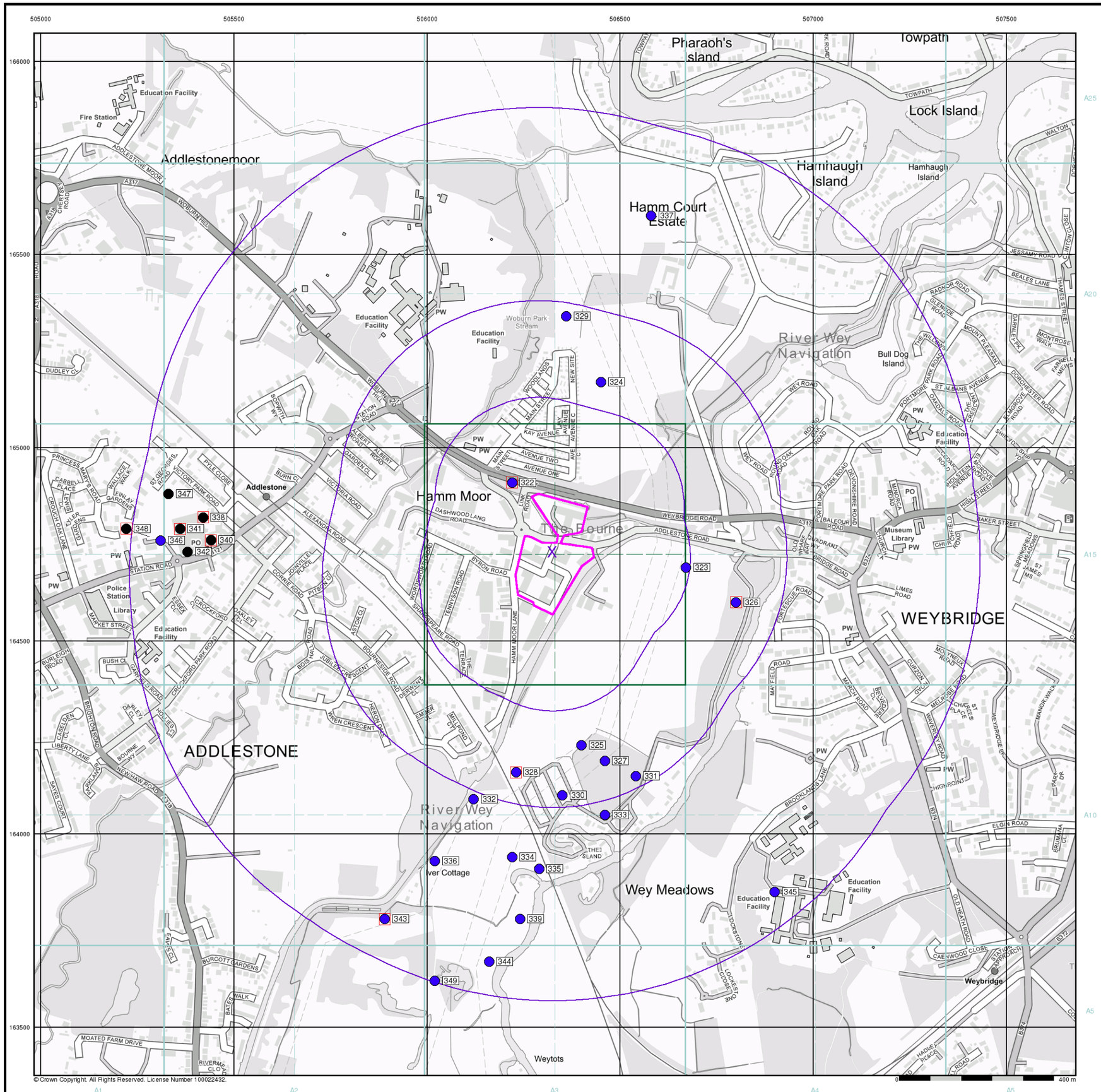


General

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

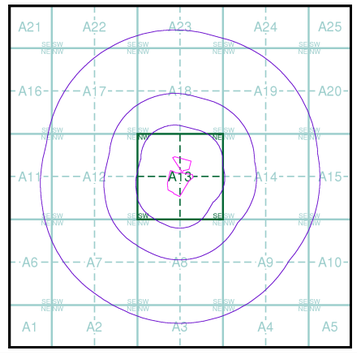
Agency and Hydrological (Boreholes)

- 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



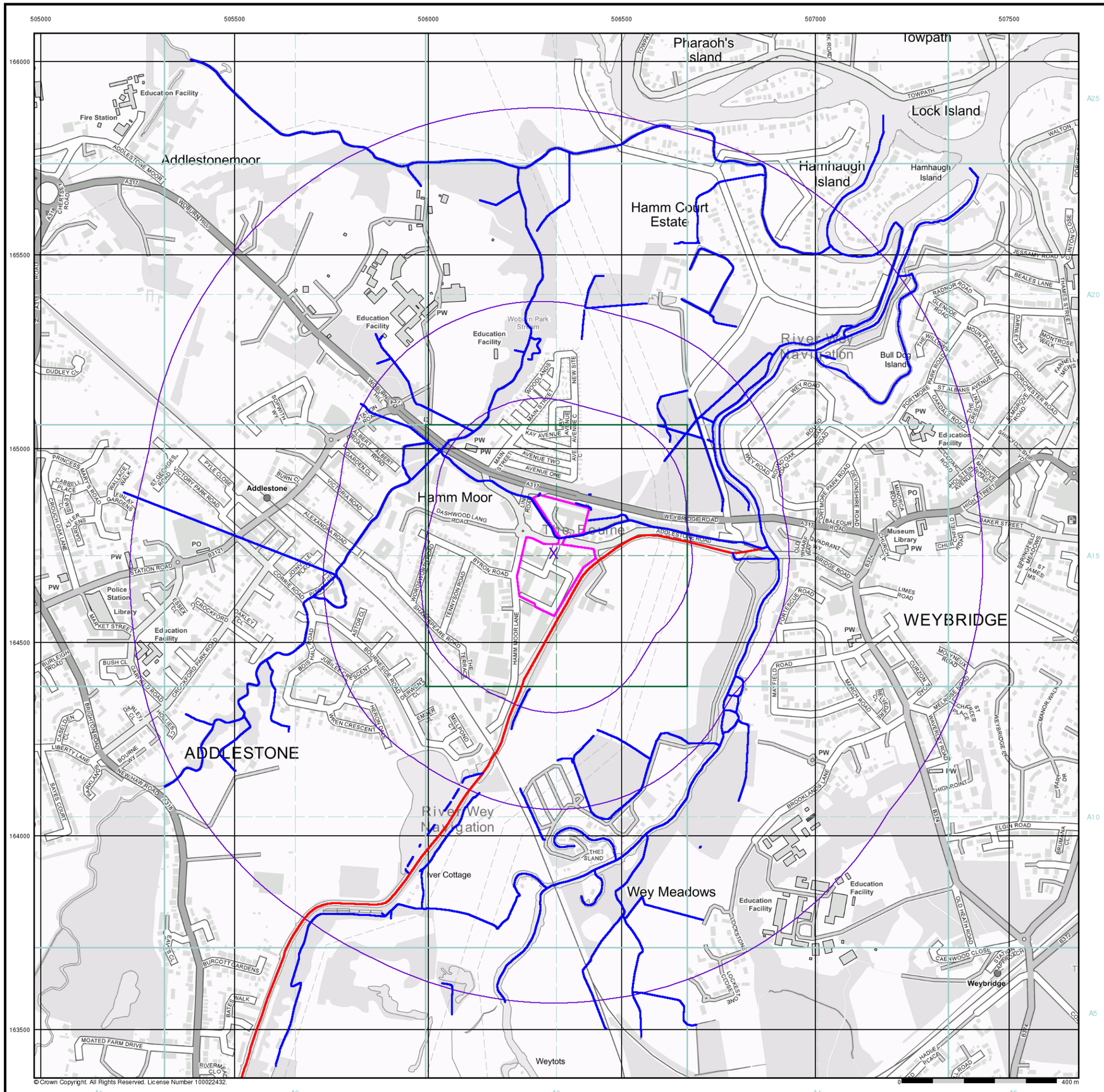
Order Details

Order Number:	287842040_1_1
Customer Ref:	470021.0000
National Grid Reference:	506330, 164730
Slice:	A
Site Area (Ha):	3.45
Search Buffer (m):	1000

Site Details

Site at 506200, 164700

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



TRC

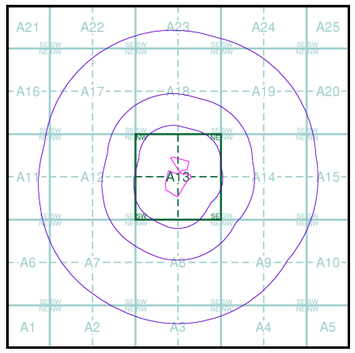
General

- 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

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Customer Ref:	470021.0000
National Grid Reference:	506330, 164730
Slice:	A
Site Area (Ha):	3.45
Search Buffer (m):	1000

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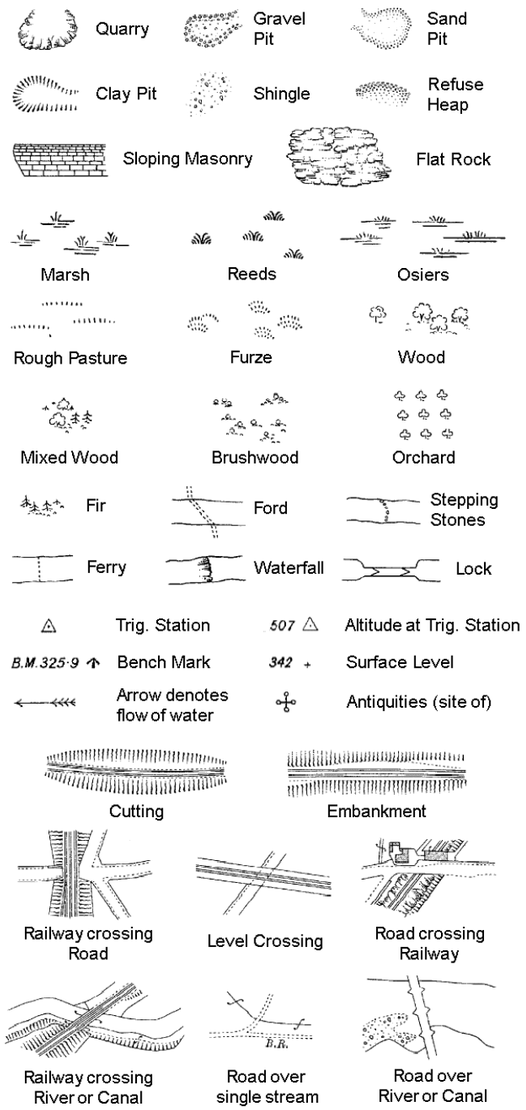
Historical Mapping Legends

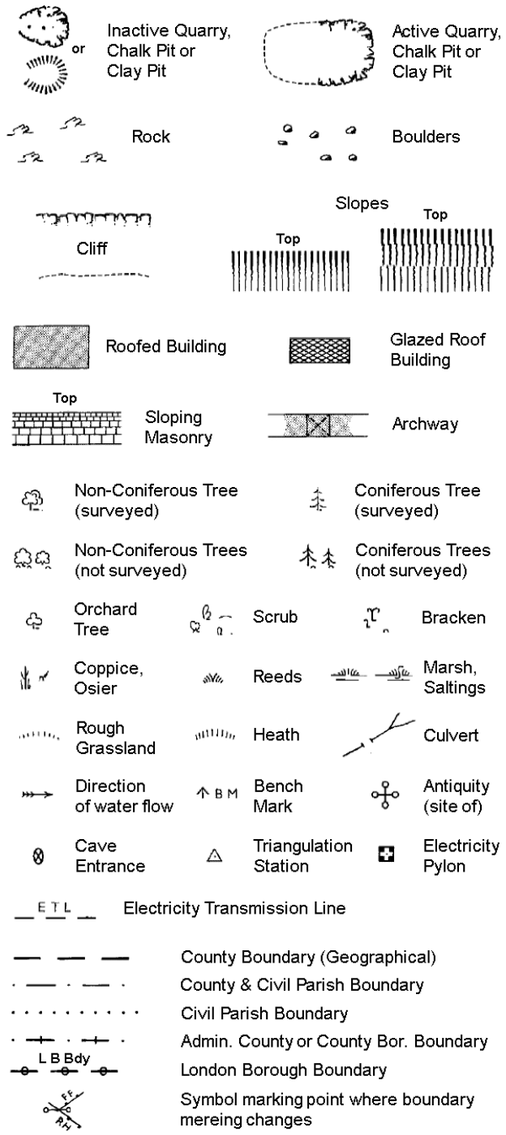
Ordnance Survey County Series and Ordnance Survey Plan 1:2,500



County Boundary (Geographical)
County & Civil Parish Boundary
Administrative County & Civil Parish Boundary
Co. Boro. Bdy.
County Borough Boundary (England)
Co. Burgh Bdy.
County Burgh Boundary (Scotland)

B P B S	Boundary Post or Stone	P.C.B	Police Call Box
B.R.	Bridle Road	P	Pump
E.P	Electricity Pylon	S.P	Signal Post
F.B.	Foot Bridge	St.	Sluice
F.P.	Foot Path	Sp.	Spring
G.P	Guide Post or Board	T.C.B	Telephone Call Box
M.S	Mile Stone	Tr.	Trough
M.P M.R	Mooring Post or Ring	W	Well

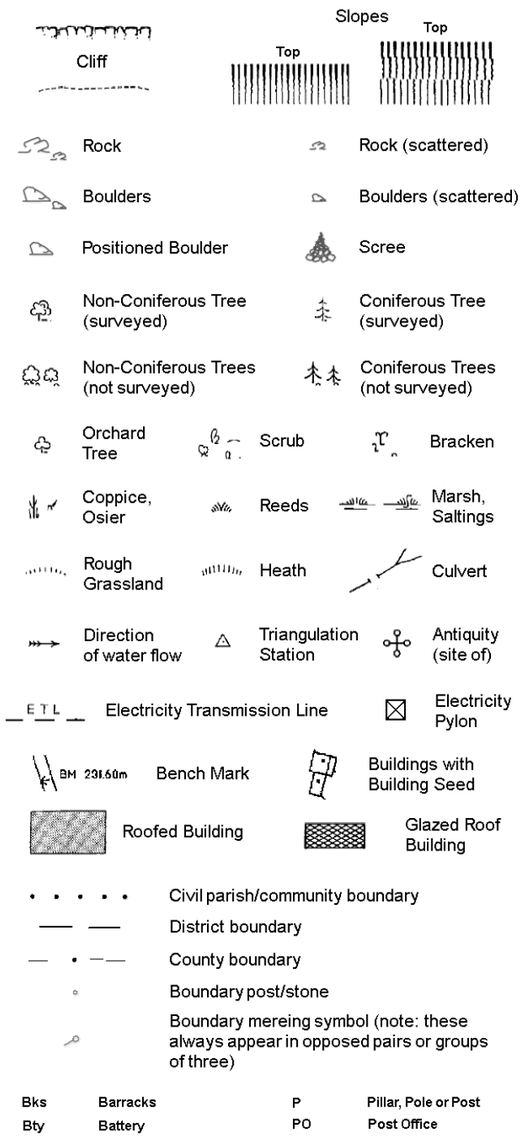
Ordnance Survey Plan, Additional SIMs and Supply of Unpublished Survey Information 1:2,500 and 1:1,250



County Boundary (Geographical)
County & Civil Parish Boundary
Civil Parish Boundary
Admin. County or County Bor. Boundary
L B Bdy
London Borough Boundary
Symbol marking point where boundary mereing changes

BH	Beer House	P	Pillar, Pole or Post
BP, BS	Boundary Post or Stone	PO	Post Office
Cn, C	Capstan, Crane	PC	Public Convenience
Chy	Chimney	PH	Public House
D Fn	Drinking Fountain	Pp	Pump
El P	Electricity Pillar or Post	SB, S Br	Signal Box or Bridge
FAP	Fire Alarm Pillar	SP, SL	Signal Post or Light
FB	Foot Bridge	Spr	Spring
GP	Guide Post	Tk	Tank or Track
H	Hydrant or Hydraulic	TCB	Telephone Call Box
LC	Level Crossing	TCP	Telephone Call Post
MH	Manhole	Tr	Trough
MP	Mile Post or Mooring Post	Wr Pt, Wr T	Water Point, Water Tap
MS	Mile Stone	W	Well
NTL	Normal Tidal Limit	Wd Pp	Wind Pump

Large-Scale National Grid Data 1:2,500 and 1:1,250



Civil parish/community boundary
District boundary
County boundary
Boundary post/stone
Boundary mereing symbol (note: these always appear in opposed pairs or groups of three)

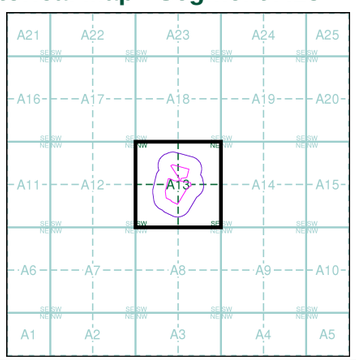
Bks	Barracks	P	Pillar, Pole or Post
Bty	Battery	PO	Post Office
Cemy	Cemetery	PC	Public Convenience
Chy	Chimney	Pp	Pump
Cis	Cistern	Ppg Sta	Pumping Station
Dismtd Rly	Dismantled Railway	PW	Place of Worship
El Gen Sta	Electricity Generating Station	Sewage Ppg Sta	Sewage Pumping Station
El P	Electricity Pole, Pillar	SB, S Br	Signal Box or Bridge
El Sub Sta	Electricity Sub Station	SP, SL	Signal Post or Light
FB	Filter Bed	Spr	Spring
Fn / D Fn	Fountain / Drinking Ftn.	Tk	Tank or Track
Gas Gov	Gas Valve Compound	Tr	Trough
GVC	Gas Governer	Wd Pp	Wind Pump
GP	Guide Post	Wr Pt, Wr T	Water Point, Water Tap
MH	Manhole	Wks	Works (building or area)
MP, MS	Mile Post or Mile Stone	W	Well

TRC

Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Surrey	1:2,500	1886	2
Surrey	1:2,500	1896	3
Surrey	1:2,500	1914	4
Surrey	1:2,500	1936	5
Ordnance Survey Plan	1:1,250	1964 - 1966	6
Additional SIMs	1:1,250	1964 - 1989	7
Ordnance Survey Plan	1:2,500	1965 - 1967	8
Ordnance Survey Plan	1:1,250	1970 - 1989	9
Additional SIMs	1:1,250	1987 - 1989	10
Large-Scale National Grid Data	1:1,250	1992	11
Large-Scale National Grid Data	1:1,250	1993	12

Historical Map - Segment A13



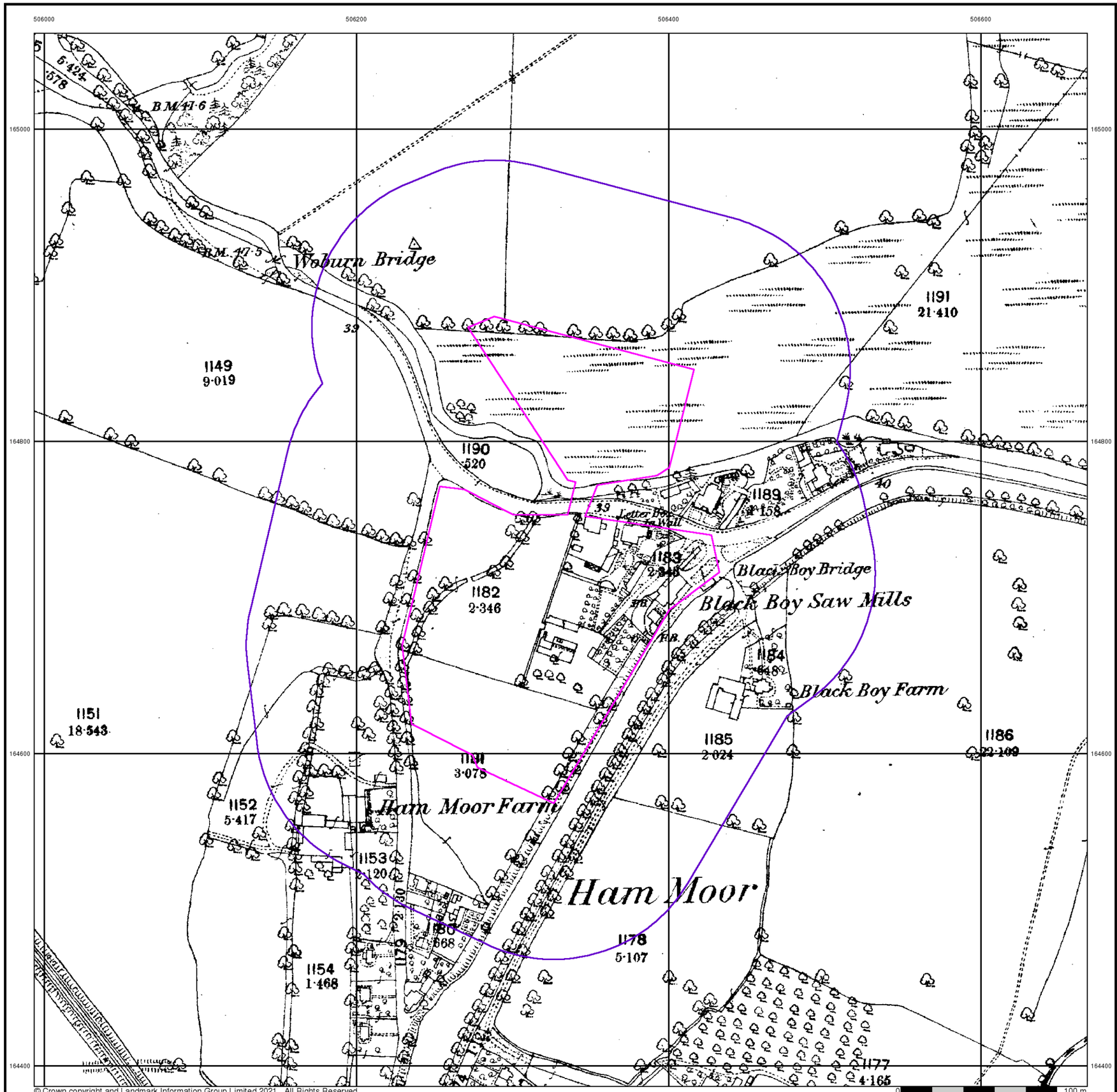
Order Details

Order Number:	287842040_1_1
Customer Ref:	470021.0000
National Grid Reference:	506330, 164730
Slice:	A
Site Area (Ha):	3.45
Search Buffer (m):	100

Site Details

Site at 506200, 164700

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



TRC

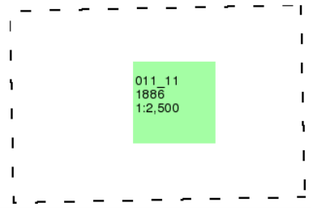
Surrey

Published 1886

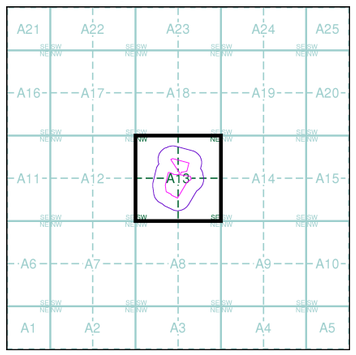
Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	287842040_1_1
Customer Ref:	470021.0000
National Grid Reference:	506330, 164730
Slice:	A
Site Area (Ha):	3.45
Search Buffer (m):	100

Site Details

Site at 506200, 164700

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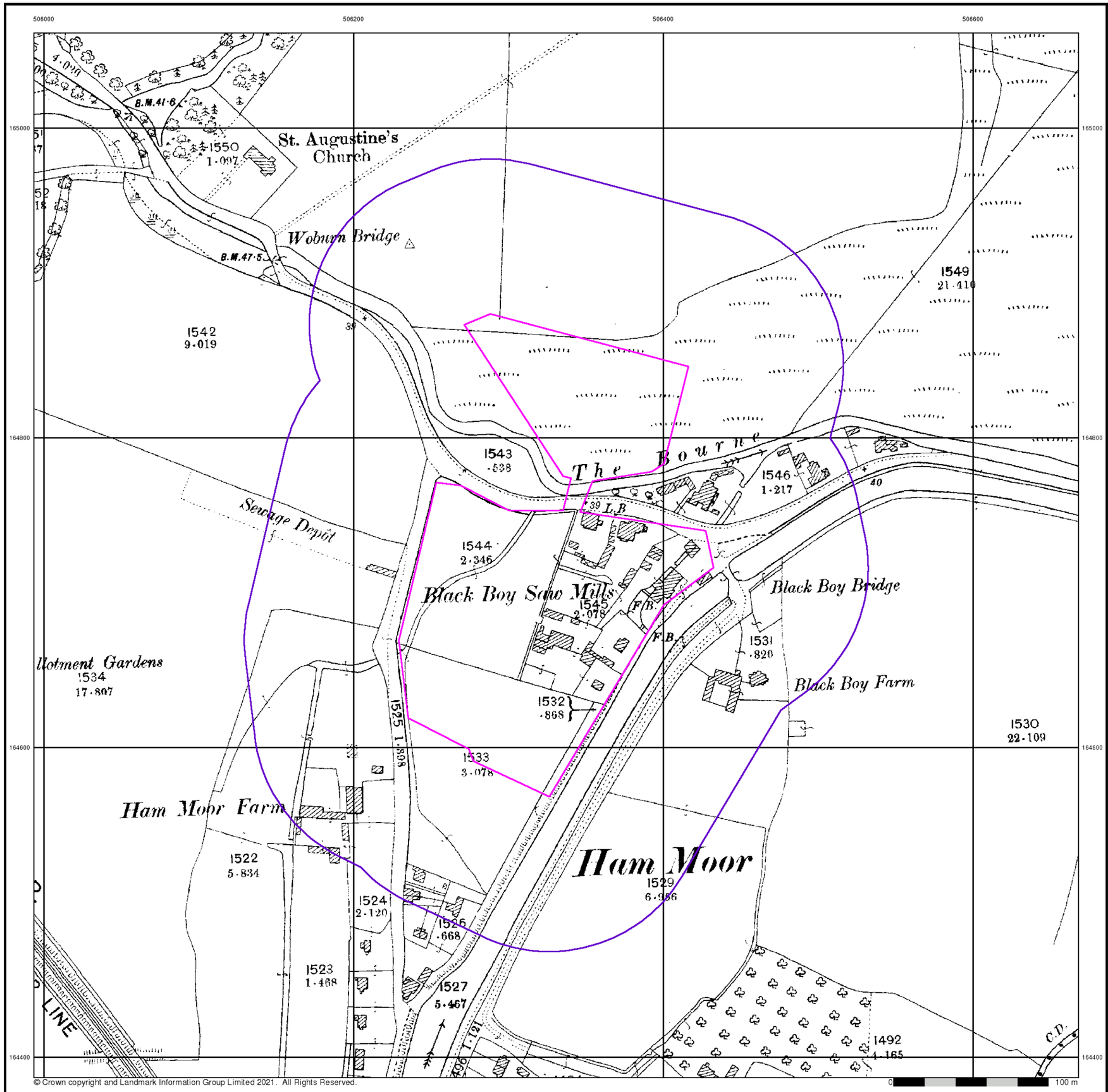


TRC

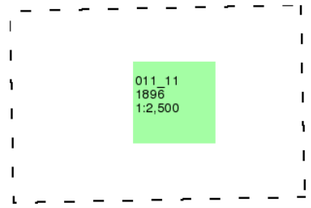
Surrey

Published 1896

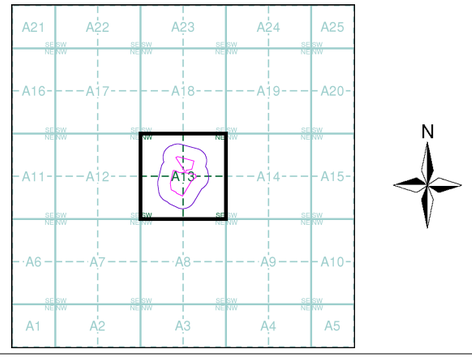
Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	287842040_1_1
Customer Ref:	470021.0000
National Grid Reference:	506330, 164730
Slice:	A
Site Area (Ha):	3.45
Search Buffer (m):	100

Site Details

Site at 506200, 164700

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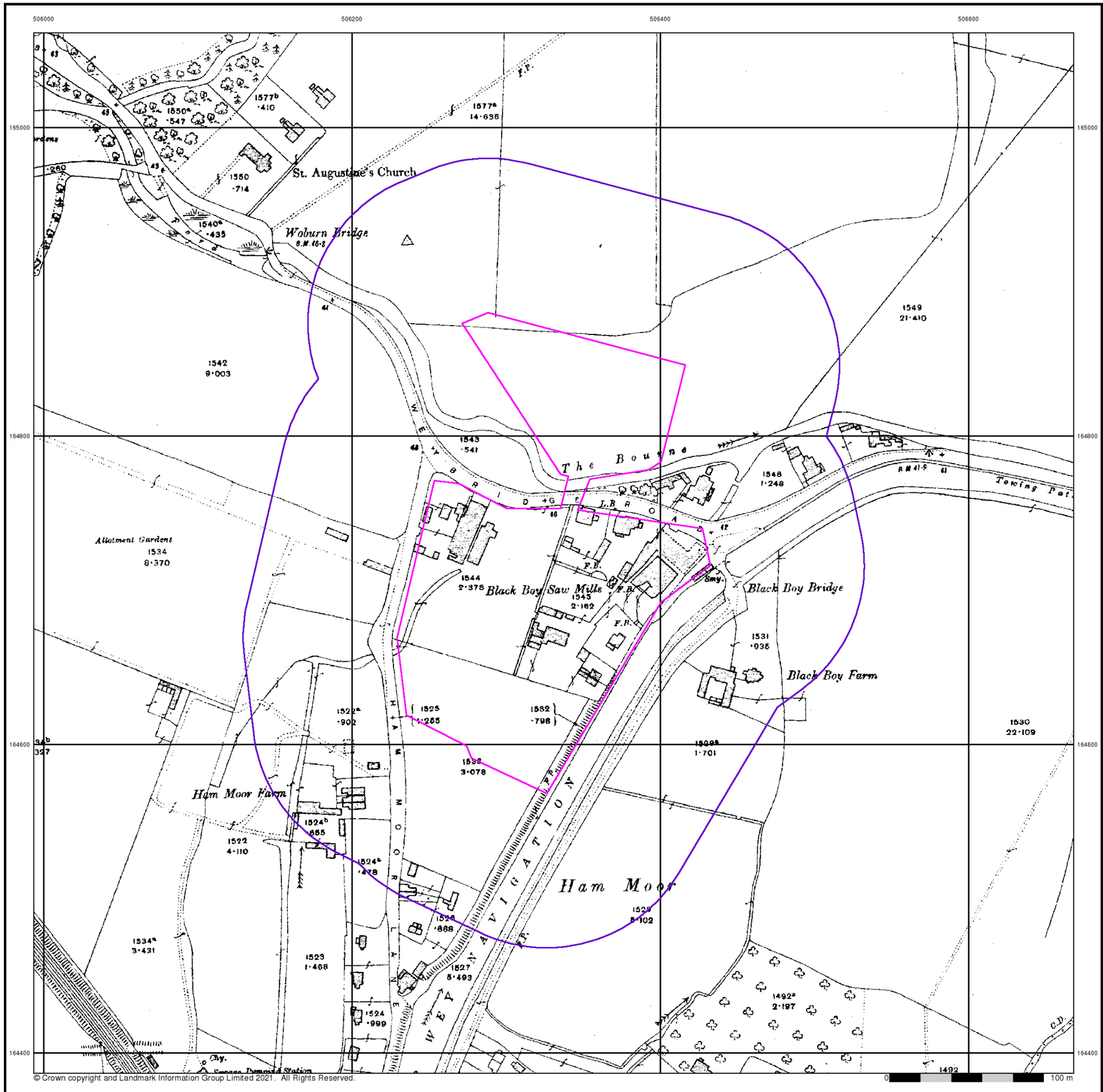


TRC

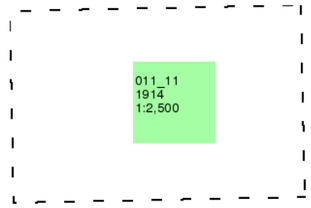
Surrey

Published 1914

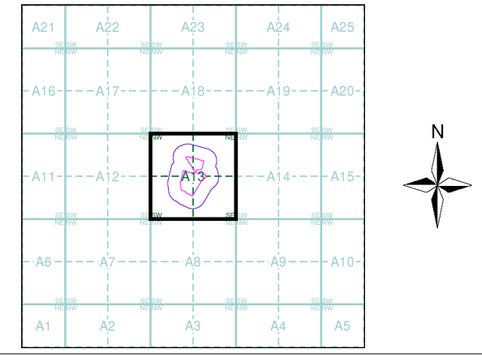
Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	287842040_1_1
Customer Ref:	470021.0000
National Grid Reference:	506330, 164730
Slice:	A
Site Area (Ha):	3.45
Search Buffer (m):	100

Site Details

Site at 506200, 164700

Landmark INFORMATION GROUP
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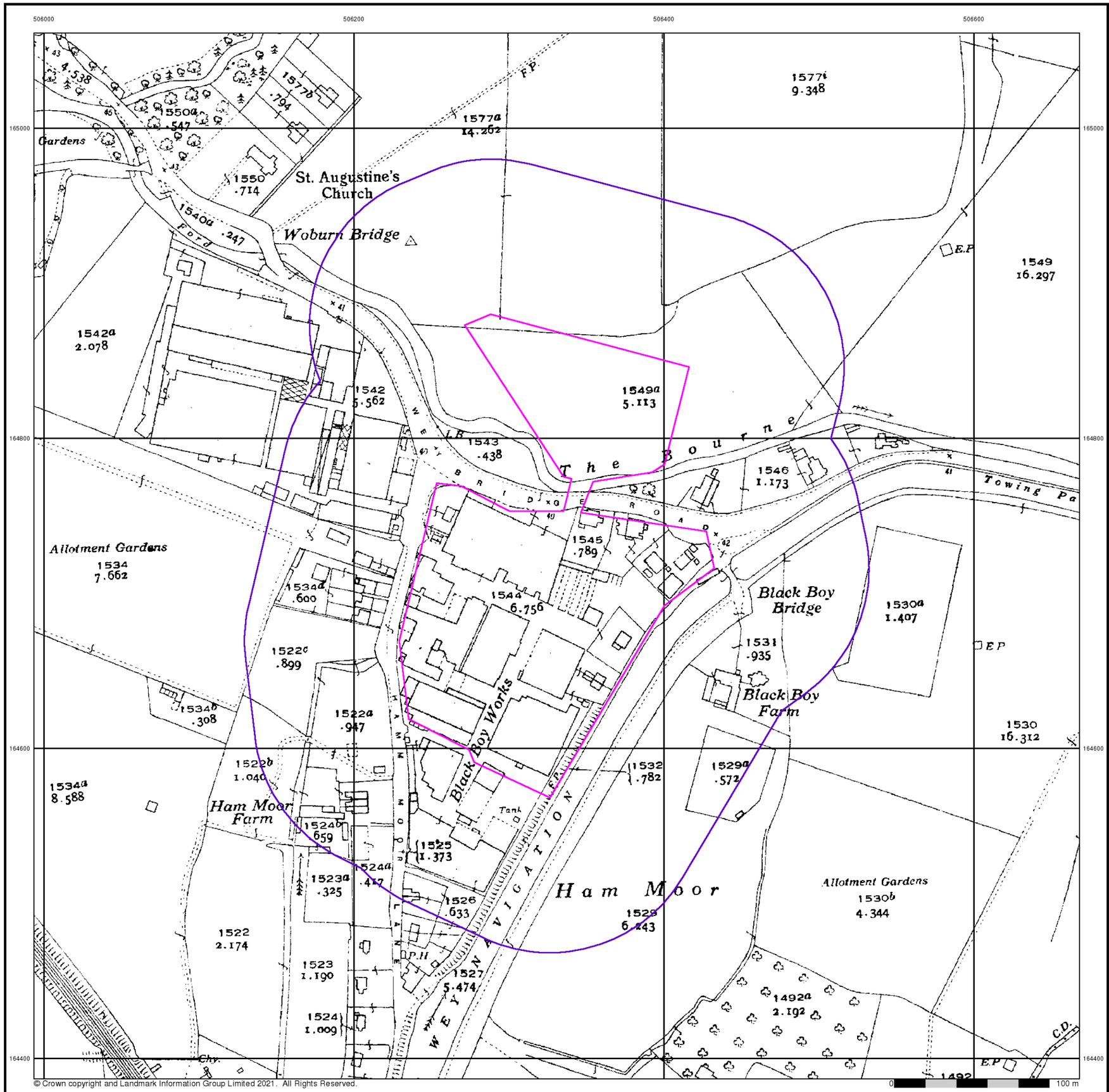
Web: www.envirocheck.co.uk



TRC

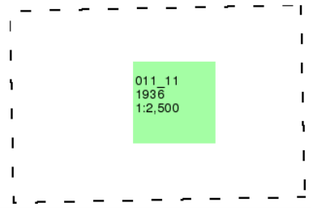
Surrey

Published 1936

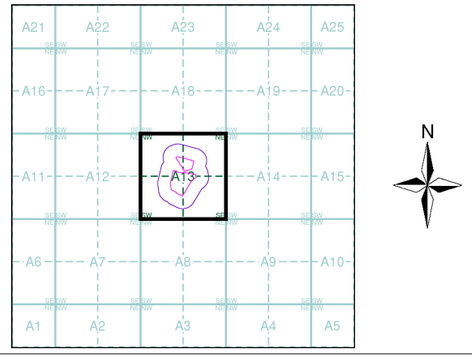
Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	287842040_1_1
Customer Ref:	470021.0000
National Grid Reference:	506330, 164730
Slice:	A
Site Area (Ha):	3.45
Search Buffer (m):	100

Site Details

Site at 506200, 164700

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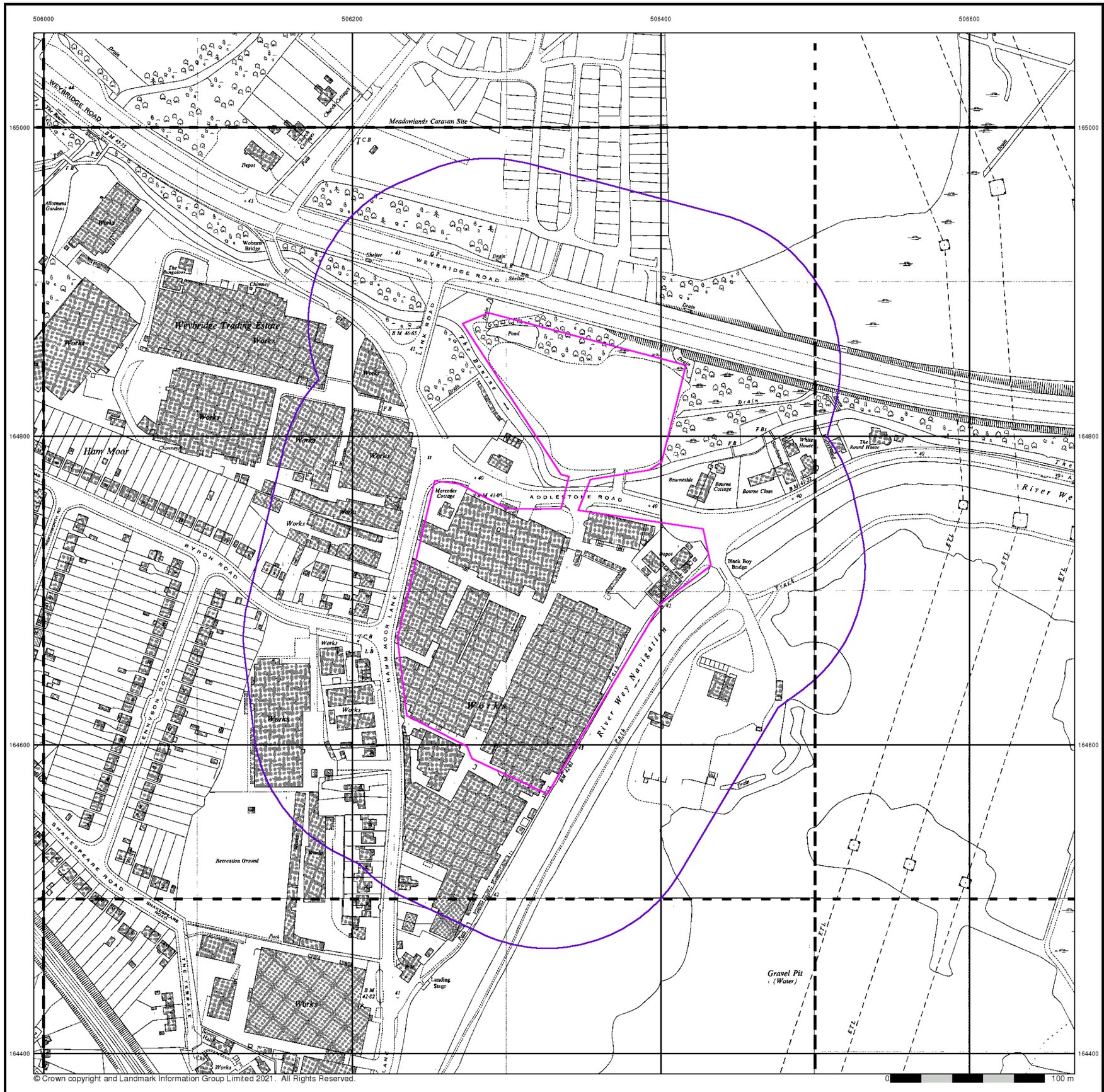


TRC

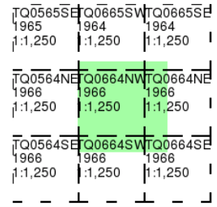
Ordnance Survey Plan

Published 1964 - 1966

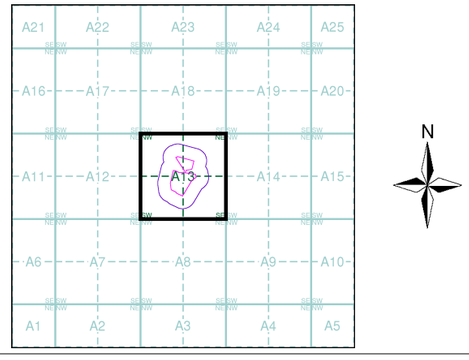
Source map scale - 1:1,250

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	287842040_1_1
Customer Ref:	470021.0000
National Grid Reference:	506330, 164730
Slice:	A
Site Area (Ha):	3.45
Search Buffer (m):	100

Site Details

Site at 506200, 164700

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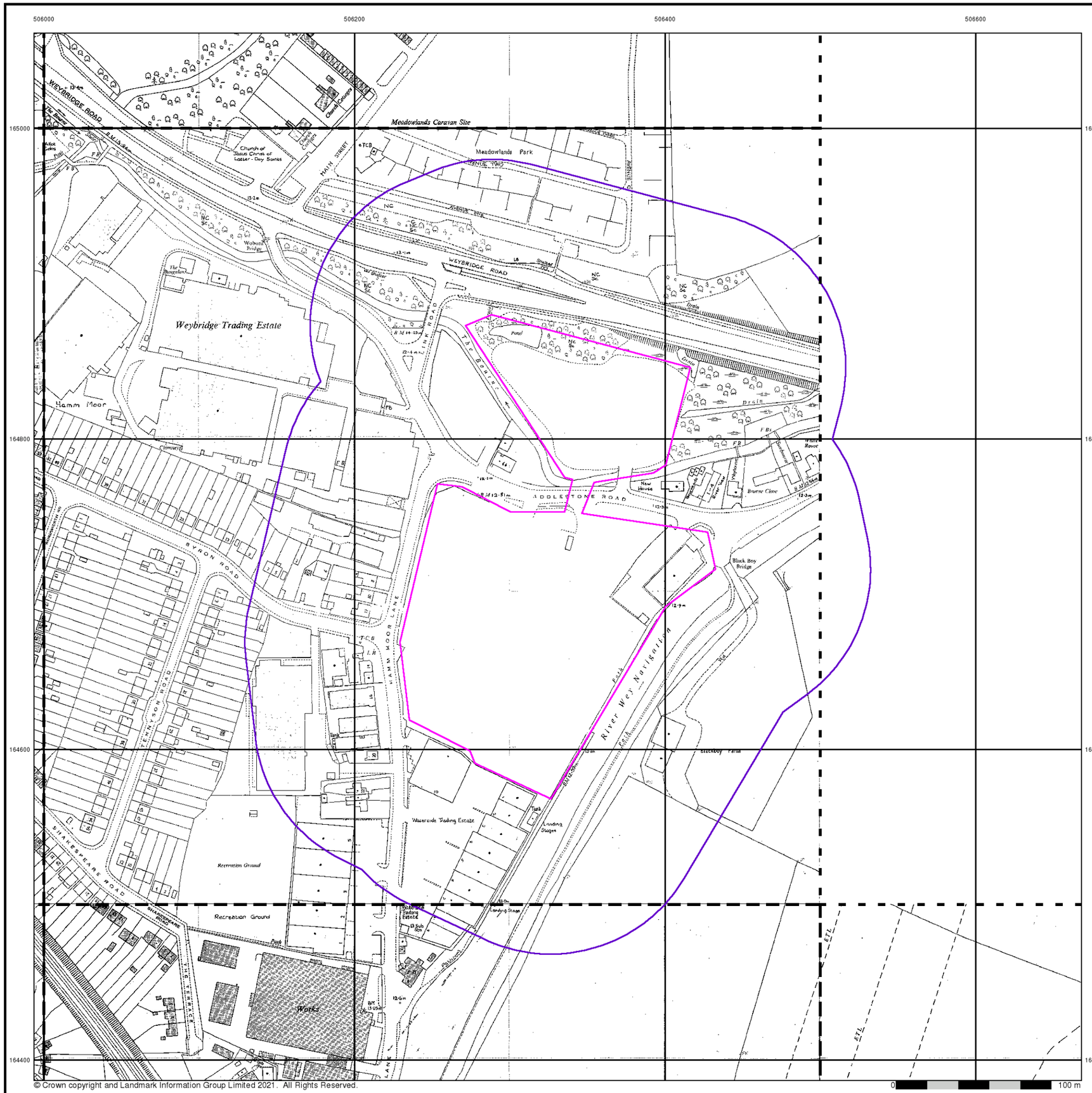


TRC

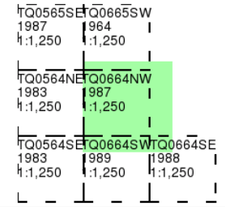
Additional SIMs

Published 1964 - 1989

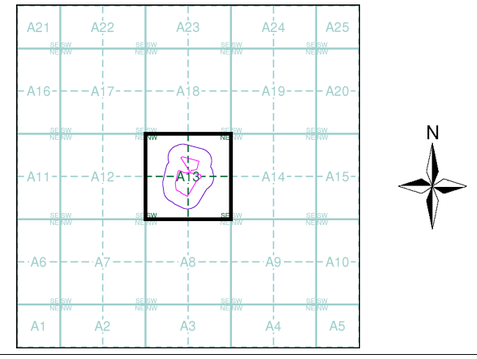
Source map scale - 1:1,250

The SIM cards (Ordnance Survey's `Survey of Information on Microfilm') are further, minor editions of mapping which were produced and published in between the main editions as an area was updated. They date from 1947 to 1994, and contain detailed information on buildings, roads and land-use. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	287842040_1_1
Customer Ref:	470021.0000
National Grid Reference:	506330, 164730
Slice:	A
Site Area (Ha):	3.45
Search Buffer (m):	100

Site Details

Site at 506200, 164700

Landmark INFORMATION GROUP

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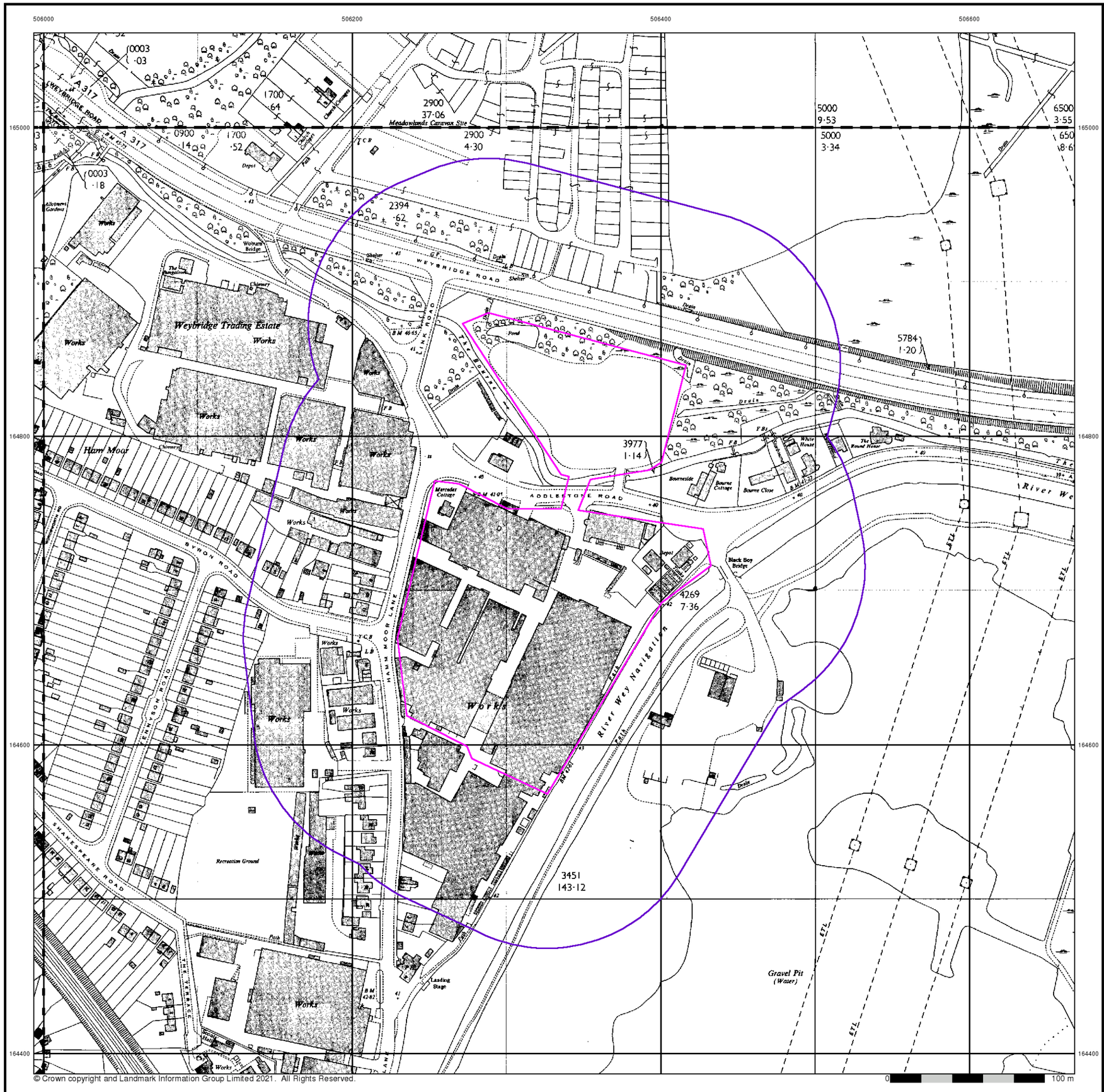


TRC

Ordnance Survey Plan

Published 1965 - 1967

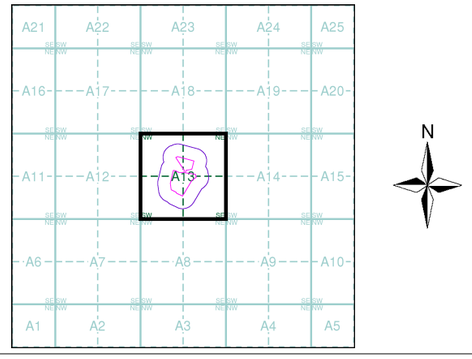
Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)

TQ0565 1966 1:2,500	TQ0665 1965 1:2,500
TQ0564 1967 1:2,500	TQ0664 1967 1:2,500

Historical Map - Segment A13



Order Details

Order Number:	287842040_1_1
Customer Ref:	470021.0000
National Grid Reference:	506330, 164730
Slice:	A
Site Area (Ha):	3.45
Search Buffer (m):	100

Site Details

Site at 506200, 164700

Landmark INFORMATION GROUP

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

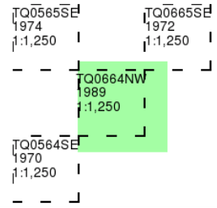
Ordnance Survey Plan

Published 1970 - 1989

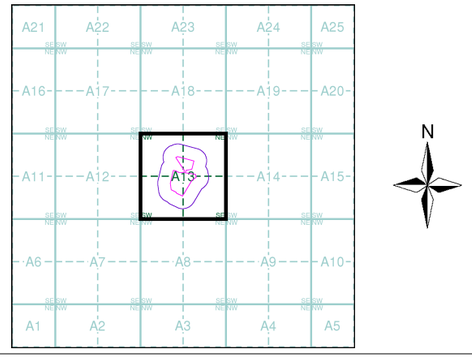
Source map scale - 1:1,250

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	287842040_1_1
Customer Ref:	470021.0000
National Grid Reference:	506330, 164730
Slice:	A
Site Area (Ha):	3.45
Search Buffer (m):	100

Site Details

Site at 506200, 164700

Landmark INFORMATION GROUP
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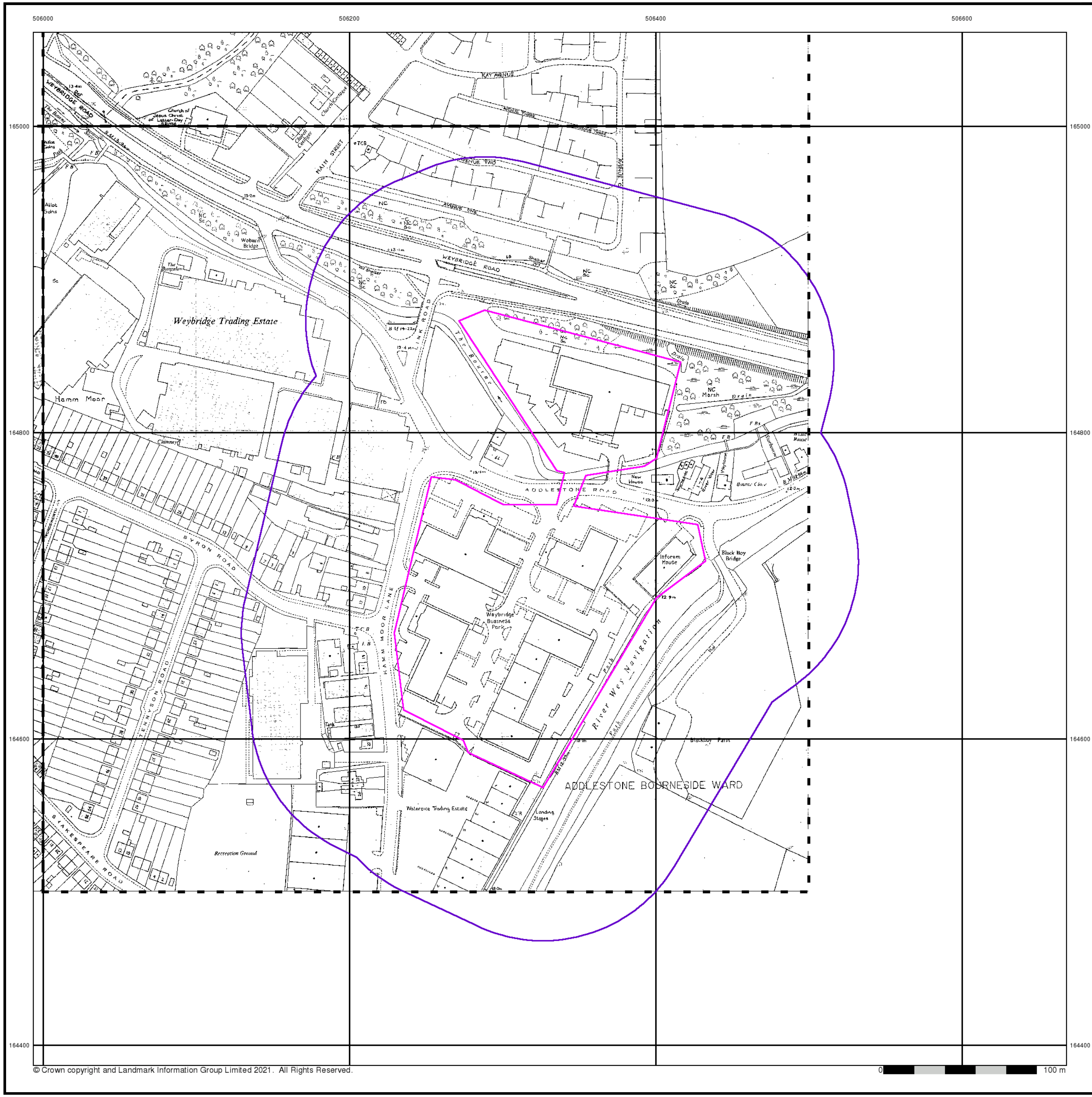


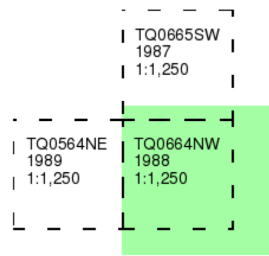
Additional SIMs

Published 1987 - 1989

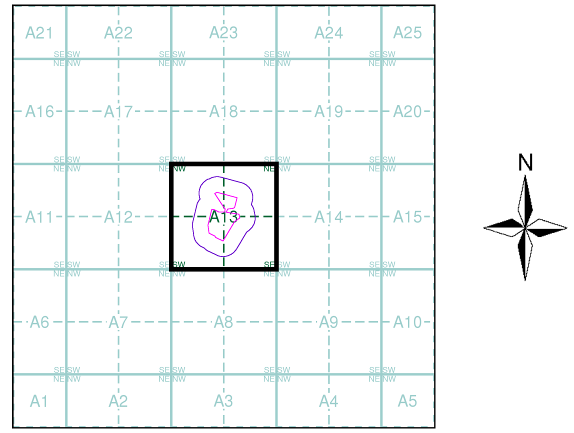
Source map scale - 1:1,250

The SIM cards (Ordnance Survey's `Survey of Information on Microfilm') are further, minor editions of mapping which were produced and published in between the main editions as an area was updated. They date from 1947 to 1994, and contain detailed information on buildings, roads and land-use. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

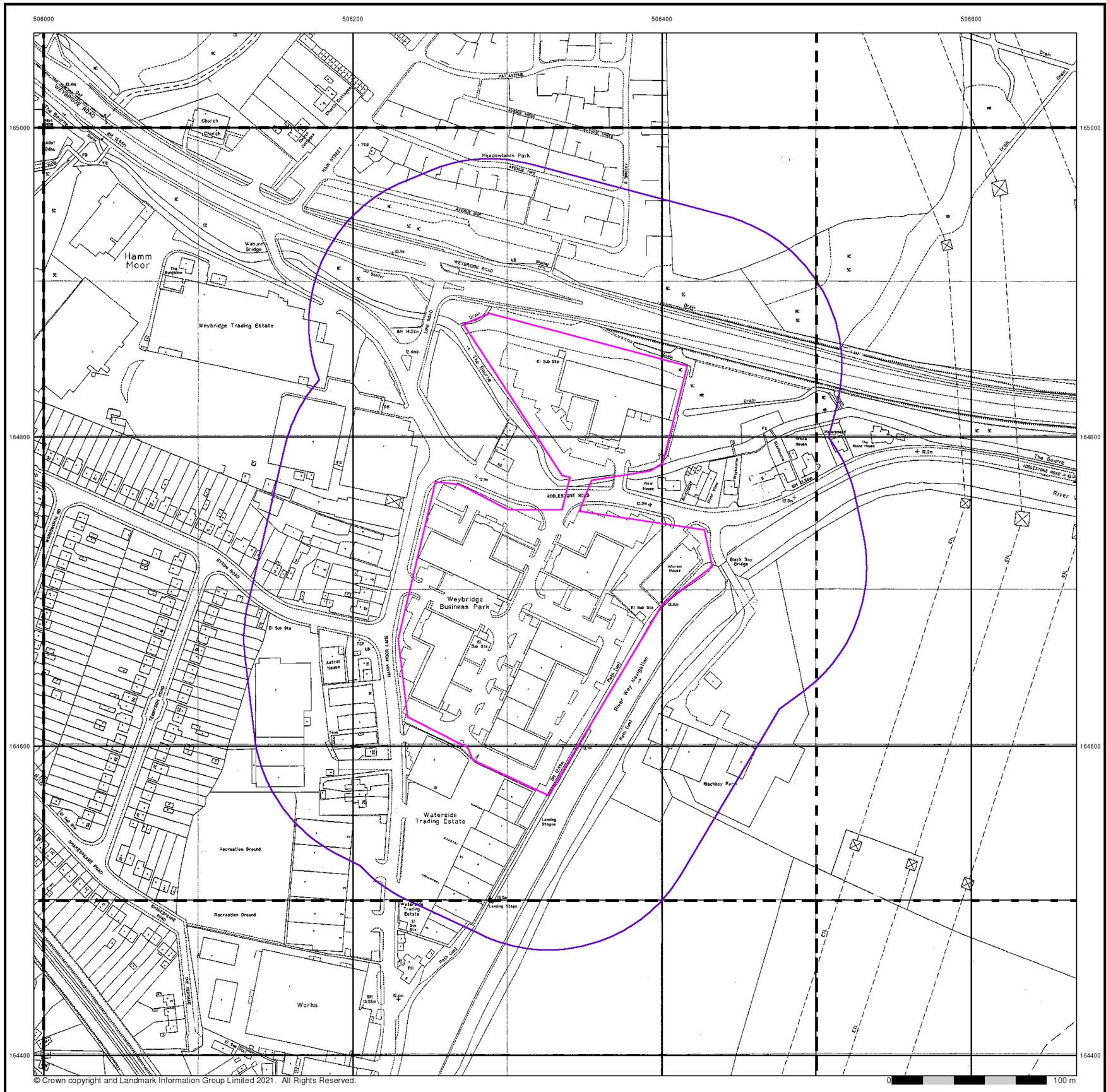
Order Number: 287842040_1_1
Customer Ref: 470021.0000
National Grid Reference: 506330, 164730
Slice: A
Site Area (Ha): 3.45
Search Buffer (m): 100

Site Details

Site at 506200, 164700

Landmark INFORMATION GROUP

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



TRC

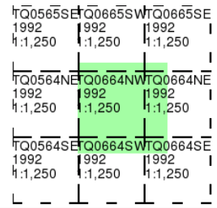
Large-Scale National Grid Data

Published 1992

Source map scale - 1:1,250

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



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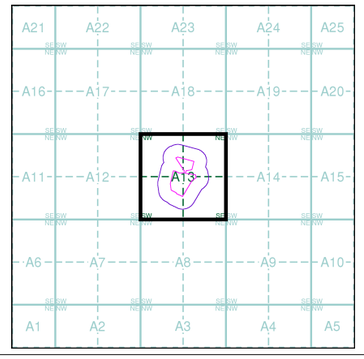

Order Details

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Slice:	A
Site Area (Ha):	3.45
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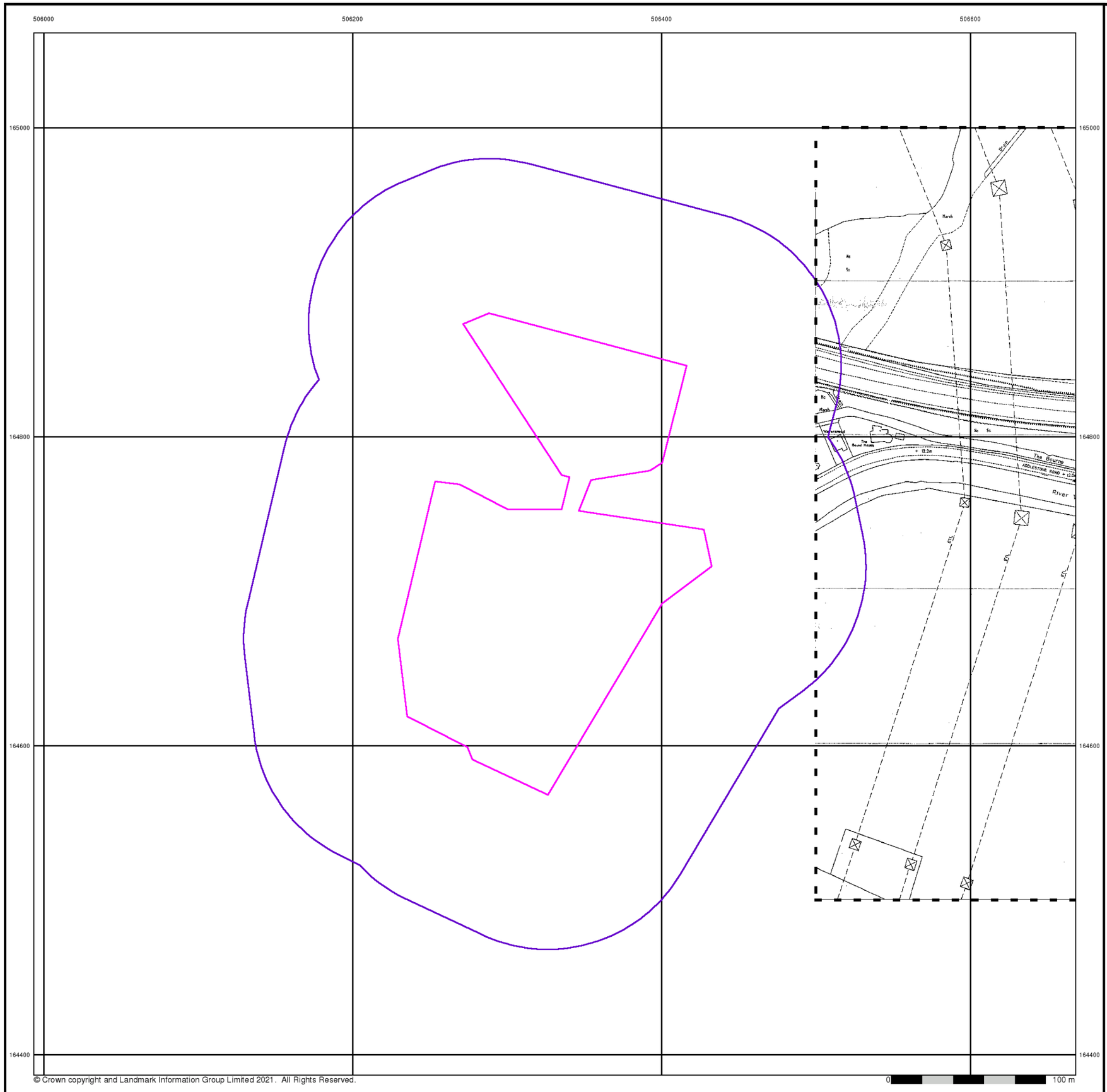

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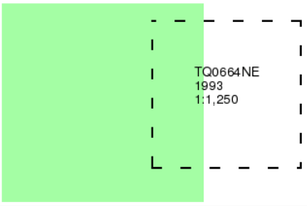
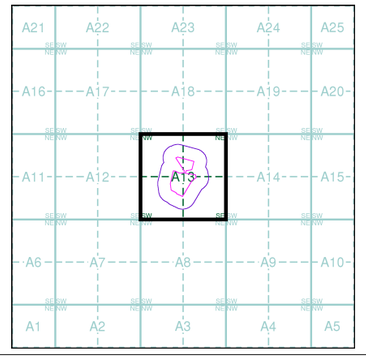


Historical Map - Segment A13



Order Details

Order Number:	287842040_1_1
Customer Ref:	470021.0000
National Grid Reference:	506330, 164730
Slice:	A
Site Area (Ha):	3.45
Search Buffer (m):	100

Site Details

Site at 506200, 164700

Landmark INFORMATION GROUP
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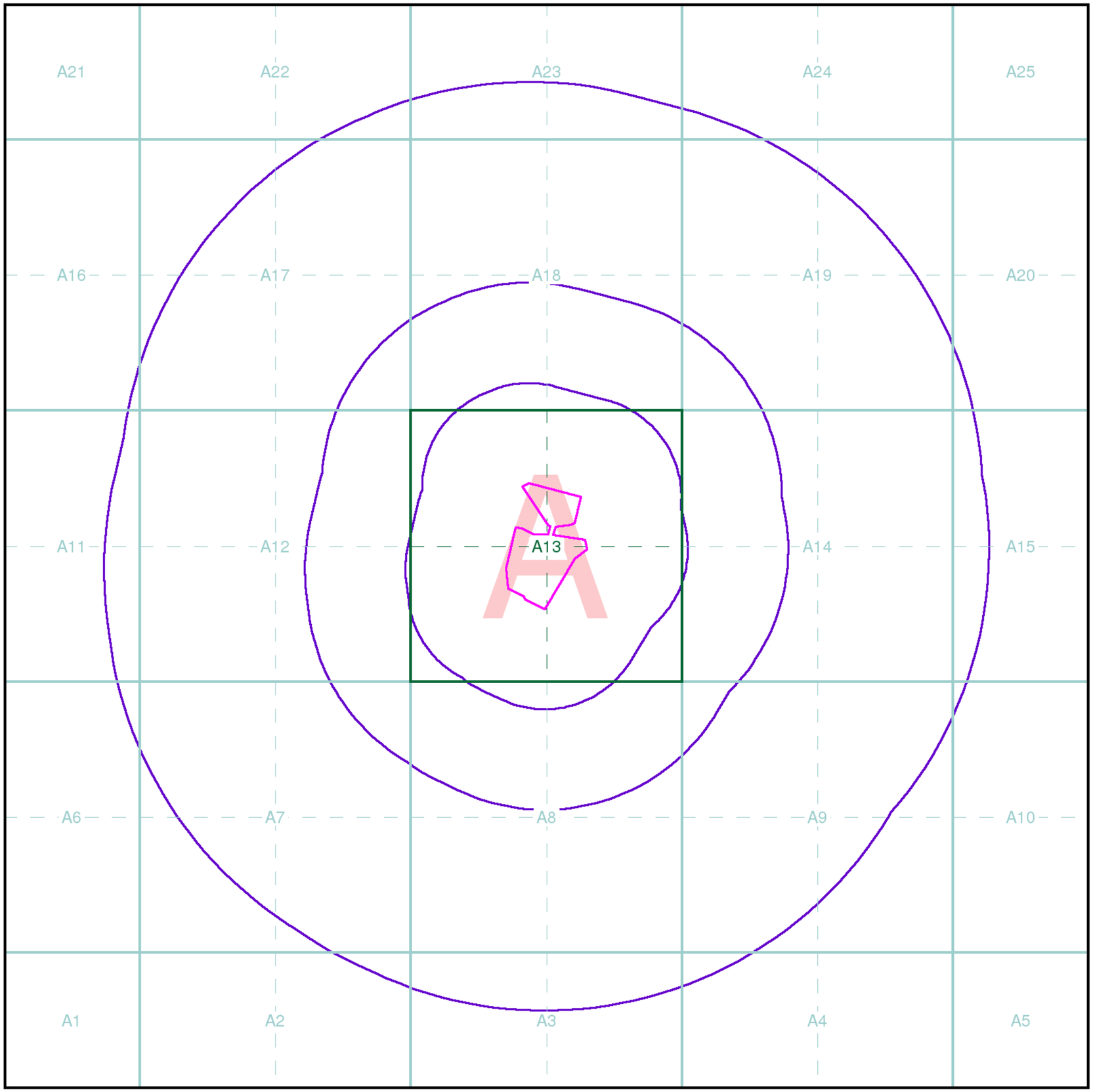

Index Map

For ease of identification, your site and buffer have been split into Slices, Segments and Quadrants. These are illustrated on the Index Map opposite and explained further below.

Slice
Each slice represents a 1:10,000 plot area (2.7km x 2.7km) for your site and buffer. A large site and buffer may be made up of several slices (represented by a red outline), that are referenced by letters of the alphabet, starting from the bottom left corner of the slice "grid". This grid does not relate to National Grid lines but is designed to give best fit over the site and buffer.

Segment
A segment represents a 1:2,500 plot area. Segments that have plot files associated with them are shown in dark green, others in light blue. These are numbered from the bottom left hand corner within each slice.

Quadrant
A quadrant is a quarter of a segment. These are labelled as NW, NE, SW, SE and are referenced in the datasheet to allow features to be quickly located on plots. Therefore a feature that has a quadrant reference of A7NW will be in Slice A, Segment 7 and the NW Quadrant.

A selection of organisations who provide data within this report:

Map data | British Geological Survey, Natural Environment Research Council | Environment Agency | Natural England

Envirocheck reports are compiled from 136 different sources of data.

Prepared For

London
WC1R 4PS

Client Details

Mr W Nitch-Smith, TRC Companies Ltd, Work.Life, 20 Red Lion Street, London, WC1R 4PQ

Order Details

Order Number:	287842040_1_1
Customer Ref:	470021.0000
National Grid Reference:	506320, 164720
Site Area (Ha):	3.45
Search Buffer (m):	1000

Site Details

Site at 506200, 164700

Full Terms and Conditions can be found on the following link:
http://www.landmarkinfo.co.uk/Terms/Show/515

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

Annex C: Site Photographs

Photographic Log

Client Name:	Site Location:	Project No.:
Bridge Industrial	Addlestone Road, Weybridge	470021.0000.0000

Photo No.	Date
1	23/11/2021

Description:
View of the southern part of the site, looking north.

Photo No.	Date
2	23/11/2021

Description:
View of Addlestone road, looking west.

Photographic Log

Client Name:	Site Location:	Project No.:
Bridge Industrial	Addlestone Road, Weybridge	470021.0000.0000

Photo No.	Date
3	23/11/2021

Description:
View of the river Wey on the eastern boundary of the site, looking north.

Photo No.	Date
4	23/11/2021

Description:
View of the river Wey on the eastern boundary of the site, looking south.

Photographic Log

Client Name:	Site Location:	Project No.:
Bridge Industrial	Addlestone Road, Weybridge	470021.0000.0000

Photo No.	Date
5	23/11/2021

Description:
View of the southern eastern part of the site, looking west.

Photo No.	Date
6	23/11/2021

Description:
View of the north western part of the site, looking east.

Photographic Log

Client Name:	Site Location:	Project No.:
Bridge Industrial	Addlestone Road, Weybridge	470021.0000.0000

Photo No.	Date
7	23/11/2021

Description:
View of the north eastern part of the site, looking west.

Photo No.	Date
8	23/11/2021

Description:
View of the north eastern part of the site, looking south west.

Annex D: Detailed UXO Risk Assessment

Detailed Unexploded Ordnance (UXO) Risk Assessment

Project Name	Weybridge, Addlestone Rd
Client	TRC Companies Ltd.
Site Address	Weybridge, Addlestone Rd, Addlestone, KT15 2UP
Report Reference	DA14630-00
Date	26/11/2021
Originator	CC

Find us on Facebook, Twitter and LinkedIn

Company No: 7717863 VAT No: 128 8833 79

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1st Line Defence Ltd

Unit 3, Maple Park, Essex Road, Hoddesdon, Herts. EN11 0EX

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Executive Summary

Site Location and Description

The site comprises of two separate site boundaries, located in Addlestone, within the County of Surrey and the Borough of Runnymede. For the purpose of this report, the sites will be referred to as Site A and Site B. Site A is situated just north of Site B.

Site A is bound to the north by Weybridge Road, to the east by vegetation, to the south by industrialised land and Addlestone Road and to the west by a rectangular structure and Weybridge Road. Site B is bound to the north by Weybridge Road, to the east by the River Wey, to the south by industrial structures and a car park and to the west by Hamm Moor Lane.

Recent aerial imagery dated 2020 indicates Site A comprises two structures, open brownfield and a section of vegetation. Site B comprises Weybridge Business Park, formed of multiple industrialised structures and land.

The site is approximately centred on the OS grid reference: **TQ 06323 64735.**

Proposed Works

Information provided by the client indicates the proposed works comprise approximately 10 window sample locations to 10m.

Geology and Bomb Penetration Depth

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 on site is not homogenous. Site A has been assessed at **Medium Risk** from German aerial delivered and anti-aircraft UXO, and **Low-Medium Risk** from Allied unexploded ordnance. Site B has been assessed at **Low-Medium Risk** from German aerial delivered and anti-aircraft UXO, and **Low Risk** from Allied unexploded ordnance. Please see Annex R for a risk map of the site. This assessment is based on the following factors:

The Risk from German Aerial Delivered Ordnance

- During WWII both Site A and Site B were located within the Urban District of Chertsey, an area recorded to have sustained a relatively low density of bombing, with an average of 22.3 bombs recorded per 1,000 acres, according to official Home Office Bombing statistics. This is likely due to the district's location away from London. However, Site B was a designated as a Luftwaffe target, in addition to other prominent targets in the vicinity of the site such as RAF Brooklands.

Site A

- Wartime OS mapping imagery indicates that Site A comprised open, undeveloped land.
- Chertsey War Damage Incident mapping highlights that several incendiary bombs were recorded on Site A. One HE bomb is highlighted partially within/ adjacent to the eastern boundary of the site, with an additional HE bomb just north of the site too.
- Post-WWII aerial imagery indicates that Site A was occupied by an area of vegetation. Although no immediate evidence of bomb damage was observable in this image, it should be noted that the ground conditions on Site A can often obscure indications of UXO, such as bomb entry holes which could have been as small as 20cm in diameter and therefore easily obscured in such ground conditions.
- Given that there were no structures on Site A or features of significance, it is unlikely that Site A would have been subject to regular access, decreasing the likelihood that evidence of UXO would have been spotted, reported and dealt with.
- In summary, several incendiary bombs were recorded on site and a high explosive bomb was partially recorded in the site boundary. It is unlikely that the site would have been regularly accessed and therefore any evidence of bombing is

UXO Risk Assessment

unlikely to have been spotted/reported. Therefore, the risk from UXO contamination on Site A has been assessed as **Medium**.

Site B

- Wartime OS mapping indicates that Site B was occupied by numerous structures associated with *Black Boy Works*.
- Chertsey War Damage Incident mapping highlights that several incendiary bombs were recorded on Site B. No high explosive bombs were recorded on site.
- Post-WWII aerial imagery indicates that the structures on site appear to survive the war externally intact and there are no obvious signs of clearance or missing structures. Some structures have white roofing, which can often be indicative of repair works, as highlighted in **Annex M2**. This is likely to be a consequence of the several incendiary bombs recorded on site.
- It is thought likely that Site B would have been subject to regular access during the war, given that it was occupied by a works. This increases the likelihood that evidence of UXO would have been spotted, reported and dealt with. Although, access to Site B may have been temporarily impeded following the recorded incendiary bombing across the site.
- The ground cover across Site B is generally considered conducive to the detection of evidence of UXO, given that any damage to structures would have been obvious. However, due to the amount of incendiary bombs recorded on site, which caused some damage to the site, as evident in aerial imagery, evidence of UXO may have been obscured by such damage.
- In summary, no positive evidence was found to indicate that any high explosive bombs fell on Site B during the war. However, many incendiary bombs were recorded on Site B which likely caused conditions to worsen on Site B (resultant rubble and debris) and it is likely that access to the site may have been reduced during this time, until it was deemed safe to return. Therefore, due to these factors, it has not been entirely possible to discount the risk from UXO on site. As such, the risk from unexploded German aerial delivered ordnance is considered to be slightly elevated above that of the 'background level' for this area, but is not considered to be high enough to warrant proactive on-site UXO support. It is recommended that all ground personnel undertaking intrusive works attend a UXO safety and awareness briefing to make them aware of the history of the site, what to look out for and what to do in the event that a suspect item is encountered.

The Risk from Allied Ordnance

- Anecdotal evidence suggests a Home Guard platoon was stationed within Site B and utilised SAA as a precaution to defend the site during air raids.
- A HAA camp and battery were located north of the Site A site boundary, where AA shells were likely stored and fired, in addition to potential items of SAA.
- In summary, these Allied features are not considered to significantly elevate the risk of Allied UXO within the site boundaries. It is unlikely that AA shells were stored within the site as the HAA battery and camp were not located in the site's immediate vicinity. However as the camp is in close proximity to Site A, it is possible that infantry stationed at the camp would use nearby fields for training purposes. Additionally, the Home Guard stationed at Site B for defensive and security measures could have used nearby fields for training drills often involving SAA or hand grenades. It is also possible that items of SAA would be stored in Site B, but is unlikely to have been used near factories, with the exception of defending the site from German aircraft. There is also no available evidence that the Home Guard stored explosives such as mortars or shells on site. It is overall not possible to discount the possibility of discovering Allied ordnance on site, as Site A was likely utilised for training purposes and drills, it has been assessed as **Low-Medium Risk** from Allied ordnance. Site B has been assessed as **Low Risk** as Allied ordnance was likely infrequently used on site due to the factories that occupied the site, and that SAA would be fired only I the event of air raids.

Post War Development

- A rectangular structure was constructed within Site A and multiple structures were cleared in Site B and replaced with modern industrial structures. 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. For example, the risk from deep buried UXO will only have been mitigated within the volumes of any post-war pile foundations or deep excavations for basement levels. The risk will however remain within virgin geology below and amongst these post-war works, down to the maximum bomb penetration depth.

Recommended Risk Mitigation Measures

The following risk mitigation measures are recommended to support the proposed works at Weybridge, Addlestone Rd:

All Works

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

Medium Risk Areas

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

- UXO Specialist On-site Support

Boreholes and Piled Foundations

- Intrusive Magnetometer Survey of all borehole and pile locations/clusters down to maximum bomb penetration depth.

German UXO 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-Medium 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 Areas of the site:

- Unexploded Ordnance Specialist - a service to support open intrusive works.
- Intrusive Magnetometer Survey – a service to support any borehole or pile locations/clusters down to an assessed maximum bomb penetration depth.

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: Weybridge, Addlestone Rd
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 Weybridge, Addlestone Rd.

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.'

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 Weybridge, Addlestone Rd. 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 Surrey History Centre.
- Historical mapping datasets.
- Historic England National Monuments Record.
- Relevant information supplied by TRC Companies Ltd.
- Available material from 33 Engineer Regiment (EOD) Archive (part of 29 Explosive Ordnance and Disposal and Search Group).
- 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 Surrey History Centre.

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/.

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

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.

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.

6. The Site

6.1. Site Location

The site comprises of two separate site boundaries, located in Addlestone, within the County of Surrey and the Borough of Runnymede. For the purpose of this report, the sites will be referred to as Site A and Site B. Site A is situated just north of Site B.

Site A is bound to the north by Weybridge Road, to the east by vegetation, to the south by industrialised land and Addlestone Road and to the west by a rectangular structure and Weybridge Road. Site B is bound to the north by Weybridge Road, to the east by the River Wey, to the south by industrial structures and a car park and to the west by Hamm Moor Lane.

The site is approximately centred on the OS grid reference: **TQ 06323 64735**.

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

6.2. Site Description

Recent aerial imagery dated 2020 indicates Site A comprises two structures, open brownfield and a section of vegetation. Site B comprises Weybridge Business Park, formed of multiple industrialised structures and land.

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

Information provided by the client indicates the proposed works comprise approximately 10 window sample locations to 10m.

8. Ground Conditions

8.1. General Geology

The British Geological Survey (BGS) map shows the site to be underlain by the Bagshot Formation, sand, sedimentary bedrock of the Palaeogene Period. The superficial deposits are listed as alluvium, clay, silt, sand and gravel of the Quaternary Period.

8.2. Site Specific Geology

Site-specific geotechnical data was not provided by the client during the production of this report.

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

Site B contained different manufacturing companies before and during WWII. The Weybridge Motor Engineering Co. Ltd was part of the Black Boy Works, the majority of the works were within the site.[2] Weybridge Motor Engineering Co. Ltd manufactured PSV coach bodies during the 1920s.[3] The Airscrew Company Ltd. Was also situated on site, being formed in 1923 manufacturing airscrews, fans and other parts for aircraft.[4] The company formed subsidiary in conjunction with Messrs Halila of London; this was called Jicwood Ltd; concerned with manufacture of wood with thermosetting resin, aircraft and commercial plywood and compressed wood using the Samsonow process.[5] Jicwood Ltd was therefore incorporated into the works on site.

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**
1936	1:2,500	Site A was situated on undeveloped open land, in contrast to Site B which comprised multiple industrialised structures as part of *Black Boy Works*. Site A was bound to the north, east and west by open land and to the south by *The Bourne* river tributary. Site B was bound to the north by Weybridge Road, to the east by the *River Wey Navigation*, to the south by other structures of *Black Boy Works* and to the west by Hamm Moor Lane.

Post-WWII		
Date	**Scale**	**Description**
1965-1967	1:2,500	Site A remained undeveloped according to post-war OS mapping. Site B experienced changes from pre-war on site with the extension of existing structures in addition to clearance with new structures being constructed.

[2] *https://www.gracesguide.co.uk/Weybridge_Motor_Engineering_Co*
[3] James Taylor, *A-Z of British Bus* Bodies, The Crowood Press Ltd, 2013.
[4] *https://www.gracesguide.co.uk/Airscrew_Co*
[5] *https://www.gracesguide.co.uk/Airscrew_Company_and_Jicwood*

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 1939 (see **Annex E**). See below for a description:

Title of Photograph	Comments
The Black Boy Works, Woburn Farm and environs, Hamm Moor, 12th January 1939	This imagery highlights a view of both site boundaries from the south-east in addition to structures, roadways and the River Wey in close proximity to the site. Site A appears mostly undeveloped with possible small structures bordering the south-west border of the site. The open ground within the site appears undisturbed. The majority of Site B appears developed with multiple structures of varying size located within the site, however an undeveloped area of vegetation can be observed in the north-east side of the site.

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 **Appendices i-iii**.

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 F**). 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.

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 G**.

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 Principle

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 F**).

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.

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 – Bagshot 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 provided for the purpose of this report. 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 relatively low numbers allowed accurate records of strikes to be maintained. These records have mostly survived. There is a negligible risk from unexploded V-weapons on land today. Even if the 1000kg warhead failed to explode, the weapons are so large that they would have been observed and dealt with at the time. Therefore, V-weapons are referenced in this report not as a viable risk factor, but primarily in order to help account for evidence of damage and clearance reported.

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. The objective of these raids was to unnerve the British public, to destroy strategic targets and to ultimately attempt to coerce Britain's capitulation from the war. A WWI map of air raids and naval bombardments across the UK was consulted, see **Annex H**. This source does not record any WWI bombing incidents to have affected the site area or Addlestone.

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 the Urban District of Chertsey

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 Urban District of Chertsey, which sustained an overall low density of bombing, as represented by bomb density data figures and maps. This density can primarily be attributed to its location away from London and other major civilian areas. Despite this, military and industrial targets were located in the wider area. Military targets include the Vickers Armstrong Aircraft Works and RAF Brooklands located approximately 2.7km and 2km south of the site respectively. Site B is also highlighted as a Luftwaffe target likely due to the factories within the site and proximity to other major targets. See **Annex I** for Luftwaffe target photography of this works.

Records of bombing incidents in the civilian areas of the Urban District of Chertsey were typically collected by Air Raid Precautions wardens and collated by Civil Defence personnel. 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 are presented in the following sections.

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 Urban District of Chertsey between 1940 and 1945.

Record of German Ordnance Dropped on the Urban District of Chertsey		
Area Acreage		**9,983**
Weapons	High Explosive bombs (all types)	190
	Parachute mines	0
	Oil bombs	0
	Phosphorus bombs	13
	Fire pots	15
	Pilotless aircraft (V-1)	4
	Long range rocket bombs (V-2)	1
Total		**223**
Number of Items per 1,000 acres		**22.3**

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. Chertsey War Damage Incident Map

A local bomb map compiled by Chertsey ARP personnel showing HE bombs, incendiary and V-Weapon strikes on the Urban District of Chertsey was obtained from Surrey History Centre. The section showing the area of the site is described in the table below and presented in **Annex J**.

Chertsey War Incident Map	
Date Range	**Comments**
1939-1945	Multiple incendiary bombs are recorded within both site boundaries. A HE bomb is highlighted adjacent to the eastern border of Site A, with another HE located approximately 60m to the north. The nearest recorded HE bomb to Site B is highlighted approximately 120m east of the site.

11.5. Chertsey Urban District Council Minute Books

Council Minute Books for Chertsey Urban District were obtained from Surrey History Centre. These books record details including the number and nature of air raids across the district, as well as information regarding the location and damage caused by bombing. These records are not considered comprehensive and do not cover the entire period of the war.

A transcript of the only relevant written record found is presented in the table below, whilst imagery of this entry is presented in **Annex K**. The most relevant section of this entry is picked out in bold.

Chertsey Urban District Council Minute Books– Annex K	
Date Range	**Comments**
28th November 1940	Many incendiary bombs in the Hamm Moor and St. Georges College area. No casualties but some damage to works in Hamm Moor area. *Likely referencing the works within Site B.*
29th November 1940	HEs at Hamm Court Estate with damage to roofs and windows of houses. *Hamm Court is located approximately 340m east from the site.*

11.6. Chertsey Schedule of War Damaged Properties

A schedule of war damaged properties within the Chertsey Urban District was obtained from Surrey History Centre. This list records the location of houses and property damaged by 'enemy action' across the district, and subject to a claim of War Damage.

Whilst these files were consulted, no reference to incidents affecting the site or surrounding vicinity could be found.

11.7. Chertsey ARP Incident Reports

ARP incident reports for Chertsey U.D. were obtained from the Surrey History Centre. These reports detail information including the date, location and damage caused by major bombing incidents in the district, and is therefore not considered to be comprehensive.

Whilst these files were consulted, no reference to incidents affecting the site or surrounding vicinity could be found.

11.8. Surrey Constabulary Situation Reports

Air raid incident reports prepared by Surrey Constabulary were obtained from the Surrey History Centre. These reports detail information including the date, type and location of air raid incidents in the county. Whilst these files were consulted, no reference to incidents affecting the site or surrounding vicinity could be found.

11.9. WWII-Era Aerial Photography

WWII-era aerial photography for the site area was obtained from the National Monuments Record Office (Historic England) / 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 M**).

WWII-Era Aerial Photography	
Date	**Description**
23rd August 1945 Historic England	This imagery captures both Site A and Site B in the immediate post-war period. No obvious indicators of damage can be observed in Site A, as the vegetation appears undisturbed and there are no visible circular depressions which could resemble bomb craters. Although, the conditions of the ground cover are unclear due to the quality of the image. It is possible that growing vegetation on site may have obscured evidence of bomb damage on site. Furthermore no signs of damage are observable on Site B. The structures on site appear well-maintained, with no obvious areas of clearance. Some structures do appear to have white roofs which can often be indicative of repair works.
12th December 1950 Britain From Above	This imagery provides a clear view of both site areas from the north. The undeveloped unmaintained ground in Site A appears to be rough in nature. Site B appears entirely developed with the occupying structures appearing undamaged with no obvious signs of clearance or potential damage.

11.10. 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.

11.11. 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.

11.12. 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.*	The Urban District of Chertsey was subject to a relatively low density of bombing during WWII, with an average of 22.3 bombs dropped per 1,000 acres, according to official Home Office Bombing statistics. This was likely due to the site's location outside of London. However, several Luftwaffe targets were noted in the area, including Site B, which was identified on Luftwaffe imagery as a target, see **Annex I**. Incendiary bombs are recorded over both Site A and Site B, according to Chertsey War Damage Incident mapping. This is corroborated by Chertsey Urban District Council minutes records. The bomb mapping also records one HE adjacent to the eastern border of Site A, with a further bomb located to the north. Another HE bomb is recorded east of Site B.
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.*	1945 aerial imagery indicates that Site A was occupied by a section of vegetation. This area of land does appear well-maintained and there are no obvious circular depressions which may resemble bomb craters, evident within this image on Site A. Although, it should be noted that given that Site A was occupied by vegetation, any indications of bombing may have been obscured. 1945 aerial imagery indicates that the structures on Site B appear to have survived the war externally intact. There are no obvious areas of clearance when compared with pre-WWII OS mapping. It should be noted that some structures in Site B appear to have white roofing, which can often be indicative of repair works.
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.*	Site A was occupied by an area of vegetation during WWII. This type of ground cover is considered unfavourable for the detection of evidence of UXO indicators. This is due to the rough undeveloped land occupying the site, where growing vegetation and mounds may have obscured evidence of bombing on site. This is especially the case considering that a UXO entry hole could have been as small as 20cm in diameter and therefore easily hidden. The ground conditions on Site B are considered favourable to the detection of evidence of UXO, given that this site comprised developed land including multiple structures including factories, therefore evidence of damage to structures such as rubble or clearance would be easily observable. However, a patch of undeveloped land in the north-east of Site B would possibly obscure evidence of UXO due to the absence of permanent structures. In addition, it should be noted that given the incendiary bombs recorded across Site B, which could have resulted in several fires, and therefore rubble and debris, may have obscured any evidence of unexploded bombs.

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.*	Site A is anticipated to have been subject to an infrequent degree of access during the war, due to the lack of permanent structures or features of significance occupying the boundary. The adjacent river tributary is likely to have impeded access to Site A from the south, with no bridge in the immediate vicinity. In contrast, Site B is considered to have been subject to a frequent level of access. The site was occupied by a variety of structures including factories, and these factories are understood to have remained operational during the war. Workers on site may have temporarily evacuated the site in anticipation of air raids, however this is not considered to significantly affect the war-time access on site.
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.
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.

12. Introduction to Allied 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.

A Home Guard platoon is understood to have been stationed at the Airscrew Company Ltd within Site B. This was likely the 3rd Surrey Battalion (Weybridge), which was formed in May 1940 by the re-designation of the Local Defence Volunteer company and comprised platoons of men in reserved occupations and those over or under age to serve in the armed forces.[6]

The following sections will examine the available information of the Home Guard platoon in the area of the site, and assess to what degree, if any, the site could have become contaminated as a result of the historic military use of the surrounding area.

12.2. Land Service Ammunition

Home Guard Units were equipped with a variety of land service weapons, including No. 36 Mills Bombs, Spigot Mortars as well as other more exotic weapons unique to the Home Guard. Live ordnance was often used during training, and accordingly may be found on areas formerly used for training or as defensive positions.

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.

[6] *https://www.wartimememoriesproject.com/ww2/allied/battalion.php?pid=7800*

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.

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 **Appendices iv - vi.**

12.3. Small Arms Ammunition

The most common type of ordnance encountered on land used by the military are items of Small Arms Ammunition (SAA). 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. Items of SAA can be accidentally initiated by striking the casing or coming into contact with fire. However even if an item functioned, the explosion would not be contained within a barrel and detonation would only result in local overpressure and very minor fragmentation from the cartridge case Images of SAA are presented in **Appendix vii.**

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.

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 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 **Appendix viii**.

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 military use, 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 military camps, depots, storage facilities, ranges and training areas 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.
- In the vast majority of cases, explosive ordnance would have been stored and available for use at military installations. Ordnance ranged from small arms and land service ammunition to weapons components and larger, aerial delivered items. During periods of heightened activity, ordnance was also frequently lost in transit, particularly between stores and assigned training locations.
- The military generally did not anticipate that their land would be later sold for civilian development, and consequently 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 military 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. Airscrew Company Ltd Home Guard

Established in 1940 as the Local Defence Volunteers, the Home Guard was tasked with the defence of Britain in the event that the country was invaded. In light of this remit, the Home Guard established a network of defensive positions across the country and were tasked with defending strategic positions and destroying or disabling bridges and other key points the enemy would want captured intact.

A Home Guard platoon was understood to be stationed within the Site B site during the war. Anecdotal evidence suggests the platoon patrolled the nearby canals and factories, this included Airscrew Company Ltd on site in addition to the Vickers and Hawker factories located at Brooklands south of the site.[7] This evidence also suggests the Home Guard installed a Lewis gun position on a factory roof within the site as a precaution against air raids.

13.3. Woburn Park Heavy Anti-Aircraft Battery

During WWII, a HAA battery is recorded to have been located approximately 120m north of the Site A site. This gun site appears to have been constructed in the typical 1941 gun site layout, with four square concrete gun emplacements arranged in a crescent and a central command post located to the rear. Several ammunition storage bunkers can be seen connected to the gun positions, which would have been used to store 3.7” ammunition and fuzes.

[7] *http://forum.commandoveterans.org/cdoForum/posts/list/6630.page*

The Woburn Park gun site was equipped with four QF 3.7" AA guns, a 'Quick firing' rifled artillery gun that could fire a HE or shrapnel shell detonated by a timer or proximity fuze. Part of the Brooklands Gun Defence Area, the Woburn Park battery was home to 301 Battery, 98th Heavy Anti-Aircraft Regiment, Royal Artillery which had its HQ in nearby Addlestone.

In contrast to Home Guard crewed sites, RA gunners would have received specialist training as part of AA command, including coordinating AA fire with searchlights and other batteries located in the Brooklands Gun Defence Area (GDA).

13.4. Woburn Park Heavy Anti-Aircraft Camp

Available information suggests that the Site A site was also situated within close proximity to a HAA Camp, situated to the west of the HAA gun site, approximately 60m from the site area. Little information can be found about the exact composition of the camp, however such camps were typically to provide accommodation for HAA gun crews, storage of ammunition and provided administrative and communications equipment to link the battery to other gun sites in the local defence area.

As a self-sufficient military camp, there was also likely to have been workshops in order to maintain the guns, storage areas for associated material, as well as other structures such as a mess hall, armoury and motor transport sheds. In the case of the Hamm Estate camp, the majority of the camp appears to be comprised of nissen huts, with a connecting access road located in the south-west. A potential storage area appears to be located in the south alongside a larger hut, perhaps used as administration block or as the camp headquarters. As an army camp, it is also possible that additional training may have taken place within the camp and its surroundings to keep the men drilled. Should such training have taken place it is possible that it may have involved small arms or land service items such as grenades.

13.5. 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 170m north of the site, in the vicinity of Woburn Park. Despite this distance the maximum effective range of an AA 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.*	Anecdotal evidence indicates that a Home Guard installation occupied Site B and it is likely that the platoon would patrol the industrialised areas for security purposes. According to anecdotal evidence, SAA from light machine guns is considered to have only been used to defend Site B during air raids. The adjacent fields to Site B, including Site A, could have been used for training purposes or drills involving the usage of Allied ordnance such as SAA or hand grenades.
Defensive Positions *Defensive positions suggest the presence of military activity, which is often indicative of ordnance storage, usage or disposal.*	A Lewis gun position was located on a factory roof within the Site B site according to anecdotal evidence, in addition to the HAA battery located north of the site.
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.*	No evidence of training or firing ranges could be found within the site or surrounding area.
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.
Ordnance Manufacture *Ordnance manufacture indicates an increased chance that items of ordnance were stored, or disposed of, within a location.*	No information of ordnance being stored, produced, or disposed of within the proposed site could be found.
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.

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-war aerial imagery Luftwaffe reconnaissance imagery, Chertsey War Damage Incident mapping, council minutes, schedule of war damaged properties, ARP incident Reports, Surrey Constabulary situation reports, RAF and post-war aerial photography, Home Office statistics and in-house information. The record set is of generally mixed quality. Whilst some records are comprehensive for the entire period of the war, others appear to only cover major raids and incidents, presenting the possibility that incidents may have been omitted. Additionally, official records for the Home Guard platoon situated on site were not available.
German Aerial Delivered Ordnance	• During WWII both Site A and Site B were located within the Urban District of Chertsey, an area recorded to have sustained a relatively low density of bombing, with an average of 22.3 bombs recorded per 1,000 acres, according to official Home Office Bombing statistics. This is likely due to the district's location away from London. However, Site B was a designated as a Luftwaffe target, in addition to other prominent targets in the vicinity of the site such as RAF Brooklands. **Site A** • Wartime OS mapping imagery indicates that Site A comprised open, undeveloped land. • Chertsey War Damage Incident mapping highlights that several incendiary bombs were recorded on Site A. One HE bomb is highlighted partially within/ adjacent to the eastern boundary of the site, with an additional HE bomb just north of the site too. • Post-WWII aerial imagery indicates that Site A was occupied by an area of vegetation. Although no immediate evidence of bomb damage was observable in this image, it should be noted that the ground conditions on Site A can often obscure indications of UXO, such as bomb entry holes which could have been as small as 20cm in diameter and therefore easily obscured in such ground conditions. • Given that there were no structures on Site A or features of significance, it is unlikely that Site A would have been subject to regular access, decreasing the likelihood that evidence of UXO would have been spotted, reported and dealt with. • In summary, several incendiary bombs were recorded on site and a high explosive bomb was partially recorded in the site boundary. It is unlikely that the site would have been regularly accessed and therefore any evidence of bombing is unlikely to have been spotted/reported. Therefore, the risk from UXO contamination on Site A has been assessed as **Medium**. **Site B** • Wartime OS mapping indicates that Site B was occupied by numerous structures associated with *Black Boy Works*. • Chertsey War Damage Incident mapping highlights that several incendiary bombs were recorded on Site B. No high explosive bombs were recorded on site. • Post-WWII aerial imagery indicates that the structures on site appear to survive the war externally intact and there are no obvious signs of clearance or missing structures. Some structures have white roofing, which can often be indicative of repair works, as highlighted in **Annex M2**. This is likely to be a consequence of the several incendiary bombs recorded on site.

	• It is thought likely that Site B would have been subject to regular access during the war, given that it was occupied by a works. This increases the likelihood that evidence of UXO would have been spotted, reported and dealt with. Although, access to Site B may have been temporarily impeded following the recorded incendiary bombing across the site. • The ground cover across Site B is generally considered conducive to the detection of evidence of UXO, given that any damage to structures would have been obvious. However, due to the amount of incendiary bombs recorded on site, which caused some damage to the site, as evident in aerial imagery, evidence of UXO may have been obscured by such damage. • In summary, no positive evidence was found to indicate that any high explosive bombs fell on Site B during the war. However, many incendiary bombs were recorded on Site B which likely caused conditions to worsen on Site B (resultant rubble and debris) and it is likely that access to the site may have been reduced during this time, until it was deemed safe to return. Therefore, due to these factors, it has not been entirely possible to discount the risk from UXO on site. As such, the risk from unexploded German aerial delivered ordnance is considered to be slightly elevated above that of the 'background level' for this area, but is not considered to be high enough to warrant proactive on-site UXO support. It is recommended that all ground personnel undertaking intrusive works attend a UXO safety and awareness briefing to make them aware of the history of the site, what to look out for and what to do in the event that a suspect item is encountered.
Allied Ordnance	• Anecdotal evidence suggests a Home Guard platoon was stationed within Site B and utilised SAA as a precaution to defend the site during air raids. • A HAA camp and battery were located north of the Site A site boundary, where AA shells were likely stored and fired, in addition to potential items of SAA. • In summary, these Allied features are not considered to significantly elevate the risk of Allied UXO within the site boundaries. It is unlikely that AA shells were stored within the site as the HAA battery and camp were not located in the site's immediate vicinity. However as the camp is in close proximity to Site A, it is possible that infantry stationed at the camp would use nearby fields for training purposes. Additionally, the Home Guard stationed at Site B for defensive and security measures could have used nearby fields for training drills often involving SAA or hand grenades. It is also possible that items of SAA would be stored in Site B, but is unlikely to have been used near factories, with the exception of defending the site from German aircraft. There is also no available evidence that the Home Guard stored explosives such as mortars or shells on site. It is overall not possible to discount the possibility of discovering Allied ordnance on site, as Site A was likely utilised for training purposes and drills, it has been assessed as **Low-Medium Risk** from Allied ordnance. Site B has been assessed as **Low Risk** as Allied ordnance was likely infrequently used on site due to the factories that occupied the site, and that SAA would be fired only I the event of air raids.

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

1st Line Defence has found no evidence in the public domain or within internal records that any official ordnance clearance operations have taken place on site. Note however that we have not received confirmation of this fact from the 33 EOD Regiment Archive (now part of 29 Regt). It should also be noted that in addition to 29 Regt archival information, 1st Line Defence also do not currently have access to data that may be relevant including 5131(BD)SQN Archive, SD Training Technical Advisory Section (TAS) and MACA Records (bomb disposal callouts).

If such information is available at a later date, it is recommended that it be reviewed as it will assist with understanding both levels and types of contamination likely to be present, and may indicate risk reduction in certain areas.

15.3. Post-War Redevelopment

A rectangular structure was constructed within Site A and multiple structures were cleared in Site B and replaced with modern industrial structures.

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. For example, the risk from deep buried UXO will only have been mitigated within the volumes of any post-war pile foundations or deep excavations for basement levels. The risk will however remain within virgin geology below and amongst these post-war works, down to the maximum bomb penetration depth.

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 works 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. Encountering Aerial Delivered Ordnance

Since an aerial delivered bomb may come to rest at any depth between just below ground level and its maximum penetration depth, there is a chance that such an item (if present) could be encountered during shallow excavations (for services or site investigations) into the original WWII ground level as well as at depth.

16.3. Land Service/Small Arms Ammunition Encounter

Items of LSA and SAA are mostly encountered in areas previously used for 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.

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.

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.

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.

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 on site is not homogenous. Site A has been assessed at **Medium Risk** from German aerial delivered and anti-aircraft UXO, and Site B has been assessed as **Low-Medium Risk**. Please see **Annex O** for a risk map of the site. There is also an assessed **Low-Medium Risk** from German unexploded ordnance across Site A and a **Low Risk** from Allied unexploded ordnance across Site B.

Site A

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

Site B

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

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.

20. Proposed Risk Mitigation Methodology

20.1. General

The following risk mitigation measures are recommended to support the proposed works at Weybridge, Addlestone Rd:

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 ***Site A***	• **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.
Borehole/Piles ***Site A***	• **Intrusive Magnetometer Survey of all borehole and pile locations down to a maximum bomb penetration depth:** 1st Line Defence can deploy a range of intrusive magnetometer techniques to clear pile locations. The appropriate technique is influenced by a number of factors, but most importantly the site's ground conditions. The appropriate survey methodology would be confirmed once the enabling works have been completed.

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 **26/11/21**

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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