO Supervisor, an on-site threat assessment will be carried out. The object will be categorised and classified according to its potential hazard and will be disposed of by the appropriate method. The disposal will be conducted either by 1ST Line Defence or by the relevant local authorities.
A clearance certificate and factual report will be issued, specifying the results of the survey, investigation, clearance and any disposal carried out.

1ST Line Defence specialists are highly trained and experienced in Unexploded Ordnance (UXO) Risk Mitigation, their technical capabilities and professionalism are recognised throughout the UK. Our clients are provided with comprehensive and thorough risk mitigation. Their technical capabilities are based on the experience of extensive field work, an in-depth knowledge of the threats and full understanding of executing clearance processes.

1ST Line Defence is able to provide tailored UXO risk mitigation strategies from preliminary desktop threat assessments through to the complete risk mitigation process concluding in clearance certification to meet the client's requirements.



Consultancy

1ST Line Defence offers consultancy in the following areas:

UXO Risk Mitigation Plans

1ST Line Defence provides a comprehensive risk mitigation plan for any site that is likely to contain, or suspected of containing UXO. This report will identify the level and nature of the risk posed on the site with recommendations for appropriate risk mitigation measures to be put in place by implementing the following:

- Historical evaluation to identify and prioritise areas at risk.
- Desk top and field studies to measure the risk posed by UXO.

Project Development

- Provide technical advice in the initial development of a project
- Preparation of tender documentation for UXO risk
- Equipment specifications and procurement
- Third party monitoring and Quality Assurance/ Quality Control of field operations
- Project Management of UXO and civil engineering tasks

Desk Top Threat and Risk Assessment

1ST Line Defence provides comprehensive reports on the potential risk posed by UXO upon the site location, extent, source and nature of potential UXO, the likelihood and consequence of encountering UXO related to the proposed use of the site. The report is completed within and to the CIRIA C681 guidelines.

Typically a full report includes:

- Conflict history of the site and surrounding area
- Historical and archived material from the public domain
- Local research including select interviews with local inhabitants where appropriate
- Military historic records
- Historical aerial photography
- Likely nature of contamination
- Weapon features and bomb penetration depth
- Recommended risk mitigation measures

Site Support

Dependent upon the site conditions, the level of risk posed by UXO and the construction method, 1ST Line Defence offers the following on-site services:

Unexploded Ordnance Awareness Briefings

> Briefings are intended to make site personnel aware of the UXO they may encounter on a contaminated site and the simple procedures necessary to ensure everyone's safety

> Each briefing is customised to meet the needs of the client and the workforce and reflects the specific history and situation of each site.

> 1ST Line Defence can provide briefings to all personnel working on a site, either as part of the overall site induction or as a separate standalone briefing.

UXO Specialist On-Site Support

In areas where the risk posed by the potential presence of UXO is low or in areas where the ground is grossly contaminated to the point where the use of detection equipment would be ineffective, 1ST Line Defence will provide UXO Specialists to monitor ground works and provide reactive support.

In the event of the discovery of a suspect item during site works the attendance of one or more of 1ST Line Defence UXO Specialists or in the appropriate circumstances a specialist on-call, has proved repeatedly to be the best method of minimising the risk to on-site personnel and limiting downtime; providing rapid on-site response; investigating any suspect items encountered, and taking the appropriate action.

As part of the UXO support, 1ST Line Defence UXO Specialists will provide UXO Awareness Briefings for all personnel working on the site, as required.

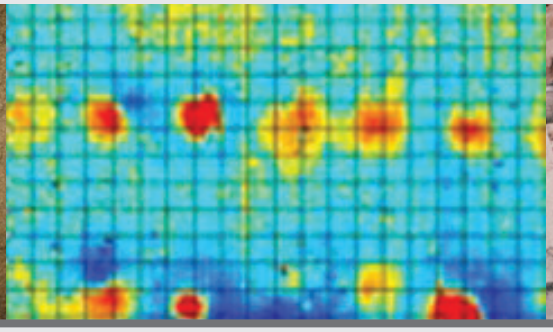
On-Call UXO Response

1ST Line Defence provides site and project specific UXO response facility when full time UXO on-site support is not warranted or is not contracted for, to meet the project needs.

This service incorporates UXO Site Specific Guidelines, procedural training and response procedures to ensure that the suitable level of UXO response is in place for the project.

Rapid Response

In the event of the discovery of UXO, 1ST Line Defence can provide reactive support to manage the incident and recommend future risk mitigation measures if required.



Surveys

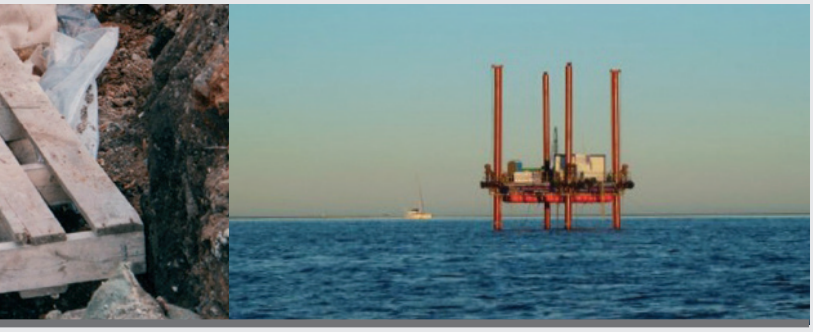
1ST Line Defence uses a wide range of specialist geophysical survey technologies, both non-intrusive and intrusive to detect buried metallic items which may be UXO. The type of survey is determined by a number of factors including the type and probable depth of UXO contamination, ground conditions and the proposed future use of the site.
Other surveys that can be carried out include archaeological and environmental.

1ST Line Defence Non-intrusive Survey Systems

1ST Line Defence provide Non-Intrusive UXO Magnetometer Surveys to detect ferrous sub-surface anomalies that have comparable mass and dimensional characteristics to items of UXO/UXB's. The survey system can detect a 50kg bomb up to 4m deep, dependant on ground and site conditions. A variety of configurations can be deployed to suit environmental conditions and clearance requirements. Typically following a UXO survey, a physical investigation of the magnetic anomalies that have been identified as suspect targets would be carried out.

Data Interpretation

1ST Line Defence uses state of the art processing software with highly-accurate object calculation producing a false color anomaly map showing all identified ferrous targets and anomalies which model as potential UXO. These targets can then be investigated by UXO Specialists to physically identify whether they are UXO or not.
Generally Non-Intrusive UXO Surveys are used on Greenfield sites as they can be ineffective on Brownfield sites.
In some circumstances the effectiveness of the survey can be limited by environmental conditions these include any nearby buildings and reinforced structures, services, ferrous material or made ground on the surface, reinforced concrete and the proximity of traffic. All of the above should be taken in to consideration during the planning and consultation with 1ST Line Defence when considering the deployment of these systems. We will not recommend the deployment of this system to our clients if there is potential for it to be ineffective and alternative methods are available to achieve the same outcome. This will generally save our clients money.



1ST Line Defence Intrusive Survey Systems

1ST Line Defence can provide Unexploded Bomb (UXB) Intrusive Survey to give clearance ahead of individual pile locations or clusters & boreholes. This method permits survey at depths not achievable by non-intrusive methods and in conditions beyond the detection capabilities of a non-intrusive survey, such as in areas of made ground. Anomalies identified during the survey, which are identified as having similar characteristics of a UXB, can be avoided or investigated dependent upon the site conditions and the client's requirements.

The UXB Intrusive Magnetometer Survey can be deployed on different platform configurations to suit specific environments that our clients require including overwater.
1ST Line Defence can provide a combined UXB and Cone Penetration Testing (CPT) Survey which will provide geotechnical data and clearance for UXB's on each position surveyed.

1ST Line Defence UXO Intrusive Survey system has the following features:

- **Rapid and Cost effective Data Acquisition**
  The system uses a specially developed sensor, which is configured to survey a column of ground as it is vertically inserted. The system can quickly and effectively record the vertical depth of a magnetic anomaly, its horizontal distance from the probe and theoretical modelled mass.
- **Flexible Data Interpretation**
  1ST Line Defence software system is specifically configured for deep UXO detection. Algorithms have been written which analyse the data and produce tailored outputs for clients allowing historically difficult sites to be surveyed by filtering out the ambient magnetic signature.
- **Flexible**
  The system can be configured in a wide variety of platforms e.g. via a wheeled or tracked rig, jack up barge or rail.

If the client has a requirement for both geo technical information as well as clearance for deep buried ordnance, 1ST Line Defence can deploy its combined magnetometer and CPT cone to provide these two data sets as a single operation.

UXO Intrusive Survey over water

Projects in the shallow marine, waterway or intertidal environment, the likely depth of munitions or the depth of clearance required by the client will be greater than the detection that can be achieved by a non-intrusive system. 1ST Line Defence will carry out an intrusive survey from a suitable platform. In such cases 1ST Line Defence is able to deploy its Intrusive Survey System from a Jack-up Barge to investigate extreme marine depths.

MARINE SERVICES

Marine and Underwater UXO

Many areas of the world's marine environment have been contaminated by explosive ordnance as a result of years of conflict, military use and sea dumping, leaving behind a legacy of unexploded ordnance including Land Service Ammunition (LSA), through to bombs and sea mines.

1ST Line Defence Marine Services include the following:

- ROV Survey
- Target Investigation
- Diver Investigation
- Mechanical Investigation

Risk Assessment

Risk assessments are carried out prior to any task to establish the nature and quantity of the potential explosive ordnance hazard that may be present in the survey area to identify and implement the appropriate risk mitigation measures.

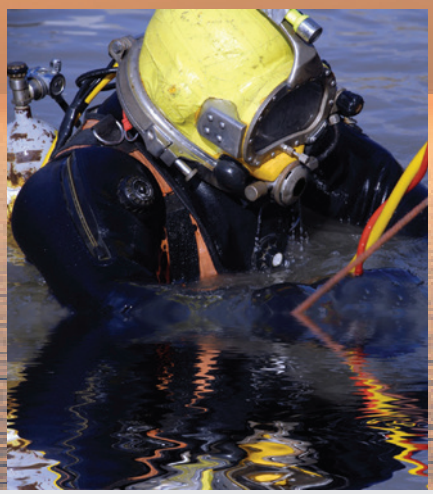
Target Investigation

All 1ST Line Defence Diving Operations are carried out in accordance with the relevant UK or International Health and Safety regulations employing suitably trained and equipped divers. Target investigation methodologies include one or a combination of the following elements:

- Visual Search
- Hand-held Instrument Detection
- Diver Supported Water Jetting
- Underwater Photo & Video
- Mechanically assisted

1ST Line Defence has developed specific ordnance clearance services specifically for ports, docks and harbour developments, offshore and near shore structures and bridge abutments.

Projects which may require Marine Services include windfarms, subsea cables, pipe laying projects, oil, gas and mineral exploration and capital dredging projects.



UXO Dredging Support

Where it is not possible to carry out proactive marine explosive ordnance surveys ahead of dredging operations, 1ST Line Defence is able to provide experienced Marine UXO Specialists On-board, On-shore or On-call to deal with any eventuality relating to explosive ordnance, bombs or other types of munitions.

UXO Services for Dredging Operations

- UXO Threat Assessment
- UXO Awareness Briefings
- On-Board & Onshore Dredging Support
- On-Call and Rapid Response Support
- Stand-by UXO Divers & Equipment
- UXO Hazard Recognition
- Clearance and Disposal

Dredging around the Clock

Where 24 hour dredging operations are to be undertaken 1ST Line Defence will provide sufficient UXO Specialists to allow shift work.

Safe Storage of Recovered Ordnance

Prior to dredging taking place suitable storage areas are prepared for the securing and segregation of different natures of ordnance and scrap on board the dredgers. Similar facilities will be prepared on the land if required. 1ST Line Defence Standing Operating Procedures determine the quantity of UXO (based on its NEQ) explosives that can be safely held on-board before it is necessary to offload for final disposal.

Minimise Downtime

To reduce downtime in the event of an ordnance find 1ST Line Defence will provide UXO Specialists on vessels to ensure immediate response to the discovery of suspicious objects or items of ordnance.

Emergency Response for the Marine Aggregate Industry

1ST Line Defence also provides an Emergency Response Capability to react to the discovery of suspicious objects or items of ordnance in marine aggregate sites.

SITE INVESTIGATION

1ST Line Defence offers a number of geophysical technologies, both digital and analogue, for the location of buried ordnance, depending on the site characteristics, the ordnance type/material and target depth of investigation; also offering geophysical surveys for archaeological and environmental targets.

Cone Penetration Testing (CPT)

1ST Line Defence can provide Cone Penetration Testing (CPT) services to determine the geotechnical engineering properties of soils and delineating soil stratigraphy.
1ST Line Defence uses state-of-the-art digital technology with cutting-edge cones, operated by experienced competent staff.

We can provide a variety of testing including:

- Digital Piezo Static Cone Penetrometer
- Video Cone Penetrometer
- Fuel Fluorescence Detector Cone
- Soil Moisture Cone Penetrometer
- MOSTAP Soil Sampler

All of our cones are of the latest digital type and run on a totally digital system; thus allowing more reliable data to be collected compared to the standard analogue systems.

All cones are regularly calibrated and checked before and during each day's testing in accordance with International Reference Test Procedures.

1ST Line Defence can provide a combined UXB and Cone Penetration Testing (CPT) Survey which will provide geotechnical data and clearance for UXB's on each position surveyed.

1ST Line Defence's CPT rigs can carry out the testing in the most demanding environments; the vehicles range from a combination tracked and wheeled vehicle to compact vehicles for restricted access.

Digital Piezo Static Cone Penetrometer

The digital peizo static cone penetrometer (CPTU) is a rugged and compact system. The analogue to digital conversion is performed down every hole with each cone possessing its own memory and identity that is automatically recognised when connected to the logging system.
The cones are of compression type, meaning the cone resistance and sleeve friction load cells are decoupled and measure independently. This can lead to readings that are more accurate from the cone. Accurate temperature compensation assures reliable performance in soft soils and where there is a big difference between air temperature and ground temperature. The cone conforms to Eurocode 7 Application Class 1.

Video Cone Penetrometer

The Video Cone Penetrometer has a miniature colour video camera, an LED light source, micro-optic components, and a durable scratch-resistant sapphire window integrated into a Digital Piezo Static Cone Penetrometer (PCPT) cone housing. This single cone will provide standard geotechnical measurements, such as tip resistance and sleeve friction, as well as high-resolution view of the soil in real time.
The video image is displayed on a portable display screen and recorded digitally onto a DVD or hard disk. A text inserter module allows the video of the test to be stamped with the depth as it increases as well as the test identification number. Post processing provides a picture log which is imposed next to the PCPT log, helping with the correlation of the soil type.
The Video Cone is a useful tool in both Contamination Detection and Soil Classification. For environmental work, the Video Cone allows the visual detection or confirmation of the presence of non-aqueous phase liquid contaminants in the soil, such as creosote, tar and gasoline. For Geotechnical work, the Video Cone shows soil texture, grain size, colour and other soil features.

Fuel Fluorescence Detector Cone

The dual down-hole Fuel Fluorescence Detector (FFD) detects the fluorescence produced by aromatic hydrocarbons when excited by an ultraviolet (UV) light source. The system is pushed into the soil using CPT equipment which provides a combination of the geotechnical information from the CPT and the geo-environmental data from the FFD. The FFD significantly reduces the time required to detect and delineate the extent of hydrocarbon fuel spills or leaking storage tanks.

By placing the dual Photomultiplier system used in the FFD down-hole, it will eliminate the signal attenuation in the optical fibre, allowing weak fluorescent compounds to be detected at any depth below ground surface.

Dual PMTs are tuned to different wavelengths; this provides the ability to differentiate between light and heavy contaminants.

This breakthrough technology produces cost savings at each stage of the site characterisation;

1. The CPT delivery system generates minimal investigation derived waste; reducing the cost of containerisation and disposal.
2. There are fewer physical samples collected, reducing associated costs with sample collection, preparation, handling and analysis.
3. The continuity of the data reduces the time and effort required for the data interpretation and presentation.
4. Using this system, the number of field days required to complete the job is reduced; this reduction in the number of field days generates immediate cost savings.

The Dual Filter FFD provides a continuous, real-time output of fluencies over the entire depth of the system, providing a more complete and easily interpreted view of the plume, compared to traditional discrete sampling methods.

Soil Moisture Cone Penetrometer

The volumetric percentage of water in soil (Soil Moisture) has become an important consideration in geotechnical and environmental design and is one of the most fundamental factors in influencing soil strength.

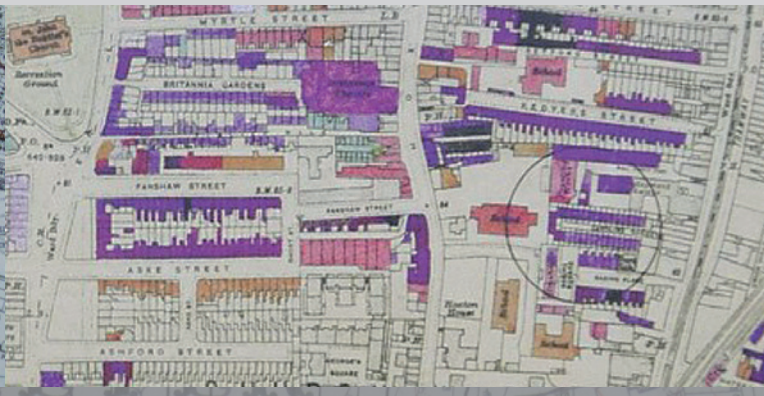
The Soil Moisture Cone (SMC) provides real-time in-situ data logs of soil moisture and resistivity without sampling; also measuring the standard geotechnical parameters from the attached Piezo cone.

The SMC takes advantage of the relationship between the soil dielectric constant and moisture, known as Topp's Equation. This relationship is not strongly influenced by soil type and resistivity if the dielectric measurement is made above a critical frequency of approximately 30MHz. The inner two electrode rings of the cone determine the soil's moisture content by measuring the frequency shift of a high frequency excitation signal as it passes through the soil near the surface of the module. The outer two rings of the four electrodes are used to measure resistivity. An AC voltage signal of constant amplitude is applied across the rings. A voltage measurement, which is proportional to the current through the soil, is made across the sampling resistor.

MOSTAP Soil Sampler

The MOSTAP soil sampler is a relatively 'undisturbed' pushed soil sampler. The sampler provides good samples for identification and classification purposes. The samples can also be used for classification lab testing and tri-axial and odometer lab tests.

The main advantage of this system is that it enables you to take samples at discrete depths. The system is pushed in the ground with the cone tip in place. When the depth of the required sample is reached a 'fishing tool' is lowered down and releases the cone tip which reveals the cutting shoe. The system is then pushed a further meter to then take the sample.



UXO THREAT ASSESSMENT

1ST Line Defence can provide preliminary and detailed threat assessments, using CIRIA C681 guidelines, of the potential Unexploded Ordnance (UXO) and Unexploded Bomb (UXB) risk, specific to your site location.
We can also recommend unbiased and appropriate UXO mitigation measures as well as providing consultation on emergency response planning.

Benefits:

- Provides specific site information and recommends measures to mitigate the risk
- Can prevent unnecessary risk mitigation if the Threat Assessment shows the risk of encountering UXO can be ruled out or isolated to a specific area of the site
- Provides a bomb penetration assessment of the site

A detailed threat assessment consists of but not limited to:

- Historical information from the public archive resources; including bomb census maps
- Historical aerial photography and satellite photographs
- History of the site and surrounding area in regards to military activity
- Military records of EOD disposal tasks
- Recommended risk mitigation measures

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