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# Annex A Site Photographs

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Plate 1: Oil Tank

Plate 2: Boiler Container





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Plate 5: Concrete Plinth 1

Decorating Waste



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# Annex B Explosive Ordnance Threat Assessment

45 Pages



# **BACTEC** | Globally Trusted Locally Dependable

Explosive Ordnance Threat Assessment

in respect of

DSDC Bicester, Oxfordshire

for

Entec UK Ltd

3063TA REV\_1

14th January 2011



Explosive Ordnance Threat Assessment

in respect of

DSDC Bicester, Oxfordshire

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3063TA REV\_1 14<sup>th</sup> January 2011

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This Report has been produced in compliance with the Construction Industry Research and Information Association guidelines for the preparation of Detailed Risk Assessments in the management of UXO risks in the construction industry.

# **Glossary of Terms**

AAA	Anti-Aircraft Artillery
ARP	Air-raid Precautions
BDO	Bomb Disposal Officer
EOD	Explosive Ordnance Disposal (current term for "bomb" disposal)
HE	High Explosive
HG	Home Guard
IB	Incendiary Bomb
kg	Kilogram
LCC	London County Council
LM	Land Mine
LSA	Land Service Ammunition (includes grenades, mortars, etc.)
Luftwaffe	German Air Force
m bgl	Metres Below Ground Level
MoD	Ministry of Defence
OB	Oil Bomb
PM	Parachute Mine
RAF	Royal Air Force
SI	Site Investigation
SAA	Small Arms Ammunition (small calibre cartridges used in rifles & machine guns)
UXB	Unexploded Bomb
UXO	Unexploded Ordnance
UXO V-1	" Unexploded Ordnance "Doodlebug" the first cruise type missile, used against London
V-1	Unexploded Ordnance "Doodlebug" the first cruise type missile, used against London from June 1944. Also known as 'Flying Bomb'.
V-1 V-2	Unexploded Ordnance "Doodlebug" the first cruise type missile, used against London from June 1944. Also known as 'Flying Bomb'. The first ballistic missile, used against London from September 1944
V-1 V-2 WWI	Unexploded Ordnance "Doodlebug" the first cruise type missile, used against London from June 1944. Also known as 'Flying Bomb'. The first ballistic missile, used against London from September 1944 First World War (1914 -1918)

## **Executive Summary**

**The Site:** DSDC Bicester is split over two areas to the immediate south-west of the town of Bicester in Oxfordshire. The northern site, known as Graven Hill is situated approximately 3km north-west of the southern site, Arncott Hill. The two sites are linked by a military railway. Site location maps are presented in Annex A. This report will focus on four specific sites within the boundary of the facility which are referred to as Site A and Site C at the Arncott site and Site D and Site E at the Graven Hill site (within site D and E are two additional potential areas of interest (labelled 1 and 2), on the north side of the hill).

**Proposed Works:** Site investigation works are planned across the site areas. Final details were not available at the time of the production of this report.

**Risk Assessment Methodology:** In accordance with CIRIA guidelines this assessment has carried out research, analysed the evidence and considered the risks that the site has been contaminated with unexploded ordnance; that such items remained on site; that they could be encountered during the proposed works and the consequences that could result. Appropriate risk mitigation measures have been proposed.

**Explosive Ordnance Risk Assessment:** BACTEC concludes that there is a **Low-Medium** risk from unexploded ordnance at the site of the proposed works. This is based on the following factors:

- DSDC Bicester has been a military depot for over 65 years. No evidence could be found to indicate that the purpose of the depot was ever for the storage of explosive ordnance. Nevertheless, as with all historic military facilities, there is always a residual risk of explosive ordnance contamination.
- During the war years, the facility would have been defended, and weaponry in the form of small arms and land service ammunition would have been stored and available for use. Furthermore, as a result of the military association with the area, it is likely that the land on and around the depot would have been utilised for ground training exercises historically.
- The 'house-keeping' of WWII facilities is known to have often been poor with unwanted and unused items of explosive ordnance frequently buried, burnt, lost or otherwise discarded within a facility perimeter. Given the available history of the site, the likelihood of this having occurred within the perimeter of DSDC Bicester itself is not considered high, but cannot be entirely discounted. The risk of encountering LSA and SAA in Proposed Additional Areas 1 and 2 is considered somewhat higher than the background level due to the areas use for US Bolero Army Camps during WWII – it is very unlikely that explosive ordnance would have been stored in large quantities within these camps, but it is likely to have been present and available for use, and potentially therefore buried and/or discarded within these areas.
- It should be noted that several search and clear operations have been undertaken at several locations on the site by 33 Engineer Regiment (EOD) in the post-war period. Although nothing was found, the requirement for and completion of such operations at the cost of the MoD indicates that there was a credible perceived threat/possibility of explosive ordnance contamination being present. It should also be noted that only small sections of DSDC Bicester have been subject to such searches, those searches only providing 12.5% clearance.
- Research indicates that bombing density over the Bicester area was low. Very few references could be found to raids over the region despite there being a number of high profile RAF targets present. ARP records for COD Bicester could not be located (reports of bombing on military land were generally made by military personnel and kept separate from civilian records). It has therefore not been possible to confirm that the facility was not attacked. However, work on the construction of the depot did not commence until after the main period of bombing in this part of the UK.
- The depot employed thousands of people and for the latter part of WWII at least, would have been manned twenty-four hours a day. It is considered very unlikely that evidence of unexploded ordnance would have been overlooked across the site subsequent to construction work beginning in June 1941. Prior to this date, the site comprised open, agricultural land on which it is conceivable that unexploded bombs could have been overlooked had they been dropped. However, given the low bombing density in this part of the county and lack of viable targets within the site area in 1940/early 1941, the likelihood of unexploded bombs having been dropped is considered minimal.

**Risk Mitigation Measures:** The following risk mitigation measures are recommended to support the proposed works:

#### All Areas

- Explosive Ordnance Safety and Awareness Briefings to all personnel conducting intrusive works.
- The Provision of Unexploded Ordnance Site Safety Instructions.

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

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### Explosive Ordnance Threat Assessment

## In Respect of

## DSDC Bicester, Oxfordshire

#### 1. Introduction

#### 1.1. Background

Entec UK Ltd has commissioned BACTEC International Limited to conduct an Explosive Ordnance Threat Assessment for the proposed works at DSDC Bicester, Oxfordshire.

Unexploded Ordnance presents a significant threat to construction projects in parts of the UK as a result of enemy actions during the two 20<sup>th</sup> Century World Wars and historic British and Allied military activity.

DSDC Bicester is a large military facility constructed in 1941 to supply the British Army with equipment and stores, its purpose and layout not changing significantly since this time. As with any historic military base, there is the potential for explosive ordnance contamination to be present, despite the facility not having been designed as an armaments storage depot. This report will assess the historic use of the site, compile and present the available information regarding the potential for an ordnance threat and present recommendations if deemed necessary to reduce or eliminate this threat. The potential for encountering unexploded airdelivered weapons will also be considered.

As a result of a generally increased risk awareness amongst professionals involved in ground engineering works and proactive health and safety measures, the threat to life and limb from unexploded ordnance has been minimised. However even the simple discovery of a suspected device during ongoing works can cause considerable disruption to production and cause unwanted delays and expense.

Such risks can be more fully controlled by a better understanding of the site-specific threat and the implementation of appropriate risk mitigation measures.

#### 2. Construction Industry Duties and Responsibilities

#### 2.1. The UK Regulatory Environment

There is no specific legislation covering the management and control of the UXO risk in the UK construction industry but issues regarding health and safety are addressed under a number of regulatory instruments, as outlined below.

In practice the regulations impose a responsibility on the construction industry to ensure that they discharge their obligations to protect those engaged in ground-intrusive operations (such as archaeology, site investigation, drilling, piling or excavations) from any reasonably foreseeable UXO risk.

#### 2.2. The Health and Safety at Work Act, 1974

The Act places a duty of care on an employer to put in place safe systems of work to address, as far as is reasonably practicable, all risks (to employees and the general public) that are reasonably foreseeable.

#### 2.3. Construction (Design and Management) Regulations 2007

This legislation defines the responsibilities of all parties (primarily the Client, the CDM Coordinator, the Designer and the Principal Contractor) involved with works.

Although UXO issues are not specifically addressed the regulations effectively place obligations on all these parties to:

- Ensure that any potential UXO risk is properly assessed
- Put in place appropriate risk mitigation measures if necessary
- Keep all parties affected by the risk fully informed
- Prepare a suitably robust emergency response plan

#### 2.4. Other Legislation

Other relevant legislation includes the "Management of Health and Safety at Work Regulations 1999" and "The Corporate Manslaughter and Corporate Homicide Act 2007".

#### 3. The Role of the Authorities and Commercial Contractors

#### 3.1. The Authorities

The Police have the responsibilities for co-ordinating the emergency services in the case of an ordnance-related incident on a construction site. They will make an initial assessment (i.e. is there a risk that the find is ordnance or not?) and if they judge necessary impose a safety cordon and/or evacuation and call the military authorities (JSEOD - Joint Services Explosive Ordnance Disposal Operations centre) to arrange for investigation and/or disposal. In the absence of an EOD specialist on site many Police Officers will use the precautionary principle, impose cordon(s)/evacuation and await advice from the JSEOD.

The priority given to the request by JSEOD will depend on their judgement of the nature of the threat (ordnance, location, people and assets at risk) and the availability of resources. They may respond immediately or as resources are freed up. Depending on the on-site risk assessment the item of ordnance may be removed or demolished (by controlled explosion) insitu. In the latter case additional cordons and/or evacuations may be necessary.

Note that the military authorities will only carry out further investigations or clearances in very high profile or high risk situations. If there are regular ordnance finds on a site the JSEOD may not treat each occurrence as an emergency and will encourage the construction company to put in place alternative procedures (i.e the appointment of a commercial contractor) to manage the situation and relieve pressure from the JSEOD disposal teams.

#### 3.2. Commercial Contractors

In addition to pre-construction site surveys and clearances a commercial contractor is able to provide a reactive service on construction sites. The presence of a qualified EOD Engineer with ordnance recognition skills will avoid unnecessary call-outs to the authorities and the Contractor will be able to arrange for the removal and disposal of low risk ordnance. If high risk ordnance is discovered actions will be co-ordinated with the authorities with the objective of causing the minimum possible disruption to site operations whilst putting immediate, safe and appropriate measures in place.

#### 4. This Report

#### 4.1. Aims and Objectives

The aim of this report is to examine the possibility of encountering any explosive ordnance during the proposed works at the Bicester site. Risk mitigation measures will be recommended, if deemed necessary, to reduce the threat from explosive ordnance during the envisaged works. The report follows the CIRIA Guidelines.

#### 4.2. Risk Assessment Methodology

The following issues will be addressed in the report:

- The risk that the site was contaminated with unexploded ordnance.
- The risk that unexploded ordnance remains on site.
- The risk that ordnance may be encountered during the proposed works.
- The risk that ordnance may be initiated.
- The consequences of initiating or encountering ordnance.

Risk mitigation measures, appropriate to the assessed level of risk and site conditions, will be recommended if required.

#### 4.3. Approach

In preparing this Explosive Ordnance Threat Assessment Report, BACTEC has considered general and, as far as possible, site specific factors including:

- Evidence of German bombing and delivery of UXBs.
- Site history, occupancy and conditions during WWII.
- The legacy of Allied military activity.
- Details of any known EOD clearance activity.
- The extent of any post war redevelopment.
- Scope of the current proposed works.

#### 4.4. Sources of Information

BACTEC has carried out detailed historical research for this Explosive Ordnance Threat Assessment including accessing military records and archived material held in the public domain and in the MoD.

Material from the following sources has been consulted:

- o The National Archives, Kew.
- o Landmark Maps.
- English Heritage National Monuments Record.
- Relevant information supplied by Entec UK Ltd.
- Available material from 33 Engineer Regiment (EOD) Archive.
- BACTEC's extensive archives built up over many years of research and hands-on Explosive Ordnance Disposal activities in the UK.
- Open sources such as published books, local historical records and the internet.

#### 4.5. Reliability of Historical Records

#### 4.5.1. General Considerations

This report is based upon research of historical evidence. Whilst every effort has been made to locate all relevant material BACTEC cannot be held responsible for any changes to the assessed level of risk or risk mitigation measures based on documentation or other information that may come to light at a later date.

The accuracy and comprehensiveness of wartime records is frequently difficult or impossible to verify. As a result conclusions as to the exact location, quantity and nature of the ordnance threat can never be definitive but must be based on the accumulation and careful analysis of all accessible evidence. BACTEC cannot be held responsible for inaccuracies or gaps in the available historical information.

#### 4.5.2. Bombing Records

During WWII considerable efforts were expended in recording enemy air raids. Air Raid Precautions (ARP) wardens were responsible for making records of bomb strikes either through direct observation or by post-raid surveys. However their immediate priority was to deal with casualties and limit damage, so it is to be expected that records are often incomplete and sometimes contradictory. Record keeping in the early days of bombing was not comprehensive and details of bombing in the early part of the war were sometimes destroyed in subsequent attacks. Some reports may cover a single attack, others a period of months or the entire war.

Records of raids that took place on sparsely or uninhabited areas were often based upon third party or hearsay information and are not always reliable; records of attacks on military or strategic targets were often maintained separately from the general records and have not always survived.

#### 5. The Site

#### 5.1. Site Location and Description

DSDC Bicester is split over two areas to the immediate south-west of the town of Bicester in Oxfordshire. The northern site, known as Graven Hill is situated approximately 3km north-west of the southern site, Arncott Hill. The two sites are linked by a military railway. Site location maps are presented in Annex A.

This report will focus on four specific sites within the boundary of the facility which are referred to as Site A and Site C at the Arncott site and Site D and Site E at the Graven Hill site. Within site D and E are two additional potential areas of interest (labelled 1 and 2), on the north side of the hill.

Site E (grid reference SP 58682 20892) is the northernmost site and comprises the strip of land around the north side of Graven Hill, bounded by a railway line to the north-west and the A41 Aylesbury Road to the north-east. Site D (SP 59191 19919) occupies the area of land around the southern side of Graven Hill, bound to the south by the military rail line. Both sites comprise a dispersed collection of large, square warehouses linked with road and rail sidings. All of the sidings link to a rail depot on the south-western boundary of Site D. The land between the warehouses primarily comprises open grassed areas with the north-western section of Site E occupied by undeveloped agricultural land.

Site C (SP 60731 17579) is situated at the western side of the Arncott site. Railway lines form the north-western and north-eastern boundaries, with Ploughley Road and Murcott Road bordering the area to the east. Site A (SP 63553 17507) is located on the eastern edge of the Arncott site and comprises and irregularly shaped parcel of land bordered by Widnell Lane to the south and the B4011 to the east. As with sites D and E, these areas are occupied by large dispersed warehouses, roads and rail sidings.

Recent aerial photographs and site plan showing the boundary of the site areas is presented in Annex B and C respectively.

#### 6. Scope of the Proposed Works

#### 6.1. General

Site investigation works are planned across the site areas. Final details were not available at the time of the production of this report.

#### 7. History of DSDA Bicester

#### 7.1. General

At the start of WWII the Royal Army Ordnance Corps required a purpose built Central Ordnance Depot (COD) to be able to respond to the requirements of the British Army. Bicester was selected due to its central location and easy access to major sea and air ports.

Construction on the site began in June 1941, took two years to complete and covered 1800 acres. In an effort to protect stock from wartime bombing raids, the depot was split over two sites – Graven Hill to the north and Arncott Hill 3.5km to the south, linked by a military railway. By September 1942, the Headquarters and first storehouse had opened and in 1943, the depot assumed its first role as a main Support Base for future operations in Europe and became an Army Mobilisation Centre (see 1943 plan of the southern section of the depot, Annex D). The Depot achieved its peak activity in the latter part of the war, when some 20,000 troops and members of the ATS were employed here. Since then the Depot has had a number of roles. In 1961 COD Bicester was selected to perform a key role in a major reorganisation of the UK Base Ordnance Installations. The Ordnance Depots at Didcot and Branston, together with their associated 'out-stations' were closed and their functions concentrated at Bicester. Further reorganisation in 1980-82 led to the closure of COD Bicester. In 1992, the facility became known as the Defence Storage and Distribution Centre, Bicester.

The depot is not understood to have ever been used for the storage and distribution of ammunition and explosive ordnance. A local historian, author of *50 Years of COD Bicester*, states that there is 'no record of explosive ordnance ever being stored, processed or disposed of within the confines of the depot perimeter'.

#### 7.2. WWII-era Aerial Photography

Historic aerial photography of the site area was requested from the National Monuments Record Office, Swindon. Images covering sites A, C and D dated August 1945, April 1947 and October 1974 are presented in Annex E. Examination of the wartime images confirms that there are no structures present considered to be associated with the large-scale storage of explosive ordnance. The site was newly opened at this time and appears well-maintained and fully operational. Evidence of camouflaging can be seen on the roofs of some of the warehouse structures, but no signs of damage, clearance or bomb craters are noted.

A large military camp is noted in the central area of the Arncott site, to the east of Site C. A legacy of explosive ordnance contamination is considered more likely in such an encampment, but the area does not fall within any of the designated work zones. A camp is also noted within Potential Additional Area 2, understood to be a US Army Bolero camp. 'Bolero' was the codename used for any facilities associated with the provision of support of the US Army. Four 'Bolero' complexes existed on Craven Hill on and around Additional Areas 1 and 2 – only one is visible of the available photography. Records indicate that that were centred on OS grid references SP 5826 079 (Romney huts), SP 5850 2064 (dispersed Nissen hut camp), SP 5936 2044 (dispersed Nissen hut camp) and SP 5914 2099 (Romney huts gun park).

#### 8. The Threat from Aerial Bombing

#### 8.1. Bicester During WWII

At the start of WWII, Bicester started receiving evacuees from London due to its relatively safe position in the centre of the UK away from major industrial centres, ports and other important strategic infrastructure.

Home Guard units were organised from May 1940 to protect the area from parachutists, patrol the locality and man defensive positions. The Home Guard numbered 1600 men by 1944 in detachments scattered throughout the Bicester area. A range of defences were constructed to repulse the threat of invasion.

Military activity in the area was pronounced with a large number of airfields, the opening of COD Bicester and many military exercises and troop movements being undertaken in the surrounding countryside. The local airfields provided vital training bases for RAF aircrews and many important secret missions were flown from RAF Bicester, situated to the north-east of the town.

#### 8.2. Bombing History of Bicester

At the start of WWII, the Luftwaffe planned to destroy key military installations, including RAF airfields and Royal Navy bases, during a series of daylight bombing raids. After the Battle of Britain these tactics were modified to include both economic and industrial sites. Targets included dock facilities, railway infrastructure, power stations, weapon manufacturing plants and gas works. As a result of aircraft losses, daylight raids were reduced in favour of attacking targets under the cover of darkness.

References could be found to only three bombing raids in the Bicester area, all apparently targeted against the RAF station to the north-east of the town. Very few details of the raids are available, but they appeared to only involve single aircraft and amounted to around 20 incendiary bombs and four high explosive bombs being dropped. No references could be found to the Ordnance Depot being targeted, possibly due to the fact work did not start on the facility until after the main period of bombing in the UK. It should be noted however that no original ARP records for the depot could be located to confirm the lack of air raids.

#### 8.2.1. Abandoned Bombs

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

Given the inaccuracy of WWII records and the fact that these bombs were 'abandoned', their locations cannot be considered definitive, nor the lists exhaustive. The MoD states that 'action to make the devices safe would be taken only if it was thought they were unstable'. It should be noted that other than the 'officially' abandoned bombs, there will inevitably be UXBs that were never recorded.

BACTEC holds no records of officially registered abandoned bombs at or near the sites of the proposed works.

#### 8.3. Likelihood of Post-raid UXO Detection

Utilising the available historical bombing it is possible to make an assessment of the likelihood that evidence of unexploded ordnance would have been noted on a site during the war and the incident dealt with or recorded at the time. Factors such as bombing density, frequency of access, ground cover, damage and failure rate have been taken into consideration.

#### 8.3.1. Density of Bombing

Bombing density is an important consideration for assessing the possibility that UXBs remain in an area. A very high density of bombs can for example result in increased levels of damage sustained to structures, greater likelihood of errors in record keeping and a higher risk that UXBs fell over the area.

Research indicates that bombing density over the Bicester area was low. Very few references could be found to raids over the region despite there being a number of high profile RAF targets present. Attempts were made to bomb RAF Bicester, to the north-east of the town, but it appears that none succeeded with only a handful of HE bombs and 20 incendiaries dropped,

all falling outside the station perimeter. ARP records for COD Bicester could not be located (reports of bombing on military land were generally made by military personnel and kept separate from civilian records). It has therefore not been possible to confirm that the facility was not attacked. However, work on the construction of the depot did not commence until after the main period of bombing in this part of the UK. In 1940/41 prior to its construction the site of the facility would not have constituted a viable bombing target.

#### 8.3.2. Frequency of Access and Ground Cover

Unexploded ordnance at sites where human access was infrequent would have a higher chance of being overlooked than at those sites which were subject to greater occupancy. The importance of a site or facility to the war effort is also an important consideration as such sites are likely to have been both frequently accessed and are also likely to have been subject to post-raid checks for evidence of UXO.

The depot employed thousands of people and for the latter part of WWII at least, would have been manned twenty-four hours a day. It is considered very unlikely that evidence of unexploded ordnance would have been overlooked across the site subsequent to construction work beginning in June 1941. Prior to this date, the site comprised open, agricultural land on which it is conceivable that unexploded bombs could have been overlooked had they been dropped. However, given the low bombing density in this part of the county and lack of viable targets within the site area in 1940/early 1941, the likelihood of unexploded bombs having been dropped is considered minimal.

#### 8.3.3. Damage

If structures on a site have been subject to significant bomb or fire damage, rubble and debris are likely to have been present; similarly an HE bomb strike on open ground is likely to have resulted in a degree of soil disturbance. Under such conditions there is a greater risk of the entry holes of unexploded bombs dropped during subsequent raids being obscured and going unnoticed.

If any damage had indeed been sustained to structures within the boundary of the depot, efforts would have been made to repair and rebuild in order to keep the depot running at full capacity. It is also likely that dedicated post-raid searches to check for damage and evidence of unexploded bombs would have been undertaken, given the importance of the facility.

#### 8.3.4. Bomb Failure Rate

There is no evidence to suggest that the bomb failure rate in the region of the site would have been different from the "approximately 10%" figure normally used.

#### 9. The Threat from Allied Military Ordnance

#### 9.1. General

DSDC Bicester has been a military depot for over 65 years. No evidence could be found to indicate that the purpose of the depot was ever for the storage of explosive ordnance. The design and layout of the depot substantiate this. The conventional design of an armaments storage facility comprises a number of small bunded structures designed to minimise the effects of an accidental explosion. No such structures are present within the DSDC depot.

Nevertheless, as with all historic military facilities, there is always a residual risk of explosive ordnance contamination. During the war years, the facility would have been defended and weaponry in the form of small arms and land service ammunition would have been stored and available for use. Furthermore, as a result of the military association with the area, it is likely that the land on and around the depot would have been utilised for ground training exercises historically.

The 'house-keeping' of WWII facilities is known to have often been poor with unwanted and unused items of explosive ordnance frequently buried, burnt, lost or otherwise discarded within a facility perimeter. Given the available history of the site, the likelihood of this having occurred within the perimeter of DSDC Bicester is not considered high, but cannot be entirely

discounted. It should be noted that several search and clear operations have been undertaken at several locations on the site by 33 Engineer Regiment (EOD) in the post-war period (see section 9.2.1). Although nothing was found, the requirement for and completion of such operations at the cost of the MoD indicates that there was a credible perceived threat/possibility of explosive ordnance contamination being present. It should also be noted that only small sections of DSDC Bicester have been subject to such searches, those searches only providing 12.5% clearance.

#### 9.2. Land Service and Small Arms Ammunition (LSA and SAA)

Typical examples of LSA are discussed below and presented in Annex F. Such weapons may have been stored and made available for use historically at the DSDC Bicester and could conceivably be encountered during intrusive works within the depot boundary, especially in previously undeveloped areas.

**a. Unexploded Munitions** – Mortars, Grenades and Explosives. A mortar relies on a striker hitting a detonator for explosion to occur. It is possible that the striker may already be in contact with the detonator and that only a slight increase in pressure would be required for initiation. Similarly, a grenade striker may either be in contact with the detonator or still be retained by a spring under tension, and therefore shock may cause it to function. Mortars and grenades can both be lethal. A grenade can have an explosive range of 15-20m.

**b.** Fuzes – The fuzes used with munitions fired on ranges are mainly of the direct impact action variety. This means that if they failed to function on impact a needle/pin may have been driven into the detonator or a very sensitive explosive compound leaving the fuze in a dangerous state. An inadvertent impact on the fuze or munition could cause the munition to detonate. The 81mm mortar falls into this category and is known throughout the EOD community as a very dangerous munition to dispose of.

**c. Miscellaneous Items** – Pyrotechnics come in a variety of types of flares and smoke generating compounds and can include the following:

- a. Magnesium
- b. Thermite
- c. Phosphorus (red white)
- d. Calcium Phosphate
- e. Sodium Nitrate
- f. Aluminium Powder
- g. Sodium Phosphide phosphorus mixture
- h. Magnesium aluminium phosphide
- i. Potassium bisulphate
- j. Smoke compounds i.e. HC, FM and FS.

**d. Small Arms Ammunition** – Ammunition boxes are known to have been processed in certain areas of DSDC Bicester and SAA may be encountered during the proposed intrusive works. However, it should be noted that even if an item functioned the explosion would not be contained within a barrel and detonation would only result in local overpressure and very minor fragmentation from the cartridge case. Images of SAA are presented in Annex F-3.

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

#### 9.2.1. EOD Bomb Disposal and Clearance Tasks

Several Explosive Ordnance Clearance Tasks have been undertaken in certain areas of the DSDC site by 33 Engineer Regiment (EOD). The first was a 12.5% search undertaken between 19<sup>th</sup> and 29<sup>th</sup> March 1975. The areas covered by this search have been overlaid onto the site map and presented in Annex G. They comprise only small sections of land, jointly comprising approximately 127 acres, and mostly fall outside this report's areas of interest. The operation did not produce any explosive ordnance finds.

The second search was undertaken between the 23<sup>rd</sup> and 25<sup>th</sup> November 1981. It covered an area of 1.4 acres centred at OS grid reference SP 595 207 (map not available, but located in the eastern section of Site E). No finds were recorded.

The site was further investigated in 2002. There was a requirement to certify sites A, B and G of the depot free from explosive ordnance contamination for the purposes of alienation (these areas have also been overlaid, Annex G). A desk-top study was undertaken by the Environmental Science Group of the Defence Logistics Organisation for these three areas. No requirement was found to conduct additional proactive EOC operations in sites A and G, but a limited intrusive and visual investigation was undertaken in the south-western corner of Site B. No explosive ordnance was found during this operation and a clearance certificate was issued by the Ministry of Defence stating that sites A, B and G are 'clear, as far as is reasonably practical, of explosive ordnance contamination'.

BACTEC does not hold records of any additional clearance tasks having been undertaken in the remaining areas of the site historically.

#### 9.3. Defending Bicester from Aerial Attack

Both passive and active defences were deployed against enemy bombers attacking targets in the Bicester region.

Passive defences included measures to hinder the identification of targets (such as a lighting blackout at night and the camouflaging of strategic installations); to mislead bomber pilots into attacking decoy sites located away from the city and to force attacking aircraft to higher altitudes with the use of barrage balloons.

Active air defence relied on a coordinated combination of fighter aircraft to act as interceptors, anti-aircraft gun batteries and later the use of rockets and missiles, in order to actively engage and oppose attacking aircraft.

#### 9.3.1. Anti-Aircraft Artillery and Projectiles

At the start of the war two types of AAA guns were deployed: Heavy Anti-Aircraft Artillery (HAA), using large calibre weapons such as the 3.7" QF (Quick Firing) gun and Light Anti-Aircraft Artillery (LAA) using smaller calibre weapons such as 40mm Bofors gun.

During the early war period there was a severe shortage of AAA available and older WWI 3" and modified naval 4.5" guns were deployed alongside those available 3.7" weapons. The maximum ceiling height of fire at that time was around 11,000m (for the 3.7" gun and less for other weapons). As the war progressed improved variants of the 3.7" gun were introduced and, from 1942, large 5.25 inch weapons began to be brought into service. These had significantly improved ceiling heights of fire reaching over 18,000m.

The LAA batteries were intended to engage fast low flying aircraft and were typically deployed around airfields or strategic installations. These batteries were mobile and could be moved to new positions with relative ease when required. The most numerous of these was the 40mm Bofors gun which could fire up to 120 x 40mm HE shells per minute to over 1800m.

The HAA projectiles were high explosive shells, usually fitted with a time delay or barometric pressure fuze to make them explode at a pre-determined height. If they failed to explode or strike an aircraft, they would eventually fall back to earth. Details of the most commonly deployed WWII AAA projectiles are shown below:

Gun type	Calibre	Shell Weight	Shell Dimensions
3.0 Inch	76mm	7.3kg	76mm x 356mm
3.7 Inch	94mm	12.7kg	94mm x 438mm
4.5 Inch	114mm	24.7kg	114mm x 578mm
40mm	40mm	0.9kg	40mm x 311mm

Although the larger unexploded projectiles could enter the ground they did not have great penetration ability and are therefore likely to be found close to WWII ground level. These shells are frequently mistakenly identified as small German air-delivered bombs, but are

differentiated by the copper driving band found in front of the base. With a high explosive fill and fragmentation hazard these items of UXO present a significant risk if encountered. The smaller 40mm projectiles are similar in appearance and effect to small arms ammunition and, although still dangerous, present a lower risk.

Numerous unexploded AAA shells were recovered during and following WWII and are still occasionally encountered on sites today.

There are no recorded HAA batteries in the Bicester area. However, the ordnance depot to the south-east of the town and the airfield to the north-east would both have been equipped with light anti-aircraft guns to defend against attack.

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

#### 10. Ordnance Clearance and Post-WWII Ground Works

#### 10.1. General

The extent to which any ordnance clearance activities have taken place on site or extensive ground works have occurred is relevant since on the one hand they may indicate previous ordnance contamination but also may have reduced the risk that ordnance remains undiscovered.

#### 10.2. EOD Clearance

Explosive ordnance clearance operations have been undertaken at certain small areas within the boundary of DSDC Bicester. However, the majority of the facility has not been subject to clearance. Those sections which have been searched were only subject to 12.5% clearance. The risk of encountering explosive ordnance has therefore not been eliminated or significantly reduced as a result of these operations.

#### 10.3. Post war Redevelopment

Examination of the available historical mapping and aerial photography indicates that relatively little development has occurred at DSDC Bicester in the post-war years. The main warehouse structures which were installed in the 1940s are still present, and the primary changes are to ancillary buildings. The majority of open, grassed areas appear never to have been subject to development or significant intrusive works.

#### 11. The Overall Explosive Ordnance Threat Assessment

#### 11.1. General Considerations

Taking into account the quality of the historical evidence, the assessment of the overall threat to the proposed works from unexploded ordnance must evaluate the following risks:

- That the site was contaminated with unexploded ordnance
- That unexploded ordnance remains on site
- That such items will be encountered during the proposed works
- That ordnance may be activated by the works operations
- The consequences of encountering or initiating ordnance

#### 11.2. The Risk that the Site was Contaminated with Unexploded Ordnance

For the reasons discussed in section 8.3, BACTEC believes that there is a minimal risk of Allied explosive ordnance contamination at the DSDC Bicester site, or that unexploded high explosive bombs and/or anti-aircraft projectiles or incendiary bombs fell unnoticed and unrecorded within the site boundary.

- DSDC Bicester has been a military depot for over 65 years. No evidence could be found to indicate that the purpose of the depot was ever for the storage of explosive ordnance. Nevertheless, as with all historic military facilities, there is always a residual risk of explosive ordnance contamination.
- During the war years, the facility would have been defended, and weaponry in the form of small arms and land service ammunition would have been stored and available for use. Furthermore, as a result of the military association with the area, it is likely that the land on and around the depot would have been utilised for ground training exercises historically.
- The 'house-keeping' of WWII facilities is known to have often been poor with unwanted and unused items of explosive ordnance frequently buried, burnt, lost or otherwise discarded within a facility perimeter. Given the available history of the site, the likelihood of this having occurred within the perimeter of DSDC Bicester itself is not considered high, but cannot be entirely discounted. The risk of encountering LSA and SAA in Proposed Additional Areas 1 and 2 is considered somewhat higher than the background level due to the areas use for US Bolero Army Camps during WWII it is very unlikely that explosive ordnance would have been stored in large quantities within these camps, but it is likely to have been present and available for use, and potentially therefore buried and/or discarded within these areas.
- It should be noted that several search and clear operations have been undertaken at several locations on the site by 33 Engineer Regiment (EOD) in the post-war period. Although nothing was found, the requirement for and completion of such operations at the cost of the MoD indicates that there was a credible perceived threat/possibility of explosive ordnance contamination being present. It should also be noted that only small sections of DSDC Bicester have been subject to such searches, those searches only providing 12.5% clearance.
- Research indicates that bombing density over the Bicester area was low. Very few references could be found to raids over the region despite there being a number of high profile RAF targets present. ARP records for COD Bicester could not be located (reports of bombing on military land were generally made by military personnel and kept separate from civilian records). It has therefore not been possible to confirm that the facility was not attacked. However, work on the construction of the depot did not commence until after the main period of bombing in this part of the UK.
- The depot employed thousands of people and for the latter part of WWII at least, would have been manned twenty-four hours a day. It is considered very unlikely that evidence of unexploded ordnance would have been overlooked across the site subsequent to construction work beginning in June 1941. Prior to this date, the site comprised open, agricultural land on which it is conceivable that unexploded bombs could have been overlooked had they been dropped. However, given the low bombing density in this part of the county and lack of viable targets within the site area in 1940/early 1941, the likelihood of unexploded bombs having been dropped is considered minimal.

#### 11.3. The Risk that Unexploded Ordnance Remains on Site

The sites have not been subject to significant post-war redevelopment or intrusive works. Most of the sections of open ground which were present during WWII are extant today. Where intrusive works have occurred post-war, this will largely have mitigated any risk of encountering ordnance as any contamination is likely to be present at only shallow depths. In areas which have not been subject to intrusive works, there is still a risk that ordnance could remain in situ.

#### 11.4. The Risk that Ordnance may be Encountered during the Works

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

The primary threat on the DSDC Bicester sites comes from items such as small arms and land service ammunition, lost, burnt, buried or otherwise discarded. Such items are only likely to be present, and therefore encountered, at shallow depths.

#### 11.5. The Risk that Ordnance may be Initiated

The risk that UXO could be initiated if encountered will depend on its condition, how it is found and the energy with which it is struck. The most violent activity on most construction sites is percussive piling.

As a result items that are shallow buried present a lower risk than those that are deep buried, since the force of impact is usually lower and they are more likely to be observed – when immediate mitigating actions can be taken.

#### 11.6. The Consequences of Encountering or Initiating Ordnance

Clearly the consequences of an inadvertent detonation of UXO during construction operations would be catastrophic with a serious risk to life, damage to plant and a total site shutdown during follow-up investigations.

Since the risk of initiating ordnance is comparatively low if appropriate mitigation measures are undertaken, the most important consequence of the discovery of ordnance will be economic. This would be particularly so in the case of high profile locations and could involve the evacuation of the public. The unexpected discovery of ordnance may require the closing of the site for any time between a few hours and a week with a potentially significant cost in lost time. Note also that the suspected find of ordnance, if handled solely through the authorities, may also involve loss of production since the first action of the Police in most cases will be to isolate the locale whilst awaiting military assistance, even if this turns out to have been unnecessary.

#### 11.7. BACTEC's Assessment

Taking into consideration the findings of this study, BACTEC considers there to be a **Low-Medium** risk from unexploded ordnance during the proposed works at DSDC Bicester:

	Level of Risk			
Type of Ordnance	Negligible		Medium	High
German HE UXBs		*		
British AAA		*		
German incendiaries and anti- personnel bombs		*		
LSA/SAA		5	*	

#### 12. Proposed Risk Mitigation Methodology

#### 12.1. General

BACTEC believes the following risk mitigation measures should be deployed to support the proposed works at the DSDC Bicester site.

#### 12.2. Recommended Risk Mitigation Measures

All Works

- **Explosive Ordnance Safety and Awareness Briefings to all personnel conducting intrusive works:** A specialised briefing is always advisable when there is a possibility of explosive ordnance contamination. It is an essential component of the Health & Safety Plan for the site and conforms to requirements of CDM Regulations 2007. All personnel working on the site should be instructed on the identification of UXB, actions to be taken to alert site management and to keep people and equipment away from the hazard. Posters and information of a general nature on the UXB threat should be held in the site office for reference and as a reminder.
- **The Provision of Unexploded Ordnance Site Safety Instructions:** These written instructions contain information detailing actions to be taken in the event that unexploded ordnance is discovered. They are to be retained on site and will both assist in making a preliminary assessment of a suspect object and provide guidance on the immediate steps to be taken in the event that ordnance is believed to have been found.

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

BACTEC International Limited

14<sup>th</sup> January 2011

# Bibliography

The key published documents consulted during this assessment are listed below:

- Bates, H, E., *Flying Bombs over England*, Frogletts Publications Ltd. 1994.
- Dobinson, C., AA Command: Britain's Anti-Aircraft Defences of the Second World War, Methuen. 2001.
- Fegan, T., The Baby Killers': German Air raids on Britain in the First World War, Leo Cooper Ltd. 2002.
- o Fleischer, W., German Air-Dropped Weapons to 1945, Midland Publishing. 2004.
- Jappy, M. J., Danger UXB: The Remarkable Story of the Disposal of Unexploded Bombs during the Second World War. Channel 4 Books, 2001.
- Price, A., Blitz on Britain, The Bomber Attacks on the United Kingdom 1939 1945, Purnell Book Services Ltd. 1977.
- Ramsey, W., *The Blitz Then and Now, Volume 1*, Battle of Britain Prints International Limited. 1987.
- Ramsey, W., *The Blitz Then and Now, Volume 2*, Battle of Britain Prints International Limited. 1988.
- Ramsey, W., *The Blitz Then and Now, Volume 3*, Battle of Britain Prints International Limited. 1990.
- Whiting, C., Britain Under Fire: The Bombing of Britain's Cities 1940-1945, Pen & Sword Books Ltd. 1999.

Annex A: Site Location Maps

Annex A



Source: © Crown copyright. All rights reserved. Licence number AL100033639

Annex B: Recent Aerial Photographs of the Site







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	Entec UI	K Ltd
DSDC	Bicester,	Oxfordshire

Source: Google Earth ™ Mapping Services

Project:

3063TA REV\_1

	Site C	Annex <b>B-3</b>
<image/>		B-3
	Approximate site bound	dary

Report Reference: 3063TA	Client:	Entec UK Ltd	M
REV_1	Project:	DSDC Bicester, Oxfordshire	BAC
Source: Google	e Earth ™ Mapping Serv	ices	

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	Site A	Annex <b>B-4</b>
<image/> <image/>		Annex B-4

Report Reference: 3063TA	Client:	Entec UK Ltd	
REV_1	Project:	DSDC Bicester, Oxfordshire	BAC
Source: Google	Earth ™ Mapping Services		

 Annex C: Site Plan

Annex C

		Site Plan	Annex C
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Annex D: 1943 Map of Arncott Site

Annex D

Annex

D



Source: Environmental Science Group

Annex E: Historic RAF Aerial Photography

Annex E





Report Reference: 3063TA	Client:	Entec UK Ltd	BAC
REV_1	Project:	DSDC Bicester, Oxfordshire	
Source: English	Heritage National	Monuments Record	·

		RAF Aerial Pho 10 <sup>th</sup> Aug	tograph, Site A ust 1945	Annex E-2
		<image/>		
Report Reference:	Client:	Entec UK Ltd		- M
REV_1	Project:	DSDC Bicester, Oxfordshire	BA	IC

ource:	English	Heritage	National	Monuments	Record
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S



Annex F: LSA/SAA

T

No. 36 'Mi	lls' Grenade		
Weight: Type: Dimensions: Filling: Remarks:	0.7kg filled (11b 6oz) Hand or discharger, fragmentation 95 x 61mm (3.7 x 2.4in) Alumatol, Amatol 2 or TNT 4 second hand- throwing fuse with approximate 30m range. First introduced May 1918.		STRIKER SARING FUL FULING HOLE FULING HOLE
No. 69.6*	nade		
Weight: Type: Date Introduced: Remarks:	0.38kg filled (0.8lb) Percussion/Blast December 1940 Black Bakelite body. Blast rather than fragmentation type. After unscrewing the safety cap, a tape is held when throwing the grenade releasing the safety bolt in the throwing motion. Detection is problematic due to its very low metal content.		
Typical Sn	noke Grenade		STRIKER SPRING
Dimensions: Type: Date Introduced: Remarks:	Approx. 65 x 115mm (2.5 x 4.5in) Smoke Current MoD issue Smoke grenades are used as ground-to-ground or ground- to-air signalling devices, target or landing zone marking devices, and screening devices for unit movement.		ADHESIVE TAPE ADHESIVE TAPE ADAPTER TOP CANISTER PRIMED CAMBRIC OR MUSLIN SAFETY LEVER COLORED SMOKE COMPOSITION PERFORATED CANISTER PAPER WRAPPING CAP CARDBOARD DISC
Report Reference:	Client:	Entec UK Ltd	
REV_1	Project:	DCDC Dissectory Ovfordabir-	BAC

DSDC Bicester, Oxfordshire

Source: BACTEC International Limited and various historical sources

# **Typical 2 inch High Explosive Mortar**

Bomb Weight: Type: Dimensions: Filling: Maximum Range: Remarks:

1.02kg (2.25lb) High Explosive 51 x 290mm (2in x 11.4in) 200g RDX/TNT 457m (500yds) Fitted with an impact fuze which detonates the fuze booster charge (exploder) and, in turn, the high explosive charge. The main charge shatters the mortar bomb body, producing near optimum fragmentation and blast effect at the target.





Annex

**F-2** 

## **Typical 3 inch Smoke Mortar**

Туре:
Dimensions:
Filling:
Maximum Range:
Remarks:

Smoke c490 x 76mm (19.3in x 3in) Typically white phosphorous 2515m (2,750yds) On impact, the fuze functions and initiates the bursting charge. The bursting charge ruptures the mortar bomb body and disperses the white phosphorous filler. The white phosphorous produces smoke upon exposure to the air



# **Typical 2 inch Illuminating Mortar**

Туре:	Illum.
Dimensions:	51 x 2
Filling:	Variou
Remarks:	The e
	the pa

51 x 290mm Various The expulsion charge ignites and ejects the candle assembly. A spring ejects the parachute from the tail cone. The parachute opens, slowing the descent of the burning candle which illuminates the target.



BACTEC - RISK MITIGATION SERVICES FOR UNEXPLODED ORDNANC Tel: +44 (0) 1634 296757 --O<u>E BIZ 942 92 82 002 06 94 94 76 25 00 9</u> --O<u>OOC 00982 00862 00862 00862 0095</u> 0086 0096 00263 0086 008



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Report Reference: Client: Entec UK Ltd 3063TA BAC REV\_1 Project DSDC Bicester, Oxfordshire Source:

BACTEC International Limited and various historical sources

Small Arms Ammunition



# Annex G: Map Showing Locations of EOD Clearance Tasks

Annex **G** 



Annex H: Anti-Aircraft Artillery

Annex **H** 

# 3.7 inch Anti-Aircraft Projectile

Weight: Dimensions: Carriage: Rate of Fire: Ceiling: Muzzle Velocity: Remarks:

12.7kg (28lb) 94 x 360mm (3.7 x 14.7in) Mobile and Static Versions 10-20 rounds per minute 9-18,000m (29-59,000ft) 792m/s (2,598ft/s) 4.5 inch projectiles were also commonly utilised





Hyde Park 1939 3.7 Inch QF gun on mobile mounting



3.7 inch AA Projectile Minus Fuze

# **Rockets/Unrotated Projectiles**

Weight:	Overall: 24.5kg (54lb) Warhead: 1.94kg (4.28lb)
Dimensions:	1930mm x 82.6mm (76 x 3.25in)
Carriage:	Mobile – transported on trailers
Ceiling:	6770m (22,200ft)
Maximum Velocity:	457mps (1.500 fps)



MK II HE Shell (3.5ka)

Rocket Battery in action



Home Guard soldiers load an anti-aircraft rocket at a 'Z' Battery



# **40mm Bofors Gun Projectile**

Unexploded 40mm Bofors projectile recovered from a marine environment

Weight: Dimensions: Rate of Fire: Ceiling: Muzzle Velocity: Remarks:

Source:

0.86kg (1.96lb) 40mm x 310mm (1.6in x 12.2in) 120 rounds per minute 23,000ft (7000m) 2,890 ft/s (881m/s) Mobile batteries - normally few records of where these guns were located

BACTEC International Limited and various historical sources



40mm Bofors gun and crew at Stanmore in Middlesex, 28 June 1940.



Report Reference: 3063TA	Client:	Entec UK Ltd	
REV_1	Project:	DSDC Bicester, Oxfordshire	

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# Annex C Dstl Radiological Desk Study

5 Pages



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Entec UK Ltd Cannon Court North Abbey Lawn Abbey Foregate Shrewsbury Shropshire SY2 5DE

(For attention of Simon Howard)

Our Ref: ESD/AS/490158/ENTEC/SH Your Ref: Email from Simon Howard (Entec UK Ltd) dated 7<sup>th</sup> January 2010

Date: 1 February 2010

#### PHASE ONE LAND QUALITY ASSESSMENT (DESK STUDY) – DSDC BICESTER

1. In response to your request, Dstl has conducted a search of records relating to any radiological contamination issues at Defence Storage and Distribution Centre (DSDC) Bicester, formerly Base Ordnance Depot (BOD) Bicester. This desk study will provide an input into the Phase One Land Quality Assessment of the afore-mentioned site.

2. It should be noted that the specific area of the site being investigated is A, C, D and E parts of DSDC Bicester. Dstl do not hold any information specifically relating to these areas, but have undertaken an information search for DSDC Bicester as a whole.

#### Desk Study Methodology

3. Dstl have searched a number of information sources including the MOD radioactive holdings database, archive and published information etc. In addition, a number of people within the Dstl Radiation Protection Advisory Body and site representatives have been consulted in order to obtain any information available relating to radiological issues.

#### **Results of Information Search**

4. Findings of the desk study are summarised in Table 1 (Annex A) which includes full references for any information identified. This table also includes information searches which did not yield any relevant information.

5. Dstl records show that a very large number of items of standard military equipment containing radioactive material have been stored at the DSDC Bicester site from at least 1994 to the present day; the site being a major distribution centre for the main storage facility at DSDA Donnington. These include various pieces of instrumentation and check sources containing the following radionuclides: tritium (H-3), nickel-63 (Ni-63), thorium-232 (Th-232), strontium-90 (Sr-90) chlorine-36 (Cl-36) and cobalt-57 (Co-57). In addition, an instrumentation dial from a Canberra cockpit containing radium-226 (Ra-226) has been stored on site since at least 1999.

6. A previous Phase One Radiological Land Quality Assessment was undertaken for the Army Base Repair Organisation (ABRO) Facility at DSDC Bicester. This report noted that a Royal Electrical and Mechanical Engineers (REME) workshop operated at the site until approximately 1986; such facilities being known for work with radioactive material. In addition, there was also a burning ground for disposal of combustible materials on one of the depot sites (specific location not known).

7. The former REME workshop (Building C32) including instrument workshop was subject to a radiological survey in 1998 to determine the extent of any contamination which may be present. No radioactive contamination was identified in the buildings themselves although Ra-226 contamination was detected at a depth of 1.5 metres to the rear of the building (activity concentration: 275 Bq/g). The report concluded by recommending that any future intrusive work in the area should be supported by health physics cover for safety purposes. Dstl do not hold any information to indicate that the area has been subject to remediation.

8. A further radiological survey was undertaken in 1998 of an area in 'A' site planned for redevelopment. Whilst this survey did identify a number of areas of elevated radiation measurements, subsequent analysis of recovered soil samples indicated that these measurements were due to naturally occurring radioactive material rather than man-made contamination.

9. In addition, low level tritium contamination was identified in the site Armoury (Armourer's workshop) in September 2001, where maintenance work had been carried out on equipment containing gaseous tritium light sources (GTLSs). The area was decontaminated by the Dstl survey team in 2004.

#### Summary

10. The information gathered in this information search has highlighted that there is Ra-226 contamination present in the ground surrounding building C32 which was formerly operated as a REME workshop. It would be appropriate to carry out further characterisation of this contamination and the surrounding areas. Based on this information and the large number of radioactive items which have been stored on site, the likelihood of contamination being present on other parts DSDC Bicester is deemed to be moderate. In particular, if any additional burning grounds, disposal areas or workshops are identified on the site, these should be subject to a radiological survey.

11. Should you obtain additional historical information which you would like Dstl to comment upon, please do not hesitate to contact me.

Regards

Signed on original

AARON SCARLETT Health Physicist Dstl RPA Body

Report prepared by:

**KEVIN WHITE** Environmental Technician Table 1. Information Sources for Phase One LQA (Desk Study) of DSDC Bicester.

INFORMATION SOURCE	COMMENTS	REFERENCE
MOD Radioactive Holdings Database	<ul> <li>Current units holding radioactive material:</li> <li>In addition to DSDC Bicester, a number of units are based at the site including 16 Cadet Training Team, 23 Pioneer Regt RLC and the Garrison SP Unit. The site holds a large number of standard items of military equipment containing minor radioactive sources including tritium (H-3), thorium (Th-232), strontium (Sr-90), cobalt (Co-57) and chlorine (CI-36). A master indicator from a Canberra cockpit containing radium (Ra-226) is also stored on site.</li> <li>Former units known to hold radioactive material:</li> <li>The units previously based at the site include 25 Freight Dist Sqn RLC, 16 Sup Regt RLC, 25 Sqn RCT, 25 Sqn RLC, 602 Signal Troop, BOD (Bicester), BOD (Bicester) - Thatcham Sub Depot and HQ 23 GP RLC. They held standard pieces of military equipment and instruments containing tritium (H-3) and nickel-63 (Ni-63).</li> <li>NOTE: The regulatory controls associated with the handling and storage of radioactive material at MOD establishments limits the likelihood of radiological contamination arising.</li> </ul>	MOD Radioactive Holdings Database (maintained by Dstl) [date of search: 28/01/2010]
Environment Agency Notifications/Approvals	DSDC Bicester hold a Notification from the Environment Agency for the keeping and use of closed sources (MOD parallel arrangements under the Radioactive Substances Act 1993).	EA Notification No. BS2453
Internet / MOD Intranet Search	An internet search did not reveal any specific information relating to possible radiological contamination issues.	Internet search: [date of search: 29/01/2010]
	A search of the MOD intranet did not return any relevant information regarding the site.	MOD Intranet [date of search: 29/01/2010]

#### ANNEX A to ESD/AS/490158/ENTEC/SH Dated 1 February 2010

INFORMATION SOURCE	COMMENTS	REFERENCE
Archive Information	A previous phase one land quality assessment was undertaken on the ABRO Facility at DSDC Bicester. This report noted that a Royal Electrical and Mechanical Engineers (REME) workshop operated at the site until approximately 1986; such facilities being known for work with radioactive material. In addition, there was also a burning ground for disposal of combustible materials on one of the depot sites (specific location not known).	Dstl internal records: 490/0103/14780/DRPS dated September 2000
Published Information	There is some published historical information relating to RAF Bicester, but this site is separate from what is now DSDA Bicester.	Bower, M.J.F (1983) 'Action Stations No. 6 Military Airfields of the Cotswolds and the Central Midlands.
Dstl Radiological Surveys	A smear survey was undertaken in the Armourer's workshop in September 2001. This identified a number of areas of tritium contamination in locations where equipment containing GTLSs had been maintained. This area was de- contaminated by the Dstl survey team in 2004.	DRPS/GMH/20068/DSDCB/GP dated 21 September 2001 283/2004 - 2 December 2004
	The former instrument shop and areas external to Building C32 were surveyed in April 1998: some Ra-226 contamination was found in one of the trial pit locations at the rear of the building (activity concentration 275 Bq/g). No contamination was found within the building.	DERA/CHS/DRPS/22/98 dated 28 May 1998
	A further radiological survey was undertaken in 1998 of an area in 'A' site planned for re-development. Whilst this survey did identify a number of areas of elevated radiation measurements, subsequent analysis of recovered soil samples indicated that these measurements were due to naturally occurring radioactive material rather than man-made contamination.	DERA/CHS/DRPS/31/98 dated 1998
	The Garrison Support Centre was monitored for concentrations of naturally occurring radon gas in 2008-2009: no significant levels were detected. The rest of DSDC Bicester including A, C, D and E sites are due to be monitored in February 2010.	ESD/LJK/630007/RADON/0X60DL dated 10 June 2009
		Dstl internal records [date of search: 29/01/10]

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INFORMATION SOURCE	COMMENTS	REFERENCE
Site Contacts (eg. Radiation Safety Officer)	The Radiation Safety Officer (RSO) for DSDA Bicester was contacted by telephone. No information relating to potential radiological contamination was known, other than what has already been identified.	Telephone Conversation: White (Dstl) / RSO (SHEQ for DSDA Bicester) of 29/01/10.
Information from Radiation Protection Advisory Body.	A number of personnel within the Dstl RPA Body were contacted requesting information on any potential contamination issues. The only additional information available related to the use of the site as a distribution centre for the main storage facility at DSDA Donnington; hence the large number of radioactive items which have been stored on site.	Email References: Brown (Dstl- Senior Health Physicist) / White (Dstl) of 28/01/10 Clark (Dstl – Senior Health Physicist) / White (Dstl) of 28/01/10 Gibbs (Dstl – Group Leader Radiation Protection) / White (Dstl) of 28/01/10 Hughes (Dstl – DSDA RPA) / White (Dstl) of 28/01/10 Lee (Dstl RAF RPA) / White (Dstl) of 28/01/10 Morgan (Dstl- Senior Health Physicist) / White (Dstl) of 28/01/10
	Previous advisory visit reports for DSDA Bicester were scrutinised, but no issues relating to radiological contamination were identified.	ESD Report No. 257/2007 dated 13 September 2007