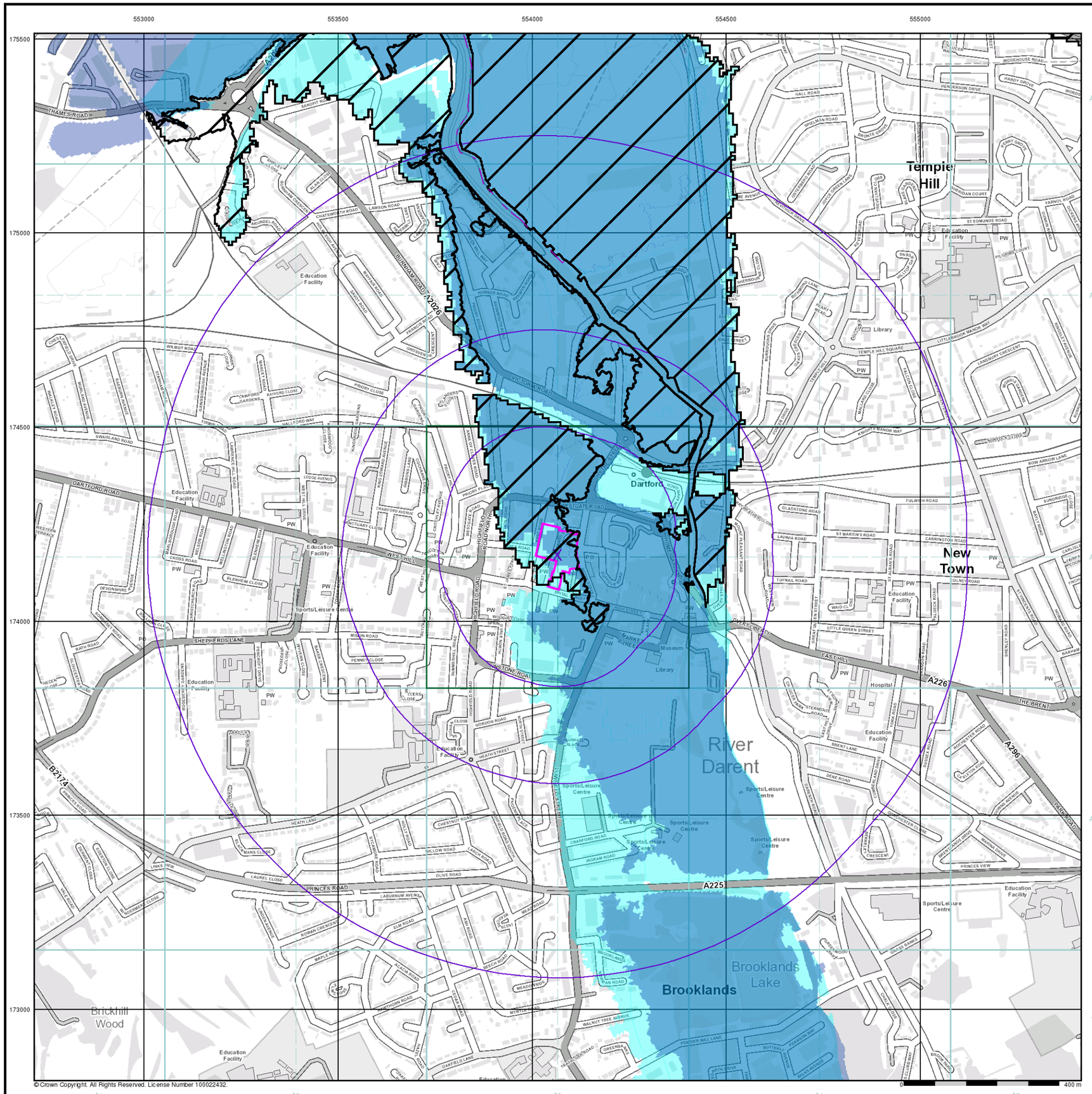

A1 A2 A3 A4 A5

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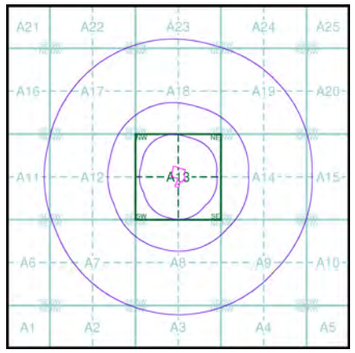
General

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

Agency and Hydrological (Flood)

- Extreme Flooding from Rivers or Sea without Defences (Zone 2)
- Flooding from Rivers or Sea without Defences (Zone 3)
- Area Benefiting from Flood Defence
- Flood Water Storage Areas
- Flood Defence

Flood Map - Slice A



Order Details

Order Number:	168151210_1_1
Customer Ref:	18-0704.01
National Grid Reference:	554070, 174170
Slice:	A
Site Area (Ha):	1.07
Search Buffer (m):	1000

Site Details

Westgate, DARTFORD, DA1 2DF

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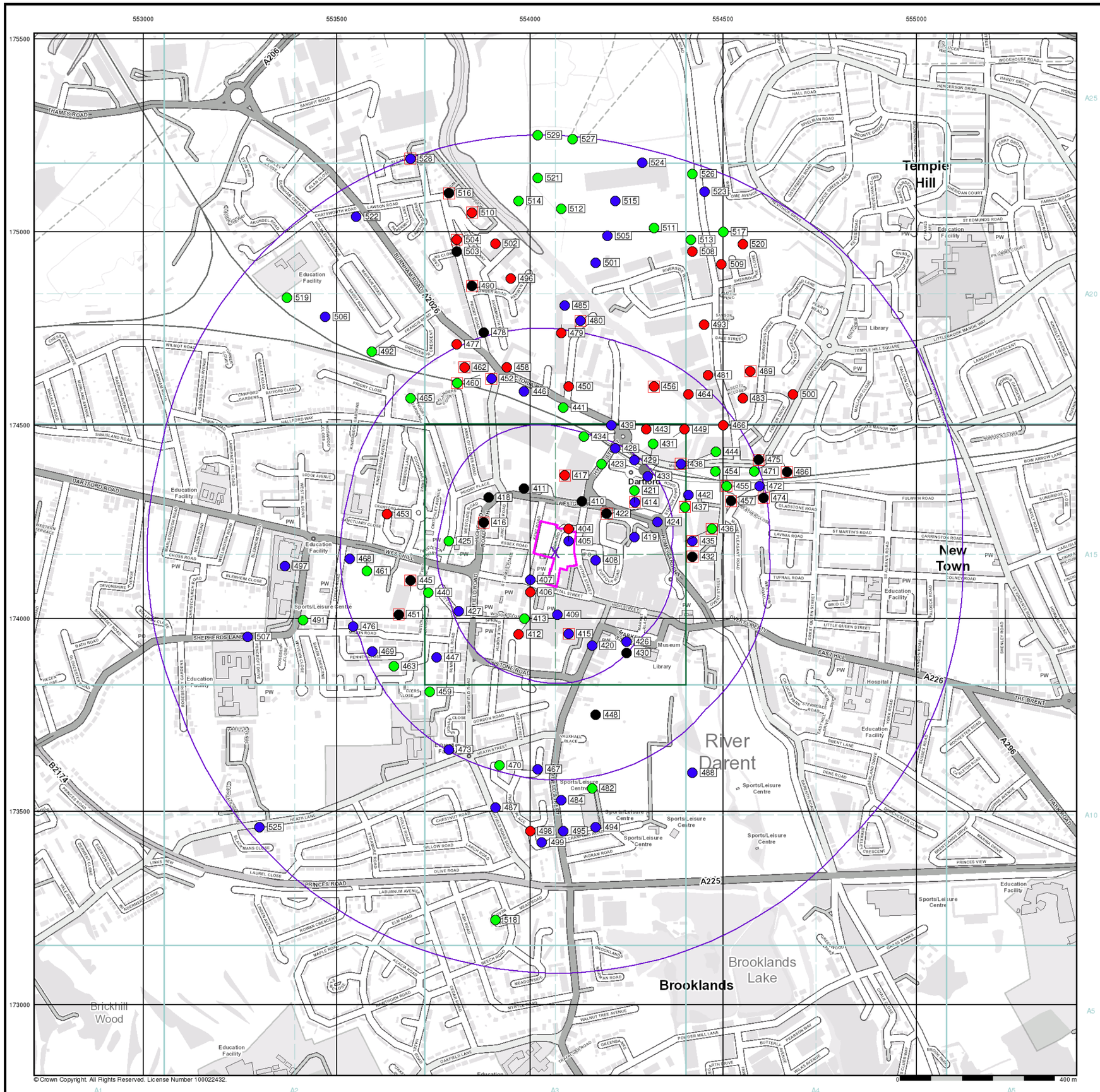

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General

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

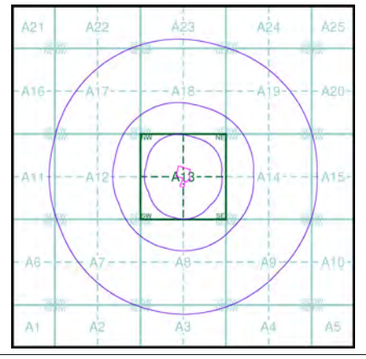
Agency and Hydrological (Boreholes)

- 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



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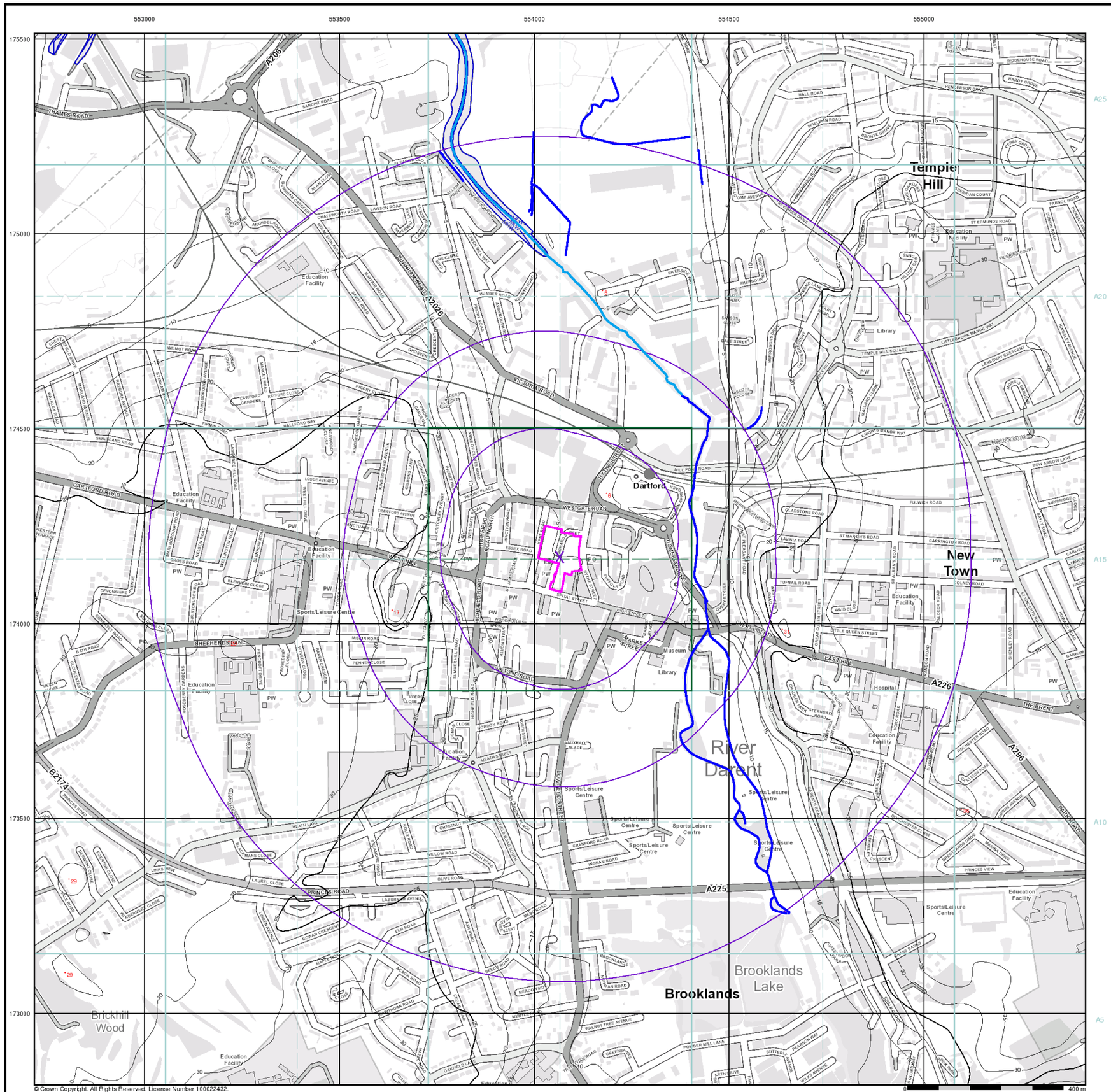

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LANDMARK INFORMATION GROUP®

General

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

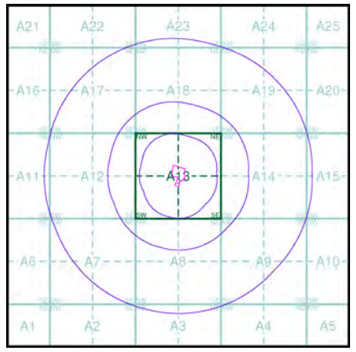
OS Water Network Data

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

Contours (height in meters)

- Standard Contour
- Master Contour
- Spot Height 167.3
- MLW Mean Low Water
- MHW Mean High Water

OS Water Network Map - Slice A



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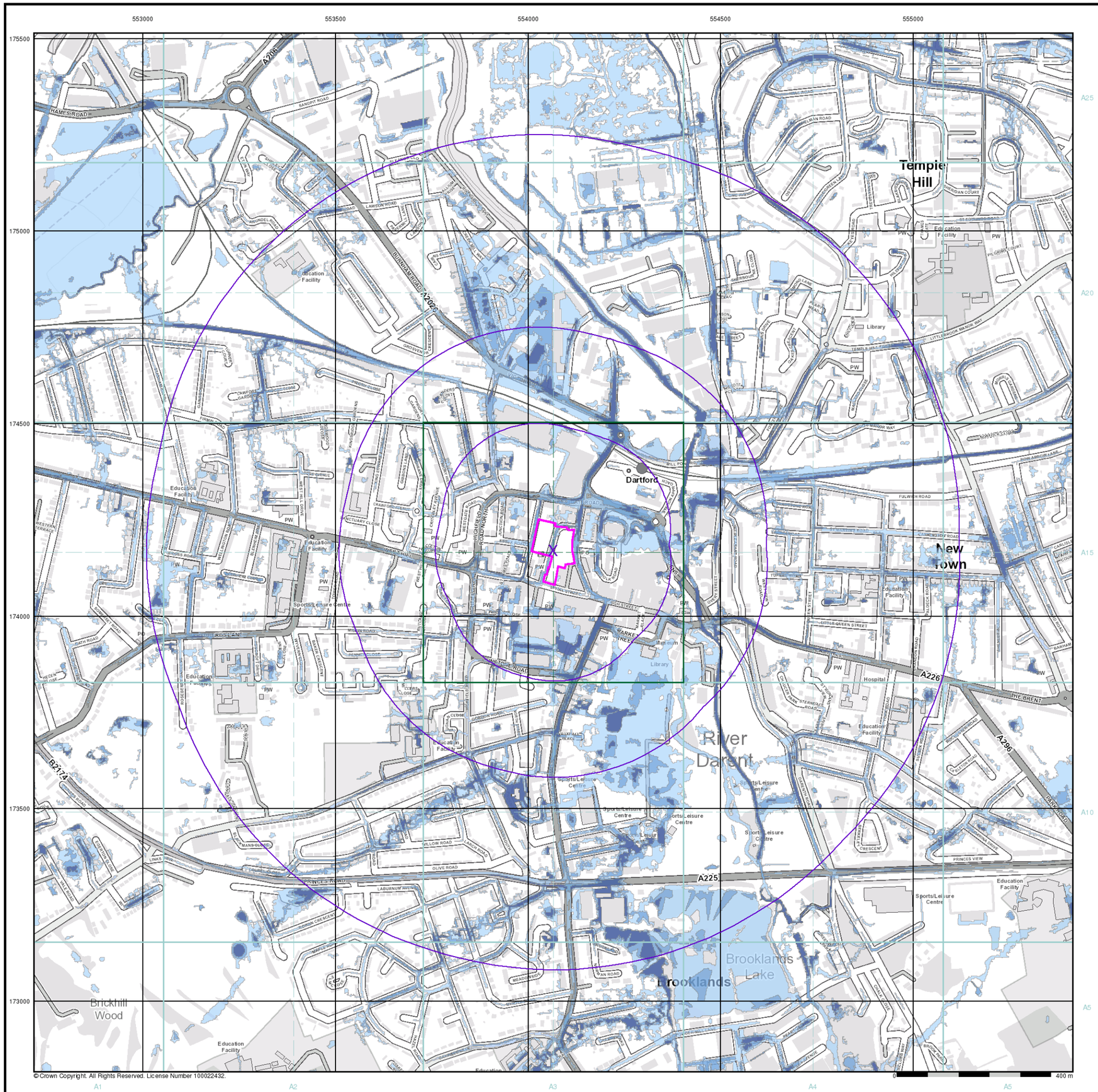

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LANDMARK INFORMATION GROUP®

General

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

Risk of Flooding from Surface Water

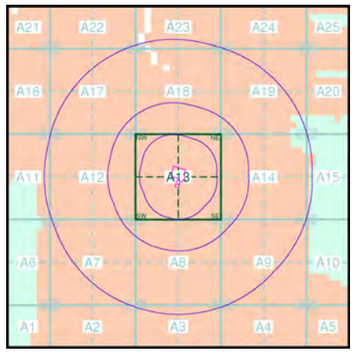
- High - 30 Year Return
- Medium - 100 Year Return
- Low - 1000 Year Return

Suitability

See the suitability map below

- National to county
- County to town
- Town to street
- Street to parcels of land
- Property

EA/NRW Suitability Map - Slice A



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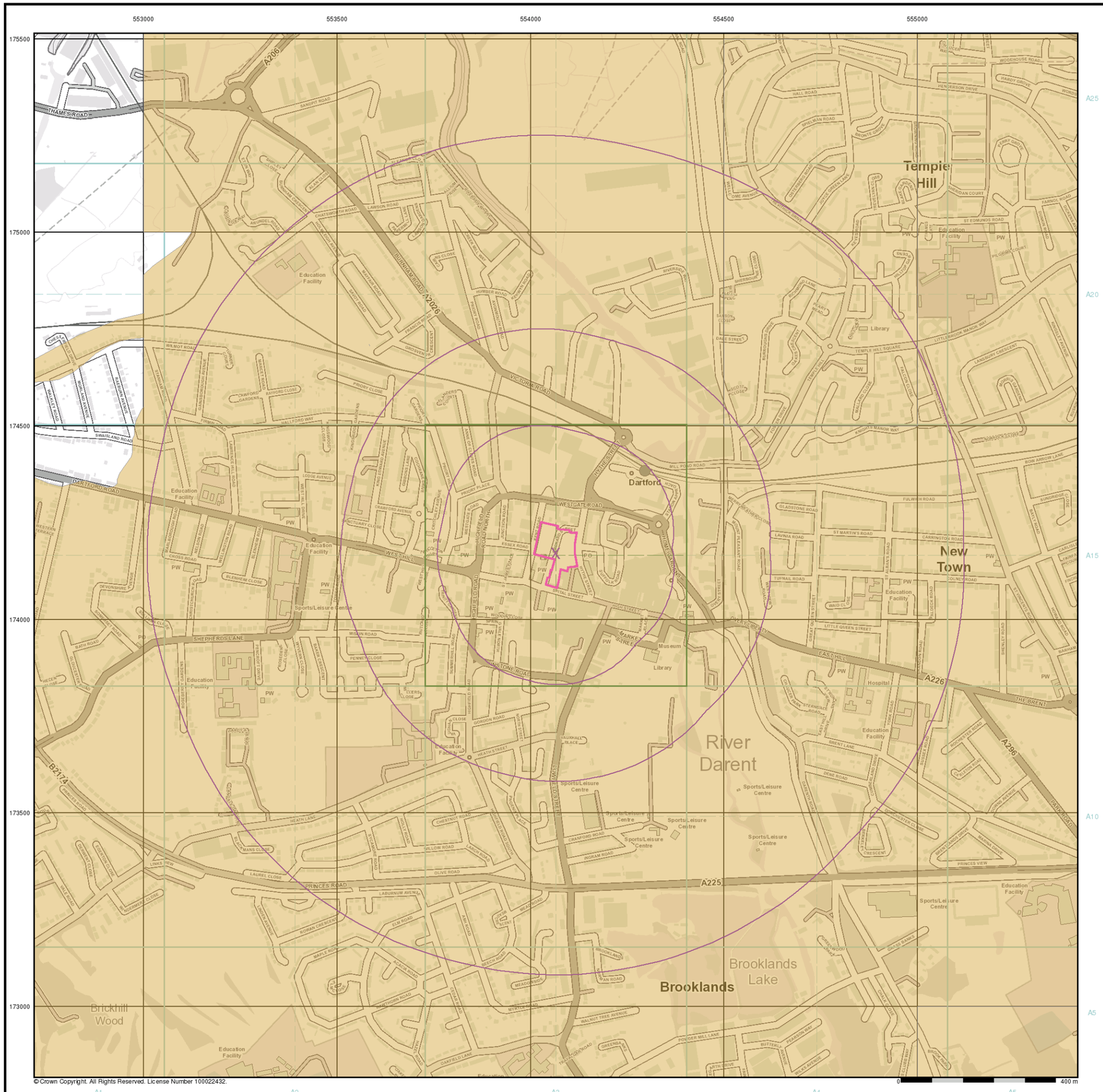

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LANDMARK INFORMATION GROUP®

General

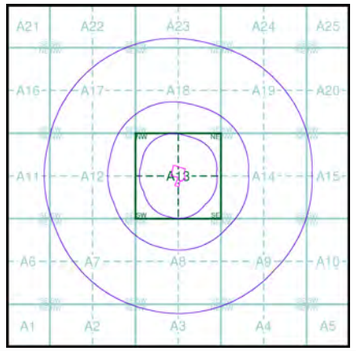
Specified Site | Specified Buffer(s) | X Bearing Reference Point

Estimated Soil Chemistry Arsenic

Arsenic Concentrations mg/kg

- < 15
- 15 - 25
- 25 - 35
- 35 - 45
- 45 - 60
- 60 - 120
- > 120

Estimated Soil Chemistry Arsenic - Slice A



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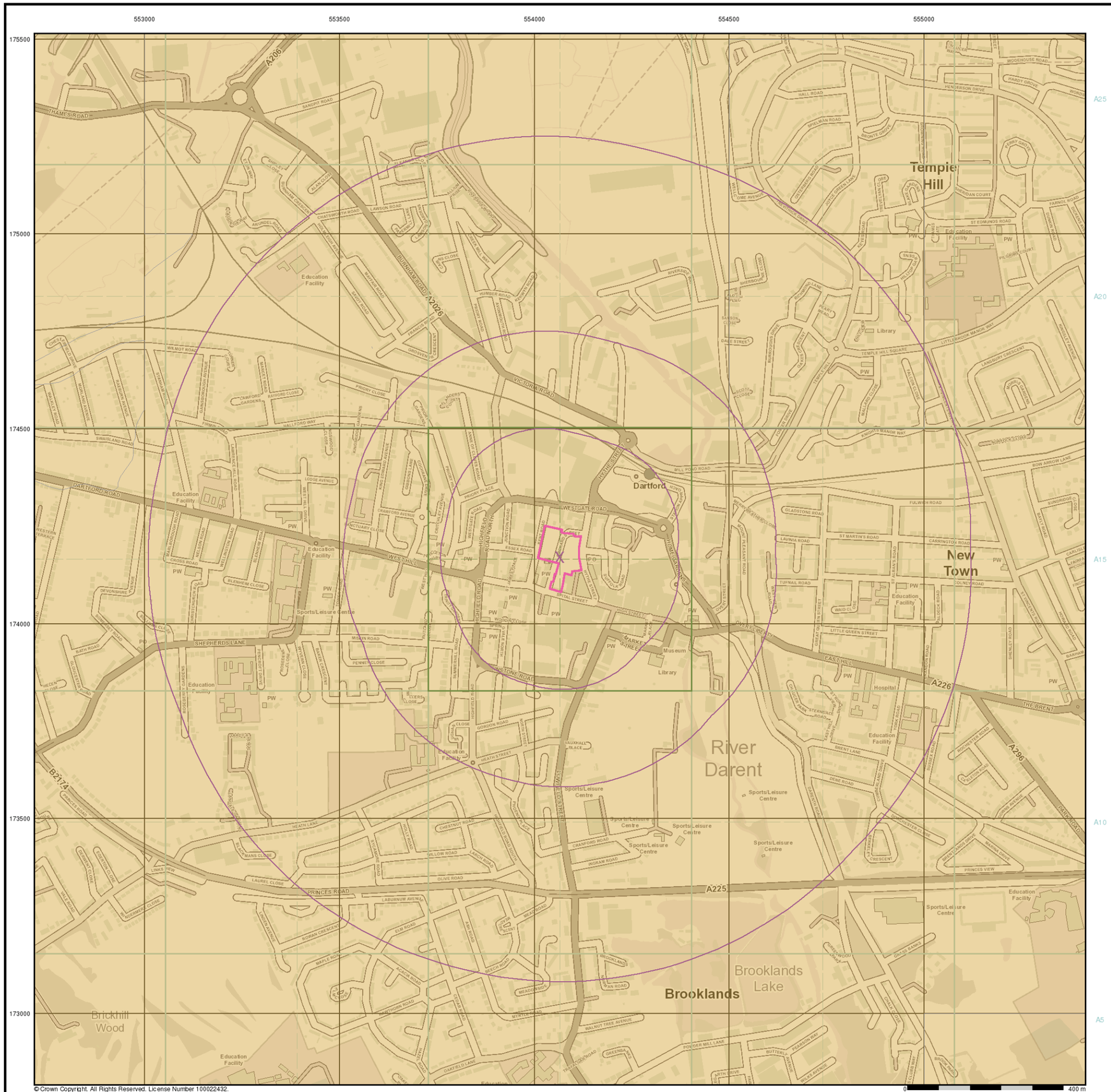

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General

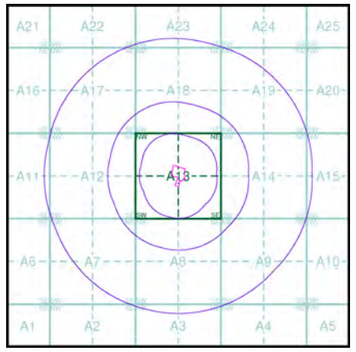
Specified Site | Specified Buffer(s) | X Bearing Reference Point

Estimated Soil Chemistry Cadmium

Cadmium Concentrations mg/kg

- < 1.8
- 1.8 - 2.2
- 2.2 - 3.0
- > 3.0

Estimated Soil Chemistry Cadmium - Slice A



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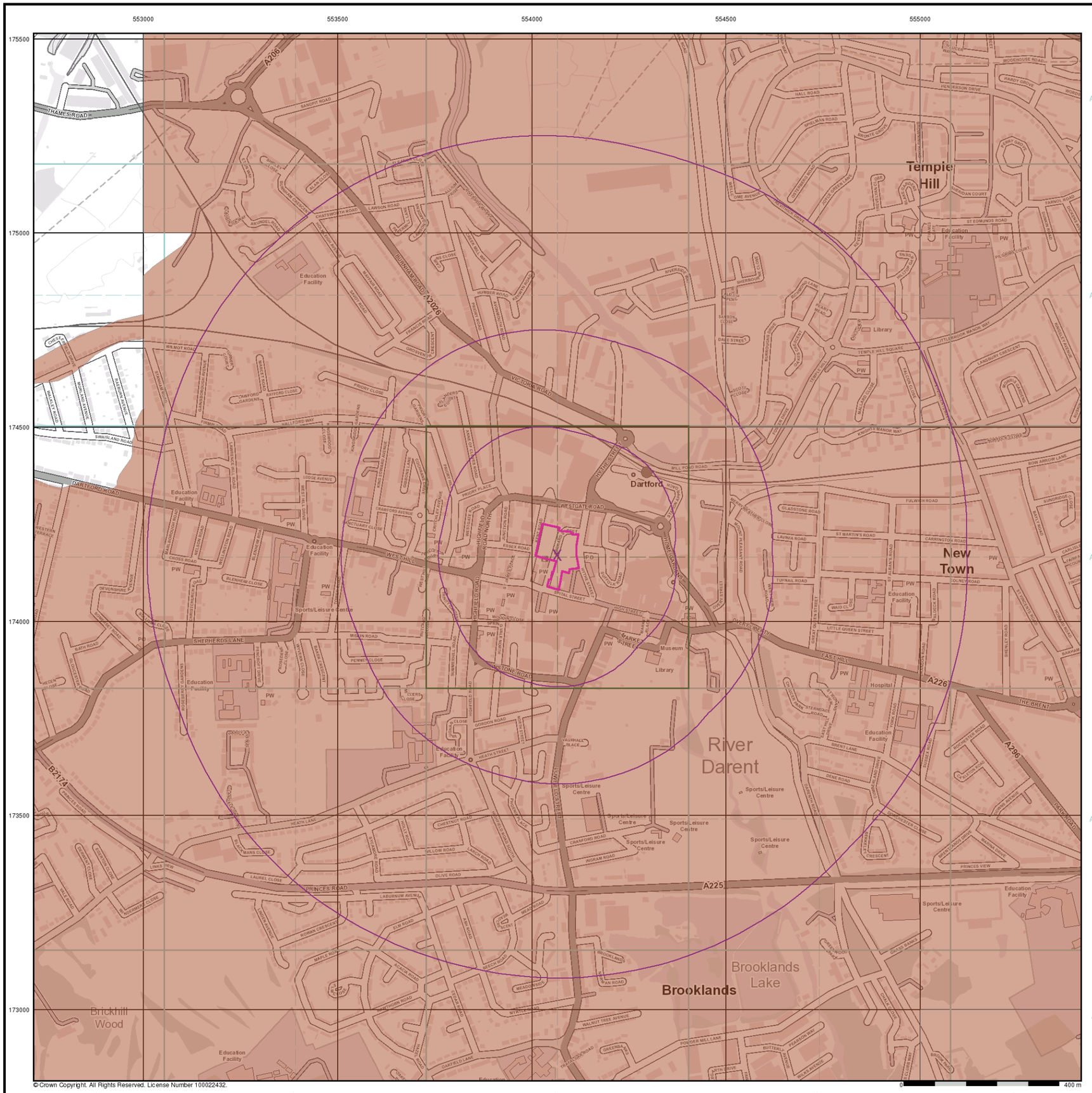


Envirocheck®
LANDMARK INFORMATION GROUP®

General

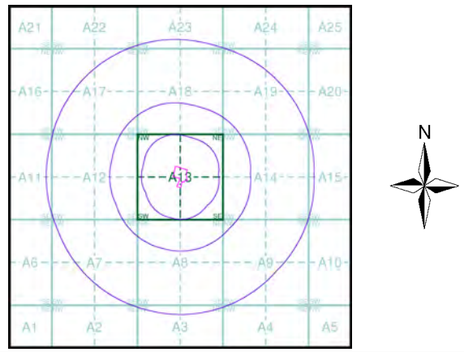
Specified Site | Specified Buffer(s) | X Bearing Reference Point

Estimated Soil Chemistry Chromium

Chromium Concentrations mg/kg

- < 20
- 20 - 40
- 40 - 60
- 60 - 90
- 90 - 120
- 120 - 180
- > 180

Estimated Soil Chemistry Chromium - Slice A



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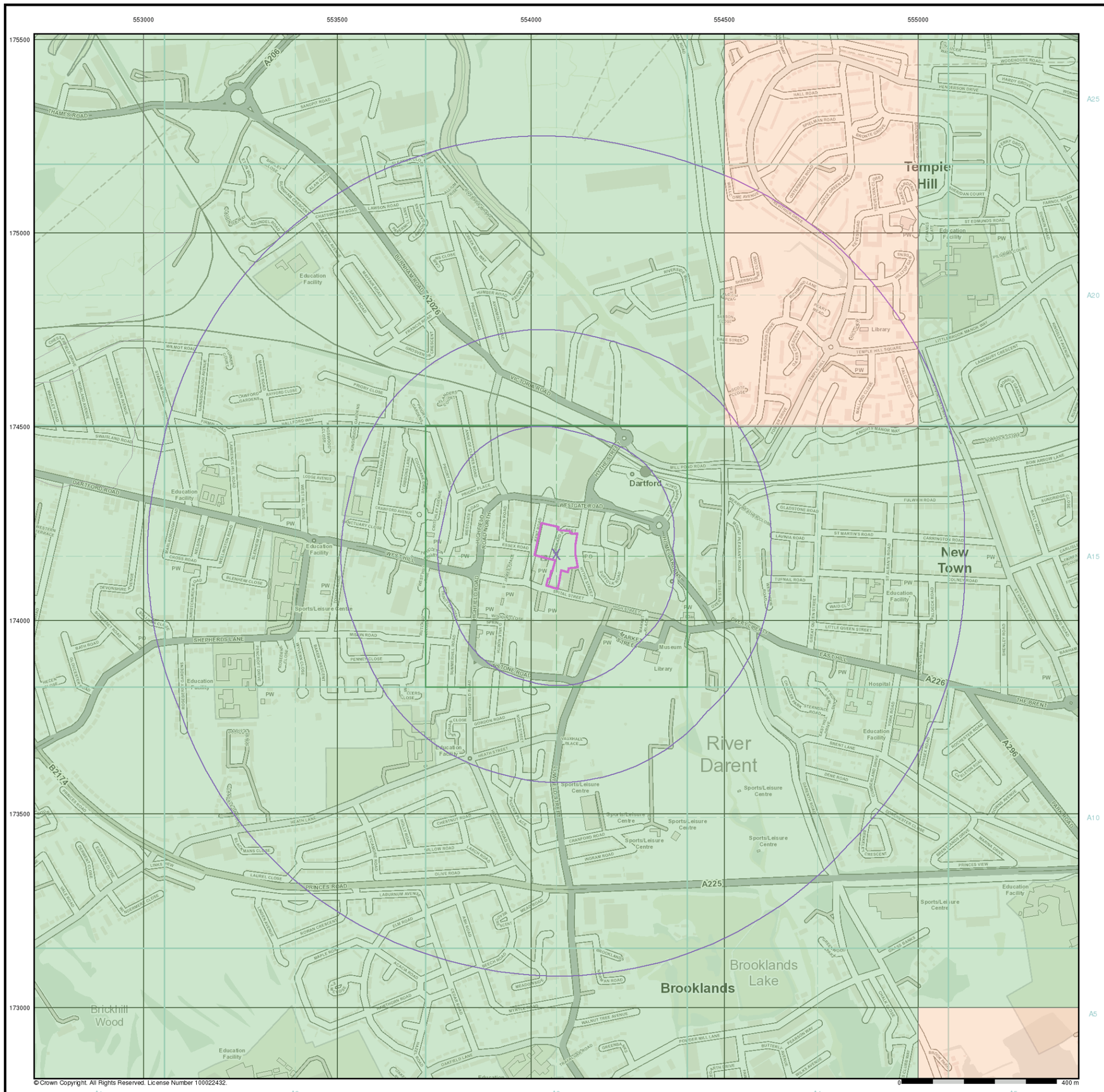

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LANDMARK INFORMATION GROUP®

General

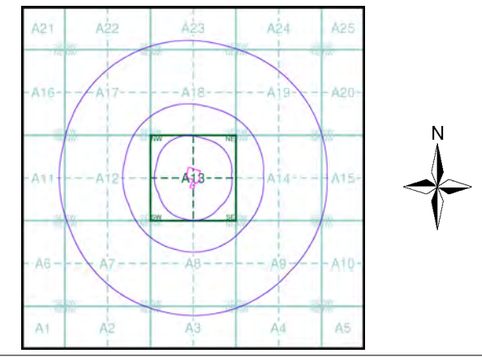
Specified Site | Specified Buffer(s) | X Bearing Reference Point

Estimated Soil Chemistry Lead

Lead Concentrations mg/kg

- <100 mg/kg
- 100 - 200
- 200 - 300
- 300 - 600
- 600 - 1200
- >1200

Estimated Soil Chemistry Lead - Slice A



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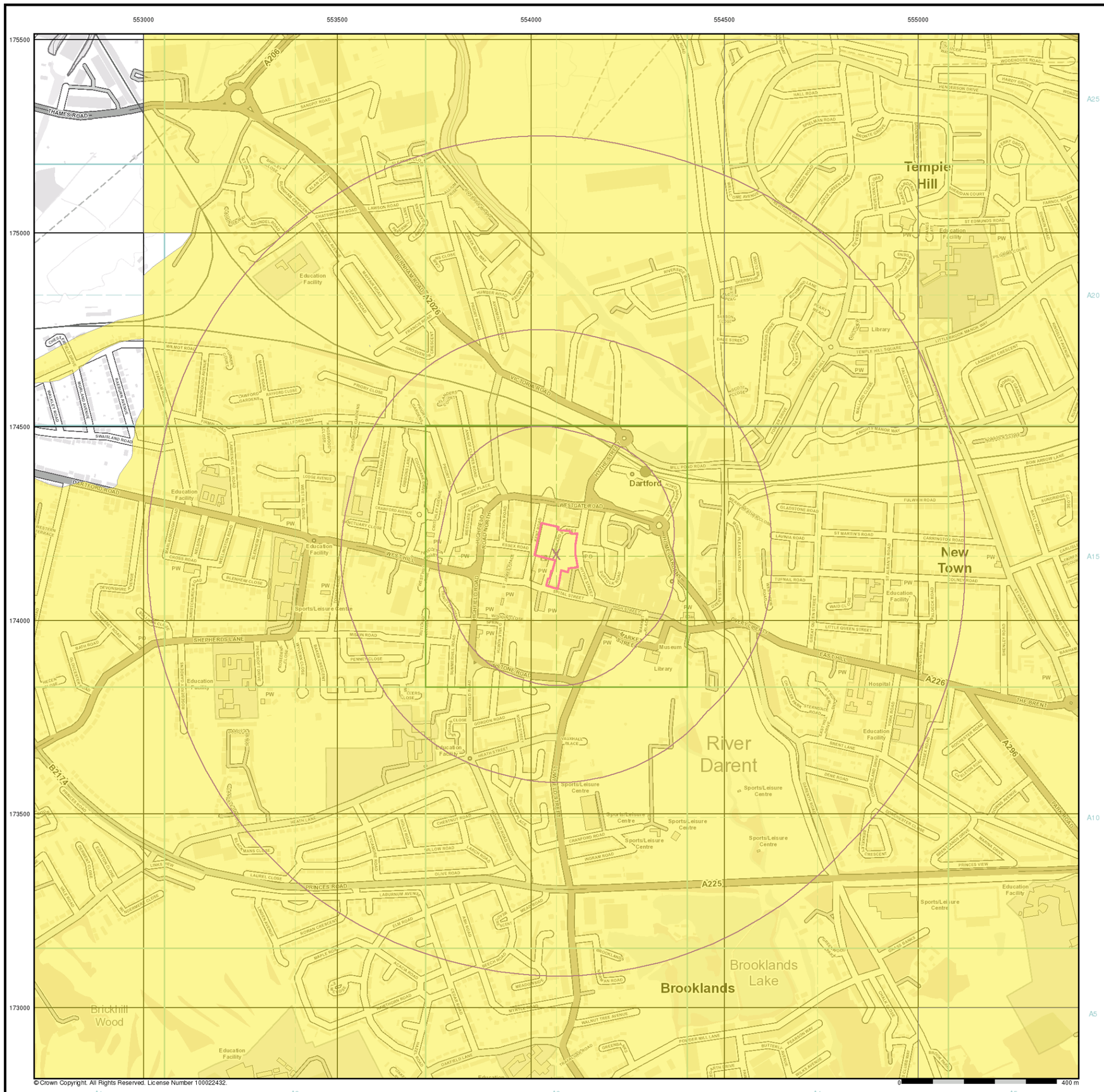

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LANDMARK INFORMATION GROUP®

General

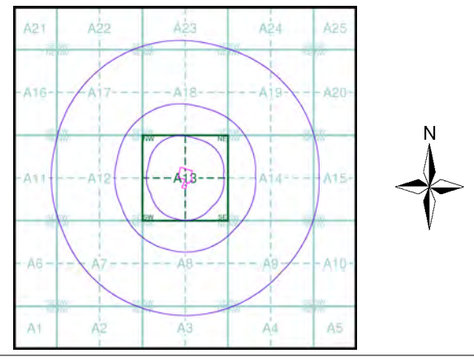
Specified Site | Specified Buffer(s) | X Bearing Reference Point

Estimated Soil Chemistry Nickel

Nickel Concentrations mg/kg

- < 15
- 15 - 30
- 30 - 45
- 45 - 60
- 60 - 80
- 80 - 100
- > 100

Estimated Soil Chemistry Nickel - Slice A



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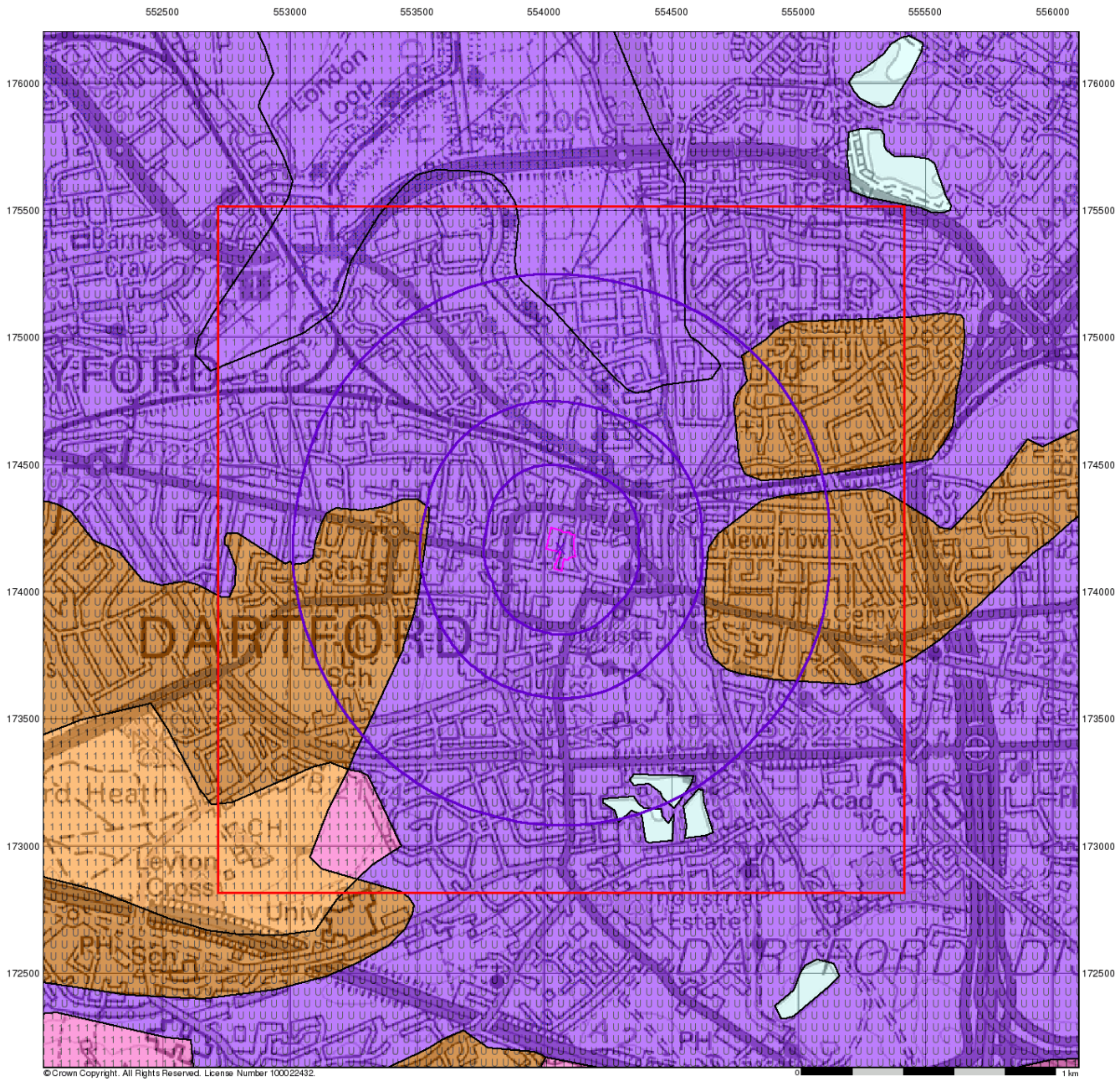

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Groundwater Vulnerability

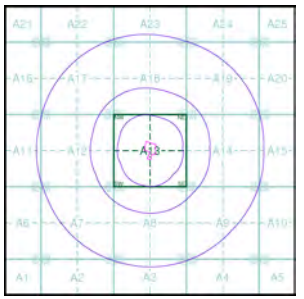
General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

Agency and Hydrological

Geological Classes	Soil Classes
Major Aquifer (Highly Permeable)	High (H) 1, 2, 3, U
	Intermediate (I) 1, 2
	Low
Minor Aquifer (Variably Permeable)	High (H) 1, 2, 3, U
	Intermediate (I) 1, 2
	Low
Non Aquifer (Negligibly Permeable)	
Water or Sea	
Drift Deposit	

Site Sensitivity Context Map - Slice A



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Slice:	A
Site Area (Ha):	1.07
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Site Details

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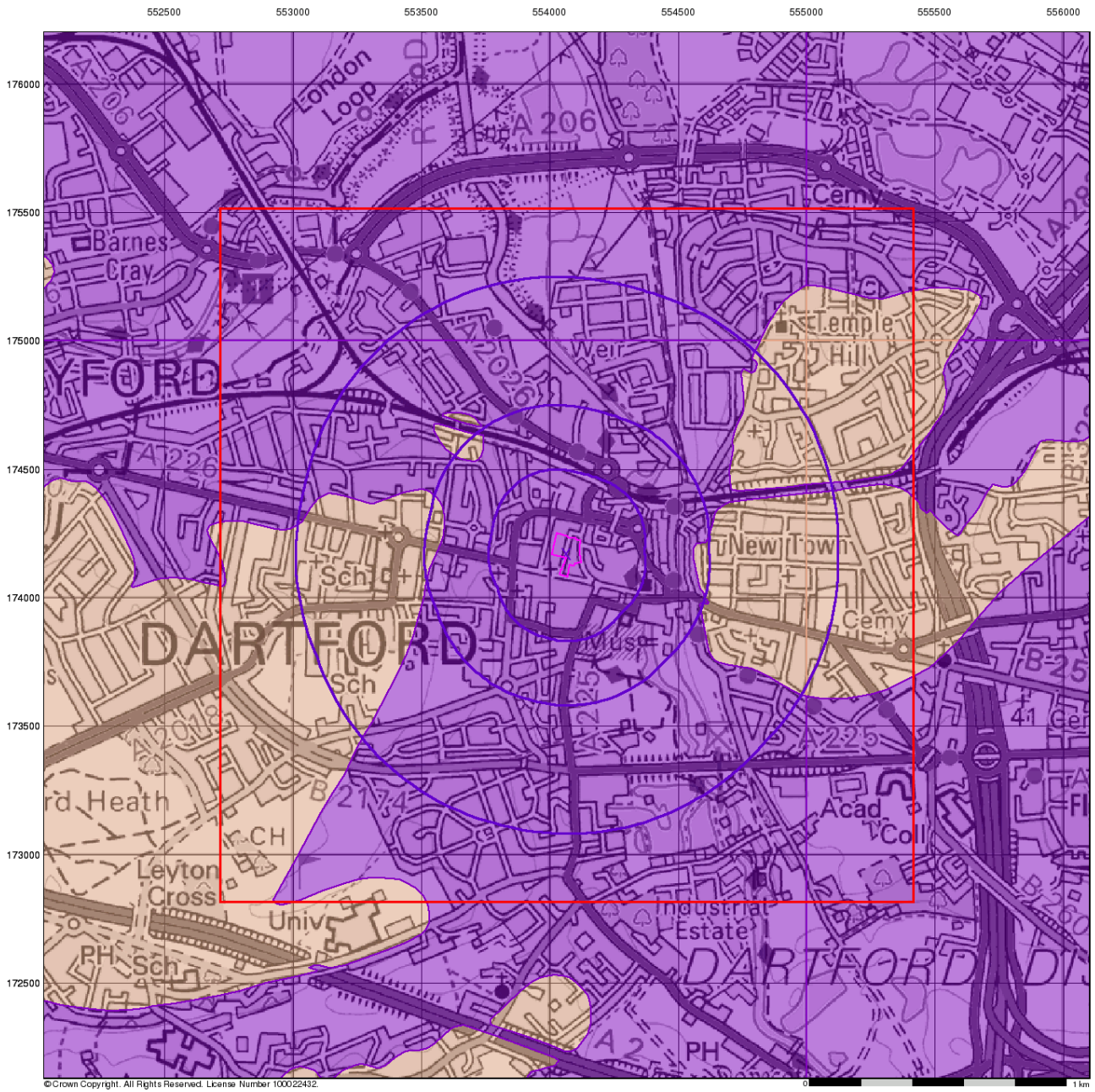

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Bedrock Aquifer Designation

General

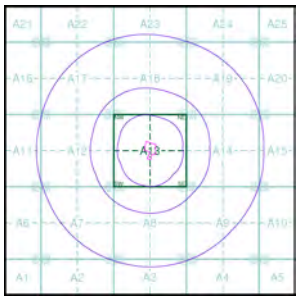
Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

Agency and Hydrological

Geological Classes

- Principal Aquifer
- Secondary A Aquifer
- Secondary B Aquifer
- Secondary Undifferentiated
- Unproductive Strata
- Unknown
- Unknown (Lakes and Landslip)

Site Sensitivity Context Map - Slice A



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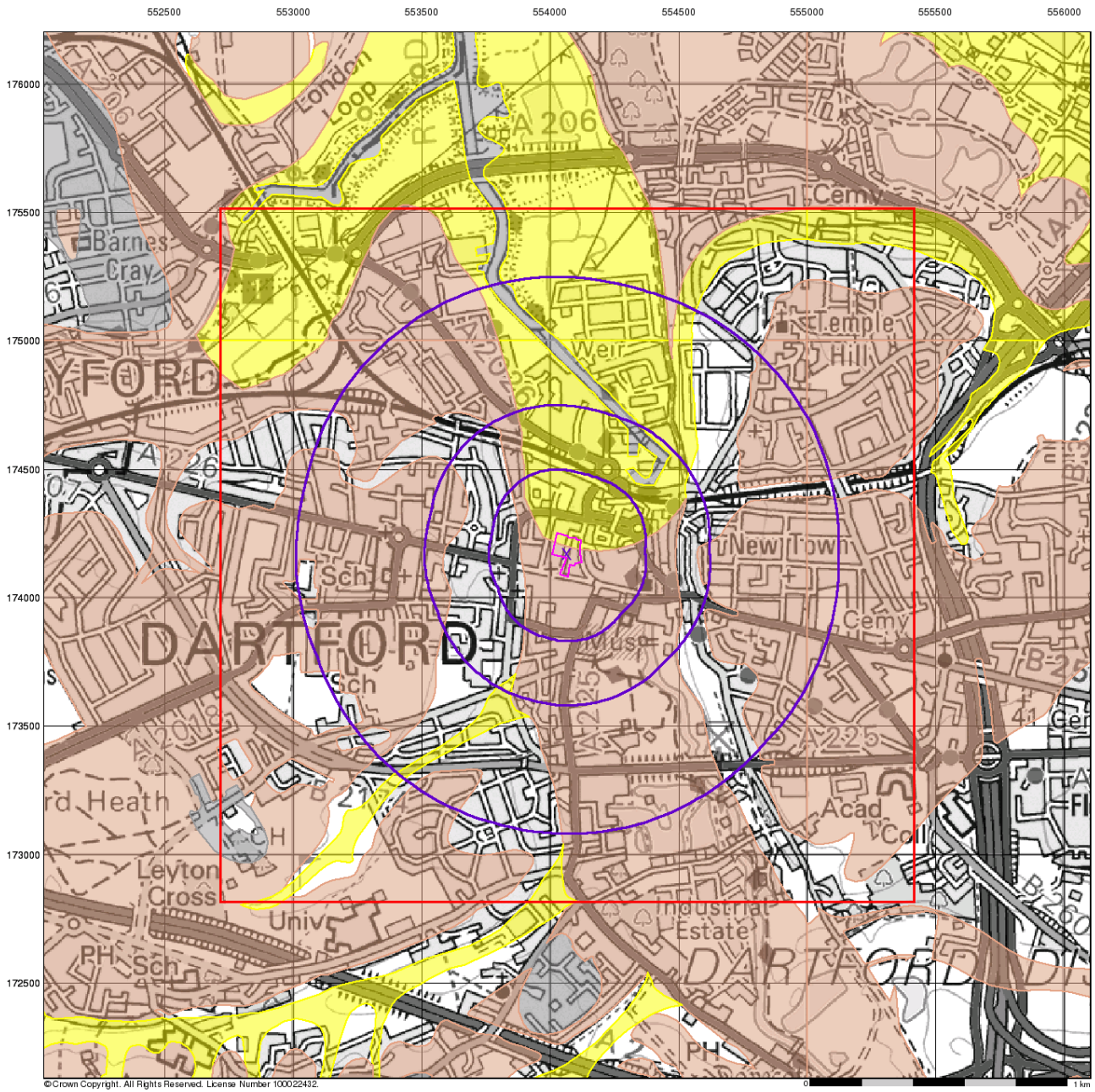

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Superficial Aquifer Designation

General

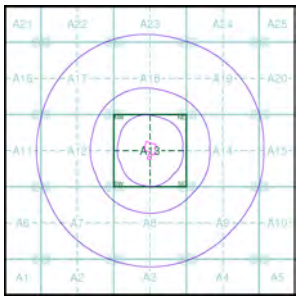
Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

Agency and Hydrological

Geological Classes

- Principal Aquifer
- Secondary A Aquifer
- Secondary B Aquifer
- Secondary Undifferentiated
- Unproductive Strata
- Unknown
- Unknown (Lakes and Landslip)

Site Sensitivity Context Map - Slice A



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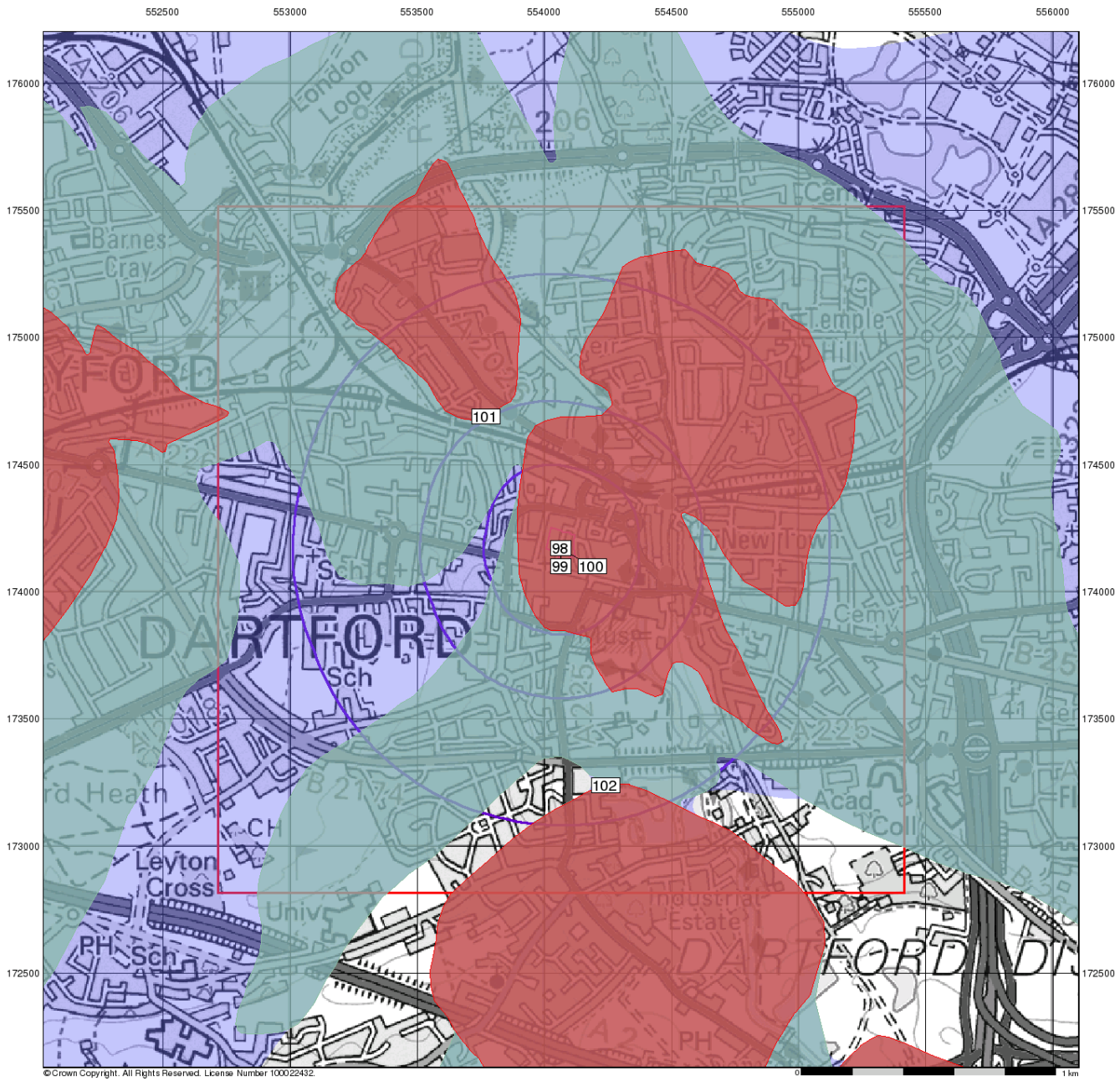

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Source Protection Zones

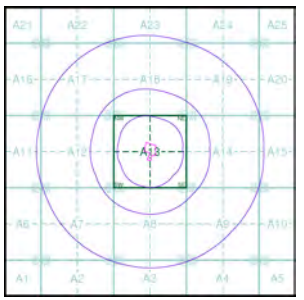
General

Specified Site | Specified Buffer(s) | Bearing Reference Point
Slice | Map ID

Agency and Hydrological

- Inner zone (Zone 1)
- Inner zone - subsurface activity only (Zone 1c)
- Outer zone (Zone 2)
- Outer zone - subsurface activity only (Zone 2c)
- Total catchment (Zone 3)
- Total catchment - subsurface activity only (Zone 3c)
- Special interest (Zone 4)

Site Sensitivity Context Map - Slice A



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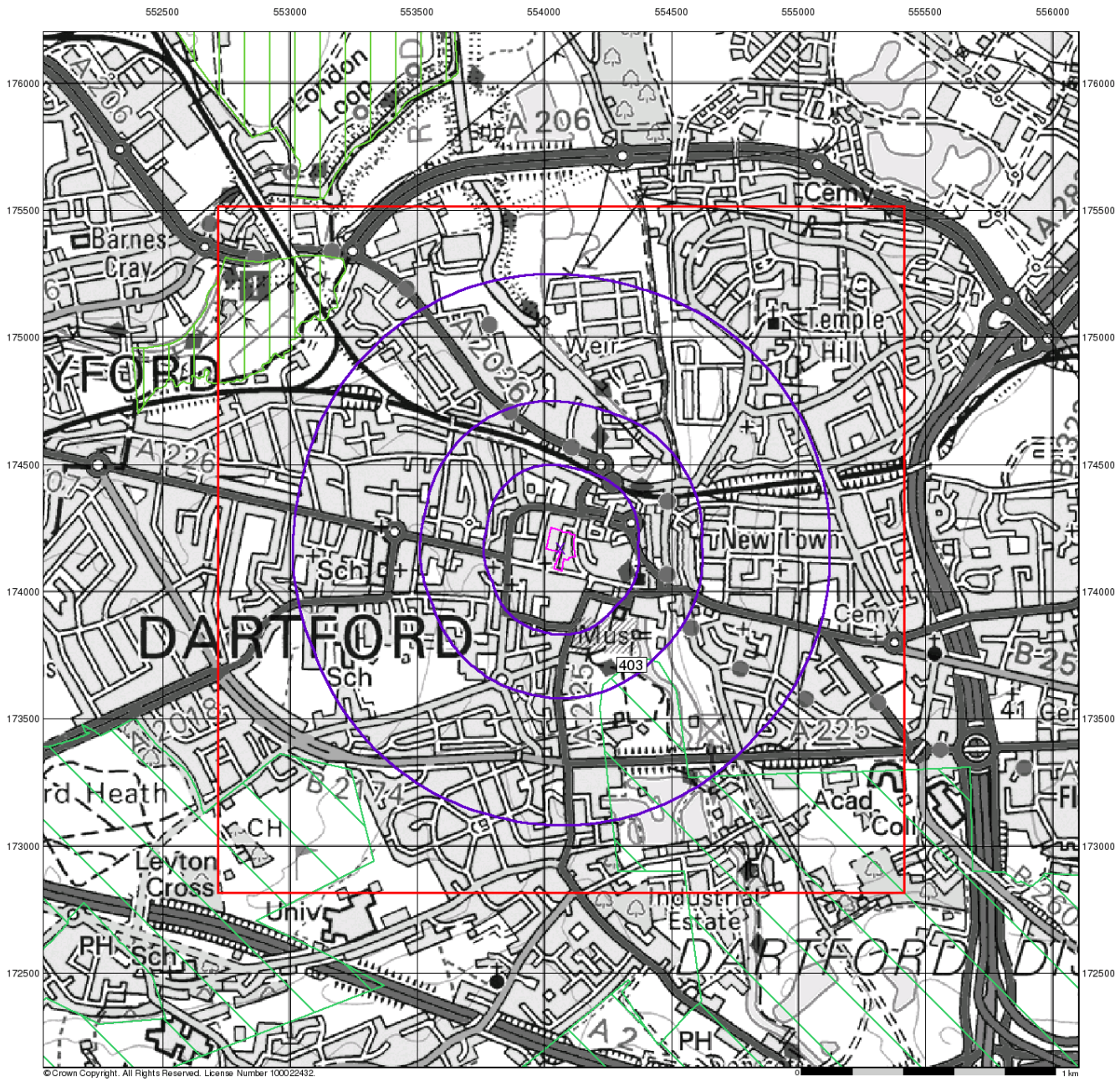

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Sensitive Land Uses

General

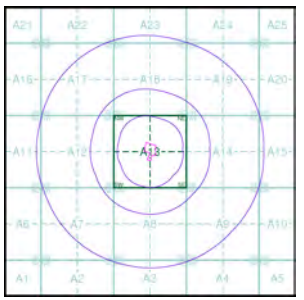
Specified Site | Specified Buffer(s) | Bearing Reference Point

Slice | Map ID

Sensitive Land Uses

- Ancient Woodland
- Area of Adopted Green Belt
- Area of Unadopted Green Belt
- Area of Outstanding Natural Beauty
- Environmentally Sensitive Area
- Forest Park
- Local Nature Reserve
- Marine Nature Reserve
- National Nature Reserve
- National Park
- Nitrate Sensitive Area
- Nitrate Vulnerable Zone
- Ramsar Site
- Site of Special Scientific Interest
- Special Area of Conservation
- Special Protection Area
- World Heritage Sites

Site Sensitivity Context Map - Slice A



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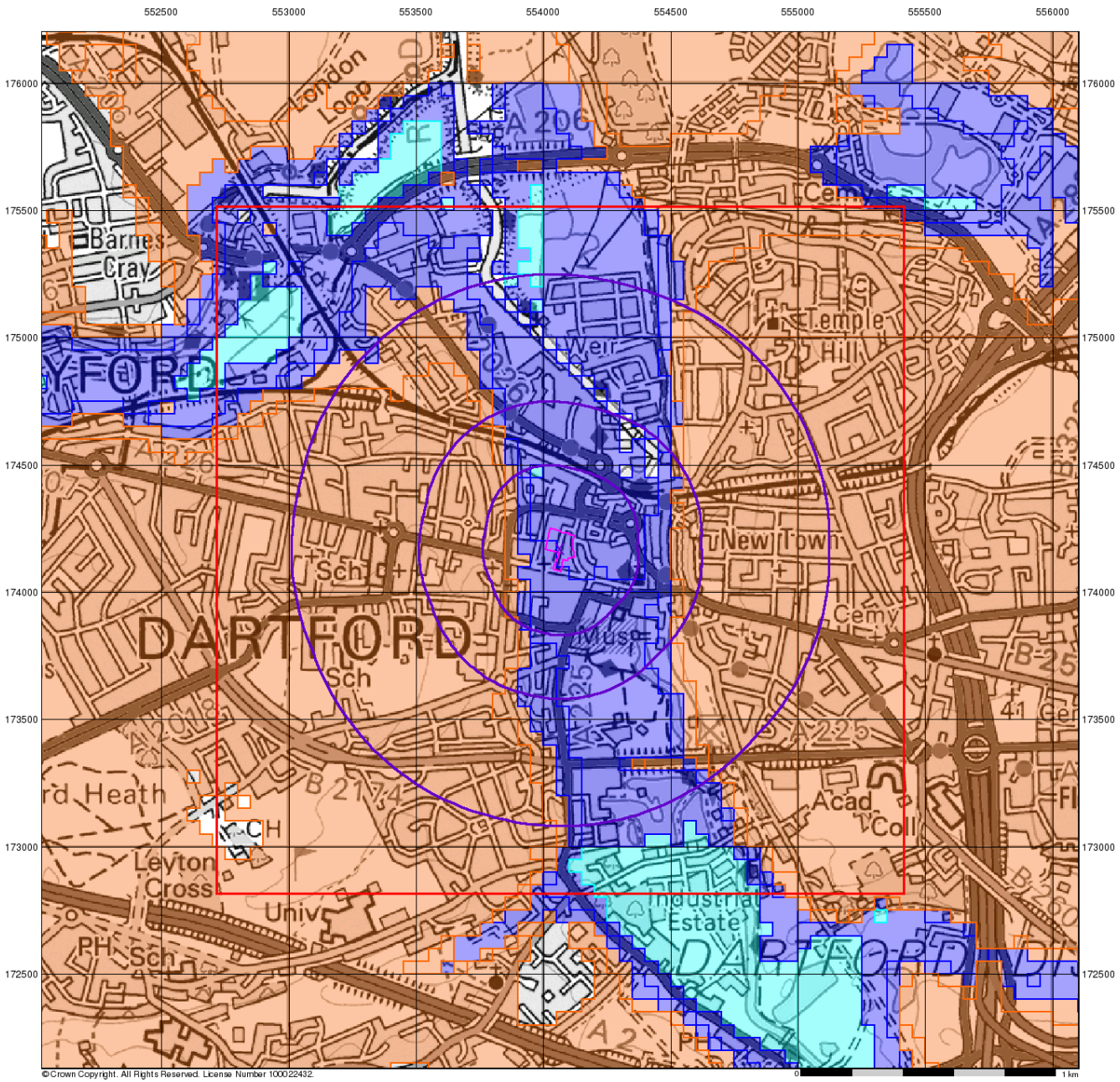

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LANDMARK INFORMATION GROUP

BGS Flood GFS Data

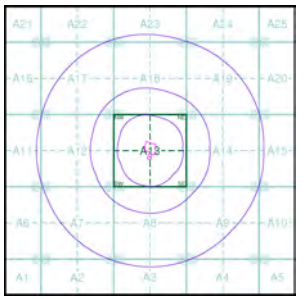
General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice

Agency and Hydrological (Flood)

- Limited Potential for Groundwater Flooding to Occur
- Potential for Groundwater Flooding of Property Situated Below Ground Level
- Potential for Groundwater Flooding to Occur at Surface

Site Sensitivity Context Map - Slice A



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Appendix F – Explosive Ordnance Desktop Threat Assessment

Explosive Ordnance Desktop Threat Assessment

Site: **Orchard Street, Dartford**

Client: **TPS Ltd**

Ref: **7666**

Date: **24th May 2018**

Dynasafe BACTEC Limited
Unit 3, The Courtyard, Campus Way, Gillingham Business Park,
Gillingham, Kent, ME8 0NZ, UK
Office: +44 (0)1634471340
www.bactec.com

Distribution

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Date of Issue: 24th May 2018 Copy no. 1

Originator: JAr

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

Dynasafe BACTEC Limited

Unit 3, The Courtyard, Campus Way, Gillingham Business Park, Gillingham, Kent, ME8 0NZ

Tel: +44 (0)1634 471340

Email: bactec.info@dynasafe.com

www.bactecuxo.com

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Glossary of Terms

AAA	Anti-Aircraft Artillery
ARP	Air-raid Precautions
BDO	Bomb Disposal Officer
EOD	Explosive Ordnance Disposal (current term for “bomb” disposal)
HE	High Explosive
HG	Home Guard
IB	Incendiary Bomb
kg	Kilogram
LCC	London County Council
LM	Land Mine
LSA	Land Service Ammunition (includes grenades, mortars, etc.)
Luftwaffe	German Air Force
m bgl	Metres Below Ground Level
MoD	Ministry of Defence
OB	Oil Bomb
PM	Parachute Mine
RAF	Royal Air Force
SI	Site Investigation
SAA	Small Arms Ammunition (small calibre cartridges used in rifles & machine guns)
UXB	Unexploded Bomb
UXO	Unexploded Ordnance
V-1	“Doodlebug” the first cruise type missile, used against London from June 1944. Also known as ‘Flying Bomb’.
V-2	The first ballistic missile, used against London from September 1944
WWI	First World War (1914 -1918)
WWII	Second World War (1939 – 1945)

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Executive Summary

THE SITE:	
Address	Orchard St, Dartford, DA1 1BG, UK
OS National Grid Reference	TQ 54067 74165
Details	The site comprises a large open area in central Dartford, bound to the east by Kent Road, to the west by Hythe Street, to the north by residential and commercial developments, and to the south by Spital Street. The east and west of the site are occupied by a hard surfaced car park and a large area of open brownfield land respectively. The south of the site is occupied by open ground and the façade of a demolished row of commercial buildings. Orchard street runs though the centre of the site, north to south.
PROPOSED WORKS:	
Development onsite includes construction of 140 residential units, a 6-screen cinema, a 109 bedroom hotel, a multi-storey car park and commercial space with bars and restaurants. Piling foundations are expected, however no basement excavation will be required. Maximum depth of ground works was unknown at the time of writing.	
Risk Assessment Methodology: In accordance with CIRIA guidelines this assessment has carried out research, analysed the evidence and considered the risks that the site has been contaminated with unexploded ordnance; that such items remained on site; that they could be encountered during any intrusive works and the consequences that could result. Appropriate risk mitigation measures have been proposed.	
Explosive Ordnance Risk Rating	***LOW*** and ***MEDIUM*** zones
Risk Map	***Annex N***
ELEVATED RISK OF CONTAMINATION FROM GERMAN AIR-DELIVERED UXO:	
• The Dartford area was repeatedly bombed during WWII. This was due to a number of known bombing targets within the area, and the site's proximity to London. Additionally, the use of the Thames as a navigational aid into central London made it vulnerable to 'tip and run' incidents. • Consequently the site occupied an area of high bombing density, as confirmed by official statistics and mapping. A consolidation of historical records indicates 1 HE strike onsite, with a further 19 within 300m of the site. • Clearance consistent with the HE strike onsite is visible in post-war OS mapping and Aerial photography. Further clearance and redevelopment is present in the east of the site. • Furthermore, whilst clearance in the east of the site is partially attributed to the demolishment of the brewery in 1939, ground disturbance in aerial photography suggests possible bomb damage. Note, this clearance is in-line with a stick of HE bombs which fell on and to the west of the site.	

- It is therefore probable that a degree of rubble and debris was present on the site for the remainder of the war. This would have increased the likelihood of a UXB falling on site unnoticed and the subsequent entry hole going unobserved. This is especially pertinent as all major raids over Kent & Greater London occurred at night.
- It is conceivable therefore that had a UXB fallen on the study area it could have remained undetected. Note that the entry hole of an SC50 (the most commonly deployed German HE bomb) could have been as little as 20cm in diameter and therefore easily obscured within soft ground or rubble.
- Had such an incident occurred, the weapon could have eventually come to rest beneath neighbouring undamaged buildings or hard-standing due to the 'J-Curve Effect'.

MINIMAL RISK OF UXO CONTAMINATION FROM GERMAN AIR-DELIVERED UXO

- Historical evidence shows that the site was situated in a densely populated area and was partly occupied by a number of terraced properties during the war. Whilst these buildings may have experienced blast damage from nearby HE strikes, it is unlikely that they would have been abandoned as a result of this. A commercial building in the southernmost extent of the site also appears to have survived the war undamaged.
- Consequently, these parts of the site would have remained inhabited / in use throughout the war and the bombing campaign, suggesting properties would have been frequently and fully accessed.
- Therefore, a UXB strike to undamaged buildings / roadways onsite would have caused substantial / obvious damage (even without detonating) or a persistent, easily identifiable entry hole, which would have been reported at the time and the UXB subsequently removed. Consequently, the chance that a UXB landed unnoticed in these parts of the site is considered highly unlikely.

RISK OF CONTAMINATION FROM BRITISH / ALLIED UXO:

Land Service Ammunition / Small Arms Ammunition	No evidence has been found to suggest that the site formerly had any British / Allied military occupation or usage that could have led to contamination with items of UXO.
Anti-Aircraft Projectiles	Five HAA batteries were situated within a 5km radius of the site during WWII. For the same reasons as given above, it is conceivable that an unexploded AA shell or rocket strike could have remained undetected on site.

THE RISK THAT UXO REMAINS ON SITE

Within the footprints of the post-war redevelopment / ground works, the risk of shallow buried UXO (especially AA shells and German 1kg incendiaries) remaining will have been partially mitigated since any such items could have been encountered and removed during soil stripping and levelling. Given the degree of post-war development onsite, it is likely that the risk from shallow buried UXO has been partially mitigated during shallow ground works.

Only within the volume of any post-war basement level bulk excavations and at the precise locations of any post-war pile foundations / boreholes, will the risk from deeper buried German HE UXBs have been completely mitigated. Whilst extensive post-war development has occurred onsite, the depth and location of any piling, or the occurrence of any bulk excavations, is unknown.

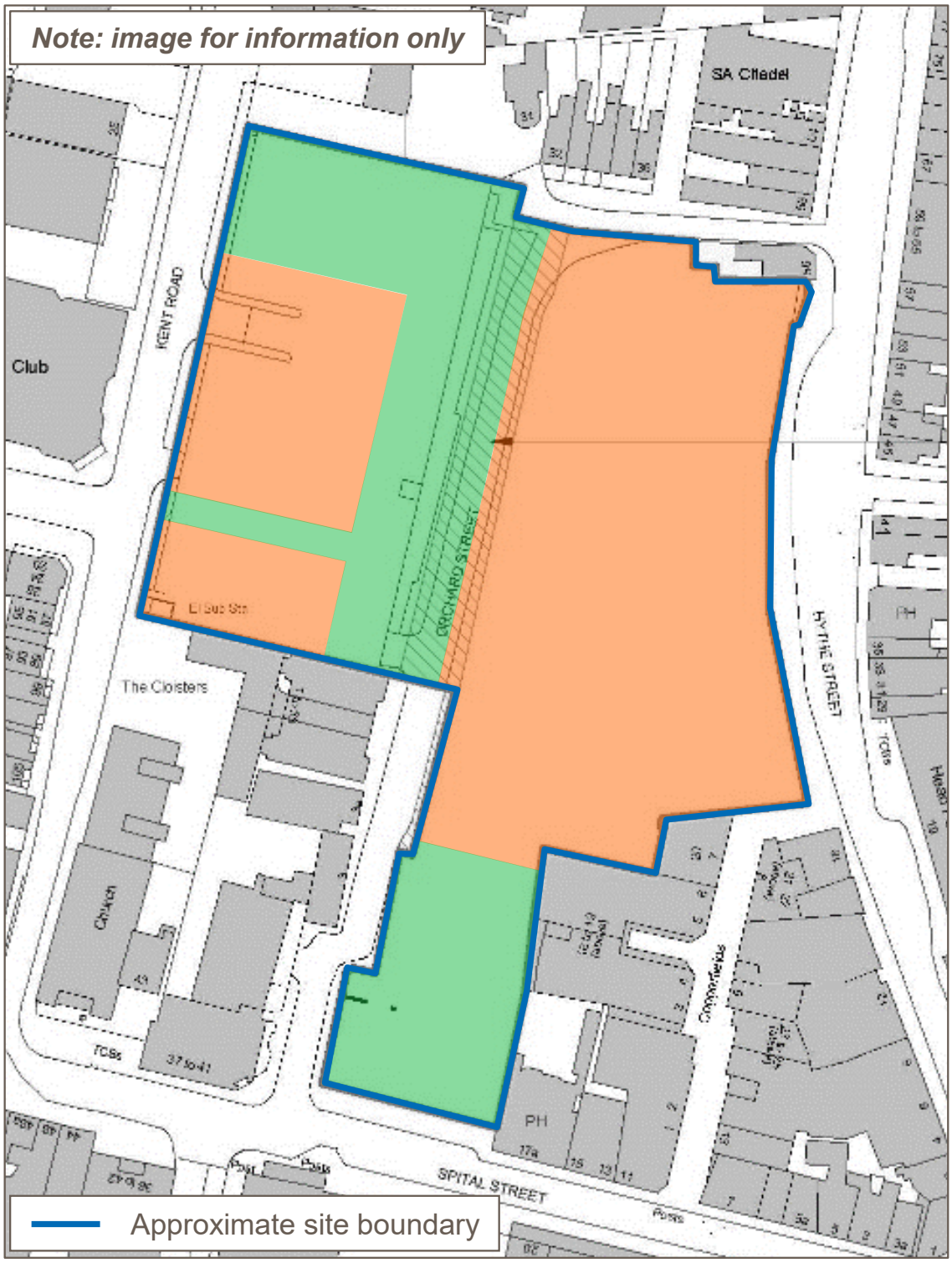
BOMB PENETRATION ASSESSMENT

It has been assessed that a 500kg bomb would have had an approximate maximum bomb penetration depth of between **8-10m** below WWII ground level. Penetration depth could potentially have been greater if the UXB was larger (though only 4% of German bombs used in WWII over Britain were of that size). Note that UXBs may be found at any depth between just below the WWII ground level and the maximum penetration depth.

RECOMMENDED RISK MITIGATION MEASURES:	*Low Risk Zone*	*Medium Risk Zone*
Site Specific Explosive Ordnance Safety and Awareness Briefings to all personnel conducting intrusive works	✓	✓
The Provision of Unexploded Ordnance Site Safety Instructions	✓	✓
Explosive Ordnance Disposal (EOD) Engineer presence on site to support shallow intrusive works	×	✓
Handheld Intrusive Magnetometer Survey of all borehole locations down to the maximum bomb penetration depth	×	×
Non-Intrusive Magnetometer Survey and Target Investigation (greenfield land only)	×	×
Intrusive Magnetometer Survey of all pile locations down to the maximum bomb penetration depth	×	✓

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

Risk Map



Low Risk Zone

- Buildings / roadways which survived WWII intact

Medium Risk Zone

- Areas of significant bomb damage / clearance
- Areas of open ground during WWII
- Buffer area to account for the J-Curve Effect

Annexes

Explosive Ordnance Threat Assessment

In Respect of

Orchard Street, Dartford

1 Introduction

1.1 Background

TPS Ltd has commissioned Dynasafe BACTEC Limited to conduct an Explosive Ordnance Threat Assessment of Orchard Street, Dartford.

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

One of the legacies of this conflict is buried unexploded air-dropped bombs or anti-aircraft projectiles resulting from the failure of a proportion of the weapons to function as designed. It is commonly accepted that the failure rate of these munitions was approximately 10% and, depending on their shape, weight, velocity and ground conditions, many penetrated the ground and came to rest at depth.

In addition, it is estimated that over 20% of the UK landmass has been used by the military at some point and between 2006 and 2009, over 15,000 items of British / Allied ordnance (excluding small arms ammunition) were found on UK construction sites (CIRIA).

Intensive efforts were made during and after the war to locate and render safe all UXO but, unsurprisingly, not all were found and dealt with. This is evidenced by the regular, on-going discoveries of UXO during construction-related intrusive ground works.

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

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

2 Construction Industry Duties and Responsibilities

2.1 The UK Regulatory Environment

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

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

2.2 The Health and Safety at Work Act, 1974

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

2.3 Construction (Design and Management) Regulations 2015

CDM 2015 ensures that health and safety within the construction industry is continually improved:

- Works are sensibly planned and managed.
- Competent staff are engaged in the works.
- Risks are identified and managed.
- All parties cooperate and coordinate activities.
- Communication flows to those who require it.
- Workers are consulted and engaged about risks and how they are being managed.

In line with CDM 2015 legislation, Dynasafe BACTEC Limited are able to assist parties in their discharge of CDM duties as follows:

- Assist Principal Designers with pre-construction information and risk assessments
- Assist the Designer with the Designer's Risk Assessment.
- Issue UXO risks as have been identified and manage risks accordingly.
- Assist the Principal Contractor with the construction phase information, in particular risk assessments and mitigation strategies.
- Plan, manage and monitor survey and clearance works under Dynasafe BACTEC Limited's control.

2.4 Other Legislation

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

3 The Role of the Authorities and Commercial Contractors

3.1 The Authorities

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

The priority given to the request by JSEODOC will depend on their judgement of the nature of the threat (ordnance, location, people and assets at risk) and the availability of resources. They will respond immediately or as resources are freed up. Depending on the on-site risk

assessment the item of ordnance may be removed or demolished (by controlled explosion) in situ. In the latter case additional cordons and/or evacuations may be necessary.

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

3.2 Commercial Contractors

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

4 This Report

4.1 Aims and Objectives

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

4.2 Risk Assessment Methodology

The following issues will be addressed in the report:

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

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

4.3 Approach

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

- Evidence of German bombing and delivery of UXBs.
- Site history, occupancy and conditions during WWII.
- The legacy of Allied military activity.
- Details of any known EOD clearance activity.

- The extent of any post war redevelopment.
- Scope of the current proposed works.

4.4 Sources of Information

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

Material from the following sources has been consulted:

- The National Archives.
- Kent History & Library Centre.
- Centre for Kentish Studies.
- Britain From Above.
- Groundsure Limited.
- Relevant information supplied by the client.
- Available material from 33 Engineer Regiment (EOD) Archive.
- Dynasafe BACTEC's extensive archives built up over many years of research and hands-on Explosive Ordnance Disposal activities in the UK.
- Open sources such as published books, local historical records and the internet.

4.5 Reliability of Historical Records

4.5.1 General Considerations

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

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

4.5.2 Bombing Records

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

Records of raids that took place on sparsely or uninhabited areas were often based upon third party or hearsay information and are not always reliable; records of attacks on military

or strategic targets were often maintained separately from the general records and have not always survived.

5 The Site and Scope of Proposed Works

Site Address	Orchard St, Dartford, DA1 1BG, UK
National Grid Reference Centre Point	TQ 54067 74165
Site Description	The site comprises a large open area in central Dartford, bound to the east by Kent Road, to the west by Hythe Street, to the north by residential and commercial developments, and to the south by Spital Street. The east and west of the site are occupied by a hard surfaced car park and a large area of open brownfield land respectively. The south of the site is occupied by open ground and the façade of a demolished row of commercial buildings. Orchard street runs though the centre of the site, north to south.
Proposed Works	Development onsite includes construction of 140 residential units, a 6-screen cinema, a 109 bedroom hotel, a multi-storey car park and commercial space with bars and restaurants. Piling foundations are expected, however no basement excavation will be required.
Maximum Depth of Ground Works	Unknown at the time of writing.
Site Location Maps, a Recent Aerial Photograph of the site and a Current Site Plan are presented in ***Annexes A***, ***B and C***.	

6 Ground Conditions

Data Source		**Description**
British Geological Survey Borehole	**Borehole Reference**	TQ57SW175
	Location	45m east
	Date	July 1976
	Recorded Shallow Geology	• 0.5m of Made Ground (concrete with soil and chalk rubble). • ≥ 4.5m of Brown Gravel and Sand.
British Geological Survey Mapping	**Superficial Deposits**	Alluvium - Clay, Silt, Sand and Gravel.
	Bedrock	Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation (undifferentiated).
Client Provided Data	**n/a**	n/a

7 Site History

7.1 Pre-WWII

The following pre-WWII OS map was reviewed.

Date	1938	**Scale**	1:2,500	**Source**	Groundsure Ltd
Observations	• Rows of terraced housing with private gardens occupy the west and east of the site. • A *Brewery* and adjoining buildings occupy the centre and south of the site. • A large ambiguous building, likely a warehouse, occupies the southernmost extent of the site. • The surrounding area is residential and commercial in nature.				
*A section of the map showing the site and immediate surrounding area is presented in **Annex D-1**.*					

7.2 Post-WWII

The following post-WWII OS map was reviewed.

Date	1961	**Scale**	1:1,250	**Source**	Groundsure Ltd
The following are indicative of serious bomb damage on early post-WWII OS mapping:					
Ruins	×	n/a			
Clearance	✓	• The entirety of the brewery has been cleared (anecdotal evidence however suggests that it was demolished in 1939, prior to start of the German bombing campaign[1]). • All the residential properties fronting *Hythe Street* have been cleared. • Seven of the properties fronting *Kent Road* have been cleared. • Further clearance is present west and south of the site.			
Redevelopment	✓	• Land previously occupied by the brewery has been partly redeveloped into several smaller buildings a single larger structure.			
Further Observations	• The majority of the west of the site appears to have remained intact.				
*A section of the map showing the site and immediate surrounding area is presented in **Annex D-2**.*					

[1] *http://breweryhistory.com/wiki/index.php?title=C_N_Kidd_%26_Son_Ltd*

8 The Threat from Aerial Bombing

8.1 General Bombing History of Dartford & Kent

8.1.1 First World War

London and Eastern England suffered aerial bombardment during WWI, beginning with indiscriminate night raids by Zeppelin airships. However as British defensive measures became more effective and aircraft development progressed, the German military switched to daylight raids by fixed wing aircraft in June 1917.

A consolidated WWI air raid map of the UK (not annexed) shows that the wider Dartford area was bombed, however no specific records of bombing were located. Note, the small scale of this map and the lack of geographical indicators means it is not possible to confirm the precise location of the site. The Thames Ammunition Works was located approximately 870m west of the site during WWI, and was a likely target for aerial bombing.

WWI bombs were generally smaller than those used in WWII and were dropped from a lower altitude, resulting 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. When combined with the relative infrequency of attacks and an overall low bombing density the threat from WWI UXBs is considered low and will not be further addressed in this report.

8.1.2 Second World War

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

As the war progressed, the strategy changed to one of attempting to destroy the morale of the civilian population by the “carpet bombing” of London. The Blitz on London began on 7th September 1940 with concentrated attacks coming to an end in May 1941 as the Luftwaffe was diverted east to prepare for ‘Operation Barbarossa’; the invasion of the Soviet Union.

During 1942 and 1943, there were a number of minor raids carried out by small formations of fighter bombers and then between January and May 1944 the Luftwaffe returned to Greater London in mass, for Operation Steinbock. These raids were executed by inexperienced Luftwaffe crews and were less frequent when compared to the original Blitz of 1940/41. In the rush to ready new air crews however, many were sent on raids with little training and therefore navigation and bombing accuracy were poor, resulting in unsustainable Luftwaffe losses and numerous aircraft dropping their bomb loads over the Home Counties, including Kent.

The Dartford area was repeatedly bombed during WWII. This was due to a number of known bombing targets within the area, including the Vickers TNT, the Portland Cement Works and Joyce Hospital. Note that the Luftwaffe believed the latter was actually an RAF base. Furthermore, Littlebrook Power Station is known to have sustained numerous bomb strikes throughout the war.

In addition, the site’s proximity to London, and the use of the Thames as a navigational aid into central London made it vulnerable to ‘tip and run’ incidents. These bomb strikes occurred when German aircraft, harassed by concentrated anti-aircraft fire and / or fighter interception, dropped their bombs prematurely / indiscriminately in order to escape the combat zone.

In Dartford, 566 HE bombs (plus 12,000 1kg IBs) resulted in damage to over 13,000 houses and the loss of 150 lives, with another 700 injured. During the autumn of 1940 (from 25th August to 23rd November), bombs fell on Dartford 69 out of a possible 90 days.

From mid-1944 the "V-weapon" (for Vengeance) campaign, using unmanned cruise missiles and rockets, represented Hitler's final attempt to reverse Germany's imminent defeat. The V1 (Flying Bomb or Doodlebug) and the V2 (Long Range Rocket) were launched from bases in Germany and occupied Europe. Totals of 2,419 V1s and 517 V2s were recorded in the London Civil Defence region.

Although these weapons caused considerable destruction, their relatively low numbers allowed accurate records of strikes to be maintained and these records have mostly survived. There is a negligible risk from unexploded V-weapons on land today since, even if an unexploded 1,000kg warhead had survived impact, the remains of the munition's body would have left incontrovertible evidence of the strike and would have been dealt with at the time.

8.2 Generic Types of WWII German Air-delivered Ordnance

The nature and characteristics of the ordnance used by the Luftwaffe allows an informed assessment of the hazards posed by any unexploded items that may remain today. Detailed illustrations of German air-delivered ordnance are presented at ***Annex E***.

- HE Bombs: In terms of weight of ordnance dropped, HE bombs were the most frequent weapon deployed. Most bombs were 50kg, 250kg or 500kg (overall weight, about half of which was the high explosive) though large bombs of up to 2,000kg were also used. HE bombs had the weight, velocity and shape to easily penetrate the ground intact if they failed to explode. Post-raid surveys would not always have spotted the entry hole or other indications that a bomb penetrated the ground and failed to explode and contemporary ARP documents describe the danger of assuming that damage, actually caused by a large UXB, was due to an exploded 50kg bomb. Unexploded HE bombs therefore present the greatest risk to present–day intrusive works.
- Blast Bombs/Parachute Mines: Blast bombs generally had a slow rate of descent and were extremely unlikely to have penetrated the ground. Non-retarded mines would have shattered on most ground types, if they had failed to explode. There have been extreme cases when these items have been found unexploded, but this was where the ground was either very soft or where standing water had reduced the impact. Dynasafe BACTEC does not consider there to be a significant threat from this type of munition on land.
- Large incendiary bombs: This type of bomb ranged in size from 36kg to 255kg and had a number of inflammable fill materials (including oil and white phosphorus), and a small explosive charge. They were designed to explode and burn close to the surface but their shape and weight meant that they did have penetration capability. If they penetrated the ground, complete combustion did not always occur and, in such cases, they remain a risk to intrusive works.
- 1kg Incendiary Bombs (IB): These bombs, which were jettisoned from air-dropped containers, were unlikely to penetrate the ground and in urban areas would usually have been located in post-raid surveys. However, if bombs did not initiate and fell in water or dense vegetation or became mixed with rubble in bomb damaged areas they could have been overlooked. Some variants had explosive heads and these present a risk of detonation during intrusive works.
- Anti-personnel (AP) Bomblets: AP bombs 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.

- Specialist Bombs (smoke, flare, etc): These types do not contain high explosive and therefore a detonation consequence is unlikely. They were not designed to penetrate the ground.

8.3 German Air-delivered Ordnance Failure Rate

Based on empirical evidence, it is generally accepted that 10% of the German HE bombs dropped during WWII failed to explode as designed. This estimate is probably based on the statistics of wartime recovered UXBs and therefore will not have taken account of the unknown numbers of UXBs that were not recorded at the time and is probably an underestimate.

The reasons for failures include:

- Fuze or gaine malfunction due to manufacturing fault, sabotage (by forced labour) or faulty installation.
- Clockwork mechanism failure in delayed action bombs.
- Failure of the bomber aircraft to arm the bombs (charge the electrical condensers which supplied the energy to initiate the detonation sequence) due to human error or equipment defect.
- Jettison of the bomb before it was armed or from a very low altitude. Most likely if the bomber was under attack or crashing.

War Office Statistics document that a daily average of 84 bombs which failed to function were dropped on civilian targets in Great Britain between 21st September 1940 and 5th July 1941. 1 in 12 of these (probably mostly fitted with time delay fuzes) exploded sometime after they fell; the remainder were unintentional failures.

From 1940 to 1945 bomb disposal teams dealt with a total of 50,000 explosive items of 50kg and over (i.e. German bombs), 7,000 AAA shells and 300,000 beach mines. These operations resulted in the deaths of 394 officers and men. However, UXO is still regularly encountered across the UK (see recent press articles, ***Annex F-1***).

8.4 UXB Ground Penetration

8.4.1 General Considerations

The actual penetration depth of aerial delivered bombs into the ground will have been determined by the mass and shape of the bomb, the velocity and angle of the bomb on impact (dependent on the height of release) and the nature of the ground and ground cover; the softer the ground, the greater the potential penetration. Peat, alluvium and soft clays are easier to penetrate than gravel and sand. Bombs are brought to rest or are commonly deflected by bedrock or large boulders.

8.4.2 The “j” Curve Effect

An air-dropped bomb falling from normal bombing altitude (say 5,000m) into homogeneous ground will continue its line of flight but turn in an upwards curve towards the surface as it comes to rest. This offset from vertical is generally thought to be about one third of the penetration depth but can be up to 15m depending on ground conditions or the bomb’s angle of impact.

8.4.3 Second World War Bomb 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, mostly in the London area. They then came to conclusions as to the likely average and maximum depths of penetration of different sized bombs in different geological strata.

The median penetration of 430 x 50kg German bombs in London Clay was 4.6m and the maximum penetration observed for the SC50 bomb was 9m.

They concluded that the largest common German bomb, 500kg, had a likely penetration depth of 6m in sand or gravel but 8.7m in clay. The maximum observed depth for a 500kg bomb was 10.2m and for a 1,000kg bomb 12.7m. Theoretical calculations suggested that significantly greater penetration depths were probable.

8.5 Initiation of Unexploded Bombs

Unexploded bombs do not spontaneously explode. All high explosive requires significant energy to create the conditions for detonation to occur. In the case of unexploded German bombs discovered within the construction site environment, there are a number of potential initiation mechanisms:

- Direct impact onto the main body of the bomb: 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) to initiate a buried iron bomb. Such violent action can cause the bomb to detonate.
- Re-starting the clock timer in the fuze: Only a small proportion of German WWII bombs employed clockwork fuzes. It is probable that significant corrosion has taken place within the fuze mechanism over the last 60 years that would prevent clockwork mechanisms from functioning, nevertheless it was reported that the fuze in a UXB dealt with by 33 EOD Regiment in Surrey in 2002 did re-commence.
- Induction of a static charge, causing a current in an electric fuze: The majority of German WWII bombs employed electric fuzes. It is probable that significant corrosion has taken place within the fuze mechanism over the last 60 years such that the fuze circuit could not be activated.
- Friction impact initiating the (shock-sensitive) fuze explosive: This is the most likely scenario resulting in the bomb detonating.

Annex F-2 details UXB incidents where intrusive works have caused UXBs to detonate, resulting in death or injury and damage to plant.

8.6 Second World War Bombing Statistics

The following table summarises the quantity of German bombs (excluding 1kg incendiaries and anti-personnel bombs) falling on the Municipal Borough of Dartford between 1940 and 1945:

Record of German Ordnance Dropped on the Municipal Borough of Dartford	
Area Acreage	4,233
High Explosive Bombs (all types)	566

Parachute Mines	-
Oil Bombs	10
Phosphorus Bombs	23
Fire Pots	-
Pilotless Missile (V1)	13
Long Range Rocket (V2)	-
Total	612
Items Per 1,000 Acres	**144.6**

Source: Home Office Statistics

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 incendiaries are not particularly significant in the threat they pose, they nevertheless are items of ordnance that were designed to cause damage and inflict injury and should not be overlooked in assessing the general risk to personnel and equipment. The anti-personnel bombs were used in much smaller quantities and are rarely found today but are potentially more dangerous. This table does not include UXO found during or after WWII.

Statistics listed within *Kent at War* (B.Ogley, 1994) record 553 HE bombs within the Municipal Borough of Dartford, as well as approximately 11,982 1kg IBs, suggesting a marginally lower bombing density.

8.7 Site Specific WWII Bombing Records

8.7.1 Dartford Consolidated Bomb Plot Map

A review was conducted of the Dartford Consolidated Bomb Plot Map. The map depicts all recorded bomb strikes on the central Dartford throughout WWII.

Note, this map should not be considered a comprehensive record of all incidents that occurred in the area during WWII as records may have been lost, discarded or destroyed post-war.

Bomb Plot Maps were reviewed for:	Municipal Borough of Dartford
Source:	National Archives
Records of bombing on / near the site were found	✓

Weapon	**Approximate distance from site**
HE bomb	Onsite
HE bomb	20m west
HE bomb	90m west

HE bomb	140m southwest
14 x HE bomb	14 further HE strikes recorded within 300m of the site.
*An extract of the map, showing bomb strikes on and in the immediate vicinity of the site, is presented in **Annex G**.*	

8.7.2 Original ARP Bombing Incident Records

Throughout WWII, records of bombing incidents were kept by the ARP and Civil Defence Office. These records were kept in the form of typed or hand-written notes and/or presented on bomb plot maps. Some other organisations, such as port authorities and railways, maintained separate records.

Note that the below list not be considered a comprehensive record of all incidents that occurred in the area during WWII as records may have been lost, discarded or destroyed post-war.

ARP written records were reviewed for:	Medway Region & Municipal Borough of Dartford
Source:	Kent History & Library Centre / Centre for Kentish Studies
Records of bombing on / near the site were found	✓

Ref	Date	Weapon	Location	Remarks / Map Ref
-	20/09/1940	Suspected Double Action bomb	Spital and Hythe Road.	No Reference. Roads closed.
1	29/09/1940	UX HE	Not specified.	Map Ref 981/923. UXO removed.
-	12/11/1940	16 x HE	Not specified.	Map Ref 981/927 to 983/936.
2	12/11/1940	UX HE	Not specified.	Map Ref 982/932. UXO destroyed.
3	15/11/1940	1 x HE	Paper Mill.	Map Ref 981/937. Water main burst.
4	15/11/1940	1 x HE	Not specified.	Map Ref 982/933.
5	15/11/1940	IBs	Paper Mill.	Map Ref 981/939. Several fires.
6	13/01/1941	UX AA Shell	Not specified.	Map Ref 988/929.
7	23/05/1941	UX AA Shell	Not specified.	Map Ref 984/923. UXO removed.
8	21/01/1944	IBs	Victoria Road.	Map Ref 983/934.
9	21/01/1944	1 x HE	Not specified.	Map Ref 984/934.

10	21/01/1944	IBs	Not specified.	Map Ref 981/936.
11	30/01/1944	2 x Phosphorous IBs	Not specified.	Map Ref 988/928.
12	04/02/1944	AB Container, Type 'G'	Not specified.	Map Ref 978/929. Few houses alight.
13	04/02/1944	AB Container, Type 'G'	Not specified.	Map Ref 978/939. Several small fires, no damage.
14	04/02/1944	AB Container, Type 'G'	Not specified.	Map Ref 980/933. Several small fires, no damage.
15	22/03/1944	AA Shell	St. Albans Road.	Map Ref 992/929.
16	06/08/1944	V1	Carrington Road.	Map Ref 994/930. Damage to 15-20 houses.
17	15/08/1944	V1	By balloon in open fields.	Map Ref 985/939. Damage to 15-20 houses.
*Records accompanied with grid references are plotted onto a WWII period Cassini map of the area, presented in **Annex H**.*				

8.7.3 Secondary Source / Anecdotal Evidence

Anecdotal evidence of local bombing incidents was sought from publications and web resources. The following references to incidents on site or in the surrounding area were found[2].

Date	Weapon	Details
05/09/1940	1 x HE bomb	County Hospital; destroyed women's ward (Approx.320m south-west of site)
19/04/1941	2 x HE bomb	Kent Road; 15 homes destroyed; 150 damaged (Onsite, on western boundary.
06/08/1944	1 x V1	Carrington Road; 20 homes destroyed, 700 damaged (Approx. 800m east)

8.7.4 WWII-era RAF Aerial Photography

The following WWII-era photography of the site was reviewed.

Source	Britain From Above	**Image Type**	Oblique Aerial	**Quality**	Small-scale
Date	2nd July 1946				

[2] *http://www.dartfordarchive.org.uk/20th_century/military_ww2.shtml*

Observations	• A large number of properties and gardens on *Kent Road* have been cleared, both within and to the west of the site. • The main brewery building has been cleared and two smaller buildings with ancillary structures now occupy the area. • All of the properties fronting *Hythe Road* have been cleared. It is not clear if this occurred as part of the demolishment of the *Brewery*, or as consequence of bomb damage.
*This image is presented in **Annex I**.*	

8.7.5 Abandoned Bombs

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

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

Dynasafe BACTEC holds no records of officially registered abandoned bombs at or near the site.	✓
Additional comments:	n/a

8.8 Site Specific Bomb Penetration Considerations

When considering an assessment of the bomb penetration at the site, the following parameters would be used:

- Geology – 0.5m of Made Ground, ≥ 4.5m of Gravel and Sand, Alluvium deposits, Lewes Nodular Chalk Formation.
- Impact Angle and Velocity – 80-90^{O} from horizontal and 267 metres per second.
- Bomb Mass and Configuration – The 500kg SC (General Purpose) HE bomb, without retarder units or armour piercing nose. This was the largest of the common bombs used against Britain.

Taking into account the above-mentioned factors it has been assessed that a 500kg bomb would have had an approximate maximum bomb penetration depth of between **8-10m** below WWII ground level. Penetration depth could potentially have been greater if the UXB was larger (though only 4% of German bombs used in WWII over Britain were of that size). Note that UXBs may be found at any depth between just below the WWII ground level and the maximum penetration depth.

8.9 Likelihood of Post-raid UXO Detection

Utilising the available historical bombing records as reviewed in *Section 8.8*, it is possible to make an assessment of the likelihood that evidence of UXO would have been noted on a site during the war and the incident dealt with or recorded at the time. Factors such as bombing density, frequency of access, ground cover, damage and failure rate have been taken into consideration.

8.9.1 Density of Bombing Assessment:

Bombing density is an important consideration for assessing the possibility that UXBs remain in an area. A very high density of bombs will have increased the likelihood of errors in record keeping at the time, as civil defence personnel and emergency services may have been overwhelmed. A higher density of bombing also increases the number of UXBs actually occurring in a given area.

The type and specific location of recorded bomb strikes is also an important consideration. If a stick of bombs (one individual aircraft's bomb load) is plotted in line with a site or is shown to straddle a site, then this raises the possibility that an unrecorded UXB from the same stick struck that site.

Density of Bombing Assessment	
Based on wartime records or secondary source information, what was the bombing density over the site?	High
Was the site ever subjected to one or more large-scale (>100 tons of ordnance) night time Blitz raids?	✓
Were any HE bomb strikes recorded on site?	✓
What is the distance between the site boundary and the closest recorded large bomb strike?	Onsite
How many HE, Parachute Mine, Oil Incendiary, Phosphorus Incendiary or Fire Pot bombs (large bombs) were recorded within a 300m radius of the site?	20
Were any nearby sticks of large bombs recorded in line with the site?	✓
Were any 1kg incendiary bomb showers recorded over the site?	✗
Additional comments:	n/a

8.9.2 Bomb Damage Assessment:

In Blitzed cities / towns throughout Britain, bomb sites were often not cleared of rubble until after the war and mid-war repairs to buildings were only carried out on the most vital facilities (power stations, gas works, weapons factories etc.). However, if a building only sustained bomb damage to its upper floors, any subsequent UXB strike to the structure will still have caused obvious damage, at ground floor level, which would have been reported and dealt with at the time.

HE bomb strikes to open ground will have resulted in a large crater and local soil disturbance. Any subsequent UXB strike will not have resulted in an easily identifiable entry hole and as such is likely to have gone unnoticed amongst the disturbed ground.

In London and south-east England, the German V1 Flying Bomb and V2 Long Range Rocket campaigns caused widespread devastation. However, as these weapons began to be utilised after the final significant Luftwaffe air raids had occurred, any serious damage caused by such weapons does not necessarily indicate an increased risk of Luftwaffe freefall UXB contamination. However, it is quite possible that serious damage inflicted during the 1940-1944 campaigns by Luftwaffe freefall bombs could have been erased by a subsequent V Weapon strike.

Bomb Damage Assessment	
A comparison of the historical records confirms that buildings within the site boundary sustained serious bomb damage.	✓
Direct or indirect evidence of HE bomb craters in open ground (within the site boundary) has been found.	×
Buildings on site were seriously damaged by a V1 and / or V2 strike.	×
Buildings on site could have been seriously damaged prior to the nearby V1 or V2 strike?	n/a
Additional comments:	n/a

8.9.3 Frequency of Access Assessment:

A UXB strike at a site where human access was infrequent would have had a lower chance of being observed, reported and recorded compared to a site which was developed and subject to regular access. UXB strikes during night time raids (when German planes could more easily evade anti-aircraft defences) are also more likely to have fallen unobserved than ones dropped during a daylight attack.

In frequently bombed cities / towns, ARP Wardens were tasked with carrying out searches for UXBs within recently bombed residential areas and schools. Similarly, many important home front facilities (factories, gas works, power stations, docks etc.) had their own dedicated ARP teams or Fire Watchers tasked with observing local air raids. Fire Watchers were mainly responsible for extinguishing 1kg incendiary bombs as well as reporting any UXB strikes. Anecdotal evidence however indicates that Fire Watchers did not always turn up for their shifts and therefore such UXB mitigating activities should not be assumed in the absence of site specific evidence. Less important buildings sustaining bomb damage would have been abandoned until after the German bombing campaign in that area had ceased and repairs could be made, greatly decreasing the level of access to that site.

Schools closed due to the evacuation of children were often requisitioned by the Civil Defence authorities to be utilised as night time First Aid posts and reception centres (providing emergency accommodation for bombed out civilians). Therefore, an increased level of access is likely at these locations.

Frequency of Access Assessment

The site was situated in a densely populated urban area during WWII and therefore would have been accessed at the outbreak of WWII.	✓
The site was exclusively or partially developed during WWII.	✓
Buildings on site survived WWII intact and therefore likely remained inhabited or in use, suggesting these localities and their immediate environs were accessed throughout the war.	✓
The site was crossed by roads / pavements or footpaths which would have been regularly used / subject to daily footfall.	✓
The site was occupied by small residential back yards / gardens, likely to have been put to use for cultivation as a result of the government's Dig for Victory Campaign.	✓
The site was occupied by a school during WWII.	×
Part of the site is likely to have been subject to post-raid searches for UXO.	✓
Buildings on site sustained serious bomb damage and as a result were likely abandoned (along with any associated gardens / open ground) for the remainder of the war.	✓
The site was occupied by peripheral open ground / wasteland, with no apparent use, which may have been neglected.	Possibly
The site may have been occupied by recreational land / sports fields which may have only experienced seasonal access.	×
The site was occupied by a graveyard which would have experienced limited access.	×
The site was occupied by agricultural land, rural countryside or woodland which would not have been accessed in full, either regularly or frequently.	×
The site was occupied by railway sidings which may not have been as regularly checked for buckling as mainline railway tracks.	×
The site was occupied by soft railway embankments which are likely to have been neglected during the war.	×
Additional comments:	n/a

8.9.4 Ground Cover Assessment:

The entry hole of a 50kg UXB (the most commonly deployed German HE bomb) could have been as little as 20cm in diameter. Wartime records also confirm that small German Incendiary Bombs, weighing just 1kg, were capable of significant penetration into soil, resulting in very small entry holes (5cm) or complete burial.

The quantity and type of ground cover present on a site during WWII would have had a significant effect, at ground level, on the visual evidence of buried UXO.

Evidence of UXO could be obscured in dense vegetation, soft ground, rubble, railway ballast or amongst stockpiled material (such as aggregate, coal or refuse heaps). A UXB strike to waterlogged ground or open water would have been immediately obscured from view beneath the waterline. Had such an incident occurred within a tidal mudflat or river bank, the resulting entry hole will have remained only temporarily, before becoming in-filled by water and sediment. Any HE UXB strike to elevated risk ground cover could potentially have come to rest beneath neighbouring undamaged buildings or hard-standing due to the 'J-Curve' Effect.

UXB strikes to undamaged/superficially damaged buildings and hard-surfaced ground will still have caused substantial damage or an easily identifiable and persistent entry hole. Similarly, it is unlikely that an HE UXB entry hole on well-maintained / manicured lawns (tennis courts, bowling greens, golf course fairways / greens, gardens in affluent areas etc), would have been overlooked. Such incidents would have been reported and the UXB subsequently removed.

Ground Cover Assessment	
The site was partially or entirely abandoned, due to bomb damage, resulting in associated open ground likely becoming overgrown.	✓
The site was occupied by dense, inaccessible vegetation during WWII.	✗
The site may have been susceptible to waterlogged conditions during WWII.	✗
The site was occupied by (possibly) unmaintained grass field during WWII.	✗
The site was part occupied by a canal, river, dock basin, lake or reservoir during WWII.	✗
The site was occupied by tidal mud or marshland during WWII.	✗
The site was occupied by railway tracks crossing soft ground during WWII.	✗
The site was occupied by stockpiled material during WWII.	✗
The site was occupied by buildings, hard-standing or other manmade structures that did not sustain any degree of bomb damage.	✓
A comparison of the historical records confirms that buildings on site sustained inconsequential minor / moderate damage.	Partially
The site was occupied by well-maintained, manicured lawn during WWII.	✗
Undamaged, developed parts of the site would have been vulnerable to the J-Curve Effect.	✓
Additional comments:	n/a

8.9.5 Bomb Failure Rate Assessment:

Based on empirical evidence, it is generally accepted that 10% of the German HE bombs dropped during WWII failed to explode as designed.

Note, due to manufacturing fault or failure of the bomber crew to correctly arm their munitions, whole bomb loads often failed to detonate. Therefore, the presence of reported UXBs increases the likelihood of an additional unrecorded UXB in the vicinity.

Bomb Failure Rate Assessment	
Evidence has been found which suggests that the bomb failure rate in the vicinity of the site would have been different from the "approximately 10%" figure normally used.	✗
Additional comments:	n/a

9 The Threat from Allied Military Ordnance

The following historical and modern facilities / activities / incidents have been found on site or in the surrounding area:

Potential Source of Contamination on Site	
Army, Navy and RAF Bases / Installations	✗
Military Training Areas / Weapons Ranges	✗
Ordnance / Explosives Factories and Storage Depots	✗
Sites Requisitioned for Military Use	✓
Military Fortifications and Coastal Defences	✗
Locations of Army Explosive Ordnance Clearance Tasks	✗
WWII Anti-Aircraft Batteries	✓
WWII Pipe Mined Locations and Beach Minefields	✗

The risk of contamination from Allied UXO on site is discussed below.

9.1 Home Guard Activity

The Home Guard (HG) was a defence organisation of the British Army, operational between 1940 and 1944. It comprised 1.5 million local volunteers, otherwise ineligible for military service and acted as a secondary defence force in case of enemy invasion. The HG guarded the coastal areas of Britain and other important facilities such as airfields, factories and explosives stores. They were also active in county towns and cities.

Official records were rarely kept by the HG and therefore any present-day evidence is usually anecdotal. However, it is known that HG personnel often carried out training (including weapons training) in open countryside on the outskirts of cities / towns. Today, items of ordnance related to the HG are occasionally encountered by members of the public and the construction industry in the British countryside. This suggests a culture of ill-discipline regarding live ammunition within HG units.

HG personnel are known to have purposefully buried caches of ammunition and weapons in tactical positions, to be exhumed and used in case of invasion. Records of such caches were not rigorously kept and some were therefore forgotten about. This is substantiated by several recent HG UXO finds (see ***Annex J***).

Home Guard Activity		
Nearest HG Battalion to the site	18th Kent (Dartford) Battalion	
Site Specific Details	• Although typically HG battalions would take part in training exercises in areas occupied by open countryside, there are several examples of HG units carrying out invasion training in urban areas. • While the possibility of these being carried out on site cannot be discounted, it is considered highly unlikely, and there is no evidence to suggest that the site was occupied / utilised by the HG.	
There is a risk of land service / small arms ammunition contamination on site.		✘

9.1.1 Anti-Aircraft Gun Batteries

At the start of the war two types of AAA guns were deployed: Heavy Anti-Aircraft Artillery (HAA) and Light Anti-Aircraft Artillery (LAA). The LAA batteries were intended to engage fast low flying aircraft and were typically deployed around airfields or strategic installations. These batteries were mobile and could be moved to new positions with relative ease when required. With four guns per battery firing several rounds per minute, AA batteries could expel numerous shells in even the shortest engagements. Numerous unexploded AAA shells were recovered during and following WWII and are still occasionally encountered on sites today.

The maximum ceiling height of fire at that time was around 11,000m however, as the war progressed, improved variants of the 3.7” gun were introduced and, from 1942, large 5.25 inch weapons were brought into service. These had significantly improved ceiling heights of fire reaching over 18,000m.

When the supply of clockwork fuses from Switzerland was cut off, Britain was forced to make its own. After four years of war, the country still lacked the engineering skills to produce a reliable fuse. This resulted in a considerable number of AA projectiles exploding prematurely, killing the gunners or failing to explode at all and falling to the ground as UXBs. In January 1944, more people in London were killed by HAA shells than by German bombs.

Anti-Aircraft Gun Batteries	
Number of HAA batteries within 5km of the site	5

Additional Comments	• Following demolition and clearance onsite, it is likely that much of the site was occupied by a degree of debris and rubble for some time during the war. • In such conditions, it is conceivable that an unexploded AA shell or a rocket strike could have gone undetected into open soft ground, especially during night-time air raids. • It is therefore conceivable that an unexploded AA shell or rocket strike could have remained undetected on site.	
There is a risk of unexploded AA shells contamination on site.		✓

9.2 The Threat Posed by British Unexploded Ordnance

9.2.1 Land Service Ammunition (LSA)

9.2.1.1 General

The term Land Service Ammunition covers all items of ordnance that are propelled, placed or thrown during land warfare. They may be filled or charged with explosives, smoke, incendiary or pyrotechnics. They can be broken into five main groups:

a. Mortars

b. Grenades

c. Projectiles

d. Rockets

e. Landmines

Unexploded or partially unexploded Mortars and Grenades are among the most common items of UXO encountered in the UK and therefore the possibility cannot be discounted that they were stores on site. They are commonly encountered in areas used by the military for training and are often found discarded on or near historic military bases. Examples of Grenades, Mortars and Home Guard weapons are presented in ***Annex K***.

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

9.2.1.2 Mortars

A mortar bomb is a fin-stabilised munition, normally nose-fuzed and fitted with its own propelling charge (primary cartridge). Range is increased by adding extra propellant (augmenting charges). They are either HE or Carrier and generally identified by their tear-dropped shape (older variants however are parallel sided) and a finned ‘spigot tube’ screwed or welded to the rear end of the body housing the propellant charge.

A mortar relies on a striker hitting a detonator for explosion to occur. It is possible that the striker may already be in contact with the detonator and that only a slight increase in pressure would be required for initiation. Discarded augmenting charges are often encountered around mortar firing areas/bases.

9.2.1.3 Grenades

A grenade is a short-range weapon which may be thrown by hand, fired from the end of a rifle or projected/propelled from a special purpose grenade launcher. They are divided into two categories; HE and Carrier (generally smoke). As with mortars, a grenade striker may either be in contact with the detonator or still be retained by a spring under tension, and therefore shock may cause it to function. A grenade can have an explosive range of 15-20m. Common older variants have a classic 'pineapple' shape; modern grenades tend to be smooth-sided.

9.2.2 Small Arms Ammunition (SAA)

The most likely type of ordnance to be encountered on site are items of SAA (bullets), especially .303" ammunition which was the standard British and Commonwealth military cartridge from 1889 until the 1950s.

However even if an item such as this 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.

Some LAA guns and RAF fighter cannons in use with British forces during WWII utilised the 20mm round. These bullets had a small fuse and a ~4gram HE or incendiary charge. Although small, this fill quantity still has the potential to cause serious injury. Images of SAA are presented in ***Annex L***.

9.2.3 Anti-Aircraft Shells

At the start of the war two types of AAA guns were deployed: Heavy Anti-Aircraft Artillery (HAA) using large calibre weapons such as the 3.7" QF (Quick Firing) gun and Light Anti-Aircraft Artillery (LAA) using smaller calibre weapons such as 40mm Bofors gun which could fire up to 120 x 40mm HE shells per minute to over 1,800m. During the early war period there was a severe shortage of AAA so older WWI 3" and modified naval 4.5" guns were also deployed.

These shells are frequently mistakenly identified as small German air-delivered bombs, but are differentiated by the copper driving band found in front of the base. Although the larger unexploded projectiles could enter the ground they did not have great penetration ability and are therefore likely to be found close to WWII ground level. With a HE fill and fragmentation hazard these items of UXO also present a significant risk if encountered.

The smaller 40mm projectiles are similar in appearance and effect to small arms ammunition and, although still dangerous, present a lower risk. Pictures of AAA projectiles are presented in ***Annex M***. Details of the most commonly deployed WWII AAA projectiles are shown below:

Gun type	Calibre	Shell Dimensions	Shell Weight	HE Fill Weight
3.7 Inch	94mm	94mm x 438mm	12.7kg	1.1kg
4.5 Inch	114mm	114mm x 578mm	24.7kg	1.7kg
40mm	40mm	40mm x 311mm	0.84kg	70g

10 Ordnance Clearance and Post-WWII Ground Works

10.1 General

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

10.2 EOD Bomb Disposal and Clearance Tasks

Dynasafe BACTEC holds a number of official records of explosive ordnance disposal operations during and following WWII, obtained from the Explosive Ordnance Disposal (EOD) Archive Information Office at 33 Engineer Regiment (EOD), British Army.

Records were found to indicate that any Army EOD tasks have taken place on site	✗
Further Comments	n/a
Records of recent local ordnance finds were found	✗
Further Comments	n/a
Dynasafe BACTEC Limited have encountered UXO in the local area	✗
Further Comments	n/a

10.3 Post War Redevelopment

The nature of post-WWII ground works, redevelopment and construction has been considered. Significant structural redevelopment on site can, in some cases, provide a level of mitigation, particularly from shallow buried items. However, if a site has not undergone any extent of redevelopment, the risk of UXO remaining within its boundaries can remain.

The site has been redeveloped post-WWII	✓
Further details	• All residential properties fronting Kent Road and Orchard Street were cleared and replaced with a *Multi-storey Car Park* in the early 1970s. • The buildings in the north and east of the site were redeveloped into a single large building in the 1970-80s, identified as a Head Post Office. • Post Office building and the commercial building in the south of the site were cleared in 2013/14, leaving a large area of hard surfaced open ground. • The Multi-storey Car Park was cleared the same year, and was replaced by a ground level hard surfaced car park.

11 The Overall Explosive Ordnance Threat Assessment

11.1 General Considerations

Taking into account the quality of the historical evidence, the assessment of the overall threat to any intrusive works from UXO must evaluate the following risks:

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

11.2 The Risk that the Site was Contaminated with Unexploded Ordnance

For the reasons discussed in *Section 9 and 10* Dynasafe BACTEC believes that there is a elevated risk that UXO contaminated the study area. This is based on the following:

GERMAN AIR-DELIVERED UXO
Elevated Risk
• The Dartford area was repeatedly bombed during WWII. This was due to a number of known bombing targets within the area, and the site's proximity to London. Additionally, the use of the Thames as a navigational aid into central London made it vulnerable to 'tip and run' incidents. • Consequently the site occupied an area of high bombing density, as confirmed by official statistics and mapping. A consolidation of historical records indicates 1 HE strike onsite, with a further 19 within 300m of the site. • Clearance consistent with the HE strike onsite is visible in post-war OS mapping and Aerial photography. Further clearance and redevelopment is present in the east of the site. • Furthermore, whilst clearance in the east of the site is partially attributed to the demolishment of the brewery in 1939, ground disturbance in aerial photography suggests possible bomb damage. Note, this clearance is in-line with a stick of HE bombs which fell on and to the west of the site. • It is therefore probable that a degree of rubble and debris was present on the site for the remainder of the war. This would have increased the likelihood of a UXB falling on site unnoticed and the subsequent entry hole going unobserved. This is especially pertinent as all major raids over Kent & Greater London occurred at night. • It is conceivable therefore that had a UXB fallen on the study area it could have remained undetected. Note that the entry hole of an SC50 (the most commonly deployed German HE bomb) could have been as little as 20cm in diameter and therefore easily obscured within soft ground or rubble. • Had such an incident occurred, the weapon could have eventually come to rest beneath neighbouring undamaged buildings or hard-standing due to the 'J-Curve Effect'.

Minimal Risk	
• Historical evidence shows that the site was situated in a densely populated area and was partly occupied by a number of terraced properties during the war. Whilst these buildings may have experienced blast damage from nearby HE strikes, it is unlikely that they would have been abandoned as a result of this. A commercial building in the southernmost extent of the site also appears to have survived the war undamaged. • Consequently, these parts of the site would have remained inhabited / in use throughout the war and the bombing campaign, suggesting properties would have been frequently and fully accessed. • Therefore, a UXB strike to undamaged buildings / roadways onsite would have caused substantial / obvious damage (even without detonating) or a persistent, easily identifiable entry hole, which would have been reported at the time and the UXB subsequently removed. Consequently, the chance that a UXB landed unnoticed in these parts of the site is considered highly unlikely.	
BRITISH / ALLIED UXO	
Land Service Ammunition / Small Arms Ammunition	No evidence has been found to suggest that the site formerly had any British / Allied military occupation or usage that could have led to contamination with items of UXO.
Anti-Aircraft Projectiles	Five HAA batteries were situated within a 5km radius of the site during WWII. For the same reasons as given above, it is conceivable that an unexploded AA shell or rocket strike could have remained undetected on site.

11.3 The Risk that Unexploded Ordnance Remains on Site

Within the footprints of the post-war redevelopment / ground works, the risk of shallow buried UXO (especially AA shells and German 1kg incendiaries) remaining will have been partially mitigated since any such items could have been encountered and removed during soil stripping and levelling. Given the degree of post-war development onsite, it is likely that the risk from shallow buried UXO has been partially mitigated during shallow ground works.

Only within the volume of any post-war basement level bulk excavations and at the precise locations of any post-war pile foundations / boreholes, will the risk from deeper buried German HE UXBs have been completely mitigated. Whilst extensive post-war development has occurred onsite, the depth and location of any piling, or the occurrence of any bulk excavations, is unknown.

11.4 The Risk that Ordnance may be Encountered during the Works

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

Since an air-dropped bomb may come to rest at any depth between just below ground level and its approximate penetration depth there is also a chance that such an item could be encountered during shallow excavations (for services or site investigations) into the original WWII ground level.

If the proposed works are due to be undertaken within post war fill material / made ground, the risk of encountering WWII UXBs is low. However, if works are to be undertaken below WWII ground level this risk is significantly higher.

11.5 The Risk that Ordnance may be Initiated

The risk that UXO could be initiated if encountered will depend on its condition, how it is found and the energy with which it is struck. The most violent activity on most construction sites is percussive piling. As a result, items that are shallow buried present a slightly lower risk than those that are deep buried, since the force of impact is usually lower and they are more likely to be observed – when immediate mitigating actions can be taken.

11.6 The Consequences of Encountering or Initiating Ordnance

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

Since the risk of initiating ordnance is significantly reduced if appropriate mitigation measures are undertaken, the most important consequence of the discovery of ordnance will be economic. This would be particularly so in the case of high profile locations and could involve the evacuation of the public.

The unexpected discovery of ordnance may require the closing of the site for any time between a few hours and a week with a potentially significant cost in lost time. Note also that the suspected find of ordnance, if handled solely through the authorities, may also involve loss of production since the first action of the Police in most cases will be to isolate the locale whilst awaiting military assistance, even if this turns out to have been unnecessary.

11.7 Dynasafe BACTEC's Assessment

Taking into consideration the findings of this study, Dynasafe BACTEC considers the UXO risk at the site to be heterogeneous and can therefore be divided into areas of ***Low*** and ***Medium*** risk.

Low Risk:

- Buildings / roadways which survived WWII intact

	Level of Risk			
Type of Ordnance	**Negligible**	**Low**	**Medium**	**High**
German High Explosive Bombs		✓		
German 1kg Incendiary Bombs		✓		
British Anti-Aircraft Shells		✓		
British Small Arms and Land Service Ammunition	✓			

Medium Risk:

- Areas of significant bomb damage / clearance
- Areas of open ground during WWII
- Buffer area to account for the J-Curve Effect

	Level of Risk			
Type of Ordnance	**Negligible**	**Low**	**Medium**	**High**
German High Explosive Bombs			✓	
German 1kg Incendiary Bombs		✓		
British Anti-Aircraft Shells		✓		
British Small Arms and Land Service Ammunition	✓			

12 Proposed Risk Mitigation Strategy

Dynasafe BACTEC recommends the following minimum risk mitigation measures be deployed to support the proposed ground works at the site:

Scope-Specific Recommended Risk Mitigation Measures	*Low Risk Zone*	*Med Risk Zone*
Site Specific Explosive Ordnance Safety and Awareness Briefings to all personnel conducting intrusive works		
A specialised briefing is always advisable when there is a possibility of explosive ordnance contamination. It is an essential component of the Health & Safety Plan for the site and conforms to requirements of CDM Regulations 2015. All personnel working on the site should be instructed on the identification of UXB, actions to be taken to alert site management and to keep people and equipment away from the hazard. Posters and information of a general nature on the UXB threat should be held in the site office for reference and as a reminder.	✓	✓
The Provision of Unexploded Ordnance Site Safety Instructions		
These written instructions contain information detailing actions to be taken in the event that unexploded ordnance is discovered. They are to be retained on site and will both assist in making a preliminary assessment of a suspect object and provide guidance on the immediate steps to be taken in the event that ordnance is believed to have been found.	✓	✓
Explosive Ordnance Disposal (EOD) Engineer presence on site to support shallow intrusive works		
When on site the role of the EOD Engineer would include; monitoring works using visual recognition and instrumentation and immediate response to reports of suspicious objects or suspected items of ordnance that have been recovered by the ground workers on site; providing Explosive Ordnance Safety and Awareness briefings to any staff that have not received them earlier and advise staff of the need to modify working practices to take account of the ordnance threat, and finally to aid Incident Management which would involve liaison with the local authorities and Police should ordnance be identified and present an explosive hazard.	✗	✓
Handheld Intrusive Magnetometer Survey of all borehole locations down to the maximum bomb penetration depth	✗	✗

As part of the EOD Engineer presence on site, Dynasafe BACTEC Ltd can deploy intrusive magnetometry techniques to provide staged clearance ahead of all the borehole locations.		
Non-Intrusive Magnetometer Survey and Target Investigation (greenfield land only)		
This survey is carried out using caesium vapour magnetometers linked to a data logger. Data is interpreted using advanced proprietary software which is capable of modelling the magnetic anomalies for mass, depth and location, thus providing information which can be used to locate discrete buried objects that may be ordnance. The system will typically locate buried ordnance to a depth of up to 4m for a 50kg bomb (the smallest HE bomb used by the Luftwaffe) and deeper for larger bombs. Additionally, the survey will locate any buried services with a magnetic signature, will indicate areas of gross magnetic "contamination" (which may indicate unknown underground obstructions) and provide information on archaeological features	✗	✗
Intrusive Magnetometer Survey of all pile locations down to the maximum bomb penetration depth		
Dynasafe BACTEC can deploy a range of intrusive magnetometry techniques to clear ahead of all the pile locations. The appropriate technique is governed 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. A site meeting would be required between BACTEC and the client to determine the methodology suitable for this site. Target investigation or avoidance will be recommended as appropriate.	✗	✓
In making this assessment and recommending these risk mitigation measures, the proposed works outlined in the 'Scope of the Proposed Works' section were considered. Should the planned works be modified or additional intrusive engineering works be considered, Dynasafe BACTEC should be consulted to see if re-assessment of the risk or mitigation recommendations is necessary.		

Dynasafe BACTEC Limited 24th May 2018

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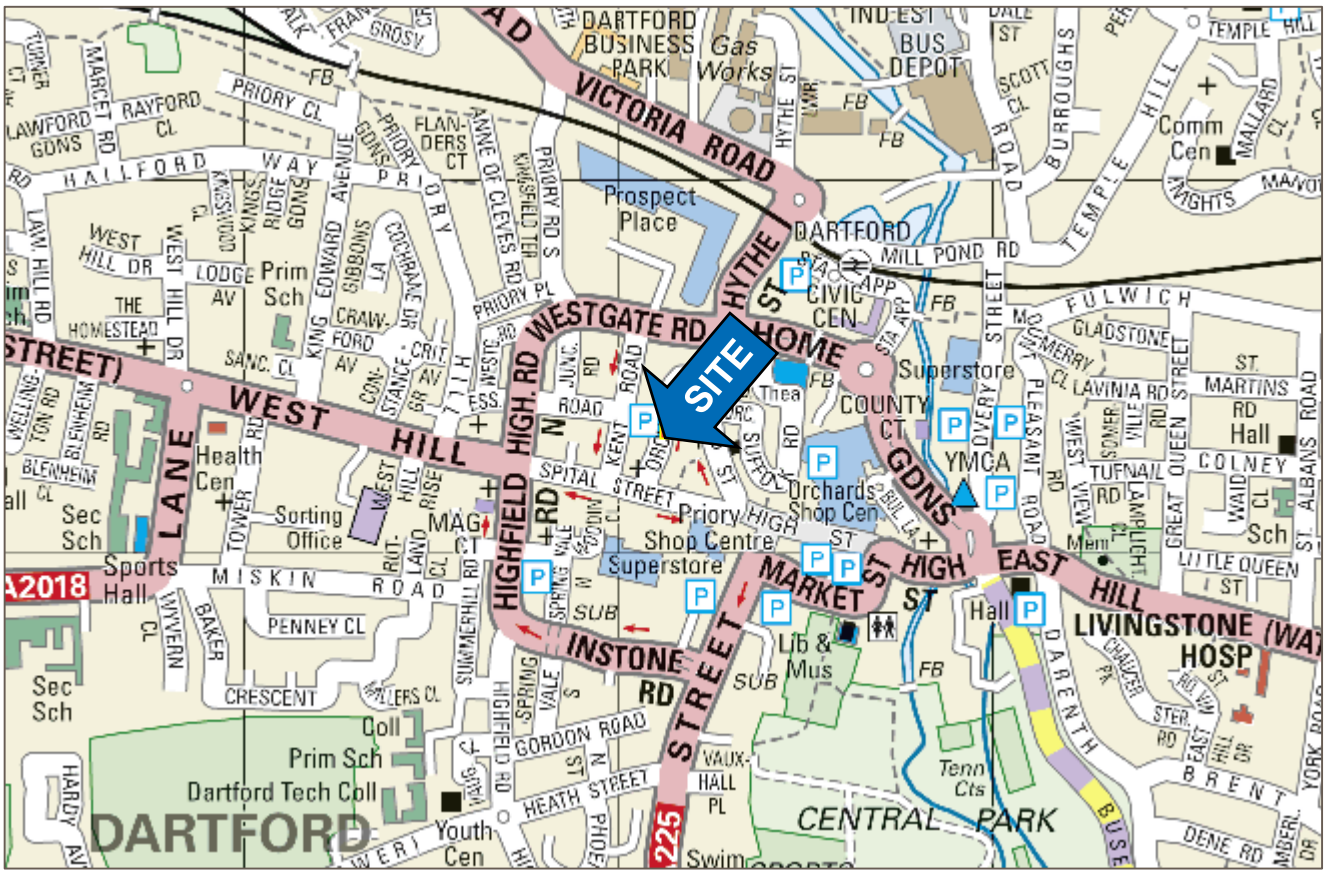
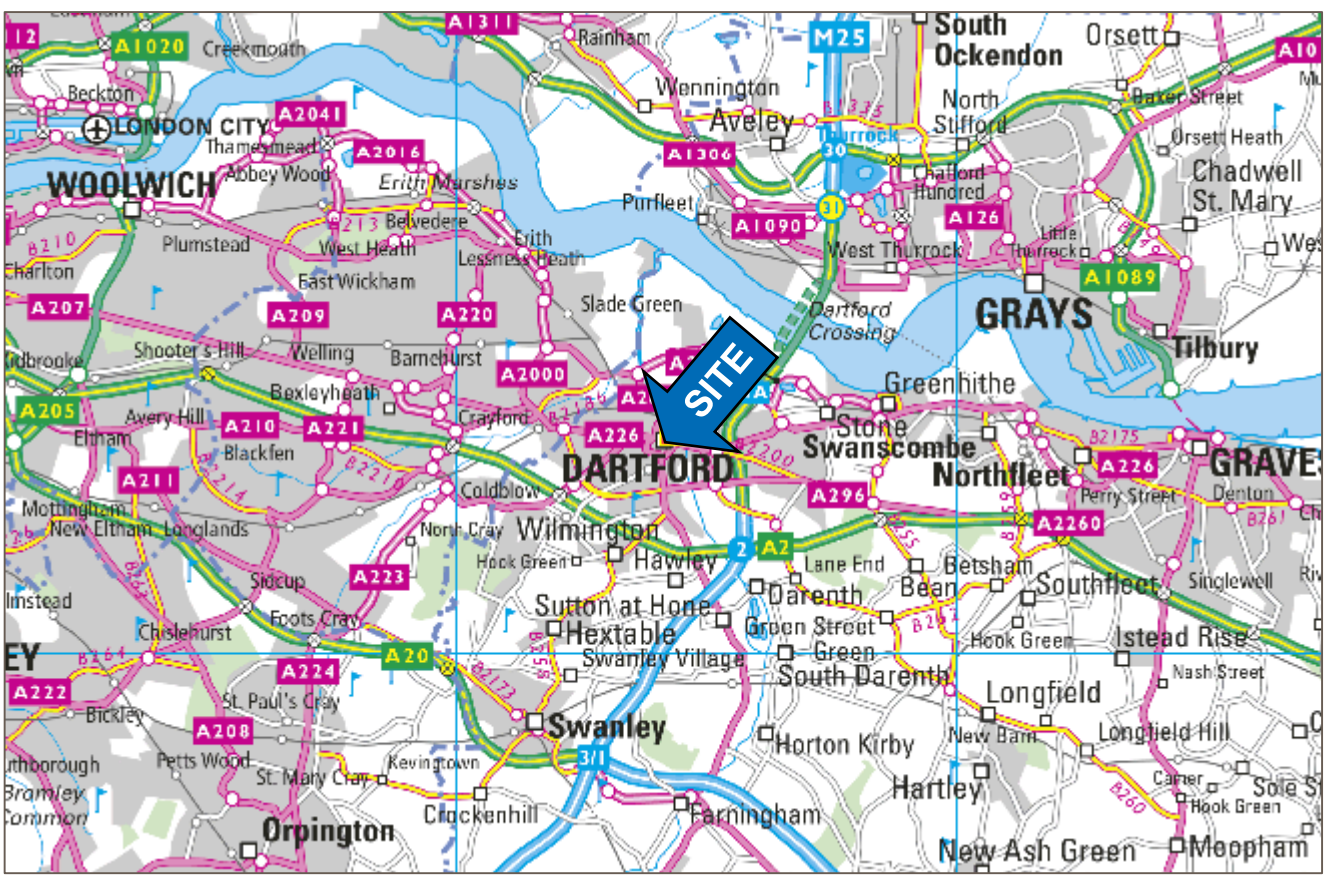
North





Report Reference:	Client:	
7666TA	TPS Ltd	DYNASAFE
	Project: Orchard Street, Dartford	

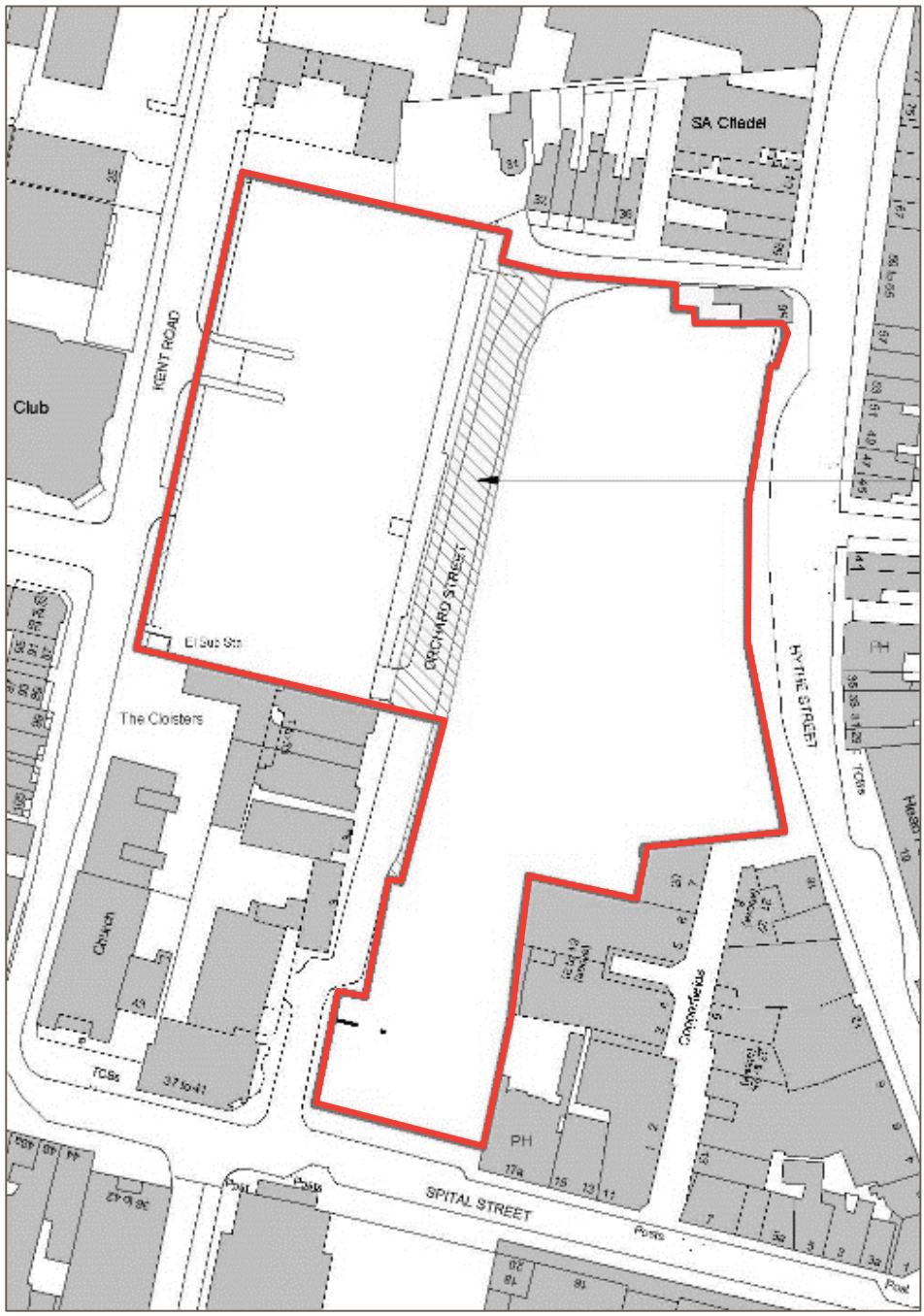
North

Approximate site boundary

Report Reference:	Client:	
7666TA	TPS Ltd	DYNASAFE
	Project: Orchard Street, Dartford	

Source: Google Earth™ Mapping Services

North



Site boundary

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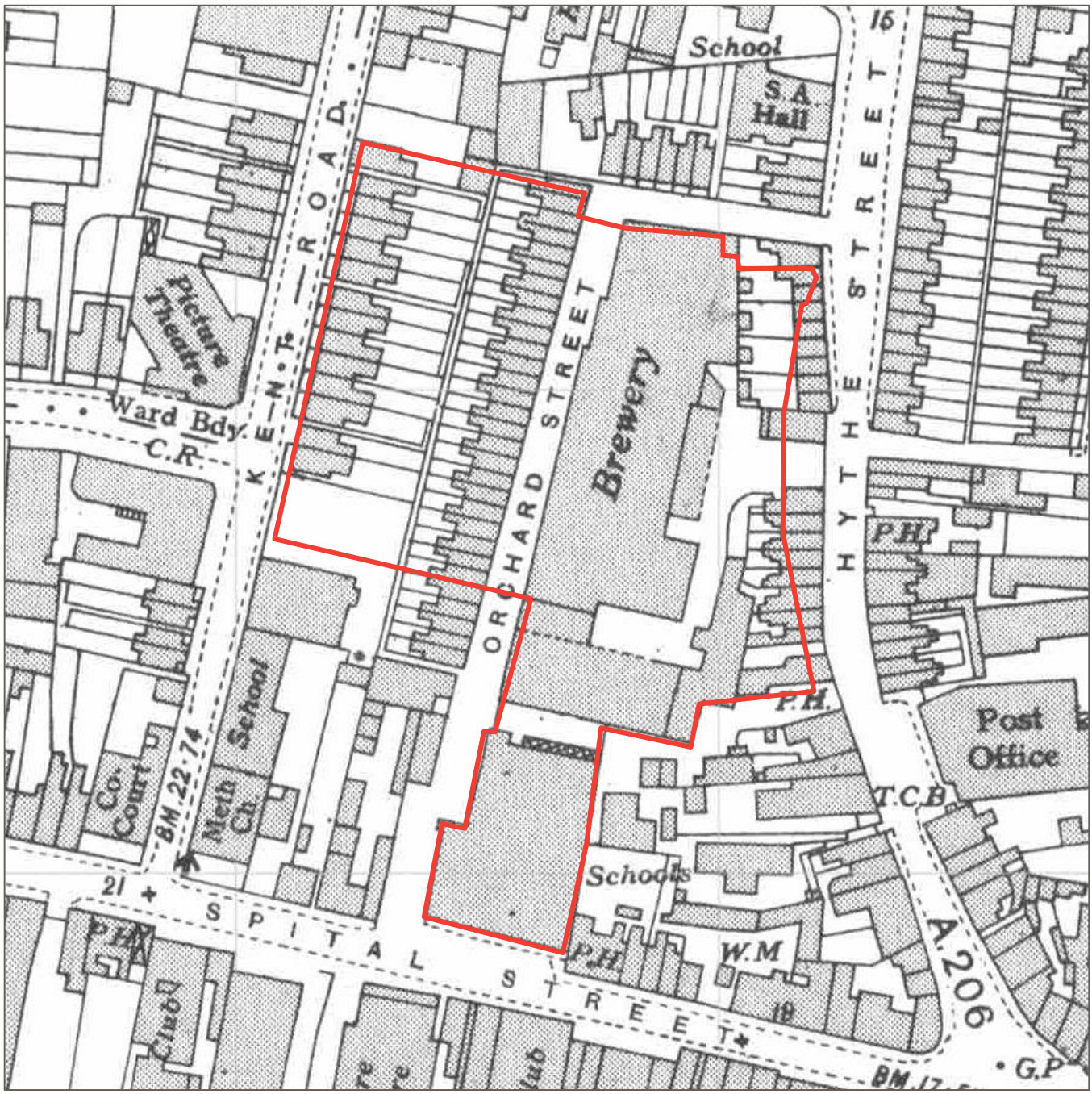
North



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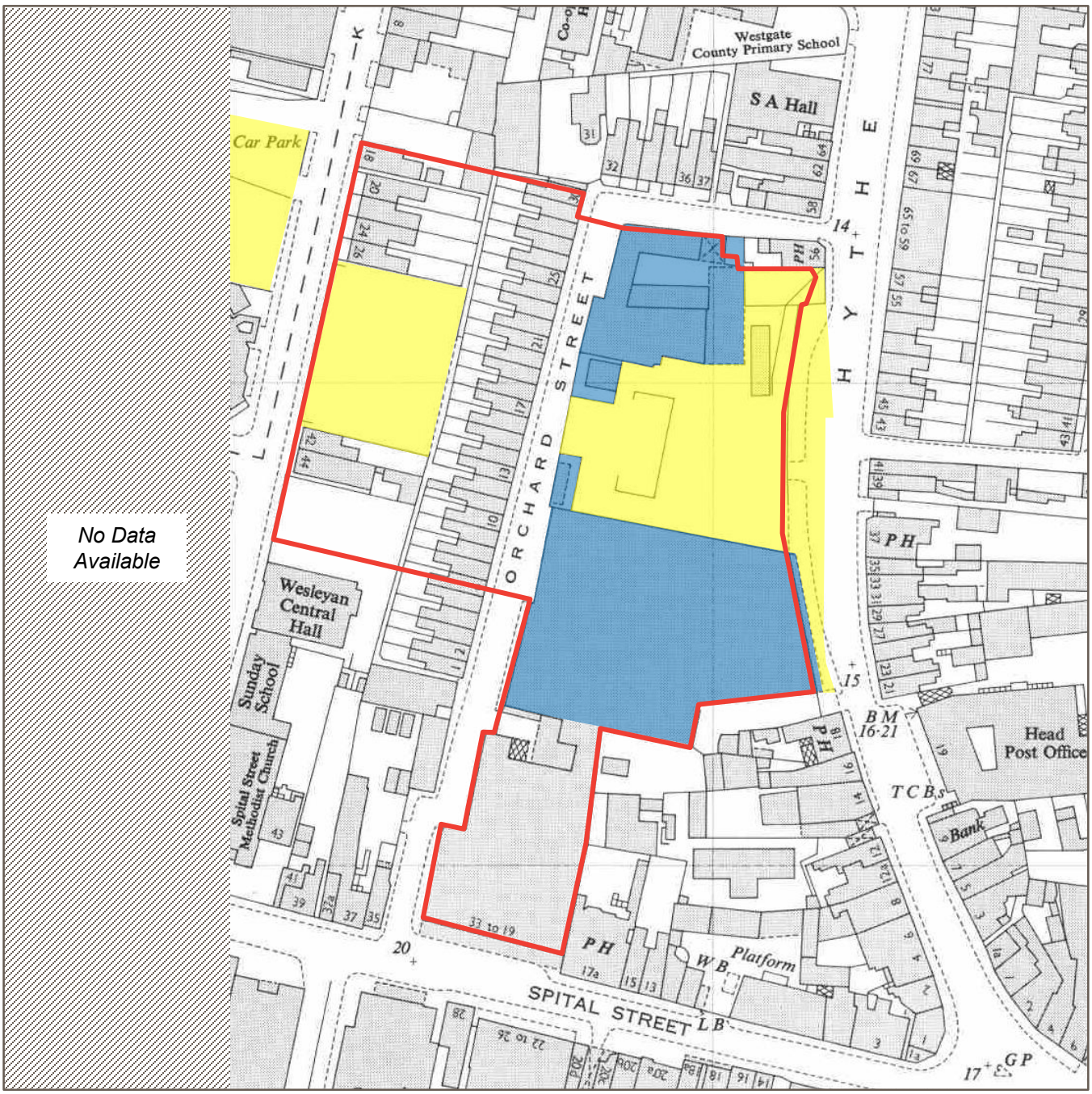


Report Reference:	Client:	
7666TA	TPS Ltd	DYNASAFE
	Project: Orchard Street, Dartford	

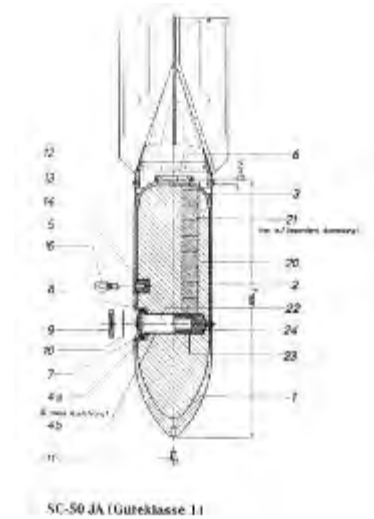
Source: Groundsure Limited

SC 50

Bomb Weight:	40-54kg (110-119lb)
Explosive Weight:	c25kg (55lb)
Fuze Type:	Impact fuze/electro- mechanical time delay fuze
Bomb Dimensions:	1,090 x 280mm (42.9 x 11.0in)
Body Diameter:	200mm (7.87in)
Use:	Against lightly damageable materials, hangars, railway rolling stock, ammunition depots, light bridges and buildings up to three stories.
Remarks:	The smallest and most common conventional German bomb. Nearly 70% of bombs dropped on the UK were 50kg.

50kg bomb, London Docklands

Minus tail section



SC-50 JA (Gurtelklasse 1)

SC 250

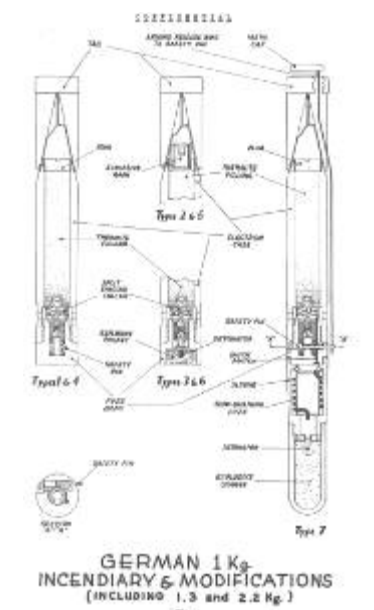
Bomb weight:	245-256kg (540-564lb)
Explosive weight:	125-130kg (276-287lb)
Fuze type:	Electrical impact/mechanical time delay fuze.
Bomb dimensions:	1640 x 512mm (64.57 x 20.16in)
Body diameter:	368mm (14.5in)
Use:	Against railway installations, embankments, flyovers, underpasses, large buildings and below-ground installations.

250kg bomb, Hawkinge

1kg Incendiary Bomb

Bomb weight:	1.0 and 1.3kg (2.2 and 2.87lb)
Filling:	680gm (1.3lb) Thermite
Fuze type:	Impact fuze
Bomb dimensions:	350 x 50mm (13.8 x 1.97in)
Body diameter:	50mm (1.97in)
Use:	As incendiary – dropped in clusters against towns and industrial complexes
Remarks:	Jettisoned from air-dropped containers. Magnesium alloy case. Sometimes fitted with high explosive charge

1. Scaffold pipe
2. Incendiary 1kg bomb
3. Incendiary bomb recently found on site in UK



Source: Dynasafe BACTEC Limited and various historical sources