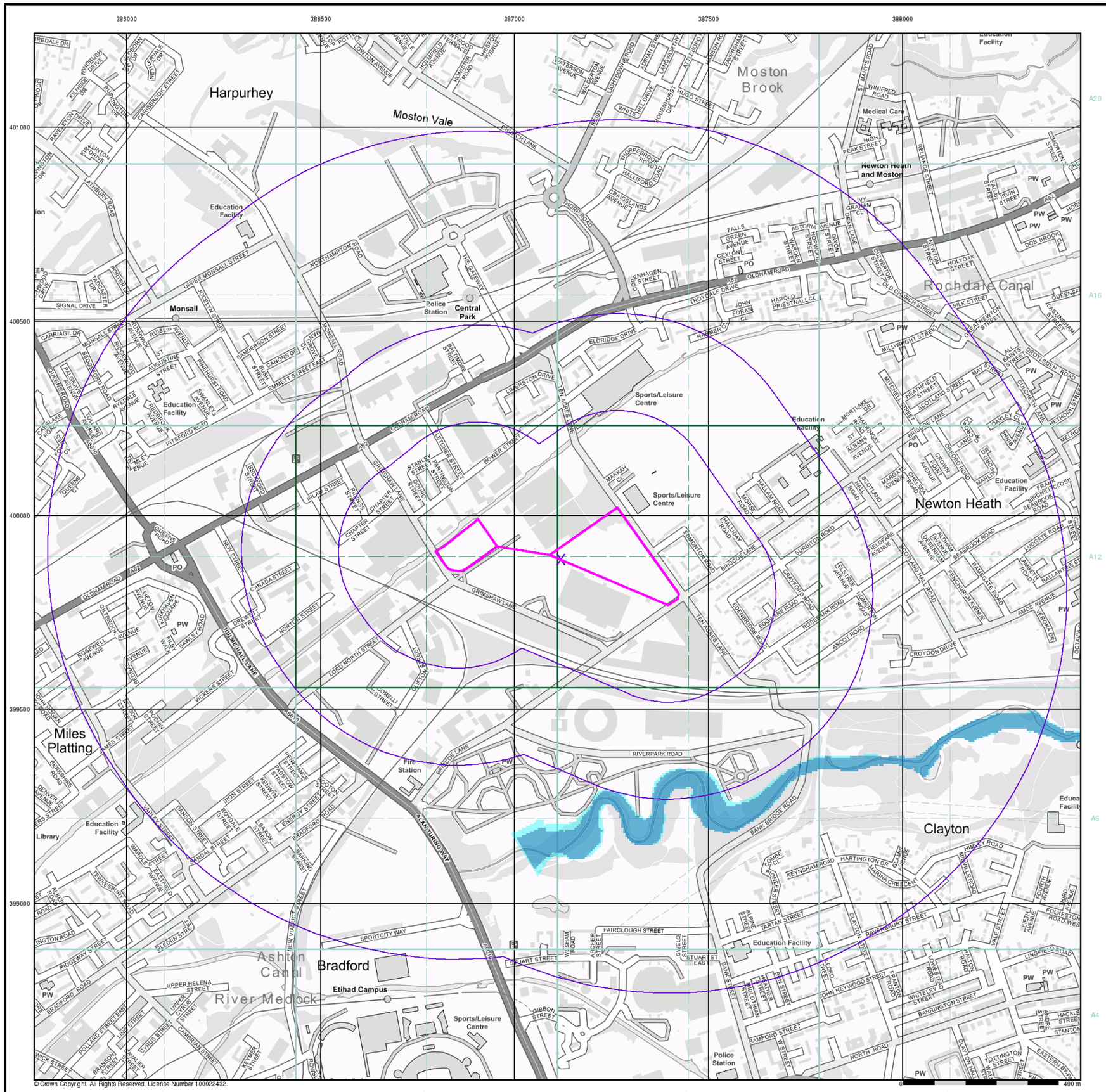
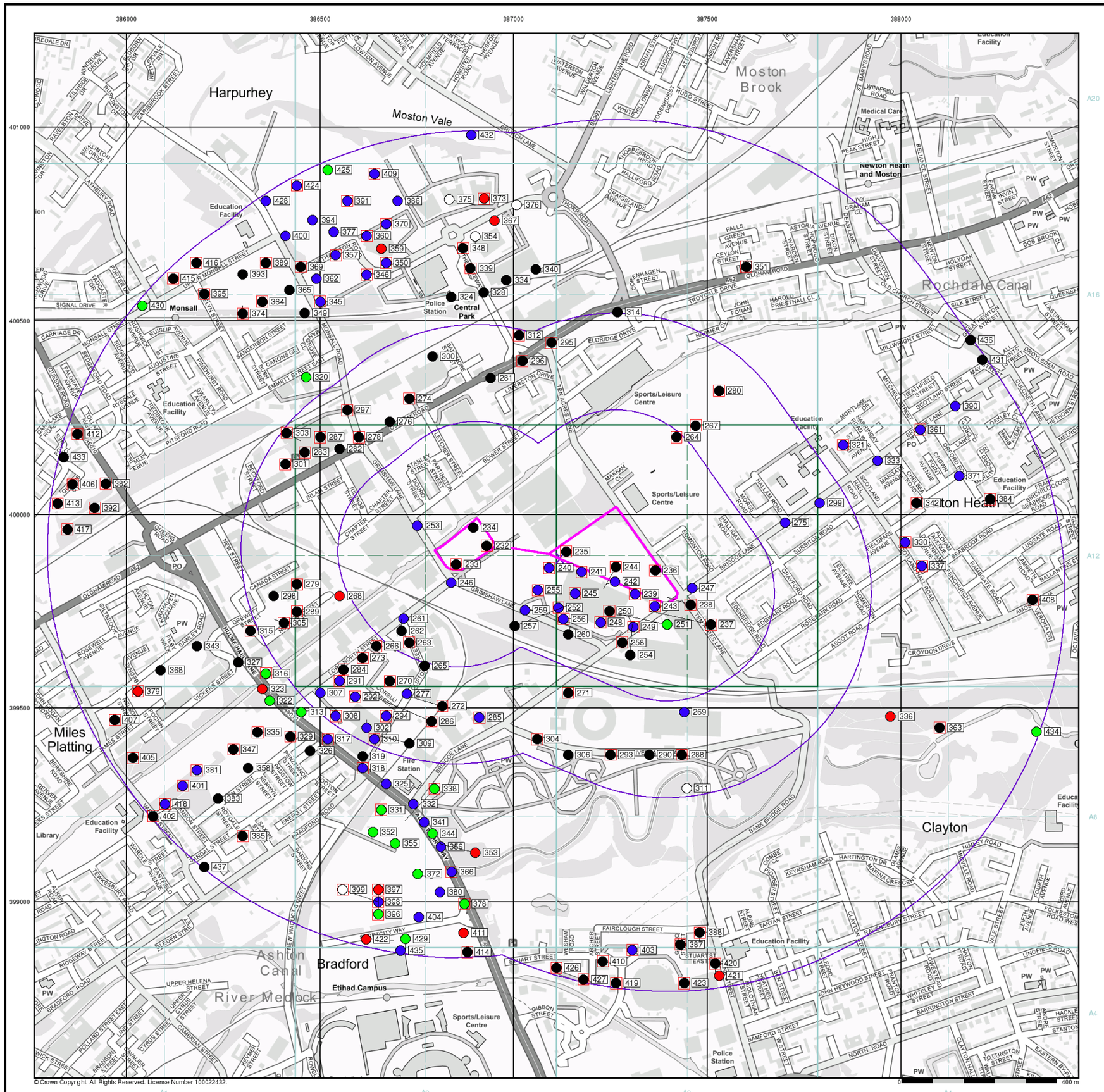

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Harpurhey
Moston Vale
Moston Brook
Newton Heath and Moston
Education Facility
Medical Care
Monsall
Police Station
Central Park
Rochdale Canal
Sports/Leisure Centre
Newton Heath
Miles Platting
Fire Station
Clayton
Ashton Canal
Bradford
Etihad Campus
River Medlock
Library
Education Facility
Police Station
PO
PW
A62
A664
A6010
OLDHAM ROAD
NORTHAMPTON ROAD
UPPER MONSALL STREET
ELDRIDGE DRIVE
GRIMSHAW LANE
ALAN TURING WAY
RIVERPARK ROAD
BANK BRIDGE ROAD
SPORTCITY WAY
TROYDALE DRIVE
THORP ROAD
CHURCH LANE
WHITE HILL DRIVE
HALLIFORD ROAD
CRAIGLANDS AVENUE
THORPEBROOK ROAD
CORPENHAGEN STREET
ASTORIA AVENUE
FALLS GREEN AVENUE
CEYLON STREET
DIXON STREET
NEWTON STREET
HOLYOAK STREET
SILK STREET
MILLWRIGHT STREET
ALL SAINTS STREET
OLDHAM ROAD
ASHTON OLD ROAD
HIGH PEAK STREET
RELIANCE STREET
MORTON STREET
IRVIN STREET
BEAUMONT STREET
BOB BROOK CL
ST MARY'S ROAD
WINIFRED ROAD
WATERSON AVENUE
WALDERTON AVENUE
LIGHTBOURNE ROAD
ADRIAN STREET
LANGWORTHY ROAD
ATTLEBORO ROAD
HONLEY AVENUE
HONLEY TERRACE
HESFORD AVENUE
LOWTON AVENUE
HOLLINWOOD AVENUE
MONSTER ROAD
WINDBUSH DRIVE
KILNSIDE DRIVE
RAVENSTONE DRIVE
KILMINTON DRIVE
ATHBURY ROAD
CARIBBROOK STREET
NETHERVALE DRIVE
REDDALE DR
WOODLEY
ION
TADCASTER DR
PORTERTON
SIGNAL DRIVE
CARRIAGE DR
MONSALL STREET
RUSLIP AVENUE
AUGUSTINE STREET
PINEHURST ROAD
SWANLEY AVENUE
REDBROOK AVENUE
PITSFORD ROAD
TEN MILE AVENUE
SANDERSON STREET
CANONS DR
EMMETT STREET EAST
MONSALL ROAD
CLOVELLY GROVE
BALTIMORE STREET
LIMERSTON DRIVE
TEN ACRES LANE
BOWER STREET
FLETCHER STREET
STANLEY STREET
PARTINGTON STREET
GROUND STREET
GRESHAM LANE
CHAPTER STREET
BERKFORD STREET
RILAND STREET
MAKAH CL
QUEENS ROAD
QUEENSWAY
CANADA STREET
NEW STREET
DREWETT STREET
NORTON STREET
LORD NORTH STREET
CORELLI STREET
CLIFTON STREET
WILMSLOW ROAD
ROSEWELL AVENUE
GLENBROOK AVENUE
LAURENCE SQUARE
TILLEY WALK
SARLEY ROAD
VICKERS STREET
JAMES STREET
STOCKPORT ROAD
BERKSHIRE ROAD
DENVER AVENUE
IRON STREET
PRIMROSE STREET
PARSON STREET
KENYON STREET
PHOTON STREET
DANSON STREET
ROYDALE STREET
SAXON STREET
ENERGY STREET
SANDAL STREET
BRADFORD ROAD
VARLEY STREET
WARDLE STREET
EASTFIELD AVENUE
FENKESBURY ROAD
SLEDEN STREET
RIDGWAY STREET
UPPER HELENA STREET
LOWER CIVILS STREET
CIVILS STREET
CAMBRIAN STREET
POLLARD STREET EAST
LIND STREET
BRANSON STREET
CHALMER STREET
FENMER STREET
ROWSLEY STREET
VIEW VIADUCT STREET
SHEPHERD STREET
FAIRCLOUGH STREET
STUART STREET
STUART ST EAST
WILSHAW ROAD
ARCHER STREET
GWELO STREET
GIBBON STREET
BRIDGE LANE
ALPINE STREET
TARTAN STREET
GLAYDS AVENUE
RAVENSBURY STREET
BANK STREET
CLAYTON STREET
JOHN HEYWOOD STREET
FANTON ROAD
LOWERFIELD ROAD
WHITELEY GROVE
BARRINGTON STREET
BAMFORD STREET
W STREET
NORTH ROAD
TOTTINGTON STREET
WESTERN STREET
EASTERN BLVD
LINGFIELD ROAD
FOLKESTONE ROAD WEST
HIMLEY ROAD
MERRILEE ROAD
FOURTH AVENUE
FIFTH AVENUE
THIRD AVENUE
VALE STREET
KEYNSHAM ROAD
HARTINGTON DR
MARINA CRESCENT
GLAMIS AVENUE
POWER STREET
COMBE CL
HETHORS STREET
MELROSE
MAY STREET
OLDHAM LANE
OLDHAM STREET
OLDHAM ROAD
HEATHFIELD STREET
SCOTLAND STREET
MITCHELL STREET
MORTLAKE DR
HARPENDEN ROAD
ST ALBANS AVENUE
OAKLEY CL
BRIDGE LANE
CROWN AVENUE
CROWN POINT AVENUE
OXFORD ROAD
MARLA
MARLA CL
FRITH CLOSE
SEABROOK ROAD
LUDGATE ROAD
LAMBETH ROAD
BALLANTYNE STREET
RAMSGATE ROAD
FENCHURCH AVENUE
AMOS AVENUE
VERONA DR
CROYDON DRIVE
ASCOT ROAD
ROSEBANK ROAD
EDGWARE ROAD
EDENBRIDGE RD
HOMERTON
CRAYFORD ROAD
SURBITON ROAD
BRISCOE LANE
HALLIDAY ROAD
SYMONTON ROAD
SCOTLAND HALL ROAD
FIELDFARE AVENUE
ALDHAM AVENUE
OVERDALE AVENUE
ANCRE STREET
HACKLEY STREET
STANTON
JOHN FORAN CL
HAROLD PRIESTNALL CL
QUEENSFERRY
CASTLEFORD
OLD CHURCH STREET
DUCKWORTH STREET
WHEELER STREET
DORNWOOD
GRAHAM CL
IVY
DEAN LANE
ROSEGARTH
PEARL
PEARL CL
DUNKIRK
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PEEL GREEN ROAD



General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Map ID
- Several of Type at Location

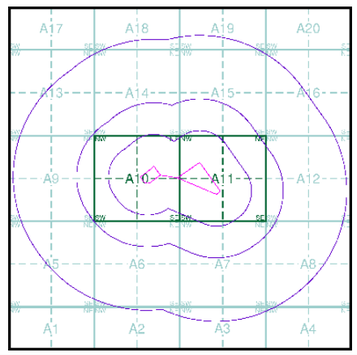
Agency and Hydrological (Boreholes)

- BGS Borehole Depth 0 - 10m
- BGS Borehole Depth 10 - 30m
- BGS Borehole Depth 30m +
- Confidential
- Other

For Borehole information please refer to the Borehole .csv file which accompanied this slice.

A copy of the BGS Borehole Ordering Form is available to download from the Support section of www.envirocheck.co.uk.

Borehole Map - Slice A



Order Details

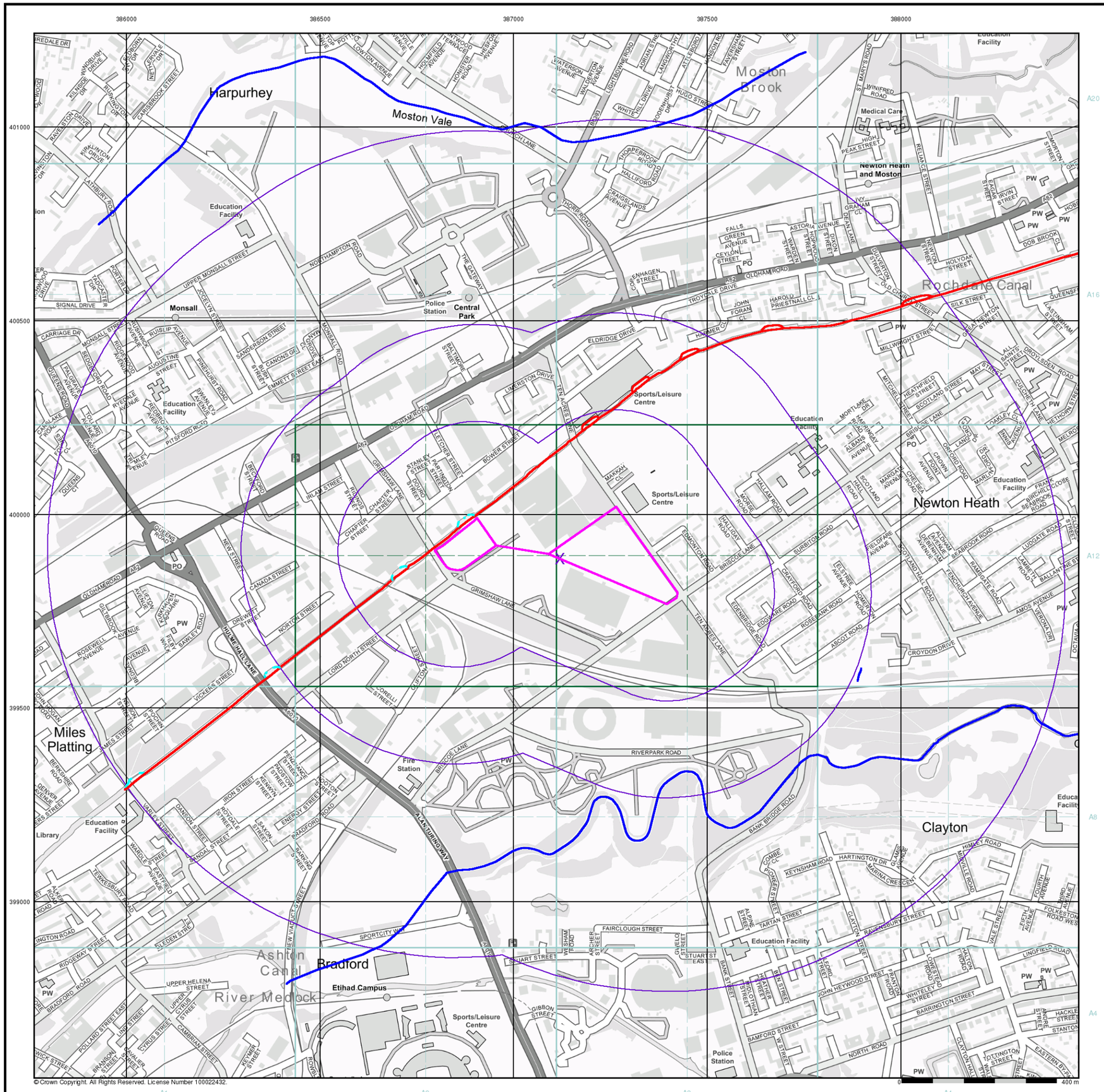
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Customer Ref:	423207
National Grid Reference:	387120, 399890
Slice:	A
Site Area (Ha):	4.66
Search Buffer (m):	1000

Site Details

Plots 1 & 2, Grimshaw Lane, MANCHESTER, M40 2AB

Landmark INFORMATION GROUP

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



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TRC

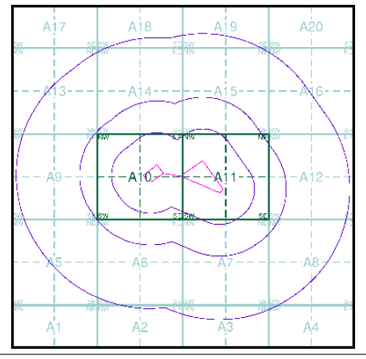
General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

OS Water Network Data

- Canal
- Reservoir
- Foreshore
- Marsh
- Tidal River
- Inland River
- Drain
- Other
- Lake
- Transfer
- Lock Or Flight Of Locks
- Sea

OS Water Network Map - Slice A



Order Details

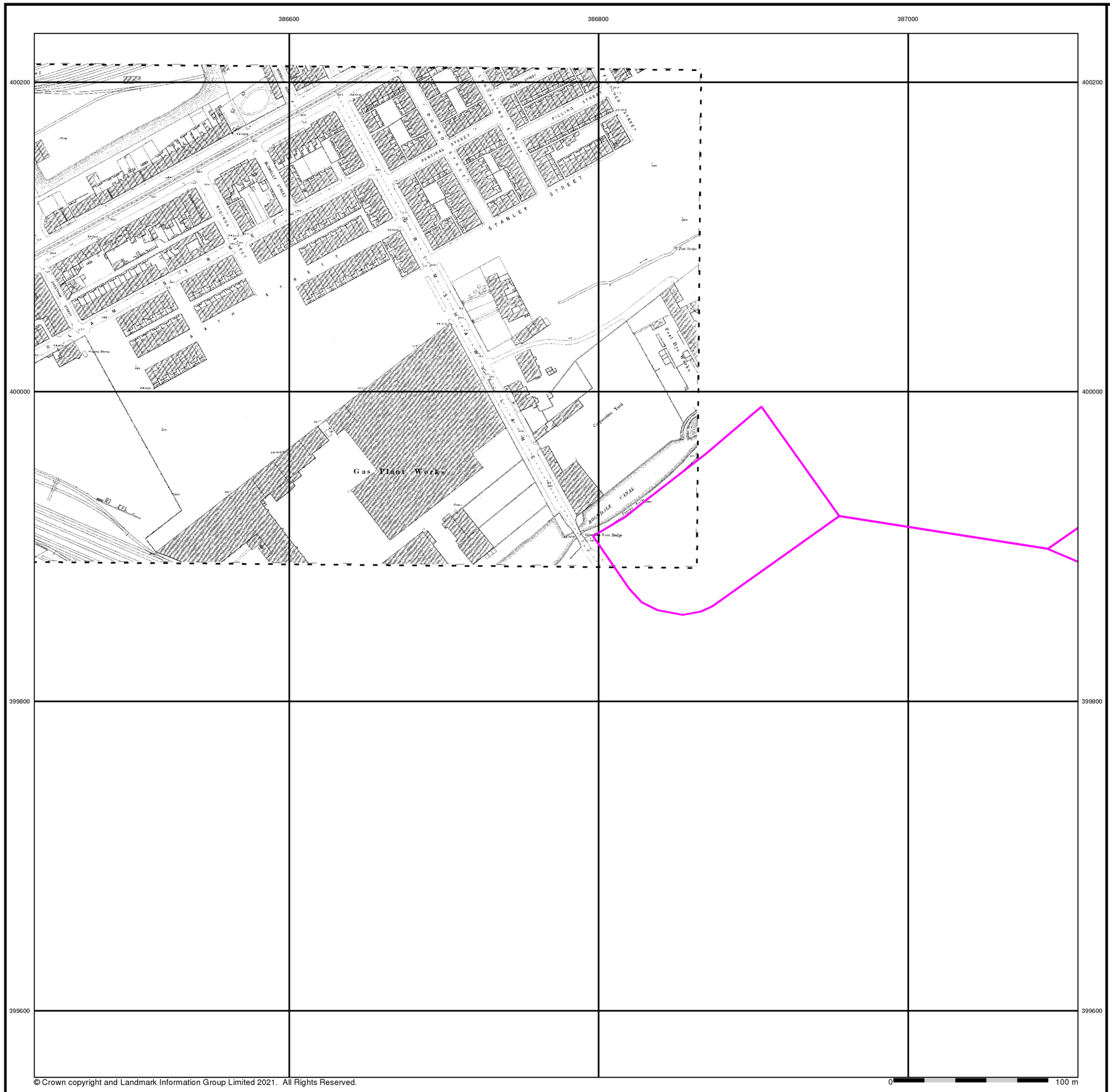
Order Number:	271094757_1_1
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Slice:	A
Site Area (Ha):	4.66
Search Buffer (m):	1000

Site Details

Plots 1 & 2, Grimshaw Lane, MANCHESTER, M40 2AB

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TRC

Lancashire And Furness

Published 1891

Source map scale - 1:500

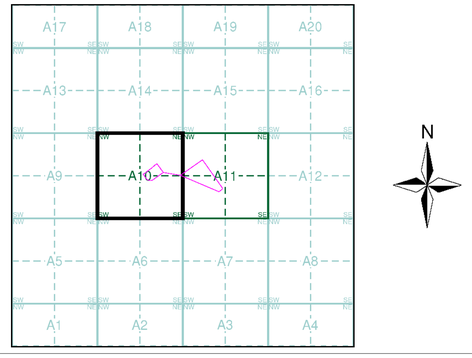
The 1:500 scale Ordnance Survey mapping was introduced in 1855 as a replacement for the 1:528 scale and to compliment the 1:2500 scale that had been implemented in 1853. By 1895, the 1:500 scale covered most towns over a population of about 4000 at the time of survey, although very few towns were mapped more than once at this scale, and none have been since 1910. The 1:500 scale gives particular emphasis to such features as lamp posts, man holes, arched passages and minor building projections. Also often featured are divisions between tenements, interior ground floor layouts of public buildings, and on earlier plans, the functions of the various parts of larger industrial premises are also indicated. Content of the plans does vary however, from one town to the next in terms of, for example, the completeness of railway tracks and the coverage of public buildings.

Please note: Due to the partial coverage of Historical Town Plans, it is possible that not all segments within an order will contain mapping. Only the segments that have Town Plan coverage will be generated.

Map Name(s) and Date(s)

104_03_025
1891
1:500

Historical Town Plan - Segment A10



Order Details

Order Number:	271094757_1_1
Customer Ref:	423207
National Grid Reference:	387120, 399890
Slice:	A
Site Area (Ha):	4.66
Search Buffer (m):	0

Site Details

Plots 1 & 2, Grimshaw Lane, MANCHESTER, M40 2AB

Landmark INFORMATION GROUP
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

Annex C: Site Photographs

Site Photographs

Client Name:	Site Location:	Project No.:
Canmoor (Manchester) Ltd	Grimshaw Lane (Plot 1)	423207.0000

Photo No.	Date
1	28/01/2021

Description:
View west across Plot 1.



Photo No.	Date
2	28/01/2021

Description:
View west towards Grimshaw Lane, waterlogging evident.



Site Photographs

Client Name:	Site Location:	Project No.:
Canmoor (Manchester) Ltd	Grimshaw Lane (Plot 1)	423207.0000

Photo No.	Date
3	28/01/2021

Description:
View north towards the Rochdale Canal.



Photo No.	Date
4	28/01/2021

Description:
View south towards Grimshaw Lane.



Site Photographs

Client Name:	Site Location:	Project No.:
Canmoor (Manchester) Ltd	Grimshaw Lane (Plot 1)	423207.0000

Photo No.	Date
5	28/01/2021

Description:
Site cabins associated with the demolition of Mather's Foundry.



Photo No.	Date
6	28/01/2021

Description:
Photograph at the western boundary of Plot 1 showing the elevation change from Grimshaw Lane.



Site Photographs

Client Name:	Site Location:	Project No.:
Canmoor (Manchester) Ltd	Grimshaw Lane (Plot 1)	423207.0000

Photo No.	Date
7	28/01/2021

Description:
View east towards the former Mather's Foundry.



Photo No.	Date
8	28/01/2021

Description:
View along the western edge of the Plot 1.



Site Photographs

Client Name:	Site Location:	Project No.:
Canmoor (Manchester) Ltd	Grimshaw Lane (Plot 1)	423207.0000

Photo No.	Date
9	28/01/2020

Description:
View north along the western/northwestern edge of the Site.



Photo No.	Date
10	28/01/2021

Description:
View southwest of Lord North Street.



Site Photographs

Client Name:	Site Location:	Project No.:
Canmoor (Manchester) Ltd	Grimshaw Lane (Plot 2)	423207.0000

Photo No.	Date
11	28/01/2021

Description:
Entrance gate with concrete to block access.



Photo No.	Date
12	28/01/2021

Description:
View southwest of the earth bund.



Site Photographs

Client Name:	Site Location:	Project No.:
Canmoor (Manchester) Ltd	Grimshaw Lane (Plot 2)	423207.0000

Photo No.	Date
13	28/01/2021

Description:
View southwest, down to the adjacent bakery site.



Photo No.	Date
14	28/01/2021

Description:
View west towards the former Mather's Foundry site.



Site Photographs

Client Name:	Site Location:	Project No.:
Canmoor (Manchester) Ltd	Grimshaw Lane (Plot 2)	423207.0000

Photo No.	Date
15	28/01/2021

Description:
View west towards the former Mather's Foundry site.



Photo No.	Date
16	28/01/2021

Description:
Fly tipped waste within Plot 2.



Site Photographs

Client Name:	Site Location:	Project No.:
Canmoor (Manchester) Ltd	Grimshaw Lane (Plot 2)	423207.0000

Photo No.	Date
17	28/01/2021

Description:
Demolition works being carried out on the adjacent site.



Photo No.	Date
18	28/01/2021

Description:
Trees and scrub within Plot 2.



Site Photographs

Client Name:	Site Location:	Project No.:
Canmoor (Manchester) Ltd	Grimshaw Lane (Plot 2)	423207.0000

Photo No.	Date
19	28/01/2021

Description:
Area of hardstanding close to the entrance of Plot 2.



Photo No.	Date
20	28/01/2021

Description:
Ditch present within the earth bund located at the east of Plot 2.



Annex D: UXO Desk Based Threat Assessment



Detailed Unexploded Ordnance (UXO) Risk Assessment

Project Name	Plot 2, Park Works, Manchester
Client	TRC Companies Ltd
Site Address	Plot 2, Park Works, Manchester, M40 2BA
Report Reference	DA12563-00
Date	28/01/21
Originator	SB

Executive Summary

Site Location and Description

The site is located in Newton Heath, Manchester. The site is bordered to the north by industrial structures associated with the Mather & Platt Park Engineering Works along Rochdale Canal, to the east by open ground and residential housing opposite Ten Acres Lane, to the south by industrial structures along Briscoe Lane, whilst the site is bordered to the west by further industrial structures, open ground and railway.

The site is currently occupied in its entirety by open brownfield land, which was largely formerly occupied by industrial warehousing demolished in the late 1990's.

The site is approximately centred on the OS grid reference: **SJ 87273 99891.**

Proposed Works

The exact nature of proposed works was not available at the time of writing, however, information provided by the client indicates the development on site will be of a commercial nature, providing employment opportunities.

Geology and Bomb Penetration Depth

The British Geological Survey (BGS) map shows Chester Formation – sandstone, of the Triassic Period. Local environment was previously dominated by rivers. Superficial deposits include till, devensian – diamicton, of the Quaternary Period. Local environment was previously dominated by ice age conditions.

Site specific geotechnical information was not available to 1st Line Defence at the time of the production of this report. An assessment of maximum bomb penetration depth can be made once such data becomes available, or by a UXO specialist during on-site support.

It should be noted that the maximum depth that a bomb could reach may vary across a site and will be largely dependent on the specific underlying geological strata and its density.

UXO Risk Assessment

1st Line Defence has assessed that the risk from items of historic Allied ordnance is not homogenous across the site area. Areas of the site that have not undergone substantial post-war redevelopment (north-east section) are considered to be of **Medium Risk** from items of Allied Ordnance, whilst areas that were occupied by both pre and post-war factory buildings and have since been demolished are considered to be of **Low Risk.** See Risk Mapping presented in **Annex P**. There is a **Low Risk** from items of German aerial delivered UXO across the site footprint. This assessment is based on the following factors:

German Aerial Delivered Ordnance

- During WWII the site was located within the County Borough of Manchester, which according to Home Office bombing statistics sustained an overall low density of bombing, with 27.1 items of ordnance recorded per 1,000 acres. Anecdotal evidence suggests that even though there were possible railway and industrial targets in the area, there was very little bombing in Newton Heath, where the site is located, and it is thought that bombing in Manchester was more concentrated in the city centre and dock area.
- Pre-war OS mapping dated 1922-1932, indicates the site consisted largely of structures associated with *Park Engineering Works,* whilst open ground occupied the north-eastern border of the site boundary. Post-war OS mapping dated 1951 indicates that additional structures have been extended in the eastern section of the site, leaving a small area of open ground in the north-eastern corner of the site.
- A Manchester bomb plot and damage map does not record any strikes within the site boundary or its environs. Whilst this map is not considered to be entirely comprehensive, it does indicate the low localised density of bombing in the area. Additionally, no damage is recorded to any structures on or surrounding the site. This is supported by post-war era oblique photography from 1953, which indicate the works survived the war structurally intact. Likewise, no reference to bombing or damage at the Mather & Platt Park Engineering Works could be found in written records or published historical accounts.
- Whilst open areas of land can be of possible concern, the vast majority of the site was occupied by structures associated with the Park Works during wartime. Therefore, it is anticipated that the majority of the site would have

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UXO Risk Assessment

been frequently accessed during the war as a result of the factory.. Given the presence of these structures and this level of access, it is considered likely that obvious indicators of UXO, such as entry holes and craters, would have been easily seen and recorded on site.

- In summary, the site is not considered to be at significant risk of German air-delivered UXO contamination. Whilst the risk of indicators of UXO going unnoticed within the open area of the site cannot be entirely discounted, evidence suggests that the general site area did not constitute a viable target, did not sustain any direct bomb strikes, and there is no obvious positive evidence of bomb damage within or in proximity to the site boundary. The risk of contamination is therefore not considered to be any higher than the 'background level' for this area of the UK.

Allied Ordnance

- The site boundary and the surrounding industrial properties, known formerly as the Mather & Platt Park Engineering Works, are understood to have become government run enterprises in both WWI and WWII. During both periods the works was requisitioned for the manufacture of ordnance components, other war related materials and the production of Avro 504 aeroplanes in association with the nearby Avro Works.
- Research suggests that during WWI Park Works was mainly involved in the manufacture of projectile casings and fuzes, as well as specialising in Howitzer (large calibre artillery guns) relining. During WWII the factory predominantly became known as a gun factory and was again used to produce ordnance components such as fuzes and weapon cases. Various munition parts such as rocket and anti-aircraft projectors, as well as cordite rolling mills were manufactured here. Due to the limitations of the available record it is assumed that Park Works may have produced an even greater diverse range of other wartime items and materials also.
- Munition components produced at Park Works are largely thought to have been subsequently transported to dedicated munition filling factories (known as ROF's) to be filled with explosives. Such items may however have been stored on site prior to their transit. Given its significant wartime output and the variety of items made, the production and usage of explosives at the Park Factory also cannot be entirely discounted. The production of fuzes in particular would have entailed the production of a small explosive component and these types of item can still pose a health risk if disturbed today.
- It was not uncommon for excess or unwanted ordnance such as fuzes to be buried or burnt within the wider premises of a factory as a means of disposal, especially if deemed faulty or in excess. Records of such practice were rarely kept. It is also difficult to ascertain what degree of clearance or disposal may have taken place in post war years.
- Given that there are no site plans available for the factory, it is not possible to determine what the structures within the site boundary were exactly used for. As such, it is not possible to discount the possibility that the site may have been located within a section of the factory used for the storage or testing of ordnance.
- However the potential for ordnance disposal (such as burial or burning) to have occurred is considered to be minimal within the footprint of the factory buildings themselves, due to the hard standing composition of their floors. The potential for such disposal is considered to be much higher within areas of open soft land, such as within the eastern section of the site during wartime. The Park Engineering works is however understood to have been significantly expanded in the post-war period, including the extension of warehousing across the eastern section of the site.
- Subsequently, because the site area is known to have been utilised to produce various ordnance components throughout both WWI and WWII, there is considered to be an elevated risk of historic Allied UXO contamination at the site of proposed works. This risk of UXO remaining today is however considered to be substantially reduced within areas of the site occupied by the pre-war factory building, which would have been less viable for ordnance disposal, and areas that have undertaken significant post-war redevelopment, as any items of ordnance should have already been encountered during previous excavation works. Therefore, the risk on-site is not considered to be homogeneous. Only the open area within the north-east section of the boundary, that has remained largely undeveloped from WWII to present day, is considered to be at an elevated risk of encountering Allied UXO (see risk mapping presented in **Annex P**).

Post-War Redevelopment

- The wartime structures of the Park Engineering Works are understood to have undergone significant extension in the post-war period, including the extension of warehousing into the eastern section of the site area. All the industrial structures within the boundary have since been demolished, notably in the 1990s. The site boundary is now occupied by an area of open ground. The risk of UXO remaining is considered to be mitigated at the location of and down to the depth of any post-war redevelopment on site. Within the footprints of post-WWII redevelopments, the risk from shallow-buried UXO (especially Allied items/components) should have been encountered/removed during initial excavations. The risk will remain within virgin geology below and amongst these post-war works, down to the maximum bomb penetration depth.

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Recommended Risk Mitigation Measures

The following risk mitigation measures are recommended to support the proposed works at the Plot 2, Park Works, Manchester site:

All Works

- UXO Risk Management Plan
- Site Specific UXO Awareness Briefings to all personnel conducting intrusive works.

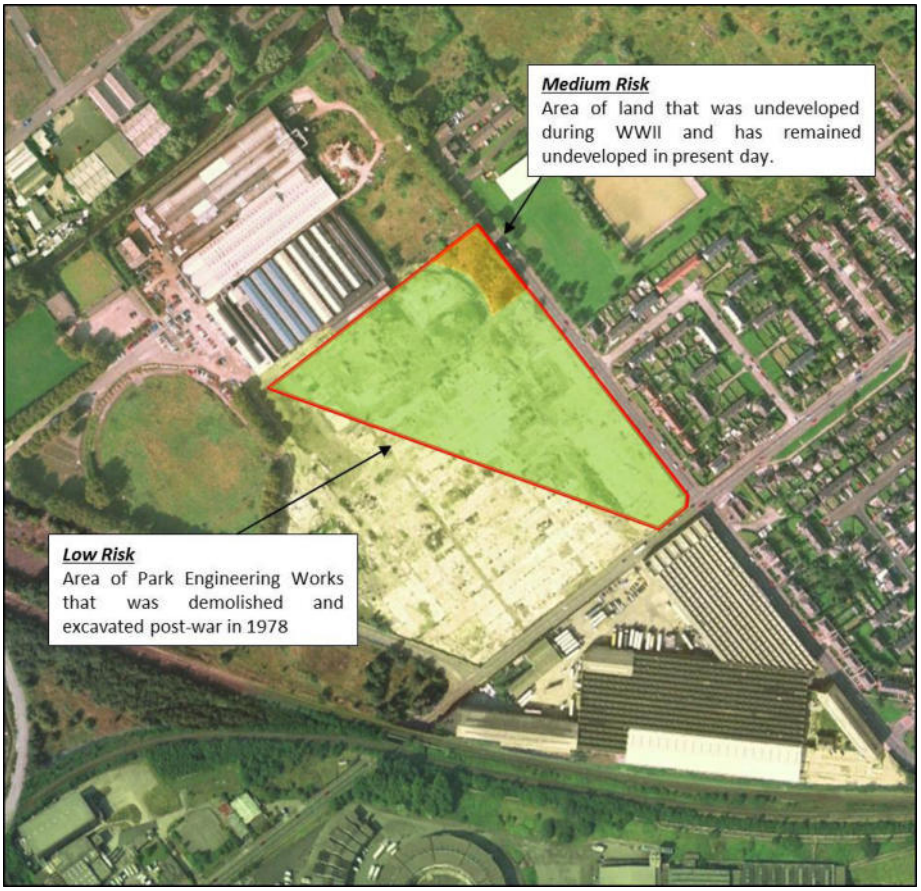
Medium Risk Area (North East Section)

Open Intrusive Works (trial pits, service pits, open excavations, shallow foundations etc.)

- UXO Specialist On-site Support

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Risk Map



For indicative purposes – not to scale.
Please note that this assessed risk map may not take into account all post-war redevelopment/excavations on site.

Low Risk

Medium Risk

1st Line Defence Risk Mitigation Services:

All Areas of the Site:

- Site Specific Unexploded Ordnance Awareness Briefings – a service recommended to all personnel conducting intrusive works.
- UXO Risk Management Plan

Medium Risk Area of the site:

- Unexploded Ordnance Specialist - a service to support open intrusive works.

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Glossary

Abbreviation	Definition
AA	Anti-Aircraft
AFS	Auxiliary Fire Service
AP	Anti-Personnel
ARP	Air Raid Precautions
DA	Delay-action
EOC	Explosive Ordnance Clearance
EOD	Explosive Ordnance Disposal
FP	Fire Pot
GM	G Mine (Parachute mine)
HAA	Heavy Anti-Aircraft
HE	High Explosive
IB	Incendiary Bomb
JSEODOC	Joint Services Explosive Ordnance Disposal Operation Centre
LAA	Light Anti-Aircraft
LCC	London County Council
LRRB	Long Range Rocket Bomb (V-2)
LSA	Land Service Ammunition
NFF	National Filling Factory
OB	Oil Bomb
PAC	Pilotless Aircraft (V-1)
PB	Phosphorous Bomb
PM	Parachute Mine
POW	Prisoner Of War
RAF	Royal Air Force
RCAF	Royal Canadian Air Force
RFC	Royal Flying Corps
RNAS	Royal Naval Air Service
ROF	Royal Ordnance Factory
SA	Small Arms
SAA	Small Arms Ammunition
SD2	Anti-personnel “Butterfly Bomb”
SIP	Self-Igniting Phosphorous
U/C	Unclassified bomb
UP	Unrotated Projectile (rocket)
USAAF	United States Army Air Force
UX	Unexploded
UXAA	Unexploded Anti-Aircraft
UXB	Unexploded Bomb
UXO	Unexploded Ordnance
V-1	Flying Bomb (Doodlebug)
V-2	Long Range Rocket
WAAF	Women’s Auxiliary Air Force
X	Exploded

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1st Line Defence Limited
Detailed Unexploded Ordnance (UXO) Risk Assessment

Site: Plot 2, Parks Works, Manchester
Client: TRC Companies Ltd

1. Introduction

1.1. Background

1st Line Defence has been commissioned by TRC Companies Ltd to conduct a Detailed Unexploded Ordnance (UXO) Risk Assessment for the works proposed at the Plot 2, Parks Works, Manchester site.

Buried UXO can present a significant risk to construction works and development projects. The discovery of a suspect device during works can cause considerable disruption to operations as well as cause unwanted delays and expense.

UXO in the UK can originate from three principal sources:

1. Munitions resulting from wartime activities including German bombing in WWI and WWII, long range shelling, and defensive activities.
2. Munitions deposited as a result of military training and exercises.
3. Munitions lost, burnt, buried or otherwise discarded either deliberately, accidentally, or ineffectively.

This report will assess the potential factors that may contribute to the risk of UXO contamination. If an elevated risk is identified at the site, this report will recommend appropriate mitigation measures, in order to reduce the risk to as low as is reasonably practicable. Detailed analysis and evidence will be provided to ensure an understanding of the basis for the assessed risk level and any recommendations.

This report complies with the guidelines outlined in *CIRIA C681*, 'Unexploded Ordnance (UXO) A Guide for the Construction Industry.'

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2. Method Statement

2.1. Report Objectives

The aim of this report is to conduct a comprehensive assessment of the potential risk from UXO at Plot 2, Parks Works, Manchester. The report will also recommend appropriate site and work-specific risk mitigation measures to reduce the risk from explosive ordnance during the envisaged works to a level that is as low as reasonably practicable.

2.2. Risk Assessment Process

1st Line Defence has undertaken a five-step process for assessing the risk of UXO contamination:

1. The likelihood that the site was contaminated with UXO.
2. The likelihood that UXO remains on the site.
3. The likelihood that UXO may be encountered during the proposed works.
4. The likelihood that UXO may be initiated.
5. The consequences of initiating or encountering UXO.

In order to address the above, 1st Line Defence has taken into consideration the following factors:

- Evidence of WWI and WWII German aerial delivered bombing as well as the legacy of Allied occupation.
- The nature and conditions of the site during WWII.
- The extent of post-war development and UXO clearance operations on site.
- The scope and nature of the proposed works and the maximum assessed bomb penetration depth.
- The nature of ordnance that may have contaminated the proposed site area.

2.3. Sources of Information

Every reasonable effort has been made to ensure that relevant evidence has been consulted and presented in order to produce a thorough and comprehensible report for the client. To achieve this the following, which includes military records and archive material held in the public domain, have been accessed:

- The National Archives and Manchester Central Library.
- Historical mapping datasets.
- Historic England National Monuments Record.
- Relevant information supplied by TRC Companies Ltd.
- Available material from 33 Engineer Regiment (EOD) Archive (now 28 Regt).
- 1st Line Defence's extensive historical archives, library and UXO geo-datasets.
- Open sources such as published books and internet resources.

Research involved a visit to The National Archives and Manchester Central Library.

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3. Background to Bombing Records

3.1. General Considerations of Historical Research

This desktop assessment is based largely upon analysis of historical evidence. Every reasonable effort has been made to locate and present significant and pertinent information. 1st Line Defence cannot be held accountable for any changes to the assessed risk level or risk mitigation measures, based on documentation or other data that may come to light at a later date, or which was not available to 1st Line Defence during the production of this report.

It is often problematic and sometimes impossible to verify the completeness and accuracy of WWII-era records. As a consequence, conclusions as to the exact location and nature of a UXO risk can rarely be quantified and are, to a degree, subjective. To counter this, a range of sources have been consulted, presented and analysed. The same methodology is applied to each report during the risk assessment process. 1st Line Defence cannot be held responsible for any inaccuracies or the incompleteness in available historical information.

3.2. German Bombing Records

During WWII, bombing records were generally gathered locally by the police, Air Raid Precaution (ARP) wardens and military personnel. These records typically contained information such as the date, the location, the amount of damage caused and the types of bombs that had fallen during an air raid. This information was made either through direct observation or post-raid surveys. The Ministry of Home Security Bomb Census Organisation would then receive this information, which was plotted onto maps, charts, and tracing sheets by regional technical officers. The collective record set (regional bomb census mapping and locally gathered incidents records) would then be processed and summarised into reports by the Ministry of Home Security Research and Experiments Branch. The latter were tasked with providing the government 'a complete picture of air raid patterns, types of weapons used and damage caused- in particular to strategic services and installations such as railways, shipyards, factories and public utilities.'[1]

The quality, detail and nature of record keeping could vary considerably between provincial towns, boroughs and cities. No two areas identically collated or recorded data. While some local authorities maintained records with a methodical approach, sources in certain areas can be considerably more vague, dispersed, and narrower in scope. In addition, the immediate priority was mostly focused on assisting casualties and minimising damage at the time. As a result, some records can be incomplete and contradictory. Furthermore, many records were even damaged or destroyed in subsequent air raids. Records of raids that took place on sparsely or uninhabited areas were often based upon third party or hearsay information and are therefore not always reliable. Whereas records of attacks on military or strategic targets were often maintained separately and have not always survived.

3.3. Allied Records

During WWII, considerable areas of land were requisitioned by the War Office for the purpose of defence, training, munitions production and the construction of airfields. Records relating to military features vary and some may remain censored. Within urban environments datasets will be consulted detailing the location of munition production as well as wartime air and land defences. In rural locations it may be possible to obtain plans of military establishments, such as airfields, as well as training logs, record books, plans and personal memoirs. As with bombing records, every reasonable effort will be made to access records of, and ascertain any evidence of, military land use. However, there are occasions where such evidence is not available, as records may not be accessible, have been lost/destroyed, or simply were not kept in the first place.

[1] http://www.nationalarchives.gov.uk/help-with-your-research/research-guides/bomb-census-survey-records-1940-1945/.

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4. UK Regulatory Environment and Guidelines

4.1. General

There is no formal obligation requiring a UXO risk assessment to be undertaken for construction projects in the UK, nor is there any specific legislation stipulating the management or mitigation of UXO risk. However, it is implicit in the legislation outlined below that those responsible for intrusive works (archaeology, site investigation, drilling, piling, excavation etc.) should undertake a comprehensive and robust assessment of the potential risks to employees and that mitigation measures are implemented to address any identified hazards.

4.2. CDM Regulations 2015

The Construction (Design and Management) Regulations 2015 (CDM 2015) define the responsibilities of parties involved in the construction of temporary or permanent structures.

The CDM 2015 establishes a duty of care extending from clients, principle co-ordinators, designers, and contractors to those working on, or affected by, a project. Those responsible for construction projects may therefore be accountable for the personal or proprietary loss of third parties, if correct health and safety procedure has not been applied.

Although the CDM does not specifically reference UXO, the risk presented by such items is both within the scope and purpose of the legislation. It is therefore implied that there is an obligation for parties to:

- Provide an appropriate assessment of potential UXO risks at the site (or ensure such an assessment is completed by others).
- Put in place appropriate risk mitigation measures if necessary.
- Supply all parties with information relevant to the risks presented by the project.
- Ensure the preparation of a suitably robust emergency response plan.

4.3. The 1974 Health and Safety at Work etc. Act

All employers have a responsibility under the Health and Safety at Work etc. Act 1974 and the Management of Health and Safety at Work Regulations 1999, to ensure the health and safety of their employees and third parties, so far as is reasonably practicable and conduct suitable and sufficient risk assessments.

4.4. CIRIA C681

In 2009, the Construction Industry Research and Information Association (CIRIA) produced a guide to the risk posed by UXO to the UK construction industry (CIRIA C681). CIRIA is a neutral, independent and not-for-profit body, linking organisations with common interests and facilitating a range of collaborative activities that help improve the industry.

The publication provides the UK construction industry with a defined process for the management of risks associated with UXO from WWI and WWII aerial bombardment. It is also broadly applicable to the risks from other forms of UXO that might be encountered. It focuses on construction professionals' needs, particularly if there is a suspected item of UXO on site, and covers issues such as what to expect from a UXO specialist. The guidance also helps clients to fulfil their legal duty under CDM 2015 to provide designers and contractors with project specific health and safety information needed to identify hazards and risks associated with the design and construction work. This report conforms to this CIRIA guidance and to the various recommendations for good practice referenced therein. It is

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recommended that this document is acquired and studied where possible to allow a better understanding of the background to both the risk assessment process and the UXO issue in the UK in general.

4.5. Additional Legislation

In the event of a casualty resulting from the failure of an employer/client to address the risks relating to UXO, the organisation may be criminally liable under the Corporate Manslaughter and Corporate Homicide Act 2007.

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5. The Role of Commercial UXO Contractors and The Authorities

5.1. Commercial UXO Specialists

The role of a UXO Specialist (often referred to as UXO Consultant or UXO Contractor) such as 1st Line Defence, is defined in CIRIA C681 as the provision of expert knowledge and guidance to the client on the most appropriate and cost-effective approach to UXO risk management at a site.

The principal role of UXO Specialists is to provide the client with an appropriate assessment of the risk posed by UXO for a specific project, and identify and carry out suitable methodology for the mitigation of any identified risks to reduce them to an acceptable level.

The requirement for a UXO Specialist should ideally be identified in the initial stages of a project, and it is recommended that this occur prior to the start of any detailed design. This will enable the client to budget for expenditure that may be required to address the risks from UXO, and may enable the project team to identify appropriate techniques to eliminate or reduce potential risks through considered design, without the need for UXO specific mitigation measures. The UXO Specialist should have suitable qualifications, levels of competency and insurances.

Please note 1st Line Defence has the capability to provide a complete range of required UXO risk mitigation services, in order to reduce a risk to as low as reasonably practicable. This can involve the provision of both ground investigation, and where appropriate, UXO clearance services.

5.2. The Authorities

The police have a responsibility to co-ordinate the emergency services in the event of an ordnance-related incident at a construction site. Upon inspection they may impose a safety cordon, order an evacuation, and call the military authorities Joint Services Explosive Ordnance Disposal Operation Centre (JSEODOC) to arrange for investigation and/or disposal. Within the Metropolitan Police Operational Area, SO15 EOD will be tasked to any discovery of suspected UXO. The request for Explosive Officer (Expo) support is well understood and practiced by all Metropolitan Boroughs. The requirement for any additional assets will then be coordinated by the Expo if required.

In the absence of a UXO specialist, police officers will usually employ such precautionary safety measures, thereby causing works to cease, and possibly requiring the evacuation of neighbouring businesses and properties.

The priority given to the police request will depend on the EOD teams judgement of the nature of the UXO risk, the location, people and assets at risk, as well as the availability of resources. The speed of response varies; authorities may respond immediately or in some cases it may take several days for the item of ordnance to be dealt with. Depending on the on-site risk assessment the item of ordnance may be removed from the site and/or destroyed by a controlled explosion.

Following the removal of an item of UXO, the military authorities will only undertake further investigations or clearances in high-risk situations. If there are regular UXO finds on a site the JSEODOC may not treat each occurrence as an emergency and will recommend the construction company puts in place alternative procedures, such as the appointment of a commercial contractor to manage the situation.

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6. The Site

6.1. Site Location

The site is located in Newton Heath, Manchester. The site is bordered to the north by industrial structures associated with the Mather & Platt Park Engineering Works along Rochdale Canal, to the east by open ground and residential housing opposite Ten Acres Lane, to the south by industrial structures along Briscoe Lane, whilst the site is bordered to the west by further industrial structures, open ground and railway.

The site is approximately centred on the OS grid reference: **SJ 87273 99891**.

Site location maps are presented in **Annex A**.

6.2. Site Description

The site is currently occupied in its entirety by open brownfield land, which was largely formerly occupied by industrial warehousing demolished in the late 1990's.

A recent aerial photograph and site plan are presented in **Annex B** and **Annex C** respectively.

7. Scope of the Proposed Works

7.1. General

The exact nature of proposed works was not available at the time of writing, however, information provided by the client indicates the development on site will be of a commercial nature, providing employment opportunities.

8. Ground Conditions

8.1. General Geology

The British Geological Survey (BGS) map shows Chester Formation – sandstone, of the Triassic Period. Local environment was previously dominated by rivers. Superficial deposits include till, devensian – diamicton, of the Quaternary Period. Local environment was previously dominated by ice age conditions.

8.2. Site Specific Geology

Site specific window sample data has been provided by TRC Companies Ltd. See below for a brief typical example of the geology encountered.

Example Window Sample	
Depth (m)	**Description**
0-0.1	Made Ground – grassy
0.1-3.9	Made Ground – firm dark grey and brown slightly sandy gravelly clay
3.9-4	Made Ground – black slightly sandy angular and sub-angular fine to coarse gravel

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9. Site History

9.1. Introduction

The purpose of this section is to identify the composition of the site pre and post-WWII. It is important to establish the historical use of the site, as this may indicate the site's relation to potential sources of UXO as well as help with determining factors such as the land use, groundcover, likely frequency of access and signs of bomb damage.

9.2. Summary of the Historical Background of the Site

Since the 1900s the site area has been occupied by the Mather and Platt Park Engineering Works (also known as the Park Works). The factory was famous for its contribution to the textile industry, and would manufacture items such as electrical pumps and generators. At the outbreak of war the factory came under control of the government in order to meet the demand for munitions. See **Section 13.2** for further information on the site's wartime usage. The section of the factory concerning the site area was demolished in the 1990s with the foundry and main office building remaining in present day.

9.3. Ordnance Survey Historical Maps

Relevant historical maps were obtained for this report and are presented in **Annex D.** See below for a summary of the site history shown on acquired mapping.

Pre-WWII		
Date	**Scale**	**Description**
1922-1932	1:2,500	Pre-war OS mapping dated 1922-1932, indicates the site consisted largely of structures associated with *Park Engineering Works.* Open ground occupies the north-eastern border of the site boundary. Structures associated *Park Engineering Works* and open ground border the site to the north, whilst open ground adjacent to Ten Acres Lane border the site to the east. An *Aero Works* borders the site to the south along Briscoe Lane, whilst a Reservoir and open ground borders the site to the west along Grimshaw Lane whilst railway is located further to the south-west.

Post-WWII		
Date	**Scale**	**Description**
1951	1:2,500	Post-war OS mapping dated 1951, indicates the site to consist of a larger portion of *Park Engineering Works,* with a smaller area of open ground in the north-eastern section of the site. Residential housing has been developed to the east of the site boundary along Staplehurst Road, whilst a *Warehouse* is labelled to the south. Some of the open ground to the west of the site now serves as a *sports ground.*

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9.4. Pre-WWII Photography of the Site

Pre-WWII aerial photography has been obtained from the Aerofilms collection available from *Britain From Above*. This imagery provides a view of the site in 1932 (see **Annex E**). See below for a description:

Title of Photograph	Comments
1932 – Park Engineering Works and Environs, Newton Heath	This photography dated 1932, shows the majority of the site to consist of structures associated with the Mather & Platt Park Engineering Works, with an area of open ground running along the site's eastern border adjacent to Ten Acres Lane. Mather & Platt Foundry borders the site to the immediate north with Rochdale Canal located further north. Open ground borders the site to the east whilst the Avro Aeroplane Factory borders the site to the south. Open ground and a reservoir border the site to the west.

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10. Introduction to German Aerial Delivered Ordnance

10.1. General

During WWI and WWII, the UK was subjected to bombing which often resulted in extensive damage to city centres, docks, rail infrastructure and industrial areas. The poor accuracy of WWII targeting technology and the nature of bombing techniques often resulted in neighbouring areas to targets sustaining collateral damage.

In addition to raids which concentrated on specific targets, indiscriminate bombing of large areas also took place. This occurred most prominently in the London 'Blitz', though affected many other towns and cities. As discussed in the following sections, a proportion of the bombs dropped on the UK did not detonate as designed. Although extensive efforts were made to locate and deal with these UXBs at the time, many still remain buried and can present a potential risk to construction projects.

The main focus of research for this section of the report will concern German aerial delivered ordnance dropped during WWII, although WWI bombing will also be considered.

10.2. Generic Types of WWII German Aerial Delivered Ordnance

To provide an informed assessment of the hazards posed by any items of unexploded ordnance that may remain in situ on site, the table below provides information on the types of German aerial delivered ordnance most commonly used by the Luftwaffe during WWII. Images and brief summaries of the characteristics of these items of ordnance are listed in **Annex F**.

Generic Types of WWII German Aerial Delivered Ordnance		
Type	**Frequency**	**Likelihood of detection**
High Explosive (HE) bombs	In terms of weight of ordnance dropped, HE bombs were the most frequently deployed by the Luftwaffe during WWII.	Although efforts were made to identify the presence of unexploded ordnance following an air raid, often the damage and destruction caused by detonated bombs made observation of UXB entry holes impossible. The entry hole of an unexploded bomb can be as little as 20cm in diameter and was easily overlooked in certain ground conditions (see **Annex F1**). Furthermore, ARP documents describe the danger of assuming that damage, actually caused by a large UXB, was due to an exploded smaller bomb. UXBs therefore present the greatest risk to present–day intrusive works.
1kg Incendiary bombs (IB)	In terms of the number of weapons dropped, small IBs were the most numerous. Millions of these were dropped throughout WWII.	IBs had very limited penetration capability and in urban areas would often have been located in post-raid surveys. If they failed to initiate and fell in water, on soft vegetated ground, or bombed rubble, they could easily go unnoticed.
Large Incendiary bombs (IB)	These were not as common as the 1kg IBs, although they were more frequently deployed than PMs and AP bomblets.	If large IBs did penetrate the ground, complete combustion did not always occur and in such cases they could remain a risk to intrusive works.
Aerial or Parachute mines (PM)	These were deployed less frequently than HE and IBs due to size, cost and the difficulty of deployment.	If functioning correctly, PMs would generally have had a slow rate of descent and were very unlikely to have penetrated the ground. Where the parachute failed, mines would have simply shattered on impact if the main charge failed to explode. There have been extreme cases when these items have been found unexploded. However, in these scenarios, the ground was either extremely soft or the munition fell into water.
Anti-personnel (AP) bomblets	These were not commonly used and are generally considered to pose a low risk to most works in the UK.	SD2 bomblets were packed into containers holding between 6 and 108 submunitions. They had little ground penetration ability and should have been located by the post-raid survey unless they fell into water, dense vegetation or bomb rubble.

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10.3. Failure Rate of German Aerial Delivered Ordnance

It has been estimated that 10% of WWII German aerial delivered HE bombs failed to explode as designed. Reasons for why such weapons might have failed to function as designed include:

- Malfunction of the fuze or gain mechanism (manufacturing fault, sabotage by forced labour or faulty installation).
- Many were fitted with a clockwork mechanism that could become immobilised on impact.
- Failure of the bomber aircraft to arm the bombs due to human error or an equipment defect.
- Jettisoning the bomb before it was armed or from a very low altitude. This most likely occurred if the bomber aircraft was under attack or crashing.

From 1940 to 1945, bomb disposal teams reportedly dealt with a total of 50,000 explosive items of 50kg, over 7,000 anti-aircraft projectiles and 300,000 beach mines. Unexploded ordnance is still regularly encountered across the UK, see press articles in **Annex H**.

10.4. UXB Ground Penetration

An important consideration when assessing the risk from a UXB is the likely maximum depth of burial. There are several factors which determine the depth that an unexploded bomb will penetrate:

- Mass and shape of bomb.
- Height of release.
- Velocity and angle of bomb.
- Nature of the ground cover.
- Underlying geology.

Geology is perhaps the most important variable. If the ground is soft, there is a greater potential of deeper penetration. For example, peat and alluvium are easier to penetrate than gravel and sand, whereas layers of hard strata will significantly retard and may stop the trajectory of a UXB.

10.4.1. The J-Curve Effect

J-curve is the term used to describe the characteristic curve commonly followed by an aerial delivered bomb dropped from height after it penetrates the ground. Typically, as the bomb is slowed by its passage through underlying soils, its trajectory curves towards the surface. Many UXBs are found with their nose cone pointing upwards as a result of this effect. More importantly, however, is the resulting horizontal offset from the point of entry. This is typically a distance of about one third of the bomb's penetration depth, but can be higher in certain conditions (see **Annex G**).

10.4.2. WWII UXB Ground Penetration Studies

During WWII the Ministry of Home Security undertook a major study on actual bomb penetration depths, carrying out statistical analysis on the measured depths of 1,328 bombs as reported by bomb disposal (BD) teams. Conclusions were drawn predicting the likely average and maximum depths of penetration of different sized bombs in different geological strata.

For example, the largest common German bomb (500kg) had a likely concluded penetration depth of 6m in sand or gravel but 11m in clay. The maximum observed depth for a 500kg bomb was 11.4m and for a 1,000kg bomb 12.8m. Theoretical calculations suggested that significantly greater penetration depths were probable.

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10.4.3. Site Specific Bomb Penetration Considerations

When considering an assessment of the bomb penetration at the site of proposed works the following parameters have been used:

- WWII geology – Chester Formation.
- Impact angle and velocity – 10-15° from vertical and 270 metres per second.
- Bomb mass and configuration – The 500kg SC HE bomb, without retarder units or armour piercing nose (this was the largest of the common bombs used against Britain).

It has not been possible to determine maximum bomb penetration capabilities at this stage due to the limitations of site-specific geotechnical information currently available. Specifically data provided is not deep enough for an accurate assessment (see Section 8.2). If required, an assessment can be made once further information becomes available or by an UXO Specialist on-site.

10.5. V-Weapons

Hitler's 'V-weapon' campaign began from mid-1944. It used newly developed unmanned cruise missiles and rockets. The V-1, known as the *flying bomb* or *pilotless aircraft*, and the V-2, a long range rocket, were launched from bases in Germany and occupied Europe. A total of 9,251 V-1s and 1,115 V-2s were recorded in the United Kingdom.

Although these weapons caused considerable damage, their range was limited by their position of deployment across Europe and as a result the vast majority of V-weapon strikes were directed against targets in the south-east of England, predominantly in the London Boroughs and Home Counties. This limitation of capability meant targets in Manchester were generally too far to be considered for V-weapon strikes by the Luftwaffe.

The risk from V-weapons is therefore considered negligible and will not be further addressed in this report.

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11. The Likelihood of Contamination from German Aerial Delivered UXBs

11.1. World War I

During WWI Britain was targeted and bombed by Zeppelin Airships, as well as Gotha and Giant fixed-wing aircraft. A WWI map of air raids and naval bombardments across England is presented in **Annex I**. This source does not record any WWI bombing incidents to have affected the site.

WWI bombs were generally smaller and dropped from a lower altitude than those used in WWII. This resulted in limited UXB penetration depths. Aerial bombing was often such a novelty at the time that it attracted public interest and even spectators to watch the raids in progress. For these reasons there is a limited risk that UXBs passed undiscovered in the urban environment. When combined with the relative infrequency of attacks and an overall low bombing density, the risk from WWI UXBs is considered low and will not be further addressed in this report.

11.2. World War II Bombing of County Borough of Manchester

The Luftwaffe's main objective for the attacks on Britain was to inhibit the country's economic and military capability. To achieve this they targeted airfields, depots, docks, warehouses, wharves, railway lines, factories, and power stations. As the war progressed the Luftwaffe bombing campaign expanded to include the indiscriminate bombing of civilian areas in an attempt to subvert public morale.

During WWII the site was located within the County Borough of Manchester, which sustained an overall low-moderate density of bombing, as represented by bombing density figures, see the following section. Manchester was not targeted with the same intensity and frequency as other major British cities such as Liverpool, Coventry and Birmingham, however it was still subject to several major raids. Manchester's Blitz was commonly called the 'Christmas Blitz' – the heaviest raids occurred on the nights of 22/23 and 23/24 December 1940, killing an estimated 684 people and injuring 2,364.

There were several Luftwaffe targets located in Manchester. Newton Heath Train Maintenance Depot was located approximately 2.2km north of this target and due to its size and composition, may have formed a potential Luftwaffe target in its own right. Wartime targeting systems did however tend to be inaccurate and consequently neighbouring targets would often sustain collateral bombing. Manchester was protected by a number of barrage balloons which forced aircraft to approach their targets at higher altitudes – reducing bomb accuracy.

Records of bombing incidents in the civilian areas of Manchester were collected by the Air Raid Precautions wardens and collated by the Civil Defence Office. Some other organisations, such as port and railway authorities, maintained separate records. Records would be in the form of typed or hand written incident notes, maps and statistics. Bombing data was carefully analysed, not only due to the requirement to identify those parts of the country most needing assistance, but also in an attempt to find patterns in the Germans' bombing strategy in order to predict where future raids might take place.

Records of bombing incidents for Manchester are presented in the following sections.

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11.3. WWII Home Office Bombing Statistics

The following table summarises the quantity of German aerial delivered bombs (excluding 1kg incendiaries and anti-personnel bombs) dropped on the County Borough of Manchester between 1940 and 1945.

Record of German Ordnance Dropped on the County Borough of Manchester		
Area Acreage		**27,255**
Weapons	High Explosive bombs (all types)	712
	Parachute mines	18
	Oil bombs	7
	Phosphorus bombs	0
	Fire pots	0
	Pilotless aircraft (V-1)	1
	Long range rocket bombs (V-2)	0
Total		**738**
Number of Items per 1,000 acres		**27.1**

Source: Home Office Statistics
This table does not include UXO found during or after WWII.

Detailed records of the quantity and locations of the 1kg incendiary and anti-personnel bombs were not routinely maintained by the authorities as they were frequently too numerous to record. Although the risk relating to IBs is lesser than that relating to larger HE bombs, they were similarly designed to inflict damage and injury. Anti-personnel bombs were used in much smaller quantities and are rarely found today but are potentially more dangerous. Although Home Office statistics did not record these types of ordnance, both should not be overlooked when assessing the general risk to personnel and equipment.

11.4. Manchester Bomb Plot and Damage Map

A bomb census map complied by Manchester City Council showing high explosive and incendiary bomb strikes on the borough was obtained from Manchester Archives. This primarily concerned the 'Manchester Blitz' period of 22nd-24th December 1940, though it records various other incidents occurring on different dates in 1940 and 1941. The section showing the area of the site is presented in **Annex J**.

Manchester Bomb Plot and Damage Map – Annex J	
Date Range	**Comments**
1940 – 1941	No bomb strikes are recorded within the site boundary or in the immediate surrounding area of the site footprint. The closest recorded HE bomb strike is located approximately 490m north-west of the site boundary (beyond the coverage of the section of the map depicted) concerning structures associated with the Gas Plant Works. Likewise, no bomb damage is recorded within the site boundary or in the immediate surrounding area of the site footprint

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11.5. Anecdotal Account of Newton Heath at War

An anecdotal account, from the BBC website 'WWII People's War', was found concerning the wartime activity of a local resident[2]. See the extract below:

'When the night raids started we all thought we would get a good share of bombs, if only for the railway yards target. But also up the road about 2 miles was the large Avro aircraft factory and we were in the middle….As it turned out we didn't get many bombs around us. This was probably due to the presence of four huge anti-aircraft guns, of 4" calibre I think, installed on Broadhurst Fields about half a mile away, complete with searchlight battery. A bit more of a favourite playground lost, but as youngsters we were completely enthralled at the sight of them, and it was very comforting during a raid to hear the deafening crump of the big guns'. [3]

Whilst this source cannot be considered a definitive account, it would suggest that the frequency and density of bombing was relatively low in the locality of the site location.

11.6. Manchester Emergency Committee's Log of Bombing Incidents 22-24th December 1940

The published source *Blitz Britain: Manchester and Salford* by Graham Phythian presents a transcript of the document 'Manchester Emergency Committee's Log of Bombing Incidents 22-24th December 1940' (hence covering the 'Manchester Blitz' period). This is stated to have been obtained from the Emergency Committee Records/Police Museum and Archives, though it was not possible to obtain the original documents. No references could be found to the *Park Engineer Works*, or surrounding roadways.

11.7. Red Sky Over Manchester

Our Blitz, Red Sky over Manchester is an illustrated booklet published in January 1941 that documented the 'Christmas Blitz' on Manchester in December 1940. This publication indicates that between 2nd and 3rd October 1940, houses on Grimshaw Lane, Newton Heath were demolished.[4] There is no reference to the *Park Engineering Works* on site.

11.8. Manchester Air Raid Damage Files

Air Raid Damage files for Manchester were obtained from The National Archives. These reports recorded information such as the date, time, type and damage caused by major bomb incidents in Manchester and are therefore not often comprehensive. No relevant information regarding the site area could be located.

11.9. Manchester War Damage to Houses Cards.

War damage cards were obtained from Manchester Central Library. These contain an alphabetical list of road names, indicating the house number, date, category of damage, and any other relevant particulars. Whilst no key has been provided, it has been assumed that 'classification' refers to the significance of damage, with 'A' being total destruction, 'B' being serious damage, etc. This record set does not record damage to factory structures such as those on site.

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[2] *https://www.bbc.co.uk/history/ww2peopleswar/stories/43/a2413243.shtml*
[3] *http://www.bbc.co.uk/history/ww2peopleswar/stories/43/a2413243.shtml*
[4] *https://issuu.com/cyberbadger/docs/our-blitz_red_sky_over_manchester*

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11.10. Post WWII-Era Aerial Photography

Post WWII-era aerial photography for the site area was obtained from the Aerofilms Collection available from *Britain from Above*. This photography provides a record of the potential composition of the site during the war, as well as its condition immediately following the war (**see Annex K**).

WWII-Era Aerial Photography	
Date	**Description**
1953 – R & J Dempster Ltd Gas Plant Works and Environs, Newton Heath	Post-war oblique photography dated 1953, indicates the site boundary to consist almost entirely of industrial structures associated with Mather & Platt Park Engineering Works, with a small area of open ground in the north-eastern corner of the site boundary. Mather & Platt Foundry and main office building borders the site to the immediate north, with residential housing and open ground to the east. Industrial structures border the site to the south whilst open ground in the form of a company cricket field borders to the west.

11.11. 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 of an entry hole was 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 or 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.

1st Line Defence holds no records of officially registered abandoned bombs at or near the site of the proposed works.

11.12. Bomb Disposal Tasks

The information service from the Explosive Ordnance Disposal (EOD) Archive Information Office at 33 Engineer Regiment (EOD) (now 29 Regt) is currently facing considerable delay. It has therefore not been possible to include any updated official information regarding bomb disposal/clearance tasks with regards to this site. A database of known disposal/clearance tasks has been referred to which does not make reference to such instances occurring within the site of proposed works. If any relevant information is received at a later date TRC Companies Ltd will be advised.

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11.13. Evaluation of German Aerial Delivered UXO Records

Factors	Conclusion
Density of Bombing *It is important to consider the bombing density when assessing the possibility that UXBs remain in an area. High bombing density could allow for error in record keeping due to extreme damage caused to the area.*	During WWII, the site was situated in the County Borough of Manchester, which was subject to a low-moderate density of bombing according to Home Office statistics, with an average of 27 incidents recorded per 1,000 acres. Anecdotal evidence suggests that despite prominent industrial fixtures in the area of Newton Heath, such as the Avro Factory, the local bombing density was considered to be lower. This is supported by the Manchester Bomb Plot and Damage Mapping which focuses on bombing incidents in Manchester during the main Blitz period between 1940 and 1941. No strikes are recorded within the site boundary or within its immediate surroundings, with the closest recorded HE bomb strike located approximately 490m north-west of the site boundary concerning structures associated with the Gas Plant Works. Comprehensive histories of the nearby Mather & Platt's Park Engineering Works were also consulted and no reference of bombing to the factory or immediate surrounds could be found.
Damage *If buildings or structures on a site sustained bomb or fire damage, any resulting rubble and debris could have obscured the entry holes of unexploded bombs dropped during the same or later raids. Similarly, a high explosive bomb strike in an area of open agricultural land will have caused soil disturbance, increasing the risk that a UXB entry hole would be overlooked.*	The Manchester Bomb/Damage Mapping does not record any damage on site or to any structures within the immediate surrounding area. The closest recorded instances of damage are located approximately 350m west of the site concerning structures associated with the Dye Works. 1953 oblique aerial photography indicates structures within the site boundary and in the wider area to have survived the war externally intact with no obvious signs of clearance to structures or ground disturbances to open areas in the wider area. Whilst structures within the site boundary associated with Mather & Platt's Park Engineering Works look to have possibly undergone some kind of roofing repairs, these repairs are evident in pre WWII oblique imagery and are therefore not considered to have been a result of planned maintenance as opposed to bomb damage.
Ground Cover *The nature of the ground cover present during WWII would have a substantial influence on any visual indication that may indicate UXO being present.*	The site was largely occupied by Mather & Platt Park Engineering Works with a small area of open ground in the north-eastern corner of the site boundary. 1953 oblique aerial photography indicates structures within the site boundary and in the wider area to have survived the war externally intact, in these areas it is anticipated that this type of ground cover would have been conducive to the detection of UXO.
Access Frequency *UXO in locations where access was irregular would have a greater chance of passing unnoticed than at those that were regularly occupied. The importance of a site to the war effort is also an important consideration as such sites are likely to have been both frequently visited and subject to post- raid checks for evidence of UXO.*	No reason could be found to suggest that the site would not have been subject to frequent and regular access throughout the war, as the site was occupied by structures associated with Mather & Platt Park Engineering Works, which appears to have survived the war intact and undamaged.
Bomb Failure Rate	There is no evidence to suggest that the bomb failure rate in the locality of the site would have been dissimilar to the 10% normally used.

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Abandoned Bombs	1st Line Defence holds no records of abandoned bombs at or within the site vicinity.
Bombing Decoy sites	1st Line Defence could find no evidence of bombing decoy sites within the site vicinity.
Bomb Disposal Tasks	1st Line Defence could find no evidence of bomb disposal tasks within the site boundary and immediate area.

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12. Introduction to Allied Explosive Ordnance

12.1. General

Many areas across the UK may be at risk from Allied UXO because of both wartime and peacetime military use. Typical military activities and uses that may have led to a legacy of military UXO at a site include former minefields, home guard positions, anti-aircraft emplacements, training and firing ranges, military camps, as well as weapons manufacture and storage areas.

Although land formerly used by the military was usually subject to clearance before returned to civilian use, items of UXO are sometimes discovered and can present a potential risk to construction projects.

This section of the report discusses the generic types of Allied ordnance typically encountered on areas associated with former military activity.

12.2. Land Service Ammunition

Mather & Platt Park Engineering Works became a government controlled enterprise throughout both WWI and WWII and produced munition components such as projectile casings and fuzes, as well as a range of other war related materials (see Section 13.2 for more information). Whilst no positive evidence of LSA production was found at Park Works, the variety of items produced is known to have been vast, and as such cannot be discounted.

The term LSA covers items of ordnance that are propelled, placed, or thrown during land warfare. These items may be filled or charged with explosives, smoke, incendiary, or pyrotechnics and can be divided into five main groups:

Land Service Ammunition	
Item	**Description**
Mortar Rounds	A mortar round is normally nosed-fused and fitted with its own propelling charge. Its flight is stabilised by the use of a fin. They are usually tear-drop shaped (though older variants are parallel sided), with a finned 'spigot tube' screwed or welded to the rear end of the body which houses the propellant charge. Mortars are either High Explosive or Carrier (i.e. smoke, incendiary, or pyrotechnic).
Grenades	A grenade is a short range weapon designed to kill or injure people. It can be hand thrown or fired from a rifle or a grenade launcher. Grenades either contain high explosive or smoke producing pyrotechnic compounds. The common variants have a classic 'pineapple' shape.
Projectiles	A projectile (or shell) is propelled by force, normally from a gun, and continues in motion using its kinetic energy. The gun a projectile is fired from usually determines its size. A projectile contains a fuzing mechanism and a filling. Projectiles can be high explosive, carrier or Shot (a solid projectile).
Rockets	Rockets were commonly designed to destroy heavily armoured military vehicles (anti-tank weapon). The device contains an explosive head (warhead) that can be accelerated using internal propellants to an intended target. Anti-aircraft rocket batteries were also utilised as part of air defence measures.
Landmines	A landmine is designed to be laid on or just below the ground to be exploded by the proximity or contact of a person or vehicle. Landmines were often placed in defensive areas of the UK to obstruct potential invading adversaries.

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In the UK unexploded or partially exploded mortars and grenades are the most common items of LSA encountered, as they could be transported and utilised anywhere. They are mostly encountered in areas used for military training and are often found discarded on or near historical military bases. Images of the most commonly found items of LSA are presented in **Annex M.**

12.3. Small Arms Ammunition

It is also conceivable that Small Arms Ammunition (SAA) was produced at the Mather & Platt Park Engineering Works, although no positive evidence has been found to support this. SAA refers to the complete round or cartridge designed to be discharged from varying sized hand-held weapons such as rifles, machine guns and pistols. SAA can include bullets, cartridge cases and primers/caps.

12.4. Defending the UK From Aerial Attack

During WWII the War Office employed a number of defence tactics against the Luftwaffe from bombing major towns, cities, manufacturing areas, ports and airfields. These can be divided into passive and active defences (examples are provided in the table below).

Active Defences	Passive Defences
• Anti-aircraft gun emplacements to engage enemy aircraft. • Fighter aircraft to act as interceptors. • Rockets and missiles were used later during WWII.	• Blackouts and camouflaging to hinder the identification of Luftwaffe targets. • Decoy sites were located away from targets and used dummy buildings and lighting to replicate urban, military, or industrial areas. • Barrage balloons forced enemy aircraft to greater altitudes. • Searchlights were often used to track and divert adversary bomber crews during night raids.

Active defences such as anti-aircraft artillery present a greater risk of UXO contamination than passive defences. Unexploded ordnance resulting from dogfights and fighter interceptors is rarely encountered and difficult to accurately qualify.

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12.4.1. Anti-Aircraft Artillery (AAA)

During WWII three main types of gun sites existed: heavy anti-aircraft (HAA), light anti-aircraft (LAA) and 'Z' batteries (ZAA). If the projectiles and rockets fired from these guns failed to explode or strike an aircraft they would descend back to land. The table below provides further information on the operation and ordnance associated with these type of weapons.

Anti-Aircraft Artillery				
Item	**Description**			
HAA	These large calibre guns such as the 3.7" QF (Quick Firing) were used to engage high flying enemy bombers. They often fired large HE projectiles, which were usually initiated by integral fuzes, triggered by impact, area, time delay or a combination of aforementioned mechanisms.			
LAA	These mobile guns were intended to engage fast, low flying aircraft. They were typically rotated between locations on the perimeters of towns and strategically important industrial works. As they could be moved to new positions with relative ease when required, records of their locations are limited. The most numerous of these were the 40mm Bofors gun which could fire up to 120 x 40mm HE projectiles per minute to over 1,800m.			
Variations in HAA and LSA Ammunition	**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
Z-AA	The three inch unrotated rocket/projectile known as the UP-3 had initially been developed for the Royal Navy. The UP-3 was also used in ground-based single and 128-round launchers known as ''Z'' batteries. The rocket, containing a high explosive warhead was often propelled by cordite.			

The closest recorded HAA to the site was located approximately 2.1km north-west of the site, however the range of a projectile can be up to 15km. The site would also have been in range of mobile light anti-aircraft guns.

The conditions in which anti-aircraft projectiles may have fallen unnoticed within a site area are analogous to those regarding aerial delivered ordnance. Unexploded anti-aircraft projectiles could essentially have fallen indiscriminately anywhere within range of the guns. The chance of such items being observed, reported and removed during the war depends on factors such as land use, ground cover, damage and frequency of access – the same factors that govern whether evidence of a UXB is likely to have been noted. More information about these factors with regards to this particular site can be found in the German Aerial Delivered Ordnance section of this report.

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

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13. The Likelihood of Contamination from Allied Ordnance

13.1. Introduction

When undertaking construction work within or immediately adjacent to a site with previous and/or current usage for munitions production, it is often considered likely to contain an elevated risk of contamination from Allied UXO. This assumption of risk is based on the following reasoning:

- The clearance of ordnance from depots, storage facilities etc. were not always effectively managed, or undertaken to equivalent degrees of certainty. In addition, search and detection equipment used over seventy years ago following WWII has proved ineffective both for certain types of UXO and at depths beyond capability.
- During periods of heightened activity, ordnance was sometimes lost in transit, particularly between stores and assigned locations.
- Appropriate ordnance disposal procedure was not always adhered to. It was not uncommon for excess or unwanted ordnance to be buried or burnt within the perimeters of a weapon's production establishment as a means of disposal. Records of such practice were rarely kept.

There are several factors that may serve to either affirm, increase, or decrease the level of risk within a site with a history of military usage. Such factors are typically dependent upon the proximity of the proposed area of works to training activities, munition productions and storage, as well as its function across the years.

This section will examine the history of the proposed site and assess to what degree, if any, the site could have become contaminated as a result of the military use of the surrounding area.

13.2. Wartime Production at the Mather & Platt Park Engineering Works

The site comprises structures associated with the Mather & Platt Park Engineering Works in Newton Heath, Manchester. It is understood that the Park Works was requisitioned by the Government and the Ministry of Munitions during both WWI and WWII. It was commonplace for such factories to be requisitioned and overhauled from their peacetime productions in order to meet the surge in demand for munitions and other war related products during wartime.

During WWI, and until 1947, a portion of the factory was used to help with the production of Avro aircraft, such as the Avro 504s – a First World War biplane. Other types of aircraft later built at Newton Heath included three-engine aircraft such as the Avro Five, Six and Eighteen, the Avro 621 Tutor and the Avro 652A Anson. The Avro Factory was located south of the proposed site, and on the outbreak of war required more space in order to produce larger quantities, so A. V Roe was offered a lease of bays in the Park Works factory in order to meet demand, See **Annex L1**. [5]

However, it was in 1915 the factory became controlled under the Munitions of War Act, and began to produce a range of munition components including 'large quantities' of projectile casings and fuzes for the war effort, and a department specialising in Howitzer relining was established. (A Howitzer is a large calibre artillery gun for long range indirect fire, and the factory is thought to have been responsible for the reconditioning of the barrels of older guns.) In addition to munition components, throughout WWI the factory produced other items such as motors for submarines and gear boxes for tanks. An electrolyser machine was also built here in the hopes of eradicating typhoid on ships. [6]

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[5] *https://www.baesystems.com/en/heritage/brownsfield-mill--newton-heath--alexandra-park--yeandon--hamble--trafford-park--failsworth-and-ashton-under-lyne*

[6] *https://sites.google.com/site/thebookofthejubilee1958/a-history-of-mather-and-platt-limited*

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At the outbreak of WWII the factory was again requisitioned by the Government and was used to produce a multitude of munition and weapon components. Projectile casings, were again manufactured here. In addition, fuzes were also manufactured in the factory, along with aircraft fuselage and pumps which understood to have been produced on masse. Sources suggest that Park Works became a known gun factory throughout WWII, and produced gun mountings, Bofors predictors, rocket projectors and cordite rolling mills. [7] Bofors predictors were used in Heavy Anti-Aircraft Batteries, whilst rocket projectors were more commonly used in Z Batteries. Its recorded that few engineering firms in the world could rival the diversified production of Mather and Platt during this time, See **Annex L**.

[7] https://sites.google.com/site/historyofmatherplattltd/

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13.3. Evaluation of Contamination Risk from Allied UXO

1st Line Defence has considered the following potential sources of Allied ordnance contamination:

Sources of Allied UXO Contamination	Conclusion
Military Camps *Military camps present an elevated risk from ordnance simply due to the large military presence and likelihood of associated live ordnance training.*	1st Line Defence could find no evidence of a military camp within the site.
Anti-Aircraft Defences *Anti-Aircraft defences were employed across the country. Proximity to anti-aircraft defences increases the chance of encountering AA projectiles.*	1st Line Defence could find no evidence of Anti-Aircraft defences such as a HAA or LAA gun emplacement occupying or bordering the site. The closest HAA was located approximately 2.1km north-west of the site, however the range of a projectile can be up to 15km. The conditions in which HAA or LAA projectiles may have fallen unnoticed within a site footprint are analogous to those regarding German aerial delivered ordnance.
Home Guard Activity *The Home Guard regularly undertook training and ordnance practice in open areas, as well as burying ordnance as part of anti-invasion defences.*	1st Line Defence has no evidence of any Home Guard activities on the site.
Defensive Positions *Defensive positions suggest the presence of military activity, which is often indicative of ordnance storage, usage or disposal.*	There is no evidence of any defensive features formerly located on or bordering the site footprint.
Training or firing ranges *Areas of ordnance training saw historical ordnance usage in large numbers, often with inadequate disposal of expended and live items. The presence of these ranges significantly impact on the risk of encountering items of ordnance in their vicinity.*	There is no evidence of such features affecting the site.
Defensive Minefields *Minefields were placed in strategic areas to defend the country in the event of a German invasion. Minefields were not always cleared with an appropriate level of vigilance.*	There is no evidence of defensive minefields affecting the site.

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Ordnance Manufacture *Ordnance manufacture indicates an increased chance that items of ordnance were stored, or disposed of, within a location.*	The site of proposed works is known to have been associated with historical ordnance manufacture activities. In both WWI and WWII the site became a Government owned enterprise to produce munition components for the war effort. Whilst it is not possible to determine exactly where in the Park Works ordnance manufacture had taken place, it must be considered a possibility that it may have occurred in factory structures within or bordering the site boundary. Evidence indicates that a range of munition components and weapon parts were manufactured in and around the at the nearby Park Engineering Works . Items such as projectile casings and fuzes were produced. Whilst such items are predominantly thought to have been subsequently transferred to dedicated munitions filling factories, they may have been stored on site prior to their transit. Such items may also have been disposed of unofficially on site if deemed faulty or as excess. It was not uncommon for excess or unwanted ordnance such as fuzes to be buried or burnt within the wider premises of a factory as a means of disposal. Records of such practice were rarely kept.
Military Related Airfields *Military airfields present an elevated risk from ordnance simply due to the large military presence and likelihood of associated live ordnance training or bombing practice.*	The site was not situated within the perimeters or vicinity of a military airfield.

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14. The Likelihood of UXO Contamination Summary

The following table assesses the likelihood that the site was contaminated by items of German aerial delivered and Allied ordnance. Factors such as the risk of UXO initiation, remaining, and encountering will be discussed later in the report.

UXO Contamination Summary	
Quality of the Historical Record	The research has evaluated pre- and post-WWII Ordnance Survey maps, pre and post WWII oblique aerial photography, the Manchester bomb plot and damage map, air raid damage files, and anecdotal record. The record set is of generally good quality and corresponds to suggest that there is no recorded evidence of bombing on site or to its immediate environs. Additionally, various anecdotal accounts correlate to explain the types of ordnance manufacture that was occurring at the former Mather & Platt Park Engineering Works.
German Aerial Delivered Ordnance	• During WWII the site was located within the County Borough of Manchester, which according to Home Office bombing statistics sustained an overall low density of bombing, with 27.1 items of ordnance recorded per 1,000 acres. Anecdotal evidence suggests that even though there were possible railway and industrial targets in the area, there was very little bombing in Newton Heath, where the site is located, and it is thought that bombing in Manchester was more concentrated in the city centre and dock area. • Pre-war OS mapping dated 1922-1932, indicates the site consisted largely of structures associated with *Park Engineering Works,* whilst open ground occupied the north-eastern border of the site boundary. Post-war OS mapping dated 1951 indicates that additional structures have been extended in the eastern section of the site, leaving a small area of open ground in the north-eastern corner of the site. • A Manchester bomb plot and damage map does not record any strikes within the site boundary or its environs. Whilst this map is not considered to be entirely comprehensive, it does indicate the low localised density of bombing in the area. Additionally, no damage is recorded to any structures on or surrounding the site. This is supported by post-war era oblique photography from 1953, which indicate the works survived the war structurally intact. Likewise, no reference to bombing or damage at the Mather & Platt Park Engineering Works could be found in written records or published historical accounts. • Whilst open areas of land can be of possible concern, the vast majority of the site was occupied by structures associated with the Park Works during wartime. Therefore, it is anticipated that the majority of the site would have been frequently accessed during the war as a result of the factory.. Given the presence of these structures and this level of access, it is considered likely that obvious indicators of UXO, such as entry holes and craters, would have been easily seen and recorded on site. • In summary, the site is not considered to be at significant risk of German air-delivered UXO contamination. Whilst the risk of indicators of UXO going unnoticed within the open area of the site cannot be entirely discounted, evidence suggests that the general site area did not constitute a viable target, did not sustain any direct bomb strikes, and there is no obvious positive evidence of bomb damage within or in proximity to the site boundary. The risk of contamination is therefore not considered to be any higher than the 'background level' for this area of the UK.

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Allied Ordnance	• The site boundary and the surrounding industrial properties, known formerly as the Mather & Platt Park Engineering Works, are understood to have become government run enterprises in both WWI and WWII. During both periods the works was requisitioned for the manufacture of ordnance components, other war related materials and the production of Avro 504 aeroplanes in association with the nearby Avro Works. • Research suggests that during WWI Park Works was mainly involved in the manufacture of projectile casings and fuzes, as well as specialising in Howitzer (large calibre artillery guns) relining. During WWII the factory predominantly became known as a gun factory and was again used to produce ordnance components such as fuzes and weapon cases. Various munition parts such as rocket and anti-aircraft projectors, as well as cordite rolling mills were manufactured here. Due to the limitations of the available record it is assumed that Park Works may have produced an even greater diverse range of other wartime items and materials also. • Munition components produced at Park Works are largely thought to have been subsequently transported to dedicated munition filling factories (known as ROF's) to be filled with explosives. Such items may however have been stored on site prior to their transit. Given its significant wartime output and the variety of items made, the production and usage of explosives at the Park Factory also cannot be entirely discounted. The production of fuzes in particular would have entailed the production of a small explosive component and these types of item can still pose a health risk if disturbed today. • It was not uncommon for excess or unwanted ordnance such as fuzes to be buried or burnt within the wider premises of a factory as a means of disposal, especially if deemed faulty or in excess. Records of such practice were rarely kept. It is also difficult to ascertain what degree of clearance or disposal may have taken place in post war years. • Given that there are no site plans available for the factory, it is not possible to determine what the structures within the site boundary were exactly used for. As such, it is not possible to discount the possibility that the site may have been located within a section of the factory used for the storage or testing of ordnance. • However the potential for ordnance disposal (such as burial or burning) to have occurred is considered to be minimal within the footprint of the factory buildings themselves, due to the hard standing composition of their floors. The potential for such disposal is considered to be much higher within areas of open soft land, such as within the eastern section of the site during wartime. The Park Engineering works is however understood to have been significantly expanded in the post-war period, including the extension of warehousing across the eastern section of the site. • Subsequently, because the site area is known to have been utilised to produce various ordnance components throughout both WWI and WWII, there is considered to be an elevated risk of historic Allied UXO contamination at the site of proposed works. This risk of UXO remaining today is however considered to be substantially reduced within areas of the site occupied by the pre-war factory building, which would have been less viable for ordnance disposal, and areas that have undertaken significant post-war redevelopment, as any items of ordnance should have already been encountered during previous excavation works. Therefore, the risk on-site is not considered to be homogeneous. Only the open area within the north-east section of the boundary, that has remained largely undeveloped from WWII to present day, is considered to be at an elevated risk of encountering Allied UXO (see risk mapping presented in **Annex P**).

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15. The Likelihood that UXO Remains

15.1. Introduction

It is important to consider the extent to which any explosive ordnance clearance (EOC) activities or extensive ground works have occurred on site. This may indicate previous ordnance contamination or reduce the risk that ordnance remains undiscovered.

15.2. UXO Clearance

Former military sites (or at least certain areas within their footprint) are often subject to clearance before they are returned to civilian use by the MoD. If a site is retained by the military, it is possible that no clearance operations have ever been undertaken. However, UXO is sometimes still discovered even on sites where clearance operations are known to have been undertaken. The detail and level of survey and targeted investigation undertaken by the military will depend on the former use of the site and purpose of the clearance (i.e. disposal, redevelopment, return to agriculture, etc.).[8] The level of clearance will also depend on the available technology, resources and practices of the day.

It therefore cannot be assumed that the risk of UXO remaining has been completely mitigated, even though EOC tasks have been undertaken at a former military site.

15.3. Post-War Redevelopment

The wartime structures of the Park Engineering Works are understood to have undergone significant extension in the post-war period, including the extension of warehousing into the eastern section of the site area. All the industrial structures within the boundary have since been demolished, notably in the 1990s. The site boundary is now occupied by an area of open ground.

The risk of UXO remaining is considered to be mitigated at the location of and down to the depth of any post-war redevelopment on site. Within the footprints of post-WWII redevelopments, the risk from shallow-buried UXO (especially Allied items/components) should have been encountered/removed during initial excavations. The risk will remain within virgin geology below and amongst these post-war works, down to the maximum bomb penetration depth.

[8] *CIRIA C681*

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16. The Likelihood of UXO Encounter

16.1. Introduction

For UXO to pose a risk at a site, there should be a means by which any potential UXO might be encountered on that site.

The likelihood of encountering UXO on the site of proposed would depend on various factors, such as the type of UXO that might be present and the intrusive works planned on site. In most cases, UXO is more likely to be present below surface (buried) than on surface.

In general, the greater the extent and depth of intrusive works, the greater the risk of encountering. The most likely scenarios under which items of 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.

Generally speaking, the risk of encountering any type of UXO will be minimal for any works planned within the footprint and down to the depth of post-war foundations and excavations.

16.2. Land Service/Small Arms Ammunition Encounter

Items of LSA and SAA are mostly encountered in areas previously used for munitions production and military training. Such items could have been lost, burnt, buried or discarded during being in use by the military. Due to this, LSA are most likely to be encountered at relatively shallow depths – generally in the top 1m below ground level. Therefore, such items are most likely to be encountered during open excavation works. In some cases, there is the potential that LSA or SAA may be present on the surface of the ground – especially in areas with active military use or were recently in use by the MoD.

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17. The Likelihood of UXO Initiation

17.1. Introduction

UXO does not spontaneously explode. Older UXO devices will require an external event/energy to create the conditions for detonation to occur. The likelihood that a device will function can depend on a number of factors including the type of weaponry, its age and the amount of energy it is struck with.

17.2. Initiating Aerial Delivered Ordnance

Unexploded bombs do not spontaneously explode. All high explosive filling requires significant energy to create the conditions for detonation to occur.

In recent decades, there have been a number of incidents in Europe where Allied UXBs have detonated, and incidents where fatalities have resulted.. There have been several hypotheses as to the reason why the issue is more prevalent in mainland Europe – reasons could include the significantly greater number of bombs dropped by the Allied forces on occupied Europe, the preferred use by the Allies of mechanical rather than electrical fuzes, and perhaps just good fortune. The risk from UXO in the UK is also being treated very seriously in many sectors of the construction industry, and proactive risk mitigation efforts will also have affected the lack of detonations in the UK.

There are certain construction activities which make initiation more likely, and several potential initiation mechanisms must be considered:

UXB Initiation	
Direct Impact	Unless the fuze or fuze pocket is struck, there needs to be a significant impact e.g. from piling or large and violent mechanical excavation, onto the main body of the weapon to initiate a buried iron bomb. Such violent action can cause the bomb to detonate.
Re- starting the Clock	A small proportion of German WWII bombs employed clockwork fuzes. It is probable that significant corrosion would have taken place within the fuze mechanism over the last 70+ years that would prevent clockwork mechanisms from functioning. Nevertheless, it was reported that the clockwork fuze in a UXB dealt with by 33 EOD Regiment in Surrey in 2002 did re-start.
Friction Impact	The most likely scenario resulting in the detonation of a UXB is friction impact initiating the shock-sensitive fuze explosive. The combined effects of seasonal changes in temperature and general degradation over time can cause explosive compounds to crystallise and extrude out from the main body of the bomb. It may only require a limited amount of energy to initiate the extruded explosive which could detonate the main charge.

17.3. Land Service /Small Arms Ammunition Initiation

Items of LSA generally do not become inert or lose their effectiveness with age. Time can 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.

If left alone, an item of LSA will pose little/no risk of initiation. Therefore, if it is not planned to undertake construction/intrusive works at the site, the risk of initiation of any LSA that may be present would be negligible. Similarly, those accessing a contaminated area would be at minimal risk if they do not interfere with any UXO present on the ground. Clearly for many end uses, however, the presence of UXO anywhere on a site would not be acceptable as it could not be guaranteed that the items will not be handled, struck or otherwise affected, increasing the likelihood of initiation.

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Items of SAA are much less likely to detonate than LSA or UXBs, but can be accidentally initiated by striking the casing, coming into contact with fire, or being tampered with/dismantled. It is likely that the detonation of an item of SAA would result in a small explosion, as the pressure would not be contained within a barrel. Detonation would only result in local overpressure and very minor fragmentation from the cartridge case.

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18. Consequences of Initiation/Encounter

18.1. Introduction

The repercussions of the inadvertent detonation of UXO during intrusive ground works, or if an item or ordnance is interfered with or disturbed, are potentially profound, both in terms of human and financial cost. A serious risk to life and limb, damage to plant and total site shutdown during follow-up investigations are potential outcomes. However, if appropriate risk mitigation measures are put in place, the chances of initiating an item of UXO during ground works is comparatively low.

The consequences of encountering UXO can be particularly notable in the case of high-profile sites (such as airports and train stations) where it is necessary to evacuate the public from the surrounding area. A site may be closed for anything from a few hours to a week with potentially significant cost in lost time. It should be noted that even the discovery of suspected or possible item of UXO during intrusive works (if handled solely through the authorities), may also involve significant loss of production

18.2. Consequences of Detonation

When considering the potential consequences of a detonation, it is necessary to identify the significant receptors that may be affected. The receptors that may potentially be at risk from a UXO detonation on a construction site will vary depending on the site specific conditions but can be summarised as follows:

- People – site workers, local residents and general public.
- Plant and equipment – construction plant on site.
- Services – subsurface gas, electricity, telecommunications.
- Structures – not only visible damage to above ground buildings, but potentially damage to foundations and the weakening of support structures.
- Environment – introduction of potentially contaminating materials.

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19. 1st Line Defence Risk Assessment

19.1. Risk Assessment Stages

Taking into account the quality of the historical evidence, the assessment of the overall risk from unexploded ordnance is based on the following five considerations:

1. That the site was contaminated with unexploded ordnance.
2. That unexploded ordnance remains on site.
3. That such items will be encountered during the proposed works.
4. That ordnance may be initiated by the works operations.
5. The consequences of encountering or initiating ordnance.

19.2. Assessed Risk Level

1st Line Defence has assessed that the risk from items of historic Allied ordnance is not homogenous across the site area. Areas of the site that have not undergone substantial post-war redevelopment (north-east section) are considered to be of **Medium Risk**, whilst areas that were occupied by both pre and post-war factory buildings and have since been demolished are considered to be of **Low Risk**. See Risk Mapping presented in **Annex P**. There is a **Low Risk** from items of German aerial delivered UXO across the site footprint.

Medium Risk Area (North East Section)

Ordnance Type	Risk Level			
	Negligible	Low	Medium	High
German Unexploded HE Bombs		✓		
German 1kg Incendiary Bombs		✓		
Allied Anti-Aircraft Artillery Projectiles		✓		
WWI and WWII-era Ordnance Components (Including Land Service and Small Arms Ammunition)			✓	

Low Risk Area

Ordnance Type	Risk Level			
	Negligible	Low	Medium	High
German Unexploded HE Bombs		✓		
German 1kg Incendiary Bombs		✓		
Allied Anti-Aircraft Artillery Projectiles		✓		
WWI and WWII-era Ordnance Components (Including Land Service and Small Arms Ammunition)		✓		

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Please note – although the risk from unexploded ordnance across the majority of this site has been assessed as 'Low', this does not mean there is 'no' risk of encountering UXO. This report has been undertaken with due diligence, and all reasonable care has been taken to access and analyse relevant historical information. By necessity, when dealing historical evidence, and when making assessments of UXO risk, various assumptions have to be made which we have discussed and justified throughout this report. Our reports take a common-sense and practical approach to the assessment of risk, and we strive to be reasonable and pragmatic in our conclusions.

It should however be stressed that if any suspect items are encountered during the proposed works, 1st Line Defence should be contacted for advice/assistance, and to re-assess the risk where necessary. The mitigation measures outlined in the next section are recommended as a minimum precaution to alert ground personnel to the history of the site, what to look out for, and what measures to take in the event that a suspect item is encountered. It should also be noted that the conclusions of this report are based on the scope of works outlined in the 'Proposed Works' section of this report. Should the scope of works change or additional works be proposed, 1st Line Defence should be contacted to re-evaluate the risk.

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20. Proposed Risk Mitigation Methodology

20.1. General

The following risk mitigation measures are recommended to support the proposed works at Plot 2, Park Works, Manchester:

Type of Work	Recommended Mitigation Measure
All Works	• **UXO Risk Management Plan** It is recommended that a site-specific plan for the management of UXO risk be written for this site. This plan should be kept on site and be referred to in the event that a suspect item of UXO is encountered at any stage of the project. It should detail the steps to be taken in the event of such a discovery, considering elements such as communication, raising the alarm, nominated responsible persons etc. Contact 1st Line Defence for help/more information. • **Site Specific UXO Awareness Briefings to all personnel conducting intrusive works.** As a minimum precaution, all personnel working on the site should be briefed on the basic identification of UXO and what to do in the event of encountering a suspect item. This should in the first instance be undertaken by a UXO Specialist. Posters and information on the risk of UXO can be held in the site office for reference.
Shallow Intrusive Works/Open Excavations in the Medium Risk Area	• **Unexploded Ordnance (UXO) Specialist Presence on Site to support shallow intrusive works** When on site the role of the UXO Specialist would include: • Monitoring works using visual recognition and instrumentation, including immediate response to reports of suspicious objects or suspected items of ordnance that have been recovered by the ground workers on site. • Providing UXO awareness briefings to any uninformed staff and advise staff of the need to modify working practices to take account of the ordnance risk. • To aid incident management which would involve liaison with the local authorities and police should ordnance be identified and present an explosive hazard.

In making this assessment and recommending these risk mitigation measures, if known, the 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, 1st Line Defence should be consulted to see if a re-assessment of the risk or mitigation recommendations is necessary.

1st Line Defence Limited **28/01/21**

This Report has been produced in compliance with the Construction Industry Research and Information Association (CIRIA) C681 guidelines for the writing of Detailed UXO Risk Assessments.

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Bibliography

- Bates, H. E., *Flying Bombs over England*, Frogletts Publications Ltd., 1994
- *Bishop, K. 60th Anniversary 1952 – 2012: Celebrating the History of Mather and Platt Ltd, Mather and Platt Long Service Association. 2012*
- Clarke, N. J., *Adolf's British Holiday Snaps: Luftwaffe Aerial Reconnaissance Photographs of England, Scotland and Wales*, Fonthill Media Ltd., 2012
- 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
- 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 Ltd., 1987
- Ramsey, W., *The Blitz Then and Now, Volume 2*, Battle of Britain Prints International Ltd., 1988
- Ramsey, W., *The Blitz Then and Now, Volume 3*, Battle of Britain Prints International Ltd., 1990
- Scofield, J., *Modern Military Matters*., Council for British Archaeology., 2004
- Stone, K., et al., *Unexploded Ordnance (UXO) A Guide For The Construction Industry (C681)*., CIRIA, 2009
- Whiting, C., *Britain Under Fire: The Bombing of Britain's Cities 1940-1945*, Pen & Sword Books Ltd., 1999

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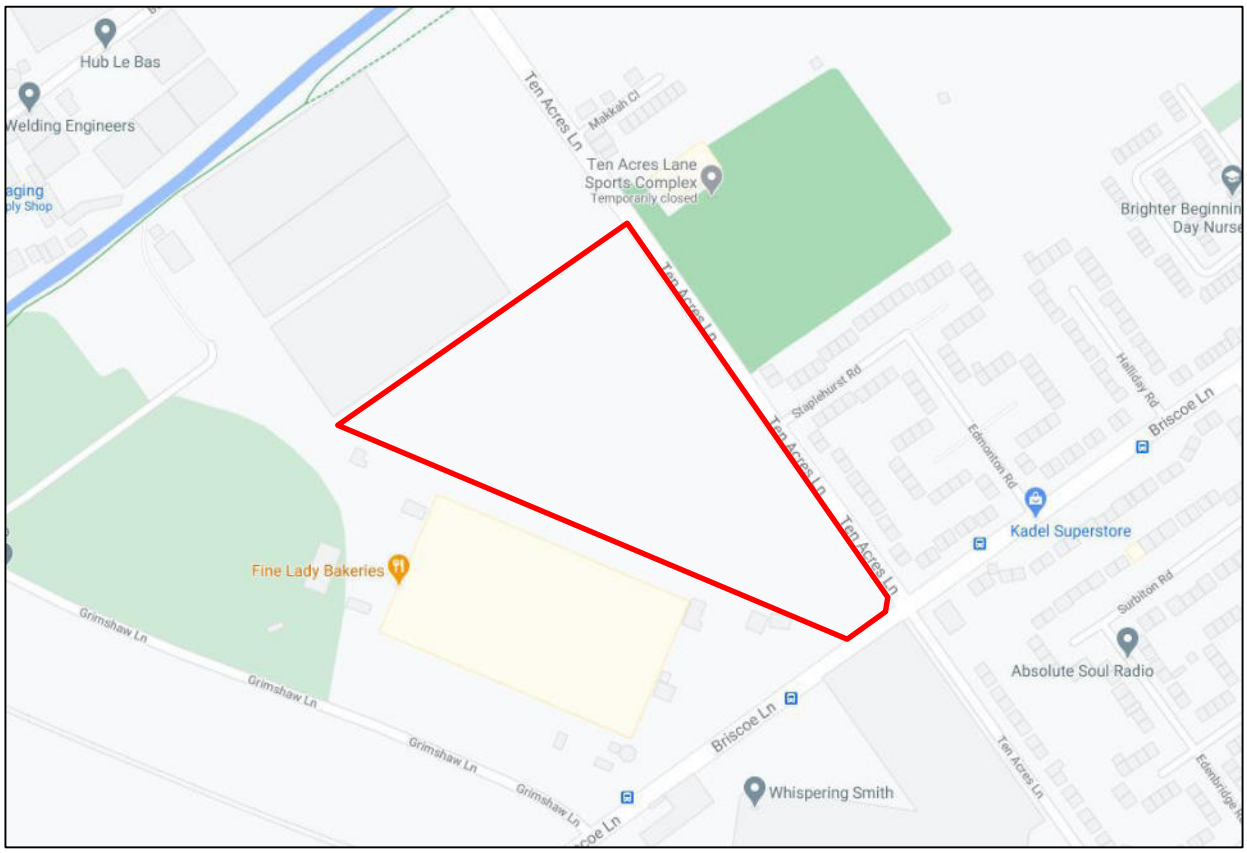
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Site Location Maps

Annex: **A**





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Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
Tel: +44 (0)1992 245 020

Client:	**TRC Companies Ltd**	**Approximate site boundary**	N
Project:	**Plot 2, Park Works, Manchester**		
Ref:	**DA12563-00**	Source: Google Maps	

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Recent Aerial Photography

Annex: **B**



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Client: **TRC Companies Ltd**

Project: **Plot 2, Park Works, Manchester**

Ref: **DA12563-00**

Source: Google Earth ™ Mapping Services

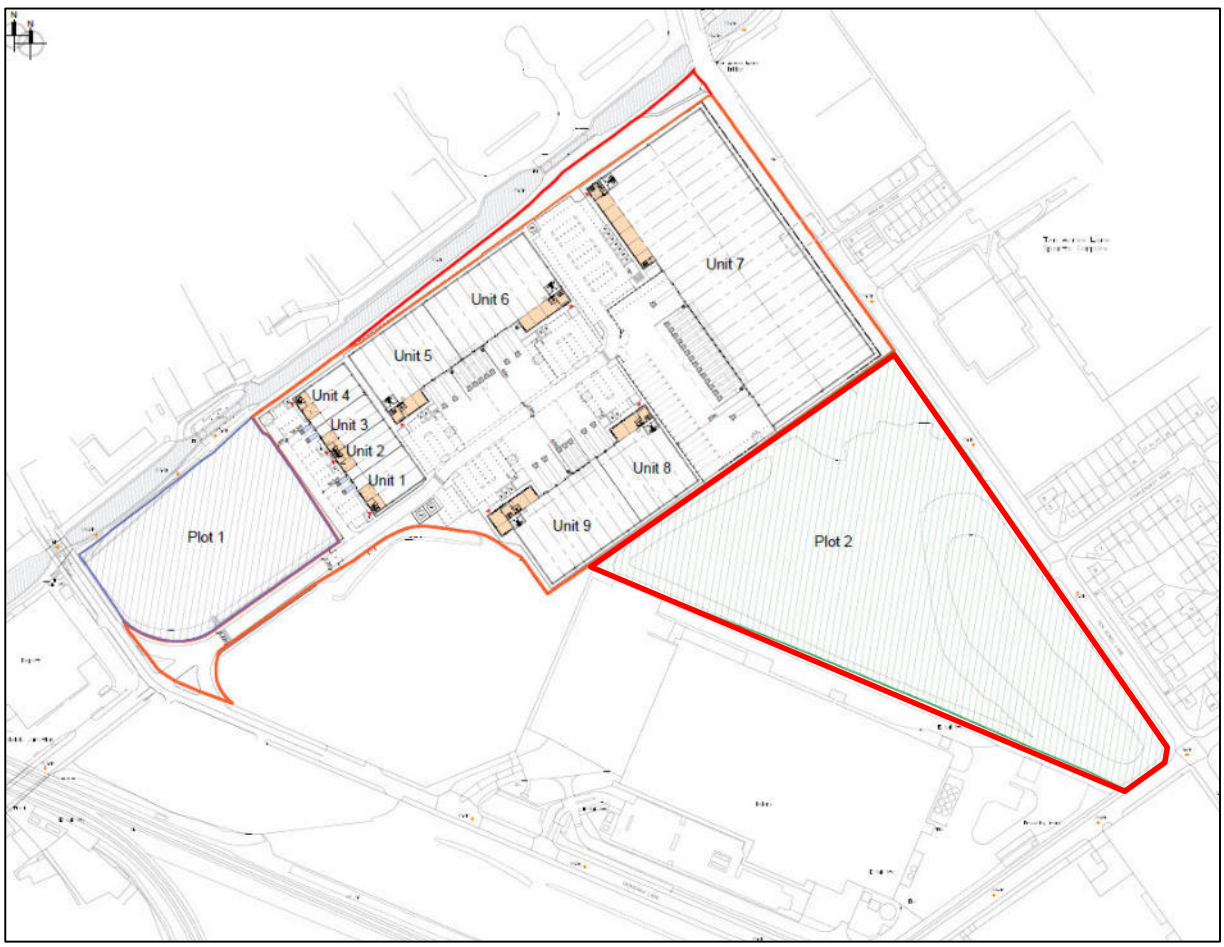
Approximate site boundary

N

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Client Provided Site Plan

Annex: **C**



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Client: **TRC Companies Ltd**

Approximate site boundary

Project: **Plot 2, Park Works, Manchester**

N

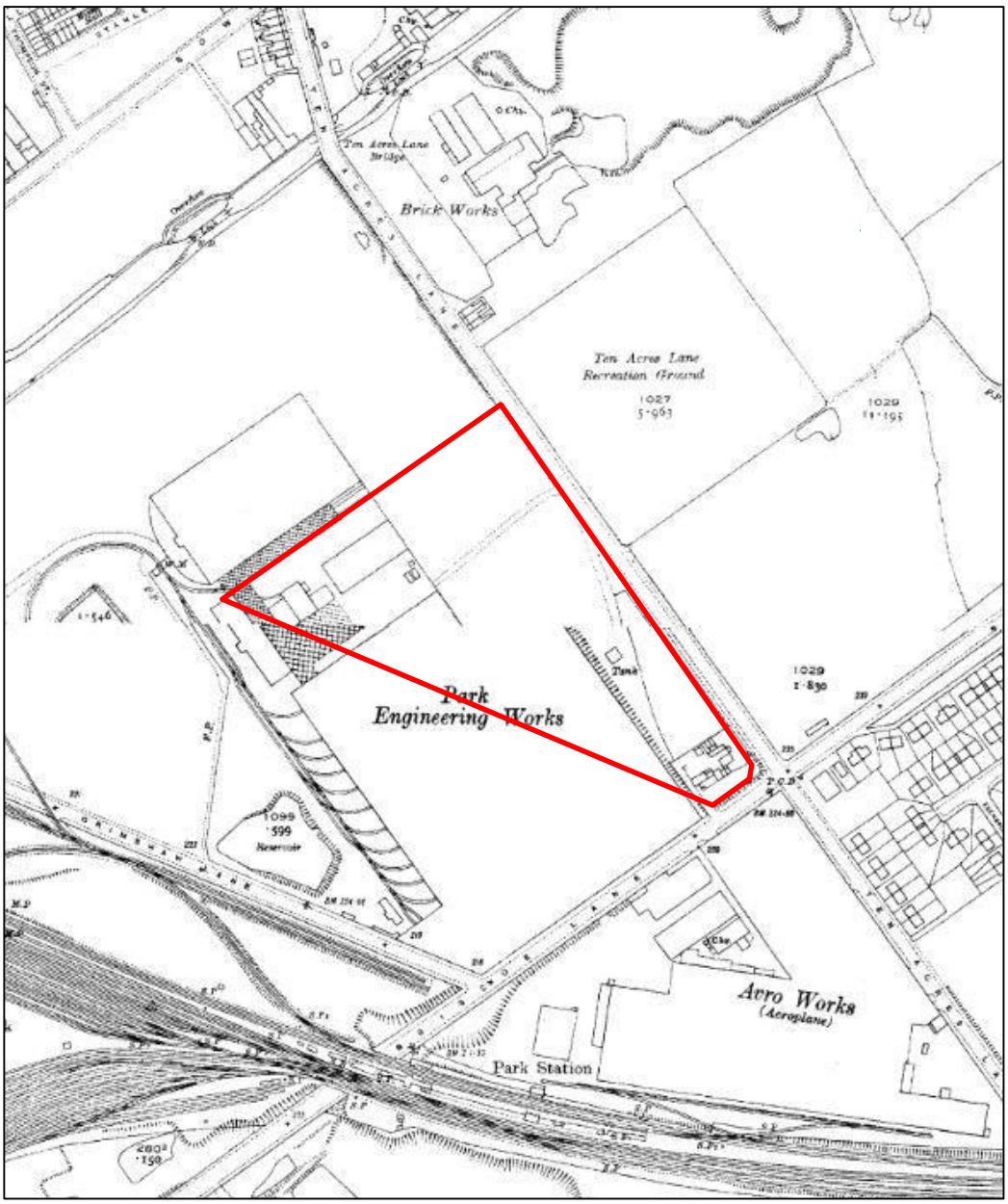
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Pre-WWII Historical Map

Annex: **D1**



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Client: **TRC Companies Ltd**

Approximate site boundary

N

Project: **Plot 2, Park Works, Manchester**

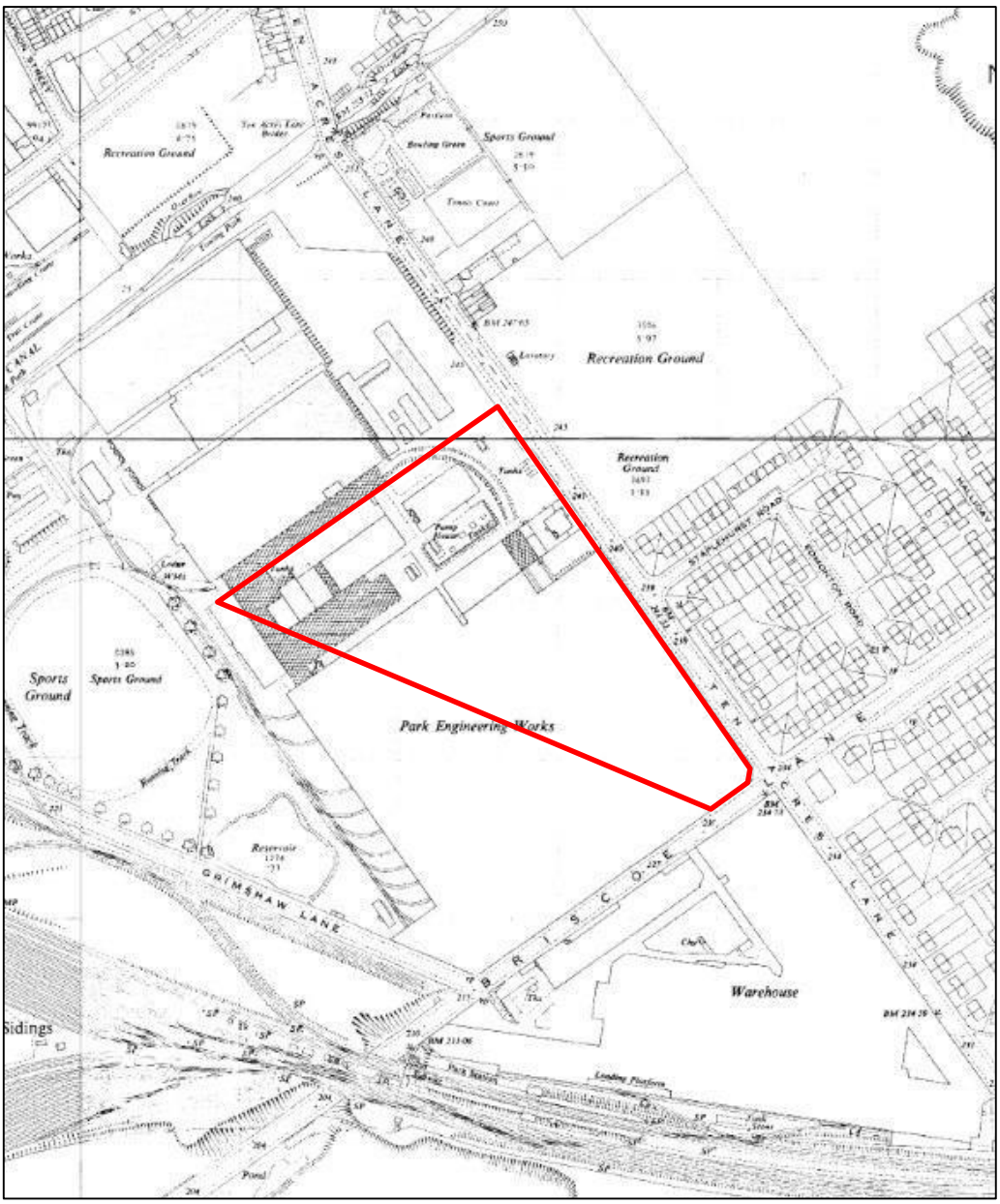
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Post-WWII Historical Map

Annex: **D2**



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Client: **TRC Companies Ltd**

Project: **Plot 2, Park Works, Manchester**

Ref: **DA12563-00**

Source: Landmark Maps

Approximate site boundary

N

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The Park Engineering Works and environs, Newton Heath, 1932



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Client: **TRC Companies**

Project: **The Project**

Ref: **DA1234-00**

Source: Britain From Above

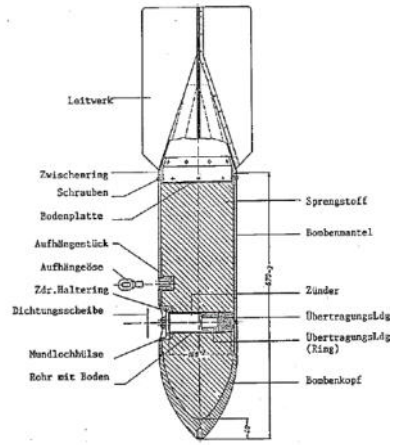
Approximate site boundary

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Examples of German Air-Delivered Ordnance

SC 50kg High Explosive Bomb

Bomb Weight	40-54kg (88-119lb)
Explosive Weight	25kg (55lb)
Fuze Type	Impact fuze/electro-mechanical time delay fuze
Bomb Dimensions	1,090 x 280mm (42.9 x 11.0in)
Body Diameter	200mm (7.87in)
Use	Against lightly damageable materials, hangars, railway rolling stock, ammunition depots, light bridges and buildings up to three stories.
Remarks	The smallest and most common conventional German bomb. Nearly 70% of bombs dropped on the UK were 50kg.

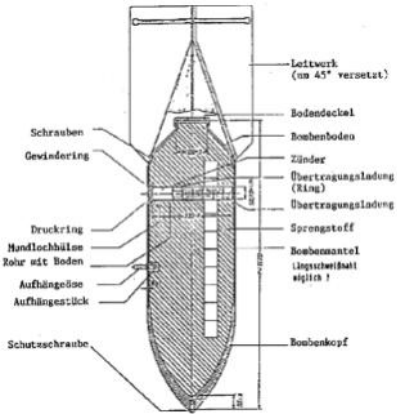






SC 250kg High Explosive Bomb

Bomb Weight	245-256kg (540-564lb)
Explosive Weight	125-130kg (276-287lb)
Fuze Type	Electrical impact/mechanical time delay fuze.
Bomb Dimensions	1640 x 512mm (64.57 x 20.16in)
Body Diameter	368mm (14.5in)
Use	Against railway installations, embankments, flyovers, underpasses, large buildings and below-ground installations.
Remarks	It could be carried by almost all German bomber aircraft, and was used to notable effect by the Junkers Ju-87 Stuka (Sturzkampfflugzeug or dive-bomber).



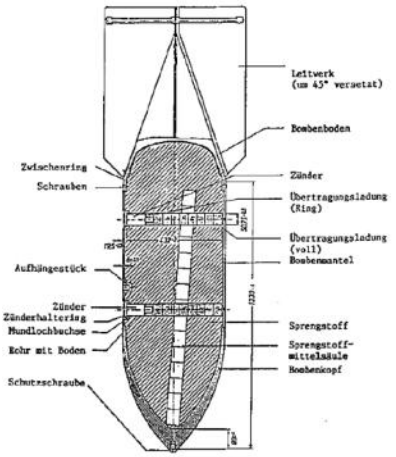


SC250 bomb being loaded onto German bomber

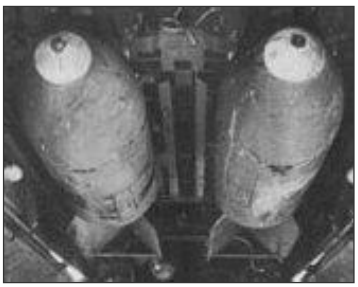


SC 500kg High Explosive Bomb

Bomb Weight	480-520kg (1,058-1,146lb)
Explosive Weight	250-260kg (551-573lb)
Fuze Type	Electrical impact/mechanical time delay fuze.
Bomb Dimensions	1957 x 640mm (77 x 25.2in)
Body Diameter	470mm (18.5in)
Use	Against fixed airfield installations, hangars, assembly halls, flyovers, underpasses, high-rise buildings and below-ground installations.
Remarks	40/60 or 50/50 Amatol TNT, trialene. Bombs recovered with Trialen filling have cylindrical paper wrapped pellets 1-15/16 in. in length and diameter forming







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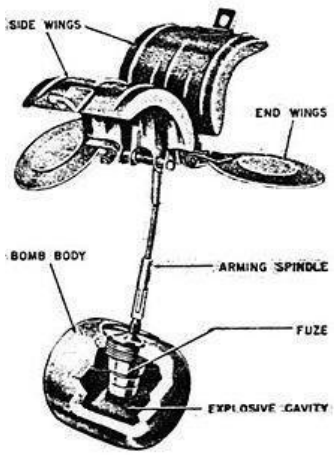
Ref: **DA12563-00**

Source: Various sources

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SD2 Anti-Personnel 'Butterfly Bomb'

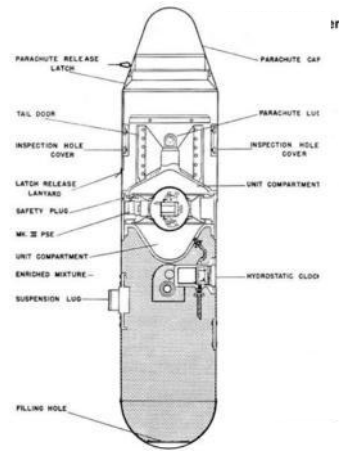
Bomb Weight	Approx. 2kg (4.41lb)
Explosive Weight	Approx. 7.5oz (225 grams) of Amatol surrounded by a layer of bituminous composition.
Fuze Type	41 fuze (time) , 67 fuze (clockwork time delay) or 70 fuze (anti-handling device)
Body Diameter	3in (7.62 cm) diameter, 3.1in (7.874) long
Use	Designed as an anti-personnel/ fragmentation weapon. They were delivered by air, being dropped in containers of 23-144 sub-munitions that opened at a predetermined height, thus scattering the bombs.
Remarks	Very rare. First used against Ipswich in 1940, but were also dropped on Kingston upon Hull, Grimsby and Cleethorpes in June 1943, amongst various other targets in UK. As the bombs fell the outer case flicked open by springs which caused four light metal drogues with a protruding 5 inch steel cable to deploy in the form of a parachute & wind vane which armed the device as it span.





Parachute Mine (Luftmine B / LMB)

Bomb Weight	Approx. 990kg (2176lb)
Explosive Weight	Approx. 705kg (1,554lb)
Fuze Type	Impact/ Time delay / hydrostatic pressure fuze
Dimensions	2.64m x 0.64m (3.04m with parachute housing)
Use	Against civilian, military and industrial targets. Used as blast bombs and designed to detonate above ground level to maximise damage to a wider area.
Remarks	Deployed a parachute when dropped in order to control its descent. Had the potential to cause extensive damage in a 100m radius.



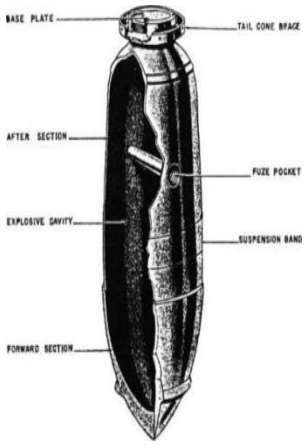






SC 1000kg

Bomb Weight	Approx. 993-1027kg (2,189-2,264lb)
Explosive Weight	Approx. 530-620kg (1168-1367lb)
Fuze Type	Electrical impact/mechanical time delay fuze.
Filling	Mixture of 40% amatol and 60% TNT, but when used as an anti-shipping bomb it was filled with Trialen 105, a mixture of 15% RDX, 70% TNT and 15% aluminium powder.
Bomb Dimensions	2800 x 654mm (110 x 25.8in)
Body Diameter	654mm (18.5in)
Use	SC type bombs are General Purpose Bombs used primarily for general demolition work. Constructed of parallel walls with comparatively heavy noses. They are usually of three piece welded construction





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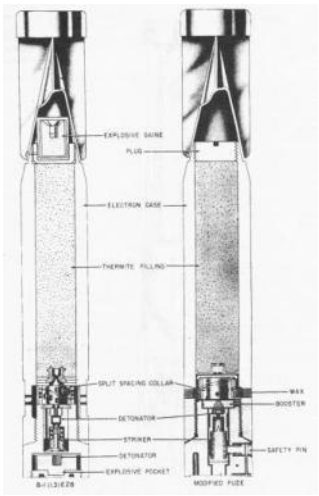
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Source: Various sources

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1kg Incendiary Bomb

Bomb Weight	Approx. 1.0 - 1.3kg (2.2 and 2.9lb)
Explosive Weight	Approx. 680g (1.5lb) Thermite 8-15gm Explosive Nitropenta
Fuze Type	Impact fuze
Bomb Dimensions	350 x 50mm (13.8 x 1.97in)
Body Diameter	50mm (1.97in)
Use	As incendiary – dropped in clusters on towns and industrial complexes
Remarks	Magnesium alloy case. Sometimes fitted with high explosive charge. The body is a cylindrical alloy casting threaded internally at the nose to receive the fuze holder and fuze.

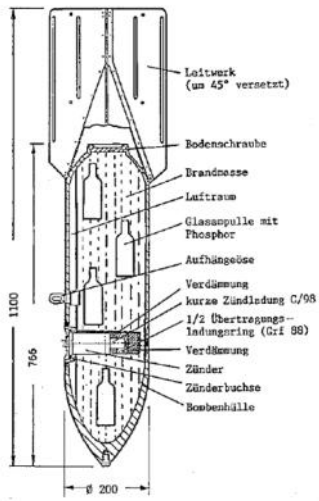


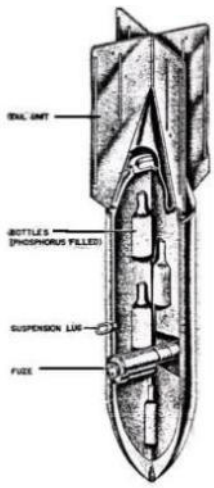




C50 A Incendiary Bomb

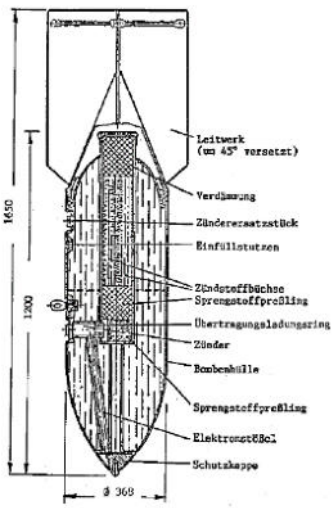
Bomb Weight	Approx. 41kg (90.4lb)
Explosive Weight	Approx. 0.03kg (0.066lb)
Incendiary Filling	12kg (25.5lb) liquid filling with phosphor igniters in glass phials. Benzine 85%; Phosphorus 4%; Pure Rubber 10%
Fuze Type	Electrical impact fuze
Bomb Dimensions	1,100 x 280mm (43.2 x 8in)
Use	Against any targets where an incendiary effect is required
Remarks	Early fill was a phosphorous/carbon disulphide incendiary mixture





Flam C-250 Oil Bomb

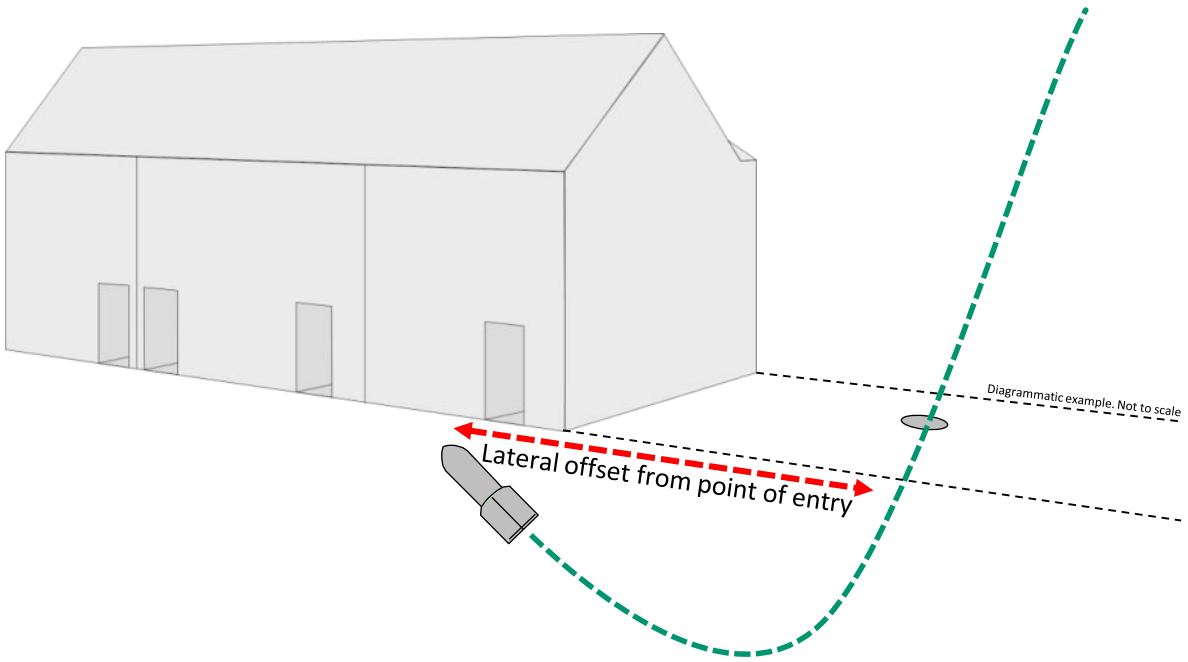
Bomb Weight	Approx. 125kg (276lb)
Explosive Weight	Approx. 1kg (2.2lb)
Fuze Type	Super-fast electrical impact fuze
Filling	Mixture of 30% petrol and 70% crude oil
Bomb Dimensions	1,650 x 512.2mm (65 x 20.2in)
Body Diameter	368mm (14.5in)
Use	Often used for surprise attacks on ground troops, against troop barracks and industrial installations. Thin casing – not designed for ground penetration





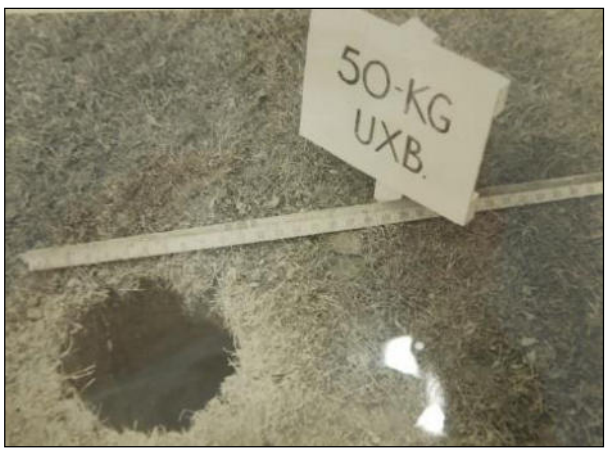
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The 'J-Curve' Effect Principle









Top: J-curve Effect - Due to angle of entry, unexploded bombs would often end their trajectory at a lateral offset from point of entry, often ending up beneath adjacent extant structures/sites. The photograph above shows 250kg bomb found in Bermondsey pointing upwards, demonstrating 'J-curve'

One of the most common scenarios for UXO going unnoticed was when a UXB fell into a 'bomb site' (such as the area shown **Top Left**), the entry hole of the bomb obscured by any debris and rubble present. Note that the entry hole of a 50kg UXB could be as little as 20cm in diameter (**Left**).

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BBC NEWS

Bermondsey bomb: World War Two device safely removed



An unexploded World War Two bomb found in south London has been driven away safely under police and Army escort.

The 500lb (250kg) device was found on a building site in Grange Walk, Bermondsey on Monday.

March 2015

BBC NEWS

Bethnal Green WW2 bomb: Experts remove unexploded device



An unexploded World War Two bomb that prompted the evacuation of 700 people in east London has been made safe and removed by the military.

Families spent the night in a school hall after the 500lb bomb was found in the basement of a building site on Temple Street, in Bethnal Green, on Monday afternoon.

A 200m (650ft) exclusion zone was set up around the device.

August 2016

BBC NEWS

Bath WW2 bomb scare: Device defused, police say



A 500lb World War Two bomb found on the site of a former school in Bath has been defused and made safe.

The discovery of the bomb on Thursday **led to the evacuation of hundreds of homes** and many road closures in the Lansdown area of the city.

A cordon around the site was lifted on Friday evening, more than 24 hours after residents were asked to leave their homes.

May 2016

BBC NEWS

London City Airport reopens after WW2 bomb moved



London City Airport has reopened after an unexploded 500kg World War Two bomb was safely moved from the area.

The device was discovered at the King George V Dock on Sunday during planned work at the east London airport.

All flights were cancelled on Monday after an exclusion zone was put in place, **with the closure affecting up to 16,000 passengers and nearby residents being evacuated from their homes.**

May 2015

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Examples of Unexpected Detonation of WWII Bombs

Annex: H2

BASF has confirmed that an explosive device, most likely a World War II-era bomb, caused the blast that left one person injured Tuesday at a plant construction site in Germany.

The explosion was reported at BASF's Ludwigshafen toluene diisocyanate (TDI) plant, which recently broke ground for a 300,000 metric tons per year TDI production plant and other construction to expand its facilities.



BASF Provides Some Details

Responding to a request from *PaintSquare News* for more information on Wednesday (Feb. 27), BASF's manager of media relations and corporate communications Europe, Ursula von Stetten, wrote in an email, "So here [are] the facts: The detonation took place at 10:00 a.m. One person was injured; the injury is not serious. He will be kept in the hospital for some days.

"Cause of the detonation was an explosive device, presumably a bomb deriving from the Second World War. The device detonated when grounding work was done. No details on [a] delay [are] available. At the moment, the exact circumstances of the incident are [being] evaluated."

1st March 2013

SPIEGEL ONLINE

Blast Kills One

World War II Bomb Explodes on German Motorway

A highway construction worker in Germany accidentally struck an unexploded World War II bomb, causing an explosion which killed him and wrecked several passing cars.



A World War II bomb has exploded during construction work on a German highway, killing one worker and injuring several motorists who were driving past, police said.

The worker had been cutting through the road surface near the south-western town of Aschaffenburg when his machine struck the bomb and triggered it. Police said they weren't sure yet what type of bomb it was. "The explosion seems to have been too small for it to have been an aircraft bomb," a police spokesman said.

23rd October 2006

WWII bomb injures 17 at Hattingen construction site



Seventeen people were injured on Friday when a construction crew unwittingly detonated a buried World War II-era bomb in Hattingen.

An excavator apparently drove over a 250-kilogramme (550 pound) American bomb, damaging surrounding buildings. Most of the injured suffered auditory trauma from the blast, and the excavator operator suffered injuries to his hands, police in the German state of North Rhine-Westphalia said.

"The hole was astoundingly small for such a large bomb full of so many explosives," Armin Gebhard, head of the Arnsberg department for military ordnance removal, told The Local. "But of course it damaged all the surrounding buildings too. We are really happy it wasn't worse."

19th September 2013

BBC NEWS

World War II bomb kills three in Germany



A special commission is investigating the causes of the explosion, while prosecutors are considering whether the team leader should face charges of manslaughter through culpable negligence, the BBC's Oana Lungescu reports from Berlin.

The blast happened an hour before the defusing operation was due to start.

Officials said the three men who died were experienced sappers, or combat engineers, who over 20 years had defused up to 700 bombs.

More than 7,000 people were immediately evacuated when the 500kg bomb was found. Several schools, a kindergarten and local companies remain closed.

2nd June 2010



June 2006

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