Sainsbury's Supermarkets Limited

SSL Lyons Farm, Worthing

Desk Study and Ground Investigation Report

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EXECUTIVE SUMMARY

SITE INFORMATION	**Client**	**Sainsbury's Supermarkets Limited**
	Site Details	The site is situated within the wider Sainsbury's supermarket complex located at Downland Business Park, Lyons Farm in Worthing. The wider site covers an area of approximately 1.96 hectares, with the centre situated at approximate National Grid Reference 515100, 105340. The nearest postcode is BN14 9LA.
	Current Land Use and Description	The site is situated within the wider Sainsbury's Supermarket site including existing superstore, petrol filling station and car park.
	Proposed Development	The proposed development is understood to comprise a single storey Grocery online (GOL) extension to the east of the existing superstore.
BACKGROUND INFORMATION	**Geology**	The published geology indicates the site is underlain by superficial Head Deposits, described by the BGS as poorly sorted and poorly stratified, angular rock debris and/or clayey hillwash and soil creep, mantling a hillslope and deposited by solifluction and gelifluction processes. This in turn is reported to be underlain by the Tarrant Chalk Member, described as soft white chalk with relatively widely spaced but large flint seams.
	Hydrogeology	The superficial deposits are classified as a Secondary (undifferentiated) Aquifer, while the Tarrant Chalk Member is classified as a Principal Aquifer. The site is noted to be located within Environment Agency Source Protection Zones I, II and III. A number of groundwater abstraction licences are reported in proximity to the site. These predominantly relate to potable water abstraction, the closes of which is located approximately 650m to the west of the site. There are also 3No. discharge consents to groundwater via soakaway reported in proximity to the site, the closest of which is situated approximately 85m west.
	Hydrology	The nearest surface water feature to the site is a stream located approximately 540m to the southwest. There are no surface water abstractions or discharge consents to surface waters reported within 500m of the site.
	Site History	Available mapping indicates the site remained undeveloped prior to 1912 at which point a small structure is noted to encroach onto the northern section of the site. From 1932, a sand pit identified outside of the site boundary on previous mapping is noted to be across the northern section of the site. From 1953, structures associated with Lyons Farm Nursery are depicted along the southern boundary of the site, with additional structures depicted across the remaining site area from 1969. Post 1994, the site is generally shown in its current layout.
	Environmental Sensitivity	The site is considered to be of moderate environmental sensitivity due primarily to the presence of the underlying Principal Aquifer of the Tarrant Chalk Formation and the associated Source Protection Zones.
GROUND INVESTIGATION	**Ground Investigation Rationale**	The exploratory ground investigation undertaken was designed to provide information on the ground conditions to aid with the design of the development; and to investigate the potential pollutant linkages identified as part of the Preliminary Risk Assessment.
	Scope of Works	The scope of works comprised the advancement of a single cable percussive borehole to a depth of 14.5mbgl and 5No. dynamic sample boreholes to depths of up to 5.45mbgl. Exploratory locations were advanced in order to gain spatial coverage of the development area, characterisation of the underlying shallow and deeper ground conditions and for the collection of representative samples for geochemical and geotechnical laboratory analysis. In addition, 4No. DCP-TRL tests were undertaken to provide indicative CBR values.
	Ground Conditions	The encountered ground conditions were reported to comprise made ground to proven depths of between 2.6mbgl and 2.9mbgl. This was noted to be underlain by superficial Head Deposits comprising medium dense to dense (locally very dense) slightly clayey, slightly sandy gravel with low cobble content. Cobbles were recorded to comprise flint, while gravel of flint and chalk was observed. The Tarrant Chalk Member was encountered from 6.2mbgl. The upper material was recovered as firm off-white to cream slightly clayey slightly sandy gravelly silt with low cobble content to a depth of 8.0mbgl. This was underlain by extremely weak, low density chalk recovered as slightly gravelly slightly clayey silt. Gravel was generally observed to comprise fine to coarse subangular chalk and flint, while cobbles was recorded as flint. Due to the drilling technique used during the intrusive investigation, a CIRIA grading could not be applied to the encountered materials. No groundwater was encountered during the intrusive works.

LAND CONTAMINATION	**Contamination Characterisation**	Laboratory analysis of representative made ground materials recorded no contaminants in excess of the relevant GAC for the site. In addition, asbestos was reported as 'not-detected' within all samples. The site is situated within an intermediate Radon Affected area. While only limited ground bulk ground gas monitoring has been undertaken to date, the site may be classified as Characteristic Situation 1 based upon the absence of significant methane and carbon dioxide concentrations. In addition, it is considered that the provision of radon protective measures will provide inherent protection against other ground gasses.
	Identified Pollutant Linkages	Human Health – Migration, ingress and accumulation of ground gas.
	Remediation Appraisal / Likely Remedial Approach	Basic radon protection measures are required for the proposed development as per the Building Regulations (2010), BRE Report BR211 (2015) Radon: Protective measures for new buildings and BRE GG75 (2015) Radon protection for new large buildings.
GROUND ENGINEERING	**Foundations**	Due to the thickness of made ground present across the site and potential loads associated with the proposed development, the use of conventional foundations may not be appropriate, and consideration should be given to the use of a piled foundation solution. For budgetary and indicative purposes only, a pile resistance in the region of 285kN is considered appropriate for a 200mm diameter pile to 10mbgl, increasing to 760kN for a 450mm to the same depth.
	Ground Floor Slabs	Given the proposed foundation solution, the use of suspended floor slabs may be appropriate for the scheme, which should incorporate the minimum void dimensions as outlined in the relevant standards.
	Preliminary Pavement Design	A CBR of <2.5% would be recommended due to the thickness of made ground recorded across the site.
	Buried Concrete	Testing undertaken to date indicates an ACEC of AC-1, requiring a Design Sulphate Class of DS-1 would be appropriate for the proposed development.

1 INTRODUCTION

1.1 Terms of Reference

1.1.1 TEC has been appointed by Fairhurst Limited on behalf of Sainsbury's Supermarkets Limited to undertake a preliminary land contamination and geotechnical assessment of SSL Lyons Farm, Worthing. All works were undertaken in accordance with our proposal letter dated 22 March 2023 and referenced RE.2303011.001.

1.2 Background

1.2.1 The site is situated within the wider Sainsbury's supermarket complex located at Downland Business Park, Lyons Farm in Worthing (Figure 1). The wider site covers an area of approximately 1.96 hectares, with the centre situated at approximate National Grid Reference 515100, 105340. The nearest postcode is BN14 9LA.

1.2.2 The proposed development is understood to comprise a single storey Grocery online (GOL) extension to the east of the existing superstore (Figure 2).

1.2.3 The aim of these works is to provide information on land contamination risk and the ground engineering conditions and constraints associated with the site with regard to the proposed development.

1.3 Scope of Works

1.3.1 The scope of work undertaken as part of this report is presented below:

- **Preliminary Risk Assessment:** this phase of assessment involves development of an initial site conceptual model, based on desk study research and a site reconnaissance survey, in order to establish whether or not there are potentially unacceptable risks.
- **Land Contamination - Generic Quantitative Risk Assessment:** this phase of assessment involves updating the site conceptual model developed as part of the Preliminary Risk Assessment based on the findings of an exploratory ground investigation. Generic assessment criteria and assumptions, if appropriate, are used to identify relevant pollutant linkages.
- **Ground Engineering:** general recommendations in relation to ground engineering for the proposed development are provided on the basis of the findings of the exploratory ground investigation.

1.3.2 The above scope of work has been undertaken in accordance with current guidance such as LCRM - *Land contamination: risk management* (Environment Agency, 2021), BS10175+A2 (2017), BS5930:2015+A1:2020 and, where appropriate, Eurocode 7.

2 PRELIMINARY RISK ASSESSMENT

2.1 Introduction

2.1.1 Information for this preliminary risk assessment (PRA) has been obtained from a site reconnaissance survey and a review of an Envirocheck® report obtained for the site (Appendix B and Appendix C) together with published available information where relevant.

2.2 Site Setting

2.2.1 A site reconnaissance survey was undertaken on 12 April 2023. A summary of the observations are presented in Table 2.1. Photographs taken during the site reconnaissance survey are presented in Appendix A.

Table 2.1: Site Details

Feature	Description	
Current Site Use	The site currently comprises an active supermarket located north of Sompting Road.	
Site Context	The site is located with a mixed-use area.	
Site Boundary Features	North	Commercial properties and electrical substation
	East	Car park associated with supermarket, Lyons Way and commercial properties beyond
	South	Commercial properties including a fuel station
	West	Sainsbury's supermarket and residential properties
Site Topography	The site was observed as being generally flat with a gentle slope down westwards, towards the proposed development area. Following a review of a topographical survey drawing for the site carried out by DTS Raeburn (drawing no. E13511/1 TOPO, dated 21/05/2021) the site is reported to slope down from 20.25mAOD (Above Ordnance Datum) within the easternmost site area down to 19.5mAOD within the western site area/ proposed development area.	
Hard and Soft Landscaping	The majority of the site is lain to hard landscaping comprising tarmacadam, concrete and brick pavement.	
Trees	Numerous deciduous and coniferous trees were observed within the eastern site boundary.	
Fuel, Hazardous Chemicals and Waste Materials Storage	A number of large refuse bins were observed, within a designated area located to the north-eastern site area of the site. Southeast of the development area, a petrol station and car wash area were observed, associated with the wider site. An electrical substation was observed immediately north of the site.	
Asbestos Containing Materials	No evidence of potential ACM was noted during site reconnaissance.	
Site Drainage	A number of manhole covers/inspection chambers were observed within the site area	
Evidence of Potential Contamination	No visual or olfactory evidence of potentially gross contamination was recorded during the site reconnaissance.	
Ground Stability Hazards	No visual evidence of ground movement/ subsidence has been observed within the site area	

2.3 Site History

2.3.1 Details of the history of the site and surrounding area, relevant to this preliminary risk assessment, have been obtained through the review of historical Ordnance Survey (OS) mapping. A summary of potentially significant features is recorded in Table 2.2, which should be read in conjunction with the full map extracts contained within Appendix B.

Table 2.2: Historical Features Summary

On Site Features			OS Dates
Earliest available mapping (1875) indicates the site remained undeveloped until 1912, where a small structure is noted to encroach onto the northern boundary of the site. A footpath is noted to dissect the site in a southeast/northwest orientation. An orchard is also noted in the northwest corner of the site.			1875 – 1912
Mapping dated 1932 indicates a sandpit depicted immediately east/northeast of the site from 1912, is noted to extend onto the in the northeast.			1932
From 1953, structures associated with Lyons Farm Nursery are depicted along the southern boundary of the site, with additional structures depicted across the remaining site area from 1969.			1953 – 1984
From 1994, the current superstore and associated infrastructure is depicted across the site area.			1994 – 2023
Surrounding Features	**Distance**	**Direction**	**OS Dates**
Well	~200m	Southeast	1898
Sand pit (later depicted on site)	~15m	East	1912 – 1932
Quarry	~35m	North	1912 – 1932
Allotment	Adjacent	Southwest	1953 – 1954
Tanks (associated with Lyons Farm Nursery)	~25m ~85m	East Northeast	1953 – 1984 1969 – 1984
Electrical substation	~95m ~50m ~85m	Southeast Northeast Southeast	1974 – 1995 1984 1994 – 1995
Garage	~100m	South	1969 – 1995

2.4 Geology

2.4.1 A summary of available geological information for the area is provided in Table 2.3.

Table 2.3: Geological Setting

BGS Geological Mapping			
Geological Unit		**Thickness**	**BGS Description**
Made Ground		Unknown	Not recorded on geological mapping but may be present on site
Superficial Deposits: Head		Unknown	Poorly sorted and poorly stratified, angular rock debris and/or clayey hillwash and soil creep, mantling a hillslope and deposited by solifluction and gelifluction processes
Solid Geology: Tarrant Chalk Member		Up to 30m	Soft white chalk with relatively widely spaced but large flint seams.
BGS Borehole Records			
BGS Reference	**Distance/ Direction**	**Depth**	**Recorded Strata**
TQ10NE29	~25m/ East	25ft/~7.6m 53ft/ ~16.15m 125ft/~38m	Gravel Marl Chalk & Flint

BGS Estimated Soil Chemistry	
Element	**Estimated Concentration**
Arsenic	15-25 mg/kg
Cadmium	<1.8 mg/kg
Chromium	60 - 90 mg/kg
Lead	<100 mg/kg
Nickel	15 - 30 mg/kg
Radon	
Radon Potential	**Radon Protection Requirement**
Intermediate Probability Radon Area (3% - 5% of homes are estimated to be at or above the Action Level)	Basic radon protective measures reported to be required

2.5 Hydrogeology

2.5.1 The Envirocheck® report and Environment Agency information records the following hydrogeological setting of the site.

Table 2.4: Hydrogeological Setting

Aquifer Status			
Geological Unit	**Groundwater Vulnerability/ Aquifer Designation**	**Environment Agency Aquifer Classification**	**Potential Hydraulic Gradient Direction**
Tarrant Chalk Formation	High Vulnerability / Principal Aquifer	Layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifers.	-
Head Deposits	Secondary (Undifferentiated) Aquifer	Assigned in cases where it has not been possible to attribute either Category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.	-

Source Protection Zones	
Type	**Distance/ Direction from Site**
Zone 1 - Inner Protection Zone	On site
Zone 2 – Outer Protection Zone	
Zone 3 – Total Catchment	

Groundwater Abstractions		
15No. records within 1km		
Details	**Abstraction Use**	**Distance/ Direction**
Broadwater Ps Borehole 1 (2No. records)	Public water supply – potable water	~650m west
Broadwater Ps Borehole 2 (2No. records)	Public water supply – potable water	~650m west
Broadwater Ps Borehole 3 (2No. records)	Public water supply – potable water	~675m west
Broadwater Ps Well (2No. records)	Public water supply – potable water	~675m west
Northbrook Ps Point 1 (Sussex) (2No. records)	Public water supply – potable water	~680m south
Penfold Road Dairy (3No. records)	General cooling	~740m south
Northbrook Ps Point 2 (Sussex) (2No. records)	Public water supply – potable water	~765m south

Discharge Consents to Groundwater		
3No. records within 1km		
Receiving Water	**Effluent Type**	**Distance/ Direction from Site**
Soakaway	Unknown	~85m west
	Sewage discharges – final/treated effluent	~375m east
	Sewage discharges – final/treated effluent	~385m east
BGS Groundwater Flooding Susceptibility		
On site – Limited potential for groundwater flooding to occur		

2.6 Hydrology

2.6.1 The hydrological setting of the site is summarised in Table 2.5.

Table 2.5: Hydrological Setting

Nearest Surface Water Features		
Feature	**River Quality (GQA Grade)**	**Distance/ Direction from Site**
Stream	-	540m southwest
Surface Water Abstractions		
None recorded within 1km		
Licensed Discharge Consents		
None recorded within 500m		
Pollution Incidents		
1No. record within 500m		
Receiving Water	**Pollutant/ Incident**	**Distance/ Direction from Site**
Unknown	Oil – Gas Oil	490m southwest
Flooding from Rivers or Seas		
On Site Designation	**Off Site Areas of Flooding**	
Flood Zone 1	None recorded	

2.7 Environmental Data

2.7.1 Additional relevant environmental data from the Envirocheck® report for the site is summarised in Table 2.6.

Table 2.6: Additional Environmental Data Summary

Landfill Sites		
No current or historical landfills recorded within 500m		
Potentially Infilled Land (Water)		
1No. Recorded within 500m		
Type	**Distance/ Direction from Site**	**Date on Mapping**
Unknown filled ground (pond, marsh, river, stream, dock etc)	~370m northwest	1899
Potentially Infilled Land (Non-Water)		
3No. Recorded within 500m		
Type	**Distance/ Direction from Site**	**Date on Mapping**
Unknown filled ground (pit, quarry etc)	~150m north	1990
	~310m northwest	1974
	~325m northwest	1974

Commercial/ Industrial Land Use (Active Contemporary Trade Directories)		
4No. significant land uses within 500m of site		
Classification	**No. within 500m**	**Distance/ Direction from Site**
Petrol filling stations	1	On site
Garages	1	~110m west
Manufacturers (lighting)	1	~70m east
Cleaning services	1	~435m southwest
Hazardous Substances (Authorisations, Consents, Incidents)		
2No. records within 500m		
Category	**Details**	**Distance/ Direction from Site**
Local Authority Pollution Prevention and Controls	PG1/14 Petrol filling station	~20m southeast and 110m south
Sensitive Land Uses		
Category	**Details**	**Distance/ Direction from Site**
Nitrate Vulnerable Zones	Sussex Chalk	On site
Environmental Sensitive Areas	South Downs (decommissioned)	~20m north
National Parks	South Downs	~135m north

2.8 Engineering Considerations

2.8.1 Engineering considerations identified from the Envirocheck® report for the site are summarised in Table 2.7.

Table 2.7: Engineering Considerations

Ground Stability Hazards						
Hazard	**Hazard Potential**					
	No Hazard	**Negligible**	**Very Low**	**Low**	**Moderate**	**High**
Collapsible ground			X			
Compressible ground	X					
Ground dissolution			X			
Landslide			X			
Running sand			X			
Shrink/swell clays			X			
Coal mining	X					
Non-coal mining		X				

BGS Recorded Mineral Sites			
4No. records within 500m			
Site Name	**Type/Commodity**	**Status**	**Distance/ Direction from Site**
Charman Dean Sand Pit	Opencast – Sand	Ceased	~10m northeast
Charman Dean	Opencast - Chalk (Tarrant Chalk Member)	Ceased	~150m north
Charman Dean Gravel Pit	Opencast – Sand and Gravel	Ceased	~330m northwest
Charman Dean	Opencast – Chalk	Ceased	~375m northwest

2.9 Regulatory Consultations

2.9.1 Regulatory consultations were undertaken with the relevant departments at Adur & Worthing Council with respect to possible environmental issues and ground conditions on-site and in the surrounding area. A summary of the responses is provided below in Table 2.8. The full responses are presented in Appendix D.

Table 2.8: Regulatory Consultations Summary

Environmental Health – Adur & Worthing Councils	• 7No areas of potentially contaminated land have been identified on or in proximity of the site, the locations of which are presented within mapping contained within Appendix D. Areas 1, 4 and 7 are noted to have previously comprised brick fields or sand pits. Area 2 is noted to have anecdotal evidence of contamination from the landowner, Area 3 is currently an engineers and industrial units, Area 5 is associated with the active petrol filling stations on the development site and Area 6 is associated with a garage located immediately south of the wider development area. Information provided by the Council indicates that investigation undertaken in Area 6 to the south of the site as part of redevelopment works recorded the presence of hydrocarbon and nickel impacted soils that were reportedly removed from the site. In addition, 5No. tanks were removed in 2004 from this location. • The Council report there are no landfill sites within 500m of the site. • A single Part B APC authorisation is held within 500m of the site. This is associated with the Petrol Filling Station associated with the development site. • The Council report there are no records held regarding storage of petroleum hydrocarbons, unexploded ordnance, problems with ground gas, naturally elevated contaminant concentrations or any other information which may impact upon the contaminative status of the site.

2.10 Outline Conceptual Model

2.10.1 In accordance with the Environment Agency Land contamination: risk management guidance, potential source-pathway-receptor contaminant linkages identified from the desk study phase are summarised in the following sections.

2.11 Potential Sources

2.11.1 Potential sources of contamination identified on and within the vicinity of the site are summarised below:

On Site Sources

- Made ground of unknown chemical composition;
- Previous and current on site activities – site currently comprises superstore with associated car parking and petrol filling station and previous gravel pit and nursery recorded on site; and
- Radon gas;

Off Site Sources

- Potentially contaminative land uses including former gravel pits / quarries and electrical substation. While a garage is recorded to the south of the site, information provided by Adur & Worthing Council indicates remediation was undertaken on the site and therefore, this feature has not been considered further within this assessment.

2.11.2 No landfills are identified within 250m of the site.

2.12 Potential Receptor Pathways

2.12.1 Potential receptors identified as part of this preliminary risk assessment are:

- Current/future site users;
- Construction workers;
- Ecological receptors;
- Controlled waters (Principal / Secondary Aquifer and Source Protection Zones (I-III);
- Proposed development/ structures.

2.13 Potential Pathways

2.13.1 Potential contaminant pathways relating to the identified receptors and contaminants of concern include:

- Dermal contact – contact with soil, dust or water;
- Ingestion - ingestion of soil, dust or water;
- Inhalation – inhalation of soil, dust or vapours;
- Vertical migration – e.g. seepage of contaminants at the ground surface (i.e. leakage/spillage of hydrocarbons) through cracks in hardstanding and/or leaching of contaminants within the unsaturated zone resulting in vertical contaminant migration; and
- Horizontal migration – e.g. lateral migration of contaminants within the saturated zone and along preferential pathways such as drainage pipe bedding.

2.14 Hazard Assessment and Risk Estimation

2.14.1 Potential pollutant linkages identified as part of this preliminary risk assessment are summarised in the Outline Site Conceptual Model presented in Table 2.9. References to risk estimations are made in accordance with the methodology presented in CIRIA publication C552 (2001) titled *'Contaminated Land Risk Assessment: A Guide to Good Practice'* and summarised in Appendix E.

Table 2.9: Outline Conceptual Model

Potential Hazard/ Source	Potential Receptor	Potential Pathway to Receptors	Potential Consequence of Source-Receptor Linkage	Potential Likelihood for Significant Source-Receptor Linkage	Risk Classification
Made ground and potentially contaminative processes – on site	Current and future site users and construction workers	Exposure to potential contaminants through ingestion, inhalation and dermal contact.	Medium	**Low Likelihood to Likely**: Given the development history recorded on site, and observations made during the site reconnaissance, the presence of made ground of unknown thickness and chemical composition, or shallow contaminants on site cannot be discounted at this stage.	**Moderate/low Risk to Moderate Risk**
	Controlled waters (Principal/ Secondary Aquifers, SPZ); and ecological receptors	Leaching of potential contaminants from made ground and vertical and lateral migration through the saturated zone to controlled waters.	Medium	**Low Likelihood**: Given the potential presence of made ground of unknown chemical composition and the recorded aquifer status of the underlying strata, a potential risk to controlled waters cannot be fully discounted. Notwithstanding this, the presence of hardstanding across the majority of the proposed development area may limit the potential for infiltration and subsequent contaminant migration.	**Moderate/low Risk**
	Current and future site users, construction workers and proposed development	Migration, ingress and accumulation of ground gasses.	Severe	**Low Likelihood**: Made ground, if present, may act as a potential source of ground gas, subject to thickness and chemical composition.	**Moderate Risk**
Potentially contaminative land uses – off site	Current and future site users, construction workers, controlled waters and proposed development.	Potential on-site contaminant / ground gas migration from off-site sources. Exposure to potential contaminants through ingestion, inhalation and dermal contact.	Medium to Severe	**Unlikely to Low Likelihood**: Potentially contaminative current and historic processes have been identified in proximity to the site. The potential for on-site contamination from identified off-site sources cannot be discounted at this stage.	**Low to Moderate Risk**
Radon	Current and future site users and proposed development.	Migration, ingress and accumulation of radon gas.	Severe	**Low Likelihood to Likely**: The site is situated within an intermediate radon affected area and basic radon protection measures are reported as necessary.	**Moderate to High Risk**

3 GROUND INVESTIGATION METHODOLOGY

3.1 Background

3.1.1 The exploratory ground investigation undertaken was designed to provide information on the ground conditions to aid with the design of the development; and to investigate the potential pollutant linkages identified as part of the Preliminary Risk Assessment.

3.1.2 All site works were undertaken in accordance with BS5930:2015+A1:2020, BS10175+A2:2017 and, where appropriate, Eurocode 7. Works were supervised by a suitably experienced geoenvironmental consultant from TEC.

3.2 Methodology

3.2.1 A summary of the ground investigation works undertaken and the rationale for each location is provided in in Table 3.1, as follows:

Table 3.1: Summary of Ground Investigation Works

Investigation Method	Location	Date(s)	Location Rationale	Purpose
Window Sample Borehole (Dando Terrier)	WS01 – WS03	13.04.2023	Positioned to provide spatial coverage across the development area	Characterisation of shallow ground conditions Collection of geochemical and geotechnical samples for analysis
Cable Percussive Borehole	BH01	12.04.2023	Positioned within footprint of proposed extension	Characterisation of deeper ground conditions for piled foundation information Collection of geochemical and geotechnical samples for analysis
Dynamic Cone Penetrometer	DCP1 – DCP4	12.04.2023	Located in approximate areas of proposed access roads/ parking	Provision of indicative Californian Bearing Ratio (CBR) values

3.2.2 Exploratory hole locations are presented on Figure 3 and detailed descriptions of encountered ground conditions are shown on exploratory hole logs presented in Appendix F.

3.3 Field Testing

3.3.1 A summary of in situ field testing undertaken as part of these ground investigation works is provided in Table 3.2.

Table 3.2: Summary of Field Testing

Field Test	Purpose
Hand Shear Vane (HSV)	Estimation of undrained shear strengths of cohesive strata
Pocket Penetrometer (PP)	Indication of unconfined compressive strength of cohesive strata
Standard Penetration Test (SPT)	Provision of strength profile of underlying ground conditions Provision of in situ densities of granular deposits
Photo-Ionisation Detector (PID)	Indication of the presence/concentrations of volatile organic compounds (VOCs)

3.4 Monitoring Works

3.4.1 A summary of the monitoring works completed at the site to date is provided below in Table 3.3.

Table 3.3: Summary of Monitoring Works

Monitoring	Instrument/ Kit	No. of Rounds	Date(s)
Ground Gas	GFM436 Landfill Gas Monitor	1	13.04.2023

3.5 Chemical Testing

3.5.1 Laboratory testing was scheduled on the basis of the Preliminary Risk Assessment and field observations.

3.5.2 Representative soil samples were collected and chemically tested at DETS, a UKAS/MCERTS accredited laboratory, for a selection of the following parameters:

Soils (Totals)

- *Heavy metals and metalloids;*
- *Total Organic Carbon (TOC);*
- *Phenols (monohydric);*
- *Total Cyanide;*
- *Sulphate, sulphide, elemental sulphur and pH;*
- *Speciated Polyaromatic Hydrocarbons (PAH);*
- *Total Petroleum Hydrocarbons (TPH-CWG), including BTEX and MTBE; and*
- *Asbestos Screen.*

3.5.3 Geochemical certificates of analysis are presented Appendix G.

3.6 Geotechnical Testing

3.6.1 Selected soil samples were submitted for geotechnical analysis at K4 Soils Ltd. Laboratory testing was scheduled upon the basis of field observations for a selection of the following:

- *Atterberg limit tests – natural moisture content, liquid limit and plastic limit;*
- *Particle size distribution (PSD) tests;*
- *Bulk Density tests; and*
- *BRE SD1 Suite B – Water soluble and acid soluble sulphates, total sulphur and pH.*

3.6.2 Soil geotechnical certificates of analysis are presented in Appendix H.

3.7 General Sampling

3.7.1 Samples were collected in accordance with the following guidance;

- BS5930:2015+A1:2020 – Code of practice for ground investigations;
- BS-EN 1997-2:2007 - Eurocode 7 — Geotechnical design —Part 2: Ground investigation and testing
- BS ISO 10175:2011+A2:2017 - Investigation of potentially contaminated sites – Code of practice;
- BS ISO 18400-105 Soil quality – Sampling - Packaging, transport, storage and preservation of samples; and
- BS ISO 18400-106 Soil quality – Sampling - Quality control and quality assurance.

4 GROUND INVESTIGATION FINDINGS

4.1 Introduction

4.1.1 A summary of encountered ground conditions for the site is provided below while detailed descriptions are shown on exploratory hole logs presented in Appendix F. Photographs of the materials encountered are presented within Appendix A.

Made Ground

4.1.2 Made ground was encountered across the site to proven depths of between 2.6mbgl and 2.9mbgl and generally comprised tarmacadam hardstanding underlain by sandy gravel / gravelly sand. The gravel was noted to comprise sandstone, flint, tarmacadam and rare plastic / charcoal. Within BH01, the upper made ground was undertaken by slightly gravelly sandy clay between 1.9mbgl and 2.9mbgl.

4.1.3 Slightly gravelly silty organic clay underlain by slightly gravelly silty clay was recorded within WS01 and WS02 to depths of between 0.50mbgl and 0.7mbgl. This was recorded to be underlain by concrete, upon which the exploratory holes were terminated due to refusal.

Superficial Deposits (Head Deposits)

4.1.4 Superficial Head Deposits were encountered across the site from depths of 2.6mbgl to a proven depth of 6.2mbgl (BH01). The encountered materials were generally noted to comprise medium dense to dense slightly clayey, slightly sandy gravel with low cobble content. Cobbles were recorded to comprise flint, while gravel of flint and chalk was observed.

Solid Geology (Tarrant Chalk Member)

4.1.5 The Tarrant Chalk Member was encountered from 6.2mbgl. The upper material was recovered as firm off-white to cream slightly clayey slightly sandy gravelly silt with low cobble content to a depth of 8.0mbgl. This was underlain by extremely weak, low density chalk recovered as slightly gravelly slightly clayey silt. Gravel was generally observed to comprise dine to coarse subangular chalk and flint, while cobbles were recorded as flint.

4.1.6 Due to the drilling technique used during the intrusive investigation, a CIRIA grading could not be applied to the encountered chalk materials.

4.2 Groundwater

4.2.1 No groundwater was encountered during the intrusive works.

4.2.2 It should be noted that groundwater conditions recorded during the investigation may not be representative of long-term conditions and that groundwater levels may vary in response to meteorological/ seasonal changes.

4.3 Contamination Observations

4.3.1 No visual or olfactory evidence of contamination was observed during the ground investigation. Screening of soil samples with a PID recorded concentrations of volatile organic compounds (VOCs) to be less than the instrument level of detection i.e. 0.0ppm.

5 LAND CONTAMINATION - GENERIC QUANTITATIVE RISK ASSESSMENT

5.1.1 The generic quantitative risk assessment comprises a screening of identified contaminants against generic assessment criteria (GAC) that are appropriate to the site setting and the receptors concerned.

5.2 Human Health

Methodology

5.2.1 Detailed information on the background legislation and selection of the GAC used within this assessment for human health is presented in Appendix J.

5.2.2 The standard land use for the site, for use in this generic assessment, has been defined as "*commercial*" based on the proposed development and in accordance with current guidance.

5.2.3 As the site investigation methodology involved targeted sampling, statistical analysis has not been undertaken and the results have been directly compared to the GAC.

5.2.4 No visual or olfactory evidence of contamination was identified within the natural ground during the site investigation. Therefore, 4No. soil samples have been collected from the made ground at depths that end users may come into contact with via the dermal contact, ingestion and inhalation pathways. Certificates of analysis for samples are contained within Appendix G.

Summary of Results

5.2.5 The full human health generic quantitative risk assessment is presented in Appendix J.

Made Ground

5.2.6 The results of the assessment recorded no exceedances of the GAC for a commercial site end use or more sensitive residential with homegrown produce site end use and therefore no contaminants of potential concern (CoPC) have been identified within the made ground.

5.2.7 An asbestos screen completed on samples of the made ground at the laboratory recorded no suspected asbestos containing material or detectable asbestos fibres.

5.3 Controlled Waters

5.3.1 Leachate analysis has not been undertaken on the sampled made ground/ shallow soils and no groundwater samples have been collected as part of this site investigation, owing to the following;

- No visual or olfactory evidence of contamination was noted during the site investigation;
- No contaminants of potential concern were recorded within the sampled made ground; and
- No groundwater was recorded during the ground investigation works to depths of up to 14.5mbgl;

5.3.2 On this basis, no risk to controlled waters from migration of leachable contaminants within the made ground or migration of dissolved phase contaminants to the wider aquifer has been identified. Therefore, these potential pollutant linkages have not been considered further within this assessment.

5.4 Ground Gas Risk Assessment

5.4.1 The risks to the development from ground gases have been assessed in accordance with the empirical, semi-quantitative approach as outlined in BS8485:2015+A1:2019 (BS8485). This process includes combining the qualitative assessment of risk (using the CSM) with ground investigation and monitoring data to derive a Characteristic Situation for the site.

Conceptual Site Model Summary

5.4.2 The following potential sources of ground gas have been identified:

On Site Ground Gas Sources

- *Infilled ground associated with the former sand pit depicted on mapping c.1930's.*

Off Site Ground Gas Sources

- *Potentially infilled ground associated with former quarries and pits recorded in proximity of the site.*

Ground Gas Monitoring Results

5.4.3 Gas monitoring was undertaken using a calibrated GFM 436 infra-red gas analyser fitted with an internal flow pod. The monitoring results are presented in Appendix I and summarised in Table 5.1.

Table 5.1: Summary of Ground Gas Monitoring Data

Borehole	Response Zone/Strata	Potential source of ground gas	No. of monitoring occasions	Maximum (Steady State) Methane (%)	Maximum Carbon dioxide (Steady State) (%)	Minimum (Steady State) Oxygen (%)	Maximum (Steady State) Flow Rate (l/hr)	Water levels (mbgl)	Range of atmospheric pressure (mb)
WS01A	Natural Ground	Potentially infilled ground onsite	1	0.0 (0.0)	0.1 (0.1)	20.0	0.0 (0.0)	Dry	1005
WS02A				0.0 (0.0)	0.0 (0.0)	20.2	0.0 (0.0)	Dry	1004 - 1005
WS03				0.0 (0.0)	0.0 (0.0)	20.4	0.0 (0.0)	Dry	1002

5.4.4 Atmospheric pressure was high and rising during the monitoring undertaken to date and therefore the results may not represent worst case conditions.

Borehole Hazardous Gas Flow Rate (Q_{hg})

5.4.5 Hazardous gas flow rates calculated for each borehole standpipe, together with the resulting implied maximum Characteristic Situation (CS), are summarised in Table 5.2.

Table 5.2: Borehole Hazardous Gas Flow Rates

Borehole	Date	Methane - Hazardous Flow Rate CH_4 Qhg (l/hr)(1)	Carbon Dioxide – Hazardous Flow Rate CO_2 Qhg (l/hr)(1)	Implied CH_4 CS	Implied CO_2 CS
WS01A	13.04.2023	0.0001	0.0001	1	1
WS02A	13.04.2023	0.0001	0.0001		
WS03	13.04.2023	0.0001	0.0001		

Note 1: Where flow rates of <0.1l/hr or concentrations of <0.1% have been recorded, a value of 0.1 (limit of detection of the instrument) has been assumed to calculate the Q_{hg}

Gas Screening Values (GSVs)

5.4.6 It is considered that there is currently insufficient data to adequately characterise the site. The initial results indicate the site may be Characteristic Situation 1. However, further monitoring would be recommended to fully characterise the ground gas regime at the site and inform the scope of ground gas protection measures required for the proposed development.

Radon

5.4.7 The site is situated within an intermediate Radon affected area as between 3% and 5% of homes are reported above the Action Level. Therefore, basic radon protection measures are required for the proposed development as per the Building Regulations (2010), BRE Report BR211 (2015) Radon: Protective measures for new buildings and BRE GG75 (2015) Radon protection for new large buildings.

5.5 Updated Conceptual Model

5.5.1 The findings of the site investigation and the GQRA have been used to update the conceptual model and confirm the relevant pollutant linkages associated with the proposed development.

Identified Sources

5.5.2 Sources of contamination/ ground gas identified on and within the vicinity of the site are summarised below:

On Site Sources

- Made ground; and
- Potentially contaminative current and historic land uses (superstore, petrol filling station and former sand pit)

Off Site Sources

- Potentially contaminative land uses; and
- Potentially infilled land.

Identified Receptors

5.5.3 Receptors identified as part of this updated conceptual model are:

- Current/future site users;
- Construction workers;
- Proposed development/ structures.

Identified Pathways

5.5.4 Potential contaminant pathways relating to the identified receptors and contaminants of concern include:

- Dermal contact – contact with soil, dust or water;
- Ingestion - ingestion of soil, dust or water;
- Inhalation – inhalation of soil, dust or vapours; and
- Migration, ingress and accumulation of ground gas (bulk gases and radon).

5.5.5 The updated conceptual model is presented in Table 5.3. References to risk estimations are made in accordance with the methodology presented in CIRIA publication C552 (2001) titled *'Contaminated Land Risk Assessment: A Guide to Good Practice'* and summarised in Appendix E.

Table 5.3: Updated Conceptual Model (Hazard Assessment and Risk Estimation)

Identified Hazard/ Source	Identified Receptor	Potential Pathway	Potential Consequence of Source-Pathway-Receptor Pollutant Linkage	Potential Likelihood for Source-Pathway-Receptor Pollutant Linkage	Risk Classification
Made ground and potentially contaminative land uses – on site	Current and future site users and construction workers	Exposure to potential contaminants through ingestion, inhalation and dermal contact.	Medium	**Unlikely**: No contaminants of potential concern have been identified within the made ground on site.	**Low Risk**
	Current and future site users, construction workers and proposed development	Migration, ingress and accumulation of ground gasses.	Severe	**Unlikely**: The encountered made ground is considered unlikely to be a potential source of significant ground gas based on its limited thickness and observed composition (with no visual evidence of degradable/ putrescible materials noted).	**Moderate/Low Risk**
Potentially contaminative land uses – off site	Current and future site users and construction workers	Exposure to potential contaminants through ingestion, inhalation and dermal contact.	Medium	**Unlikely**: No evidence of potential contaminant migration from off-site sources was recorded during the intrusive works.	**Low Risk**
	Current and future site users, construction workers and proposed development	Migration, ingress and accumulation of bulk ground gas.	Severe	**Unlikely to Low Likelihood**: Monitoring to date indicates the site may be classified as Characteristic Situation 1, although further monitoring during periods of low and falling pressure would be recommended to confirm the preliminary findings. Notwithstanding this, the provision of radon protection measures will provide inherent protection against bulk gasses.	**Moderate/Low Risk**
Natural Ground: Radon	Future site users.	Ingress of radon gas into properties and inhalation	Medium	**Low Likelihood**: The site is located within a reported radon affected area and basic radon protection measures are identified to be required.	**Moderate/Low Risk**

6 LAND CONTAMINATION - CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

6.1.1 No visual or olfactory evidence of significant contamination was noted during the ground investigation.

6.1.2 Laboratory analytical results of the encountered near surface materials reported both organic and inorganic contaminants to be below the relevant GAC for both a commercial site end use and more conservation residential site end use with homegrown produce.

6.1.3 Based on the limited ground gas monitoring undertaken to-date together with the conceptual site model, it is possible that the site may potentially be considered as Characteristic Situation 1.

6.1.4 The site is situated within an intermediate Radon affected area. Given the identified radon probability, and as the required radon protection measures will provide inherent protection against ingress of other bulk ground gases potentially sourced from off site features (i.e. potentially infilled quarry and historic landfill), no ground gas monitoring or further assessment is therefore considered necessary.

6.2 Remedial Appraisal

6.2.1 Basic radon protection measures are required for the proposed development as per the Building Regulations (2010), BRE Report BR211 (2015) Radon: Protective measures for new buildings and BRE GG75 (2015) Radon protection for new large buildings.

6.3 General Considerations

6.3.1 Given the presence of general made ground, good brownfield site working practices should be adopted by construction workers to mitigate against potential risks.

6.3.2 Should water supply pipes be placed within the made ground encountered at the site, due consideration would need to be given to the UK Water Industry Research Ltd (UKWIR) guidance.

6.3.3 Based on our conceptual understanding of the site to-date, it would be anticipated that similar ground conditions to those encountered as part of this assessment exist across the site areas where access has been possible. However, should significant thicknesses of made ground be encountered, or visual or olfactory evidence of potentially significant contamination be identified during the development works, further investigation and assessment may be required.

7 GROUND ENGINEERING

7.1 Proposed Development

7.1.1 The development area is situated within the wider SSL Lyons Farm site, and includes the existing superstore, petrol filling station and car park.

7.1.2 The proposed development is understood to comprise a single storey GOL extension to the east of the existing superstore (Figure 2).

7.1.3 Although no details have been provided to TEC, column loads in the order of 100kN have been assumed at this preliminary stage and general recommendations with regards to the ground engineering have been made on this basis.

7.2 Site Preparation

7.2.1 A number of services are reported within the wider site area. Consideration to the removal / re-routing of some of these may be required during the construction works.

7.3 Geotechnical Test Data Summary

7.3.1 Laboratory test data are presented in Appendix H while in situ test results are presented on the engineering logs Appendix F.

Plasticity

7.3.2 Atterberg Limit tests were undertaken on 2No. samples obtained from site, as summarised in Table 7.1 below.

Table 7.1: Summary of Laboratory Test Results

Moisture Content (%)	Plasticity Index (%)	% passing 425µm sieve	Modified Plasticity Index[(1)] (%)	Volume Change Potential[(1)]
15 – 24	8 - 15	52 – 56	4.5 - 7.8	Non-plastic

Note 1: Based on recommendations provided in the NHBC Standard

Particle Size Distribution

7.3.3 Particle Size Distribution (PSD) testing was undertaken on 8No. samples of the more granular deposits on site. A summary of the testing is detailed within Table 7.2 below.

Table 7.2: Summary of Laboratory Test Results

Gravel (%)	Sand (%)	Silt (%)	Clay (%)
33.4 – 70.7	1.6 – 44.5	7.2 – 24.8[(1)]	3.2 – 12.6[(1)]

Note 1: A combined fines component of 0.2% was reported for BH01 at 4.0mbgl and 29.4% for BH01 at 6.20mbgl.

7.3.4 Standard Penetration Testing (SPT) undertaken within the underlying superficial Head Deposits, recorded an 'N' value of between 23 and >50, suggesting the granular deposits are generally medium dense becoming dense to very dense with depth.

7.3.5 While specific testing was not undertaken, a friction angle of Ø' of 40° to 50°may be derived for the generally medium dense to dense slightly clayey, slightly sandy gravel with low cobble content associated with the Head Deposits (Schmertmann (1975), Meyerhoff (1956), Carter, M. and Bentley, S. (1991) and Swiss Standard SN 670 010b) and it is suggested that a characteristic friction angle, Ø', of 42° is used within the design.

7.4 Foundations

7.4.1 Due to the thickness of made ground present across the site and potential loads associated with the proposed development, the use of conventional foundations may not be appropriate, and consideration should be given to the use of a piled foundation solution.

7.4.2 For budgetary and indicative purposes only, a range of pile resistances have been provided in Table 7.3 below, calculated in accordance with BS8004 for a number of assumed pile diameters.

Table 7.3: Summary of Pile Resistances

Pile Depth (mbgl)	Pile Diameter (mm)			
	200	250	300	450
10	285kN	370kN	480kN	760kN

7.4.3 The proximity of adjacent structures and the environmental sensitivity of the site will need to be carefully considered when choosing the most appropriate pile type and methodology and it is suggested that a specialist piling contractor should be consulted regarding the piling options and detailed design of most appropriate option. Notwithstanding this, the use of CFA or bored piles would be considered most appropriate in this instance.

7.5 Ground Floor Slabs

7.5.1 Given the proposed foundation solution, the use of suspended floor slabs may be appropriate for the scheme, which should incorporate the minimum void dimensions as outlined in the relevant standards.

7.6 Preliminary Pavement Design

7.6.1 The CBR results are summarised in Table 7.4 including recommended values for preliminary design purposes based upon these initial findings. The results are presented in Appendix K.

Table 7.4: Summary of CBR Data

Stratum	Method	Derived CBR Values (%)	Recommended CBR for Preliminary Design (%)
Assumed formation level >500mmbgl	DCP[(1)]	4.4 - >20[(2)]	5

Note 1: Jones CR and R Jolt (1991)
Note 2: CD225 (2020) Design for new pavement foundations (formerly IAN 73/06 revision 1 (2009), HD 25/94) and LR1132 (1984), assumes low water table and average and well drained construction conditions

7.6.2 Notwithstanding this, given the recorded thickness of made ground across the site, a CBR of <2.5% would be recommended where formations are within this material.

7.6.3 It should be noted that all road formations should be proof rolled and soft spots removed and replaced with selected granular fill and, where adoptable, a pavement of sufficient thickness (>450mm) to prevent the penetration of frost should be employed.

7.6.4 CBR values of the subgrade should be confirmed by in situ testing when final formation levels are known.

7.7 Excavations

7.7.1 Excavations at the site may be achievable using conventional equipment.

7.7.2 No groundwater was encountered to depths of up to 14.5mbgl during the ground investigation and therefore, groundwater ingress into excavations is considered unlikely to be significantly problematic.

7.7.3 It should be noted that groundwater levels might fluctuate according to the season and from year to year. This may have implications on recommendations, including those for foundations and excavations. Accordingly, a careful watch should be maintained during any future groundworks and the recommendations presented in this report may be subject to amendment should additional information becoming available.

7.7.4 It is recommended that appropriate shoring/temporary works are used in accordance with current Health and Safety requirements where access for personnel is required into excavations.

7.8 Protection of Buried Concrete

7.8.1 The desk study and observations of the encountered ground materials during the intrusive works indicate the site would be categorised as:

- 'Brownfield locations', including potential aggressive materials or leachates, except those containing pyrite;

7.8.2 At this stage, there is insufficient data to confirm the mobility of groundwater at the site (and potential changes that may result during construction) and therefore a mobile groundwater has been assumed.

7.8.3 It should be noted that groundwater samples have not been collected as part of this scope of work.

7.8.4 The results of the testing of the soil samples, together with the resulting Aggressive Chemical Environment for Concrete (ACEC) Class and Design Sulphate (DS) Class, as derived in accordance with BRE Special Digest 1, are presented in Table 7.5. The full laboratory results are presented in Appendix H.

Table 7.5: Summary of ACEC

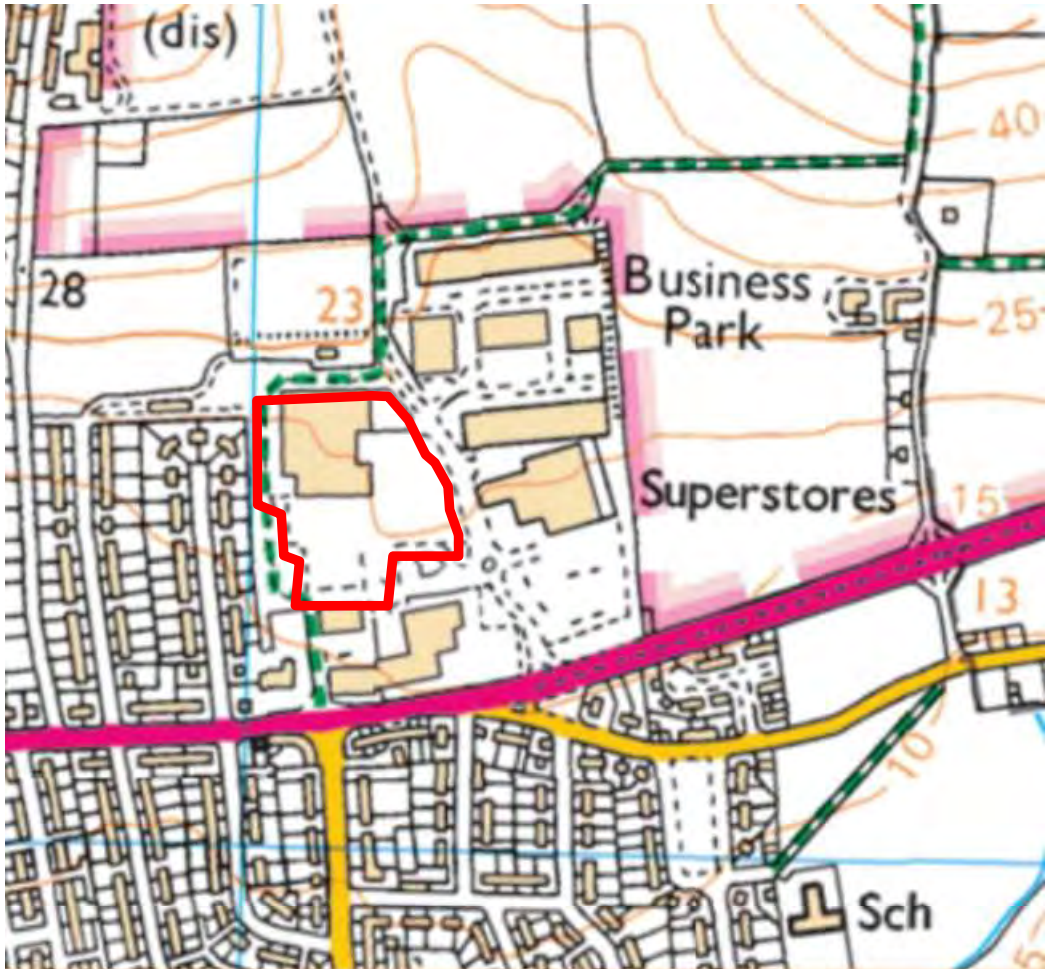
Stratum	No. of tests	pH	Water Soluble Sulphate (mg/l)	Oxidisable Sulphides (%)	Total Potential Sulphates (%)	ACEC(1)	DS Class(1)
Made Ground	9	7.6 – 9.5	30 – 200	0.0 – 0.10	0.06 – 0.15	AC-1	DS-1
Head Deposits	1	8.8	32	0.01	0.06	AC-1	DS-1
Tarrant Chalk Member	1	9.2	62	0.0	0.03	AC-1	DS-1

Note 1: Based on a characteristic value derived for a data set of <5 samples per stratum (maximum water soluble sulphate concentration/ lowest pH) as per BRE SD1

TEC

Figures and Drawings

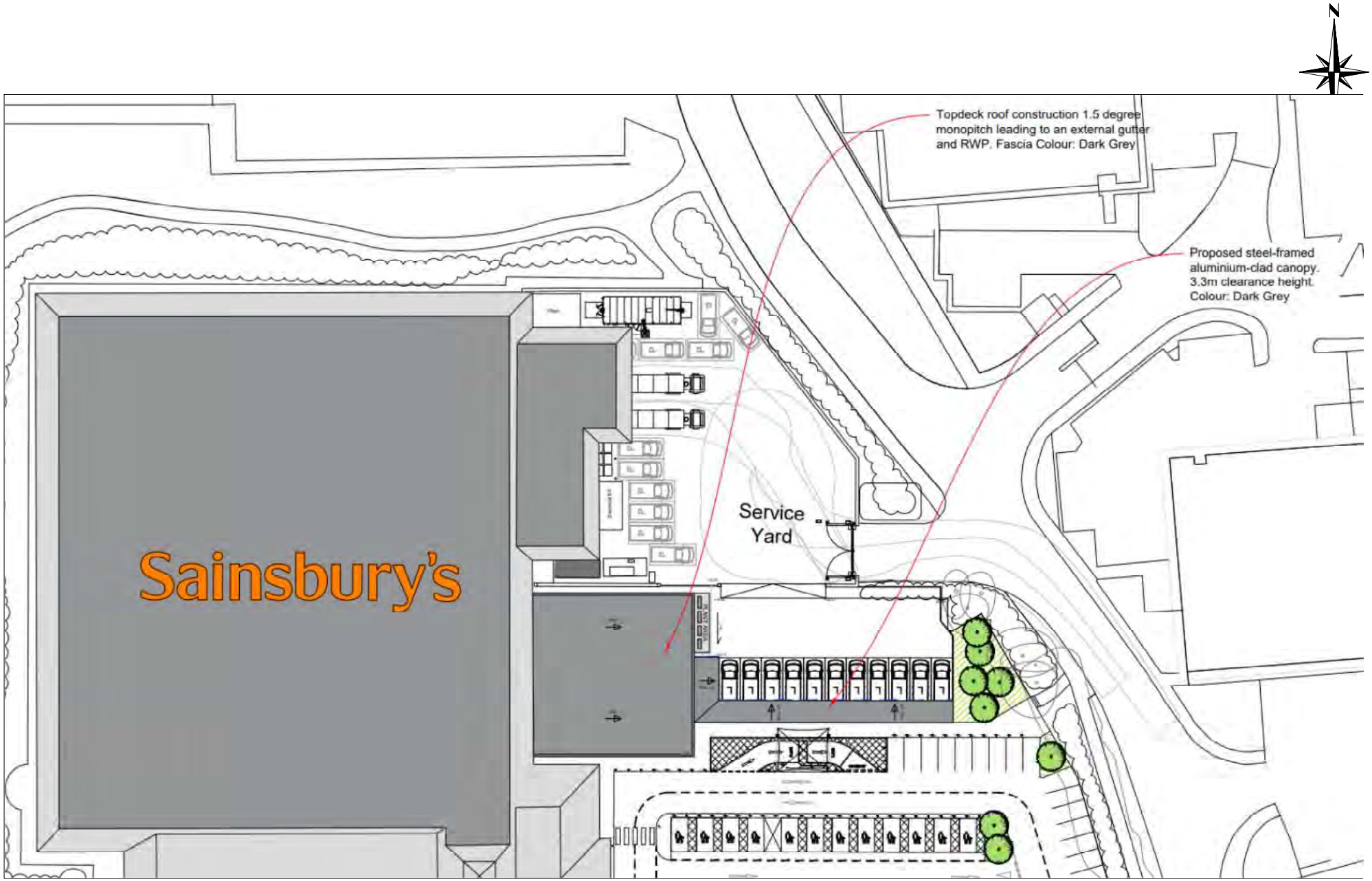




Approximate Site Location:

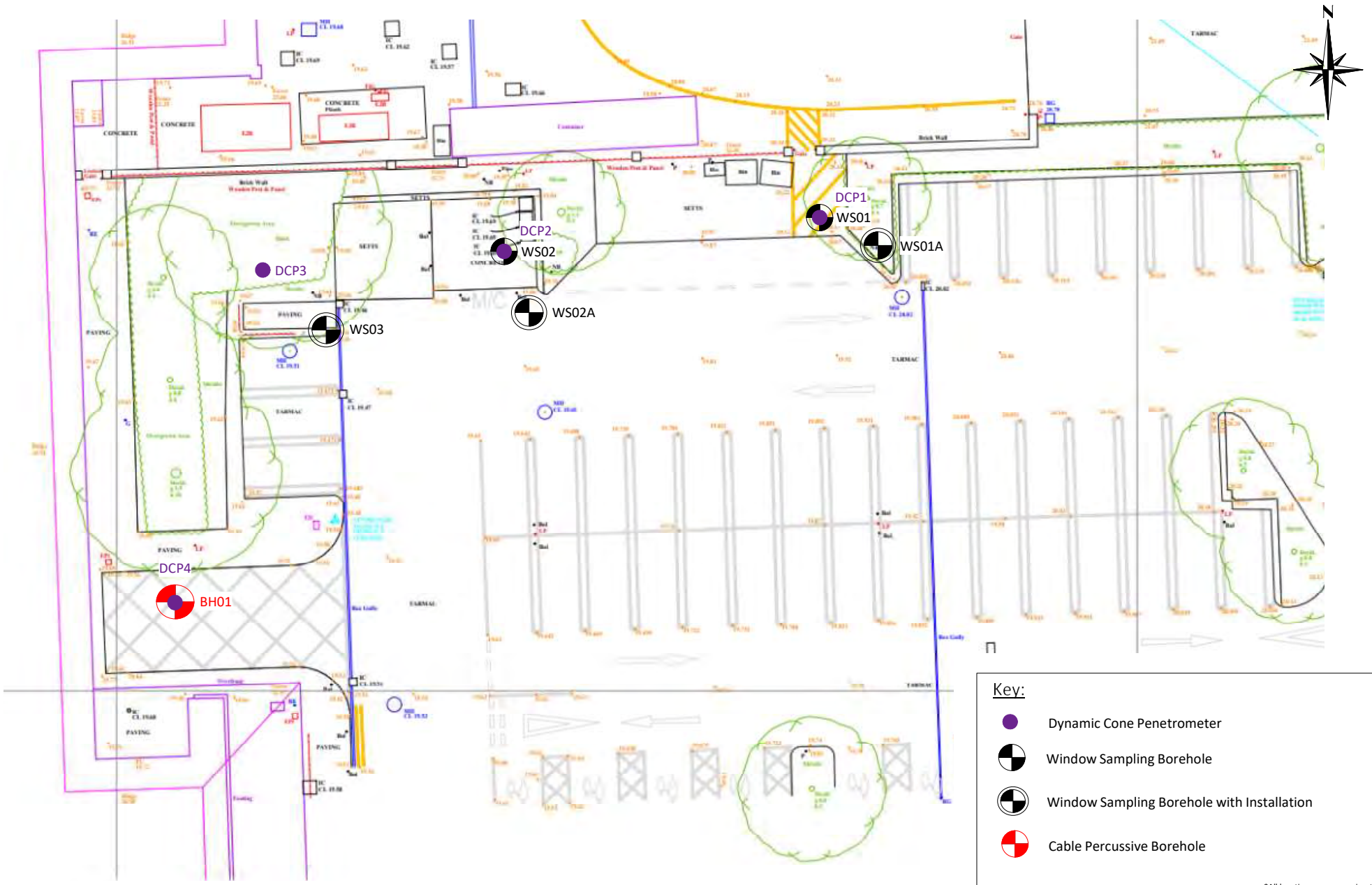
Ordnance Survey © Crown Copyright [2023] All rights reserved.
Licence number 100043301

tec	TEC The Old Chape 35a Southover Wells, Somerset BA5 1UH	Tel: 01749 677760 Email: info@tecon.co.uk Web: www.tecon.co.uk	Site Name: SSL Lyons Farm, Worthing	Drawing Name: Site Location Plan	Client Name: Sainsbury's Supermarkets Ltd	Project No: 2303011.001	Figure No: 1	Date: May 2023	Scale: NTS



Extract of CHQ Architects - Proposed Roof Plan. Reference: CHQ.21.16155. Drawing No. PL-A-2008, Rev A; dated 24/11/21.

tec	TEC The Old Chapel 35a Southover Wells, Somerset BA5 1UH	Tel: 01749 67776C Email: info@tecon.co.uk Web: www.tecon.co.uk	Site Name: SSL Lyons Farm, Worthing	Drawing Name: Proposed Development Plan	Client Name: Sainsbury's Supermarkets Ltd	Project No: 2303011.001	Figure No: 2	Date: May 2023	Scale: NTS



Extract of DTS Raeburn - Sainsbury's Lyons Park. Drawing No. E13511/1 TOPO; dated 21/05/21.

tec	TEC The Old Chapel 35a Southover Wells, Somerset BA5 1UH	Tel: 01749 67776C Email: info@tecon.co.uk Web: www.tecon.co.uk	Site Name: SSL Lyons Farm, Worthing	Drawing Name: Exploratory Hole Location Plan	Client Name: Sainsbury's Supermarkets Ltd	Project No: 2303011.001	Figure No: 3	Date May 2023	Scale: NTS

Appendix A

Site Photographs



Photograph 1: View towards proposed development site area, facing west.



Photograph 2: View across site facing north, with an electrical substation further beyond.



Photograph 3: View across site facing east.



Photograph 4: View across site facing south, with a petrol station further beyond.



Photograph 5: A number of manhole covers located within the northern site area.



Photograph 6: Encountered cobbles of flint within BH01 at 5.0mbgl.



Photograph 7: Encountered ground conditions within borehole WS01.



Photograph 8: Encountered ground conditions within borehole WS01A.



Photograph 9: Encountered ground conditions within borehole WS02A.



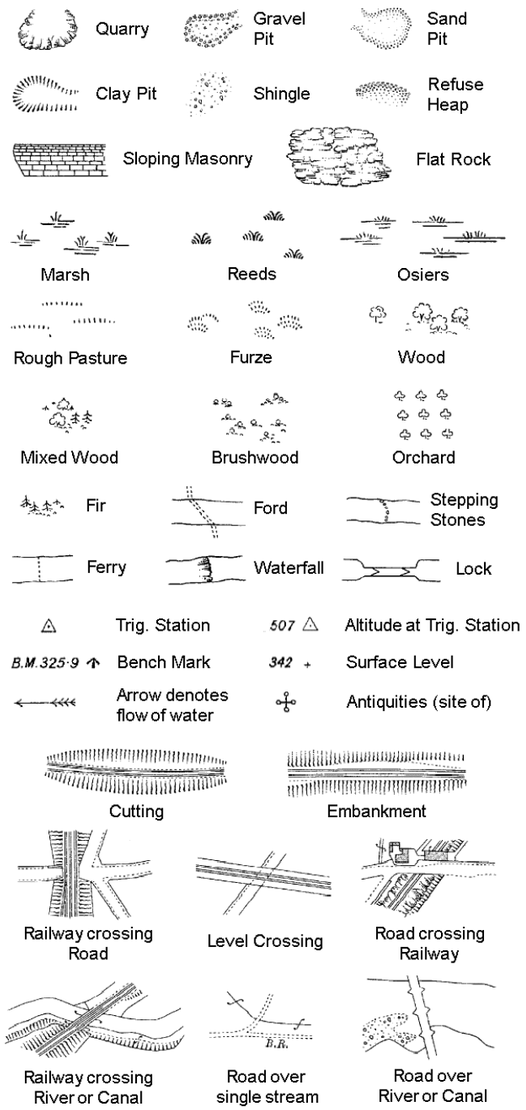
Photograph 10: Encountered ground conditions within borehole WS03.

Appendix B

Historical Maps

Historical Mapping Legends

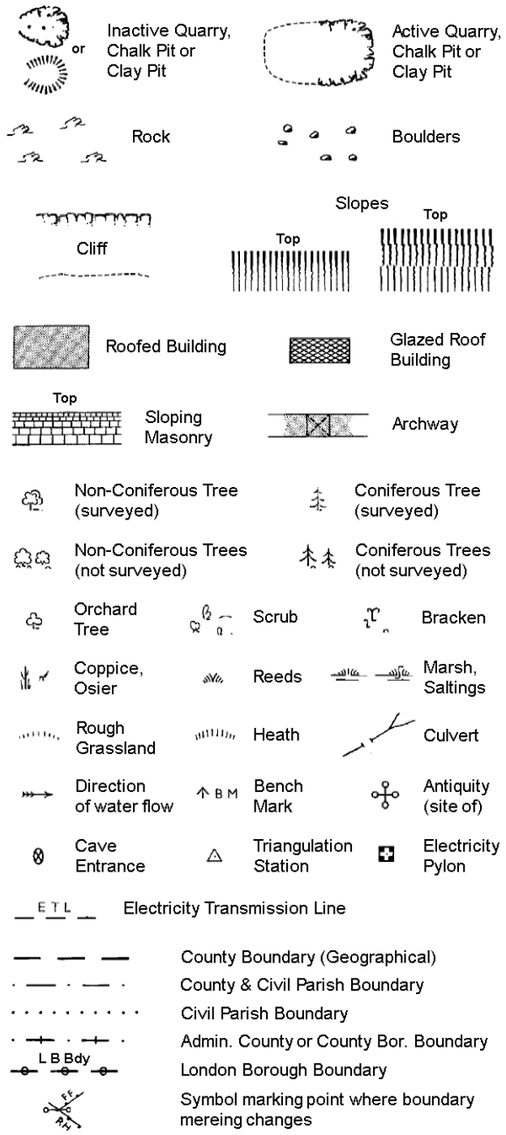
Ordnance Survey County Series and Ordnance Survey Plan 1:2,500



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

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

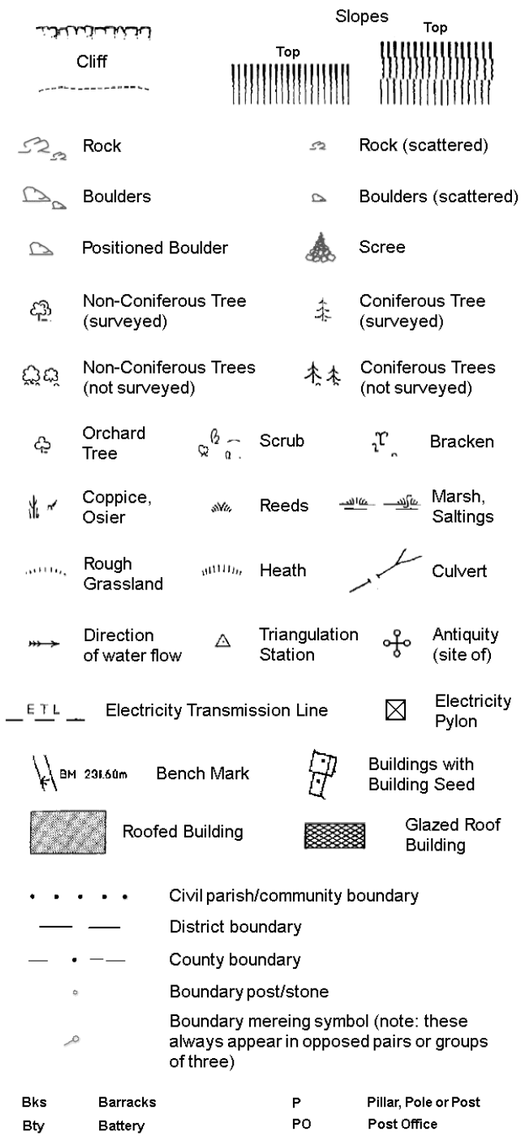
Ordnance Survey Plan, Additional SIMs and Supply of Unpublished Survey Information 1:2,500 and 1:1,250



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

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

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



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

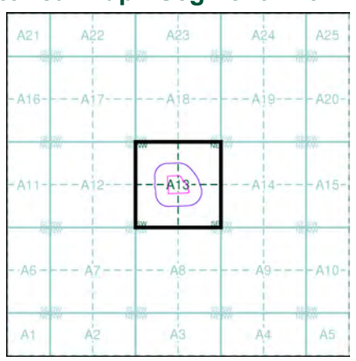
Bks	Barracks	P	Pillar, Pole or Post
Bty	Battery	PO	Post Office
Cemy	Cemetery	PC	Public Convenience
Chy	Chimney	Pp	Pump
Cis	Cistern	Ppg Sta	Pumping Station
Dismtd Rly	Dismantled Railway	PW	Place of Worship
El Gen Sta	Electricity Generating Station	Sewage Ppg Sta	Sewage Pumping Station
El P	Electricity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

tec

Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Sussex	1:2,500	1875 - 1876	2
Sussex	1:2,500	1898	3
Sussex	1:2,500	1912	4
Sussex	1:2,500	1932	5
Ordnance Survey Plan	1:1,250	1953 - 1973	6
Ordnance Survey Plan	1:2,500	1954	7
Ordnance Survey Plan	1:1,250	1960 - 1971	8
Supply of Unpublished Survey Information	1:1,250	1974	9
Ordnance Survey Plan	1:1,250	1976	10
Additional SIMs	1:1,250	1984 - 1992	11
Additional SIMs	1:1,250	1988	12
Large-Scale National Grid Data	1:1,250	1994	13
Large-Scale National Grid Data	1:1,250	1995	14
Historical Aerial Photography	1:2,500	1999	15

Historical Map - Segment A13



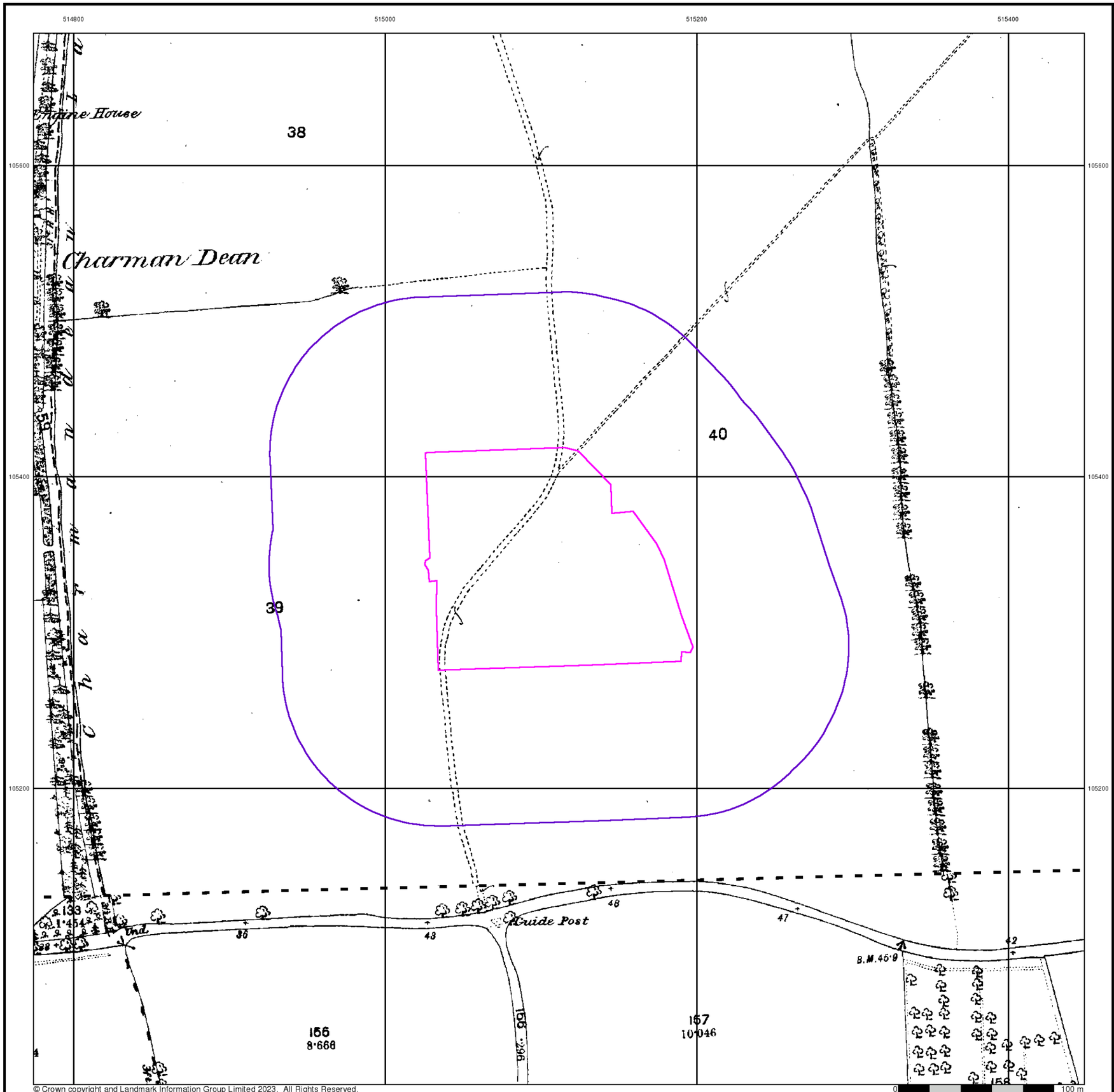
Order Details

Order Number: 309737039_1_1
Customer Ref: 2303011 - Lyons Farm, Worthing
National Grid Reference: 515100, 105340
Slice: A
Site Area (Ha): 1.96
Search Buffer (m): 100

Site Details

Sainsburys Supermarkets Ltd, Downland Business Park, Lyons Way, WORTHING, BN14 9LA

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



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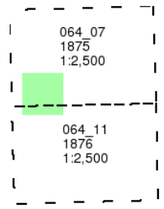
Sussex

Published 1875 - 1876

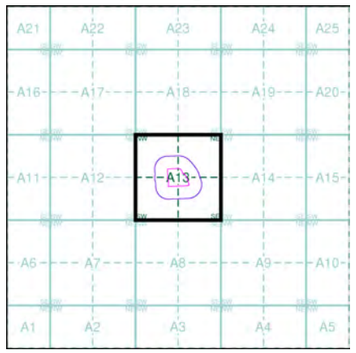
Source map scale - 1:2,500

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

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	309737039_1_1
Customer Ref:	2303011 - Lyons Farm, Worthing
National Grid Reference:	515100, 105340
Slice:	A
Site Area (Ha):	1.96
Search Buffer (m):	100

Site Details

Sainsburys Supermarkets Ltd, Downland Business Park, Lyons Way, WORTHING, BN14 9LA

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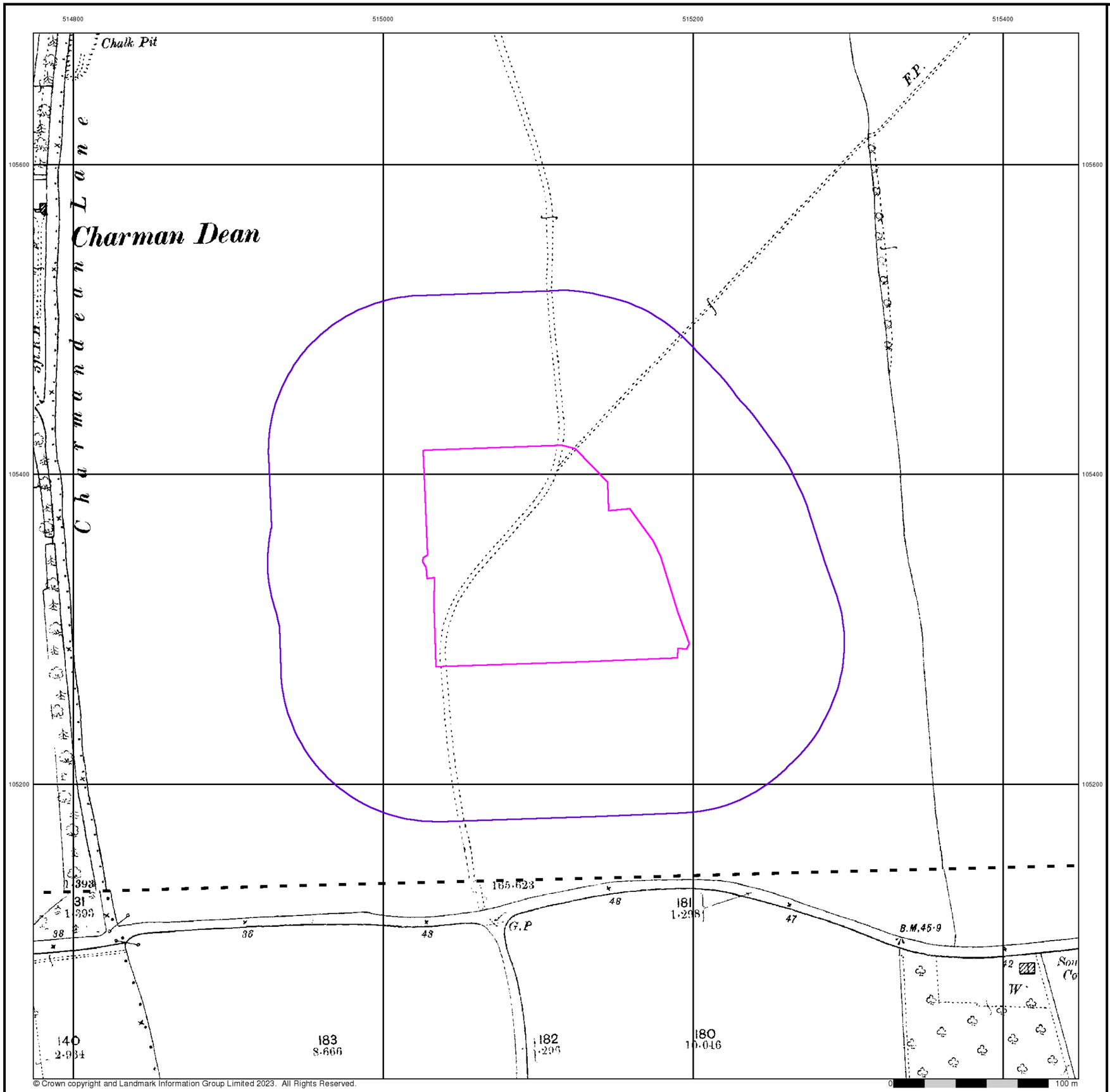

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Sussex

Published 1898

Source map scale - 1:2,500

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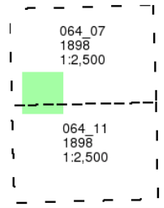
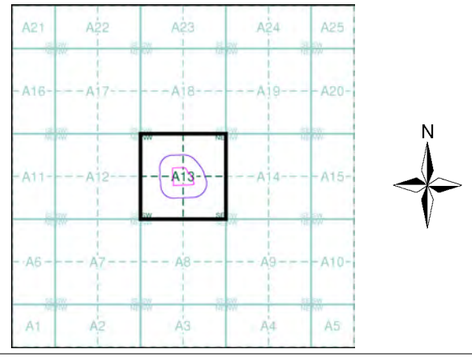
Map Name(s) and Date(s)



Historical Map - Segment A13



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Slice:	A
Site Area (Ha):	1.96
Search Buffer (m):	100

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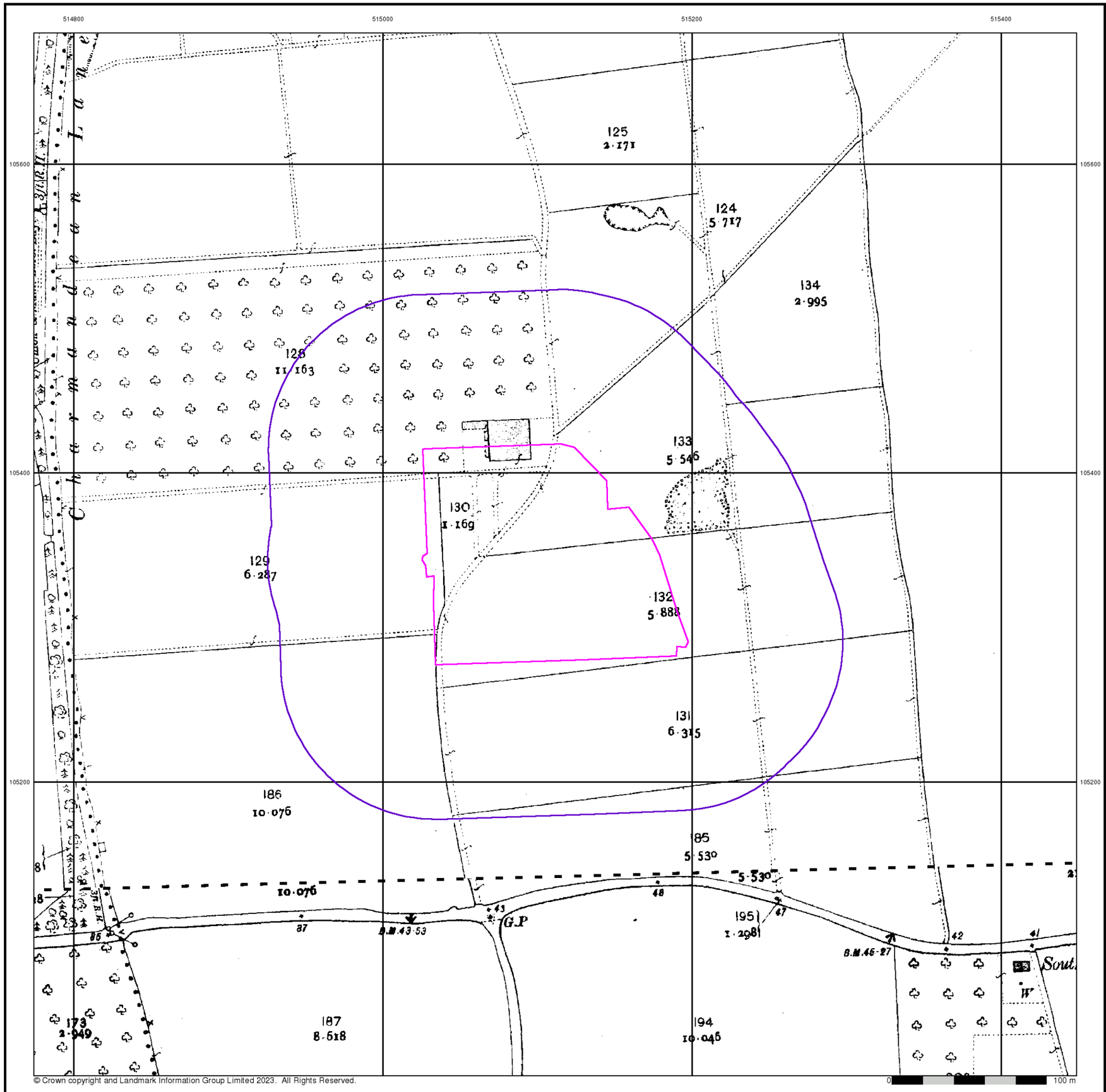

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tec

Sussex

Published 1912

Source map scale - 1:2,500

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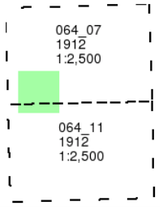
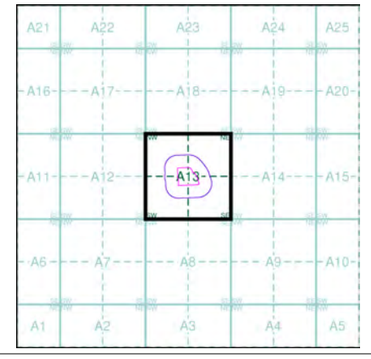


Historical Map - Segment A13



Order Details

Order Number:	309737039_1_1
Customer Ref:	2303011 - Lyons Farm, Worthing
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Slice:	A
Site Area (Ha):	1.96
Search Buffer (m):	100

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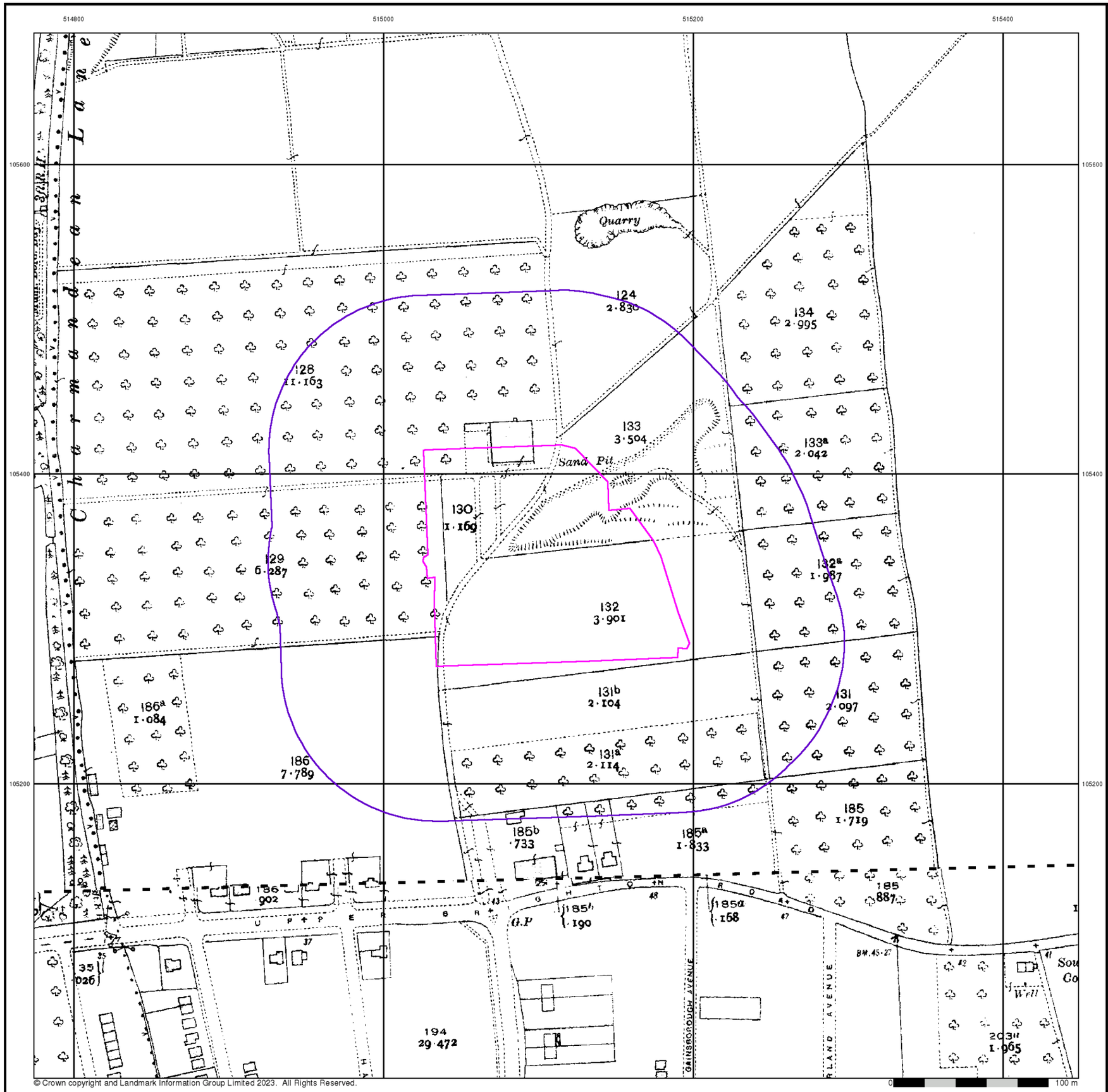

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Sussex

Published 1932

Source map scale - 1:2,500

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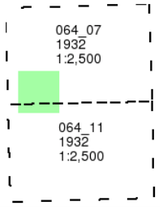
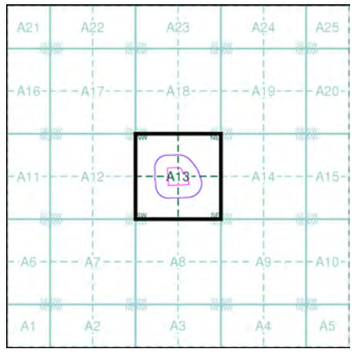


Historical Map - Segment A13



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Search Buffer (m):	100

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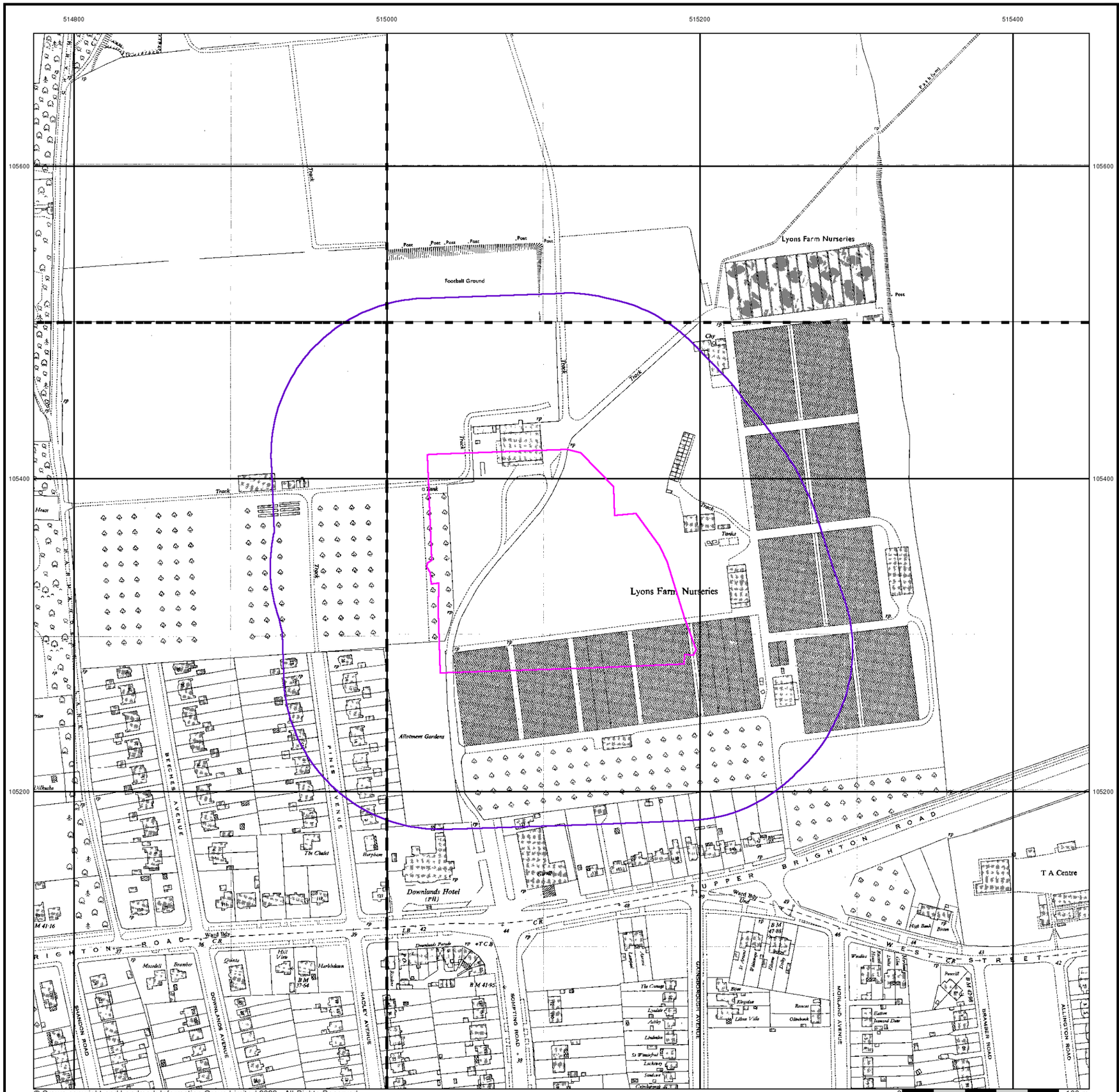

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Ordnance Survey Plan

Published 1953 - 1973

Source map scale - 1:1,250

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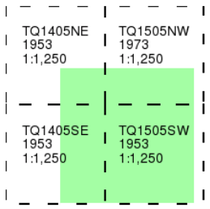
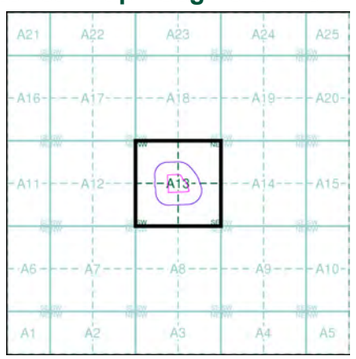
Map Name(s) and Date(s)



Historical Map - Segment A13



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National Grid Reference:	515100, 105340
Slice:	A
Site Area (Ha):	1.96
Search Buffer (m):	100

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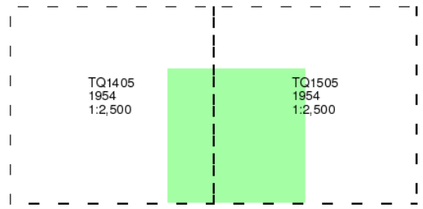
Ordnance Survey Plan

Published 1954

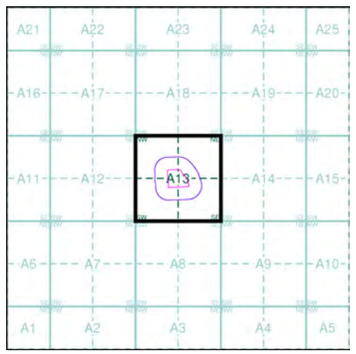
Source map scale - 1:2,500

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

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

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Slice:	A
Site Area (Ha):	1.96
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514800 515000 515200 515400

105600 105400 105200

Amherst Nursery
Lyons Farm Nurseries
Amherst Nursery
Tanks
Track
Track
Track
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Tank
Track
El Sub Sta
The Downlands Hotel (P H)
The Cholet
Surgery
Downlands Parade
Shelter
Garages
Ward Bdy
Kinnoull Court
The Limes
Hill View
Orpheus
Mendehill
Bramber
BRIGHTON ROAD
UPPER BRIGHTON ROAD
SOMPTING BY-PASS
DOWNLANDS GARDENS
BEECHES AVENUE
PINES AVENUE
SHANDON ROAD
DOWNLANDS AVENUE
THORLEY AVENUE
SOMPTING ROAD
CONISBOROUGH AVENUE
MORLAND AVENUE
BRAMBER ROAD
ALLINGTON ROAD
BM 37.66
BM 47.79
BM 42.29
BM 51.53
M 41.16
TCB
TCB
32.0m
0 100 m

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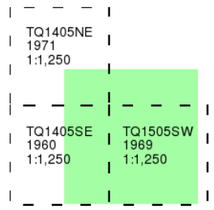
Ordnance Survey Plan

Published 1960 - 1971

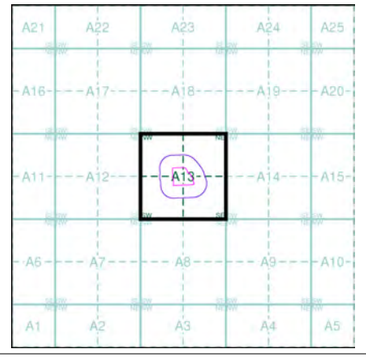
Source map scale - 1:1,250

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

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	309737039_1_1
Customer Ref:	2303011 - Lyons Farm, Worthing
National Grid Reference:	515100, 105340
Slice:	A
Site Area (Ha):	1.96
Search Buffer (m):	100

Site Details

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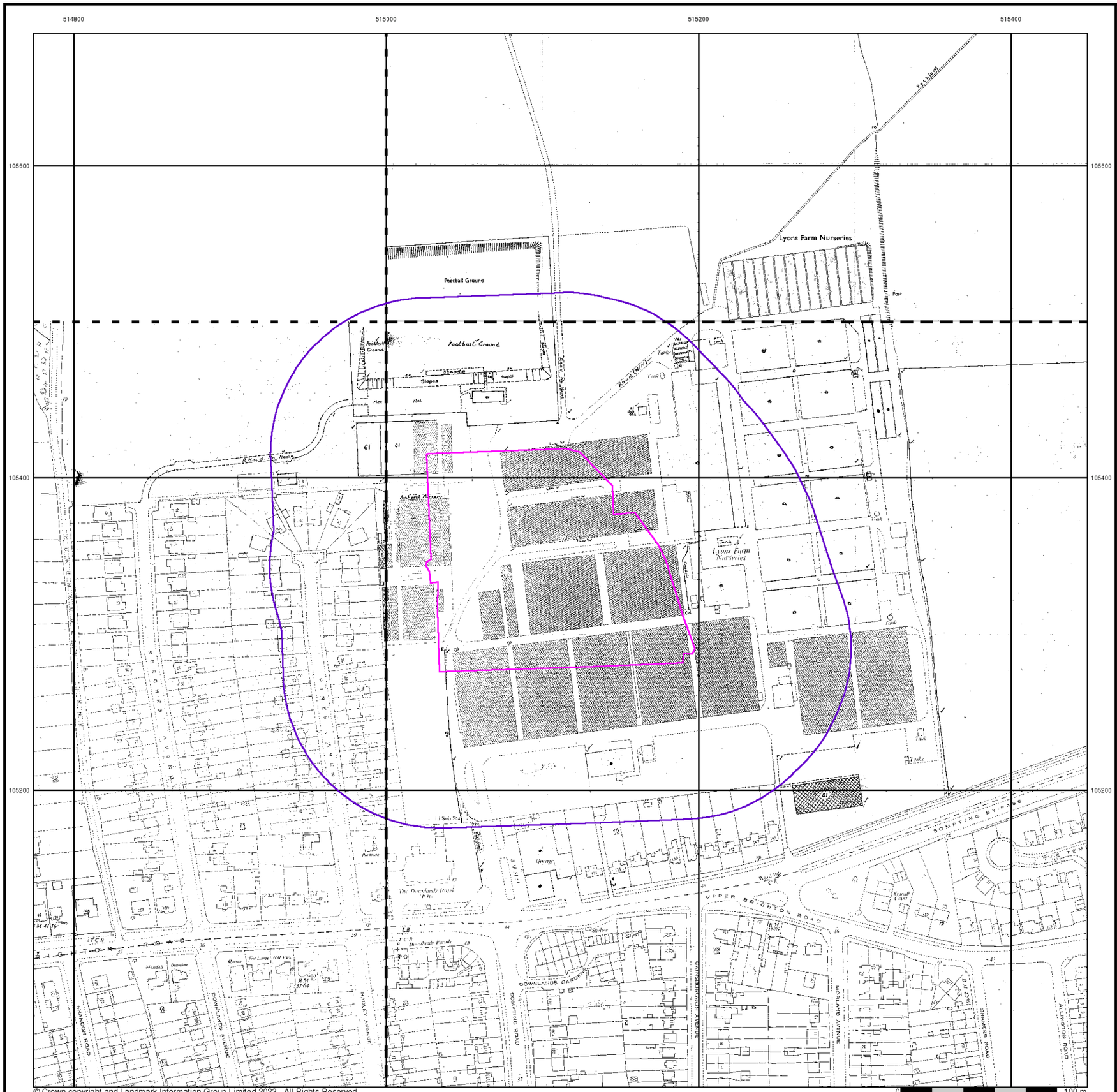

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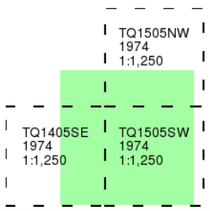
Supply of Unpublished Survey Information

Published 1974

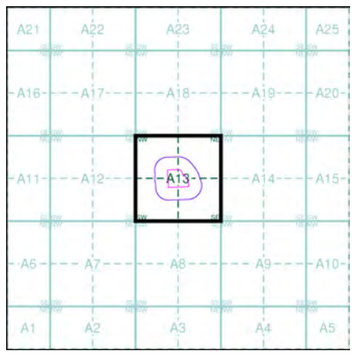
Source map scale - 1:1,250

SUSI maps (Supply of Unpublished Survey Information) were produced between 1972 and 1977, mainly for internal use at Ordnance Survey. These were more of a `work-in-progress' plan as they showed updates of individual areas on a map. These maps were unpublished, and they do not represent a single moment in time. They were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A13



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514800
515000
515200
515400
105600
105400
105200
Football Ground
Amherst Nursery
Croft Cottage
Pitmeater
Path (um)
BM 15.99m
BM 11.47m
Pond
Sluice
Sluice
Sluice



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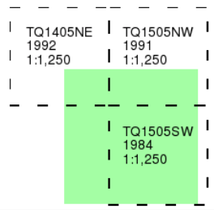
Additional SIMs

Published 1984 - 1992

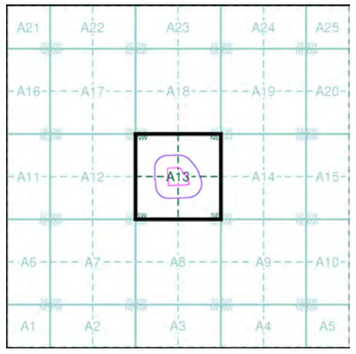
Source map scale - 1:1,250

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

Map Name(s) and Date(s)



Historical Map - Segment A13



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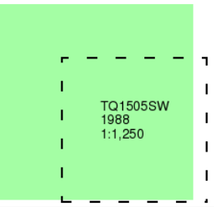
Additional SIMs

Published 1988

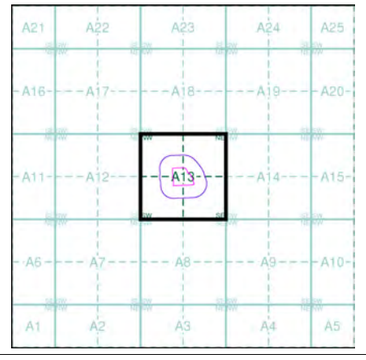
Source map scale - 1:1,250

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

Map Name(s) and Date(s)



Historical Map - Segment A13



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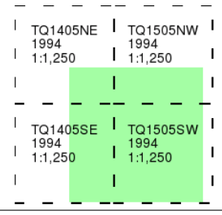
Large-Scale National Grid Data

Published 1994

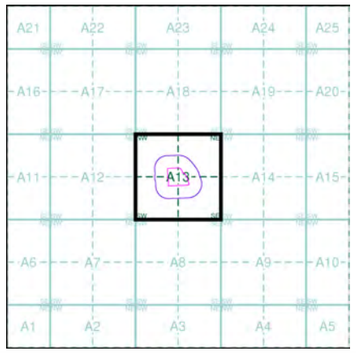
Source map scale - 1:1,250

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

Map Name(s) and Date(s)



Historical Map - Segment A13



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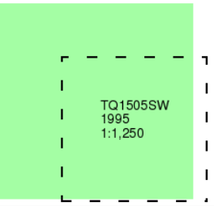
Large-Scale National Grid Data

Published 1995

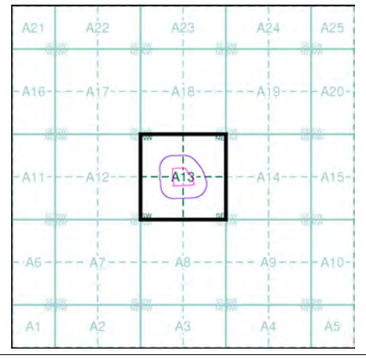
Source map scale - 1:1,250

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

Map Name(s) and Date(s)



Historical Map - Segment A13



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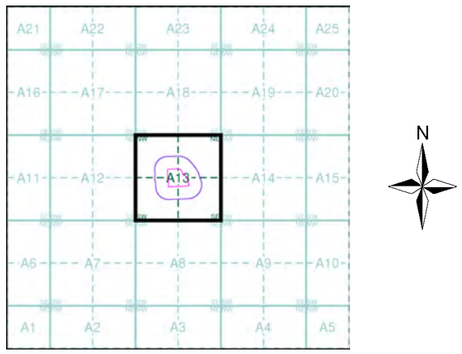
Historical Aerial Photography

Published 1999

This aerial photography was produced by Getmapping, these vertical aerial photographs provide a seamless, full colour survey of the whole of Great Britain

Historical Aerial Photography - Segment A13



Order Details

Order Number:	309737039_1_1
Customer Ref:	2303011 - Lyons Farm, Worthing
National Grid Reference:	515100, 105340
Slice:	A
Site Area (Ha):	1.96
Search Buffer (m):	100

Site Details

Sainsburys Supermarkets Ltd, Downland Business Park, Lyons Way, WORTHING, BN14 9LA

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

Historical Mapping Legends

Ordnance Survey County Series 1:10,560

Gravel Pit
Sand Pit
Other Pits
Quarry
Shingle
Orchard
Osiers
Reeds
Marsh
Mixed Wood
Deciduous
Brushwood
Fir
Furze
Rough Pasture
Arrow denotes flow of water
Trigonometrical Station
Site of Antiquities
Bench Mark
Pump, Guide Post, Signal Post
Well, Spring, Boundary Post
·285 Surface Level
Sketched Contour
Instrumental Contour
Main Roads
Fenced
Un-Fenced
Minor Roads
Fenced
Un-Fenced
Sunken Road
Raised Road
Road over Railway
Railway over River
Railway over Road
Level Crossing
Road over River or Canal
Road over Stream
Road over Stream
County Boundary (Geographical)
County & Civil Parish Boundary
Administrative County & Civil Parish Boundary
Co. Boro. Bdy. County Borough Boundary (England)
Co. Burgh Bdy. County Burgh Boundary (Scotland)
R.D. Bdy. Rural District Boundary
Civil Parish Boundary

Ordnance Survey Plan 1:10,000

Chalk Pit, Clay Pit or Quarry
Gravel Pit
Sand Pit
Disused Pit or Quarry
Refuse or Slag Heap
Lake, Loch or Pond
Dunes
Boulders
Coniferous Trees
Non-Coniferous Trees
Orchard
Scrub
Coppice
Bracken
Heath
Rough Grassland
Marsh
Reeds
Saltings
Building
Direction of Flow of Water
Shingle
Sand
Glasshouse
Pylon
Pylon
Electricity Transmission Line
Sloping Masonry
Cutting
Embankment
Standard Gauge Multiple Track
Road Under
Road Over
Level Crossing
Foot Bridge
Standard Gauge Single Track
Siding, Tramway or Mineral Line
Narrow Gauge
Geographical County
Administrative County, County Borough or County of City
Municipal Borough, Urban or Rural District, Burgh or District Council
Borough, Burgh or County Constituency
Shown only when not coincident with other boundaries
Civil Parish
Shown alternately when coincidence of boundaries occurs

BP, BS	Boundary Post or Stone	Pol Sta	Police Station
Ch	Church	PO	Post Office
CH	Club House	PC	Public Convenience
F E Sta	Fire Engine Station	PH	Public House
FB	Foot Bridge	SB	Signal Box
Fn	Fountain	Spr	Spring
GP	Guide Post	TCB	Telephone Call Box
MP	Mile Post	TCP	Telephone Call Post
MS	Mile Stone	W	Well

1:10,000 Raster Mapping

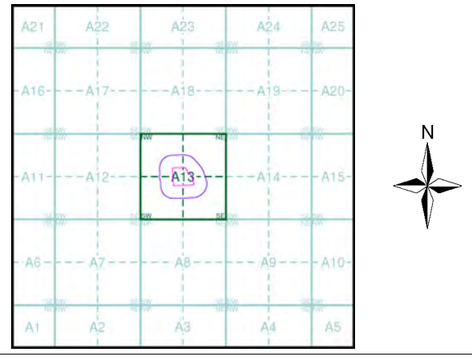
Gravel Pit
Refuse tip or slag heap
Rock
Rock (scattered)
Boulders
Boulders (scattered)
Shingle
Mud
Sand
Sand Pit
Slopes
Top of cliff
General detail
Underground detail
Overhead detail
Narrow gauge railway
Multi-track railway
Single track railway
County boundary (England only)
Civil, parish or community boundary
District, Unitary, Metropolitan, London Borough boundary
Constituency boundary
Area of wooded vegetation
Non-coniferous trees
Non-coniferous trees (scattered)
Coniferous trees
Coniferous trees (scattered)
Positioned tree
Orchard
Coppice or Osiers
Rough Grassland
Heath
Scrub
Marsh, Salt Marsh or Reeds
Water feature
Flow arrows
MHW(S) Mean high water (springs)
MLW(S) Mean low water (springs)
Telephone line (where shown)
Electricity transmission line (with poles)
BM 123.45 m Bench mark (where shown)
Triangulation station
Point feature (e.g. Guide Post or Mile Stone)
Pylon, flare stack or lighting tower
Site of (antiquity)
Glasshouse
General Building
Important Building

tec

Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Sussex	1:10,560	1879	3
Sussex	1:10,560	1899	4
Sussex	1:10,560	1913	5
Sussex	1:10,560	1913	6
Sussex	1:10,560	1913	7
Sussex	1:10,560	1932 - 1933	8
Sussex	1:10,560	1938 - 1950	9
Historical Aerial Photography	1:10,560	1947	10
Historical Aerial Photography	1:10,560	1947	11
Sussex	1:10,560	1952	12
Ordnance Survey Plan	1:10,000	1961 - 1963	13
Ordnance Survey Plan	1:10,000	1969	14
Ordnance Survey Plan	1:10,000	1971 - 1975	15
Ordnance Survey Plan	1:10,000	1979	16
Ordnance Survey Plan	1:10,000	1983	17
Ordnance Survey Plan	1:10,000	1990 - 1992	18
Brighton	1:10,000	1990	19
10K Raster Mapping	1:10,000	2000	20
10K Raster Mapping	1:10,000	2006	21
VectorMap Local	1:10,000	2022	22

Historical Map - Slice A



Order Details

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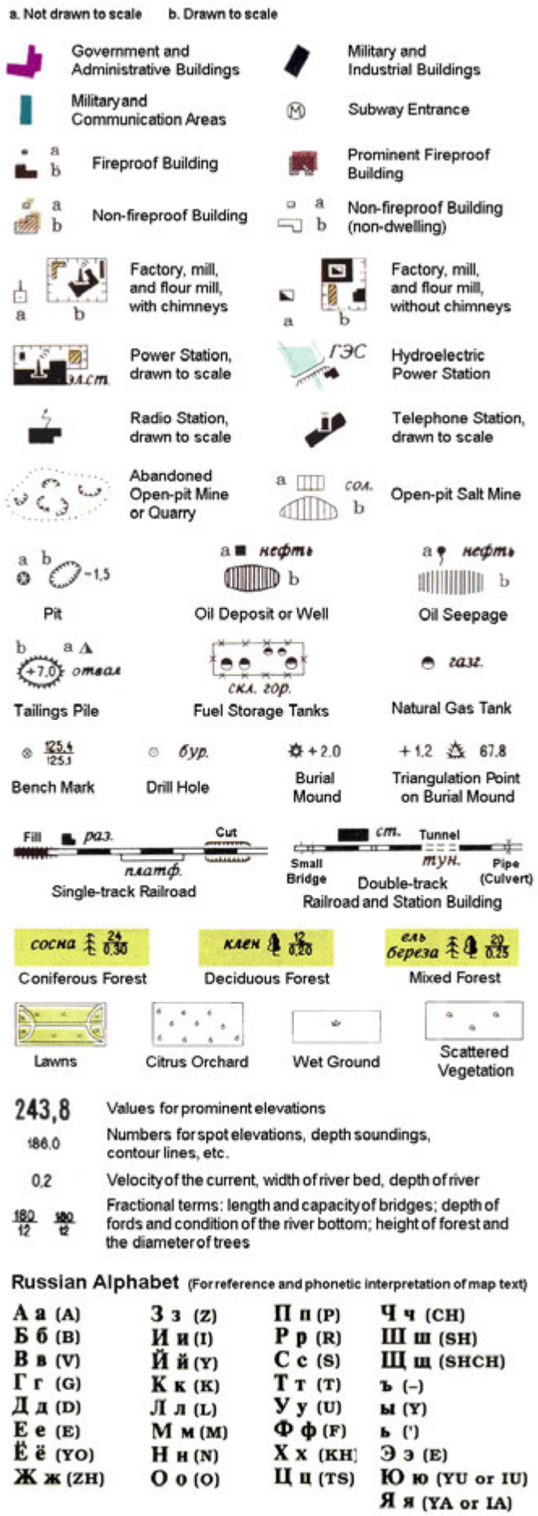
Russian Military Mapping Legends

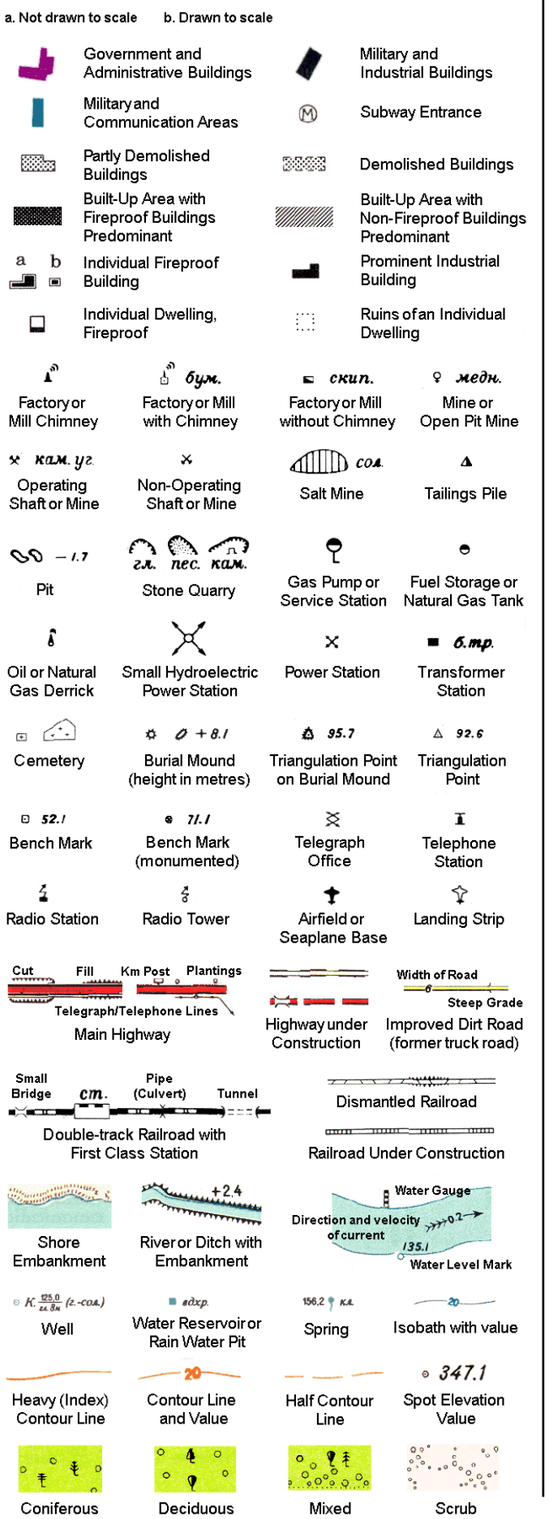
1:5,000 and 1:10,000 mapping



Russian Alphabet (For reference and phonetic interpretation of map text)

А а (A)	З з (Z)	П п (P)	Ч ч (CH)
Б б (B)	И и (I)	Р р (R)	Ш ш (SH)
В в (V)	Й й (Y)	С с (S)	Щ щ (SHCH)
Г г (G)	К к (K)	Т т (T)	ъ (–)
Д д (D)	Л л (L)	У у (U)	ы (Y)
Е е (E)	М м (M)	Ф ф (F)	ь (')
Ё ё (YO)	Н н (N)	Х х (KH)	Э э (E)
Ж ж (ZH)	О о (O)	Ц ц (TS)	Ю ю (YU or IU)
			Я я (YA or IA)

1:25,000 mapping



Key to Numbers on Mapping

Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Sussex	1:10,560	1879	3
Sussex	1:10,560	1899	4
Sussex	1:10,560	1913	5
Sussex	1:10,560	1913	6
Sussex	1:10,560	1913	7
Sussex	1:10,560	1932 - 1933	8
Sussex	1:10,560	1938 - 1950	9
Historical Aerial Photography	1:10,560	1947	10
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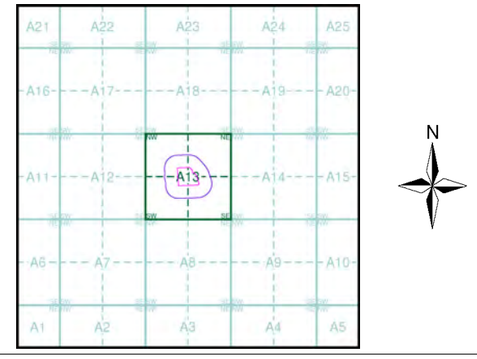
Ordnance Survey Plan	1:10,000	1979	16
Ordnance Survey Plan	1:10,000	1983	17
Ordnance Survey Plan	1:10,000	1990 - 1992	18
Brighton	1:10,000	1990	19
10K Raster Mapping	1:10,000	2000	20
10K Raster Mapping	1:10,000	2006	21
VectorMap Local	1:10,000	2022	22

Russian Map - Slice A



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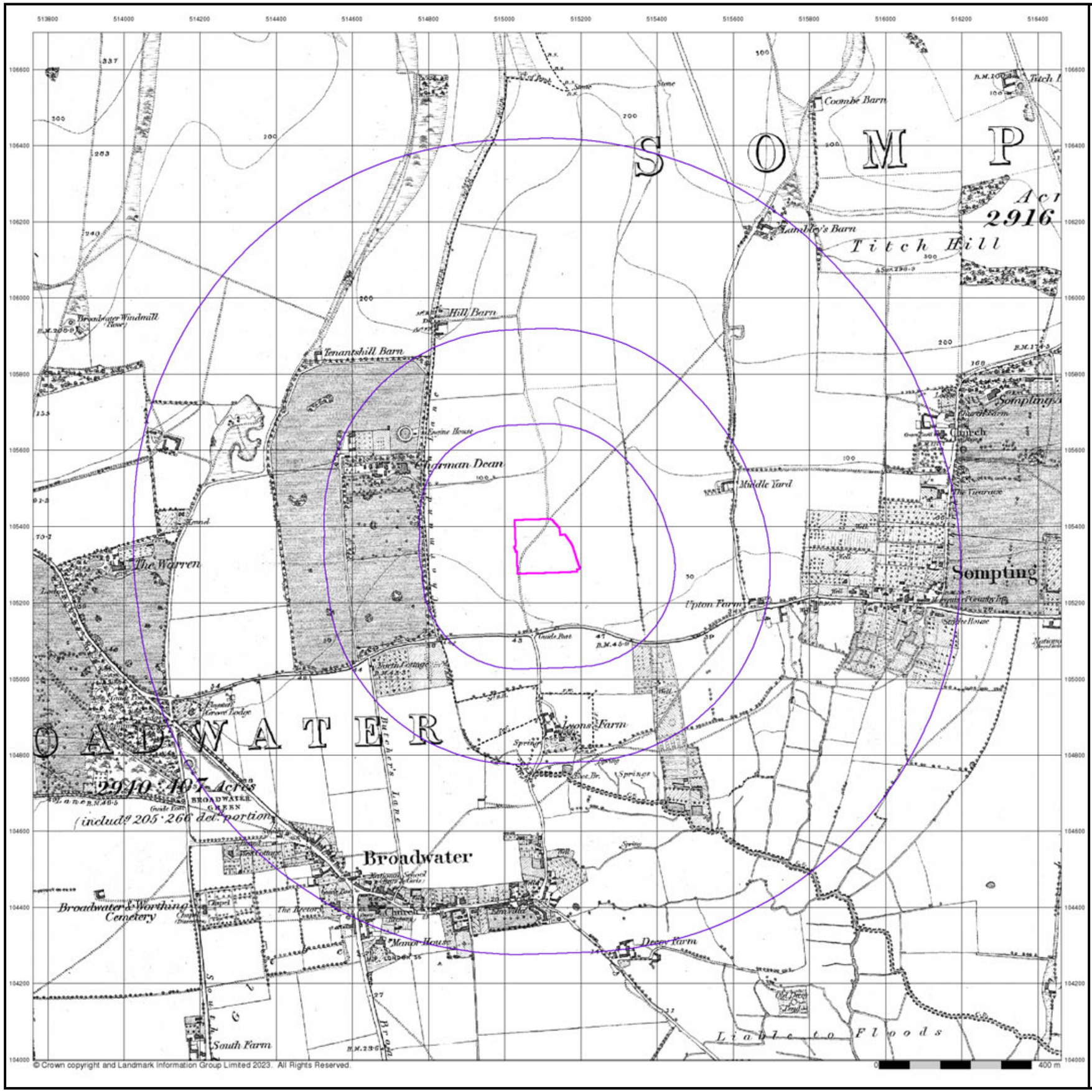

Sussex

Published 1879

Source map scale - 1:10,560

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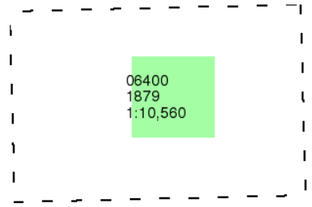
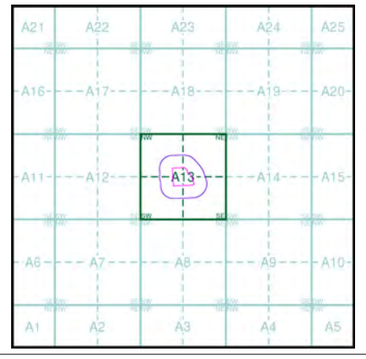
Map Name(s) and Date(s)



Historical Map - Slice A



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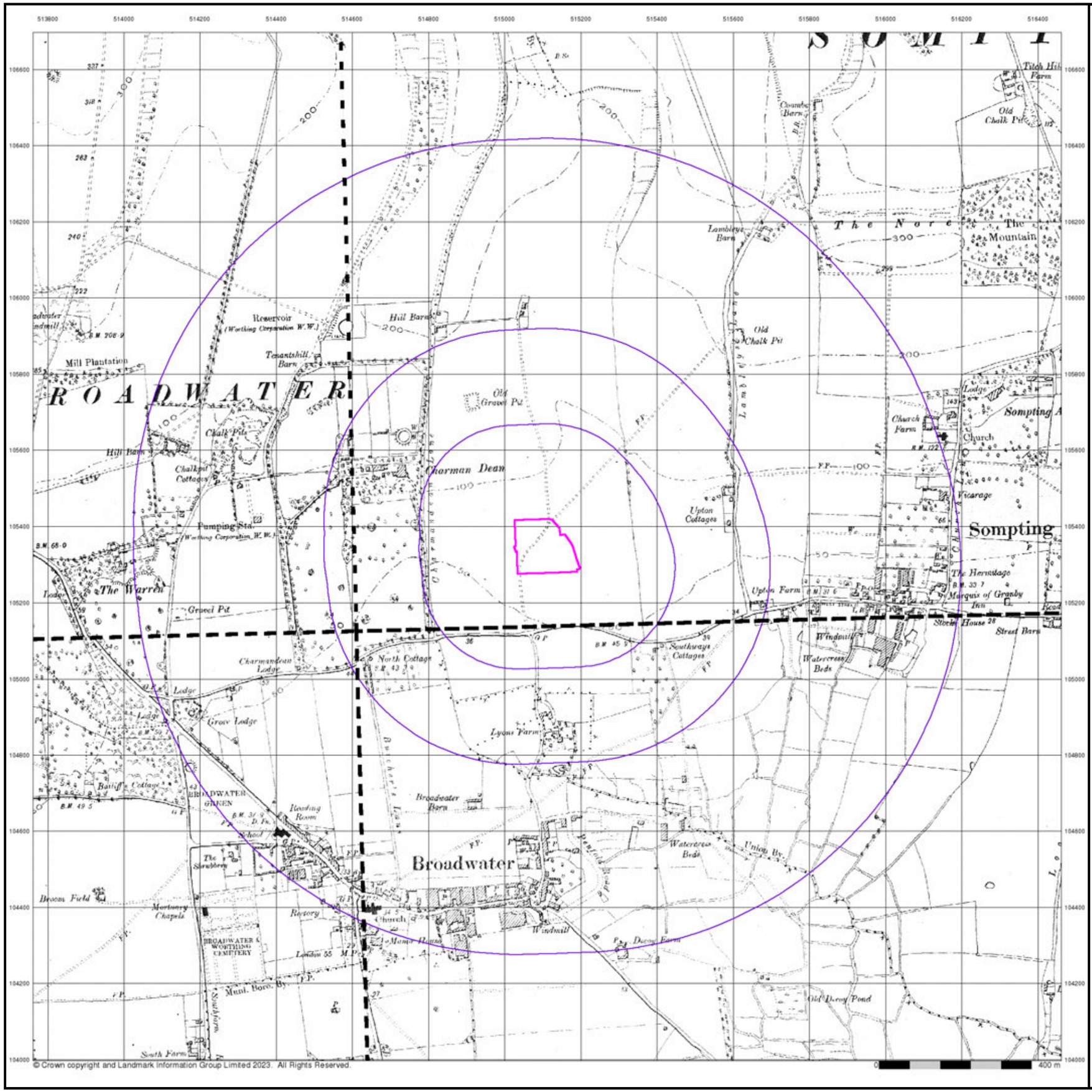
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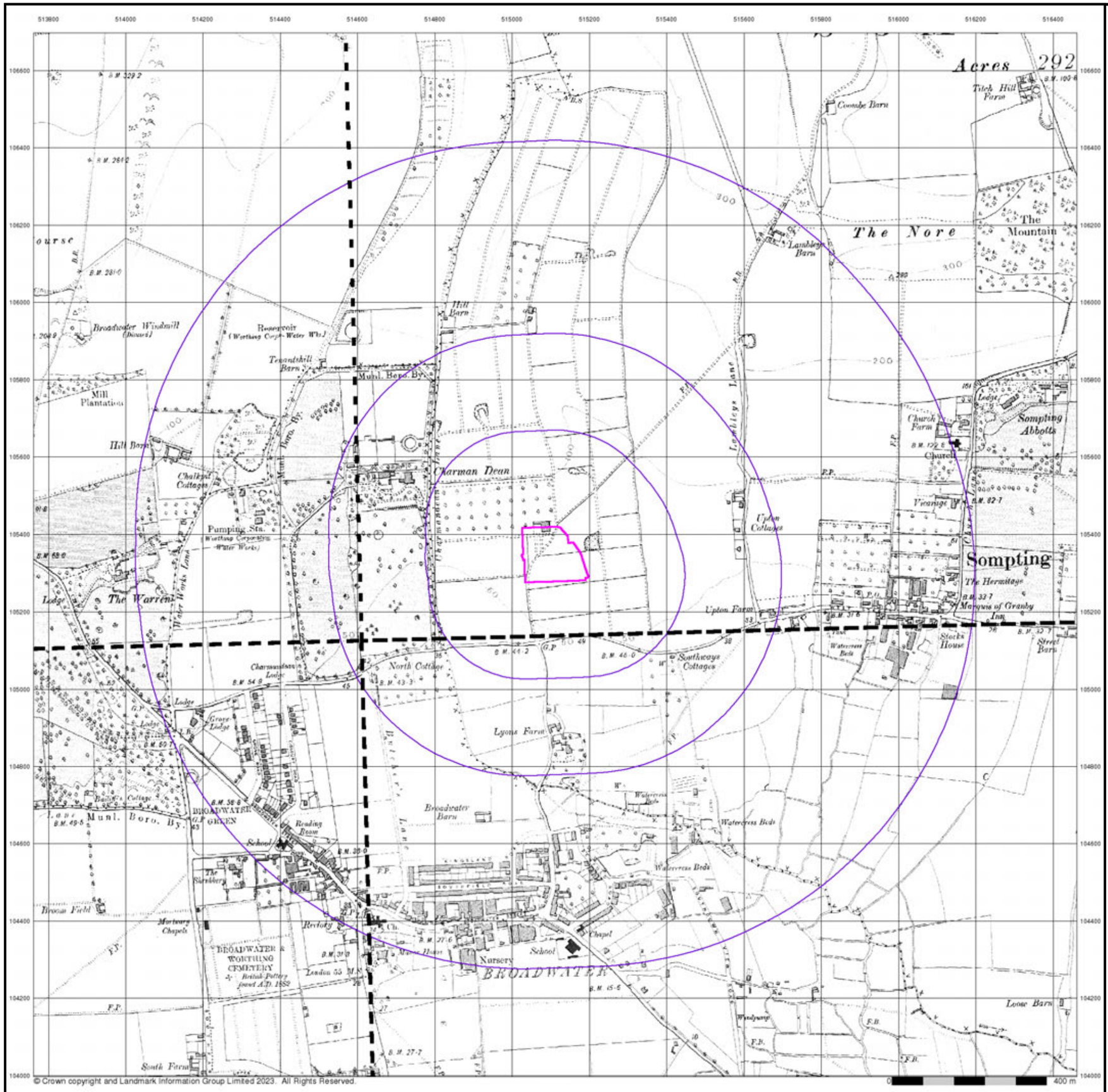
106400
106200
106000
105800
105600
105400
105200
105000
104800
104600
104400
104200
104000
ROADWATER
Broadwater
Sompting
The Mountain
Reservoir
(Worthing Corporation W.W.)
Hill Barn
Tenantshill Barn
Mill Plantation
Old Chalk Pit
Old Gravel Pit
Chalk Pits
Charman Dean
Lambleys Barn
Church Farm
Church
Vicarage
Lodge
Upton Cottages
Upton Farm
The Hermitage
Marquis of Granby Inn
Stocks House
Street Barn
Windmill
Watercress Beds
Southways Cottages
North Cottage
Charmandean Lodge
Grove Lodge
Lyons Farm
Broadwater Barn
Reading Room
Mortuary Chapels
Rectory
Manor House
Old Drove Pond
Pumping Sta.
Gravel Pit
The Warren
Hill Barn
Titch Hill Farm
Old Chalk Pit
Coombe Barn
Lambleys Lane
The Nore
Broadwater Lane
Broadwater Green
Broadwater & Worthing Cemetery
Broom Field
South Farm
Mill Plantation
Chalkpit Cottages
Bailiff's Cottage
Lodge
Grove Lodge
Lodge
Lodge



Sussex

Published 1913

Source map scale - 1:10,560

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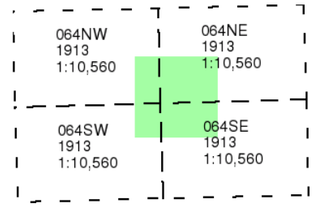
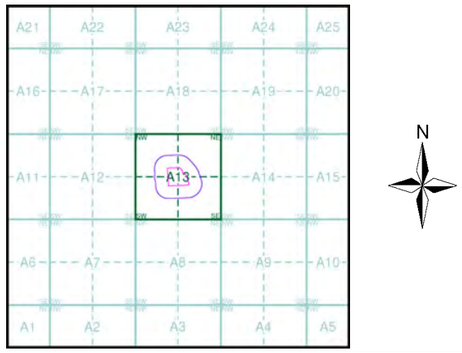
Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

Order Number:	309737039_1_1
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Slice:	A
Site Area (Ha):	1.96
Search Buffer (m):	1000

Site Details

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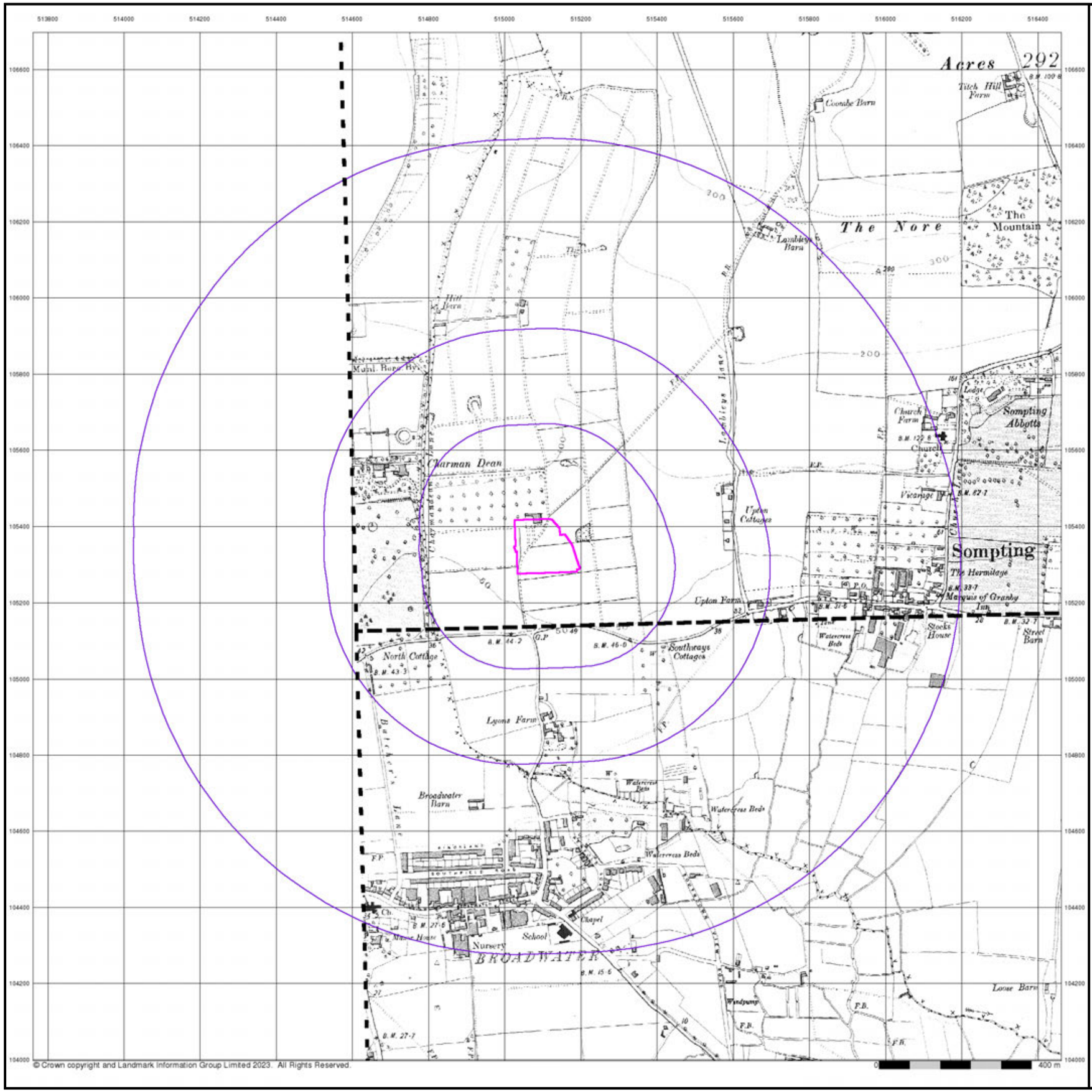

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Sussex

Published 1913

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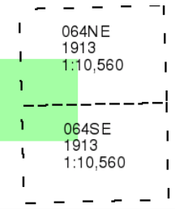
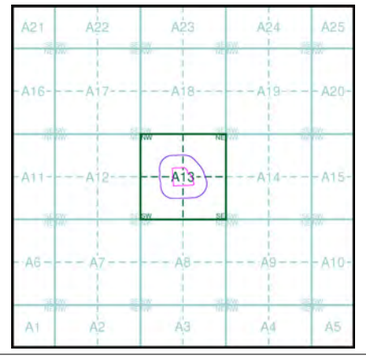


Historical Map - Slice A



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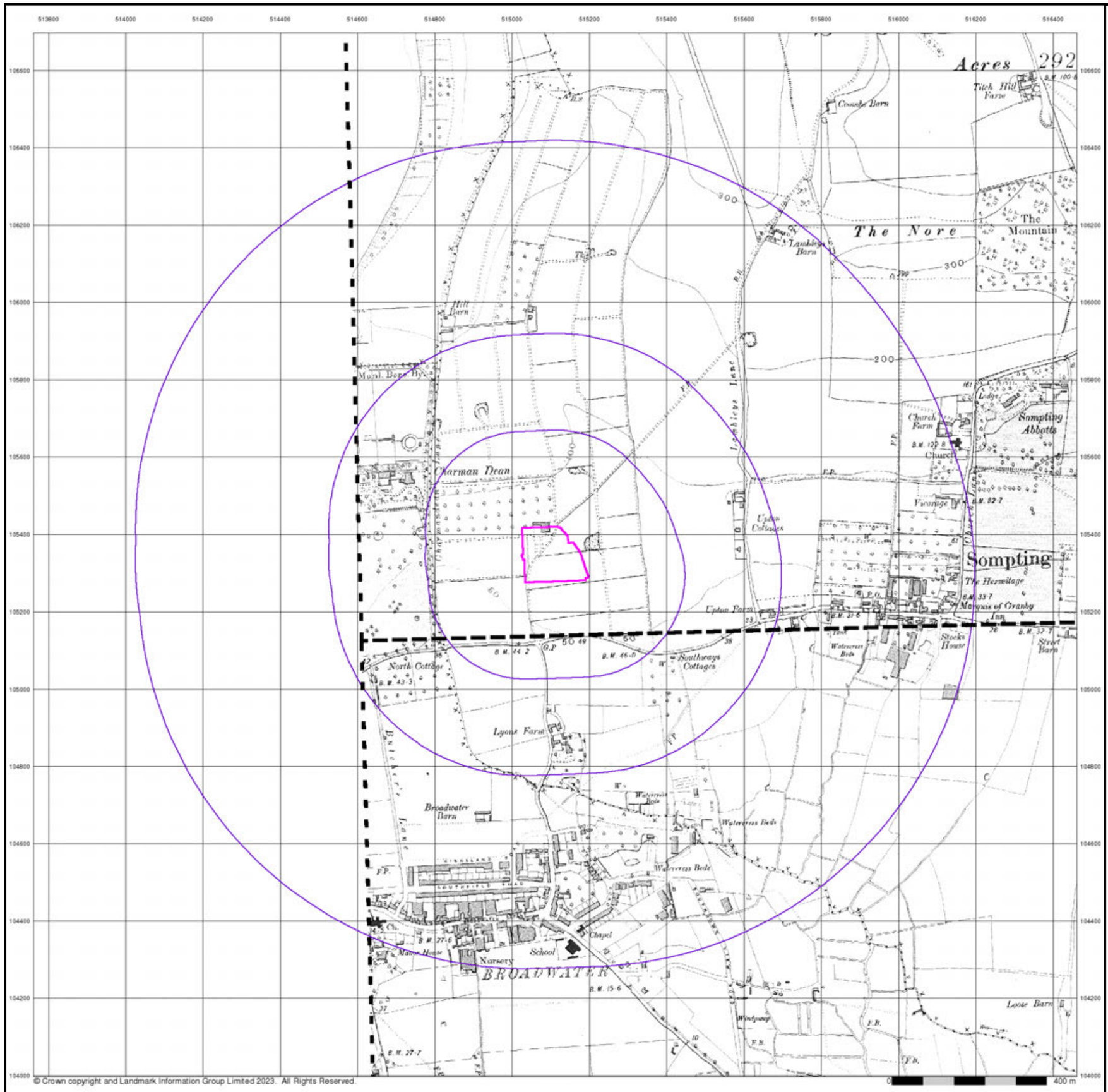

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Sussex

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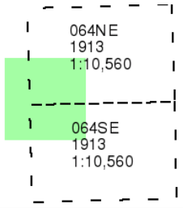
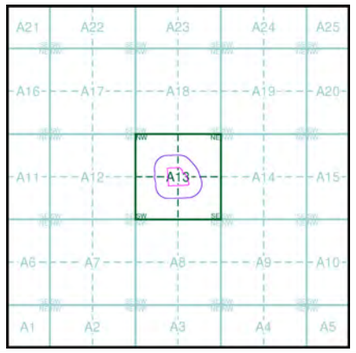


Historical Map - Slice A



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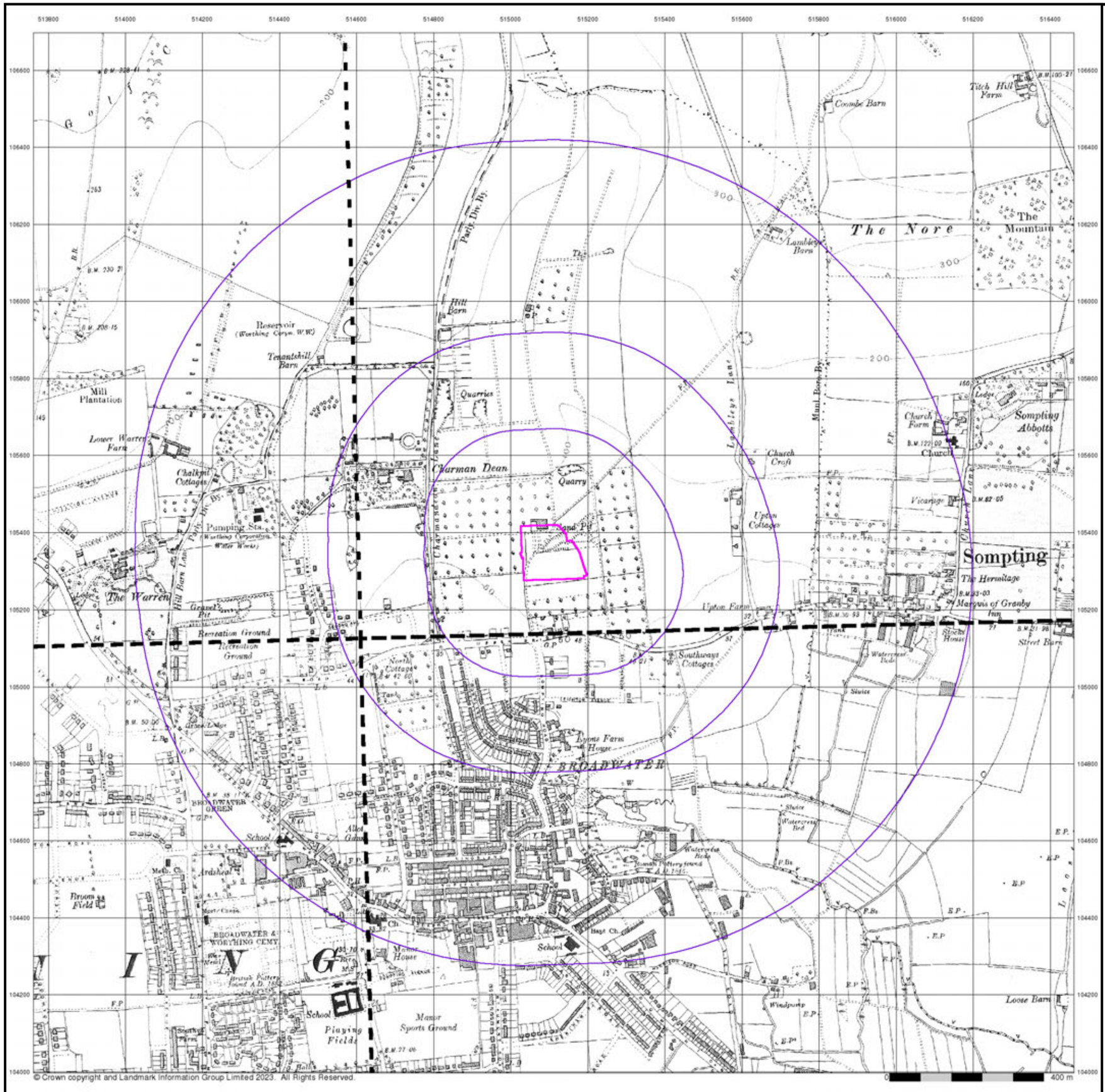

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Sussex

Published 1932 - 1933

Source map scale - 1:10,560

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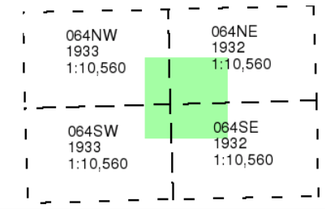
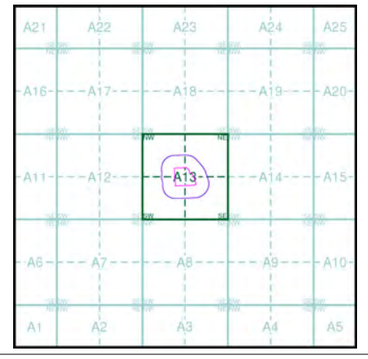
Map Name(s) and Date(s)



Historical Map - Slice A



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Sussex

Published 1938 - 1950

Source map scale - 1:10,560

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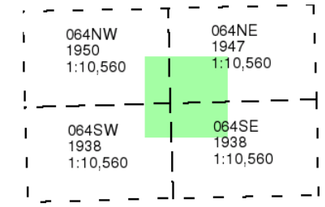
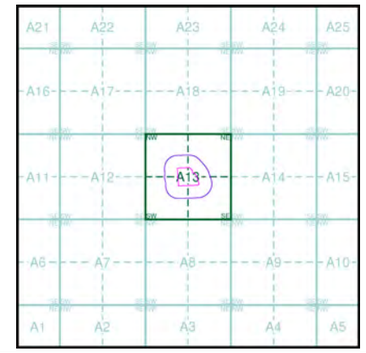


Historical Map - Slice A



Order Details

Order Number:	309737039_1_1
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National Grid Reference:	515100, 105340
Slice:	A
Site Area (Ha):	1.96
Search Buffer (m):	1000

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Historical Aerial Photography

Published 1947

Source map scale - 1:10,560

The Historical Aerial Photos were produced by the Ordnance Survey at a scale of 1:1,250 and 1:10,560 from Air Force photography. They were produced between 1944 and 1951 as an interim measure, pending preparation of conventional mapping, due to post war resource shortages. New security measures in the 1950's meant that every photograph was re-checked for potentially unsafe information with security sites replaced by fake fields or clouds. The original editions were withdrawn and only later made available after a period of fifty years although due to the accuracy of the editing, without viewing both revisions it is not easy to spot the edits. Where available Landmark have included both revisions.

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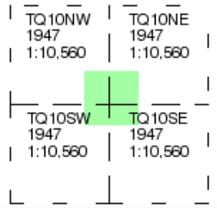
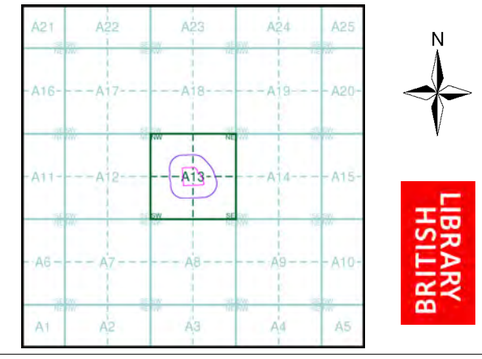
Map Name(s) and Date(s)



Historical Aerial Photography - Slice A



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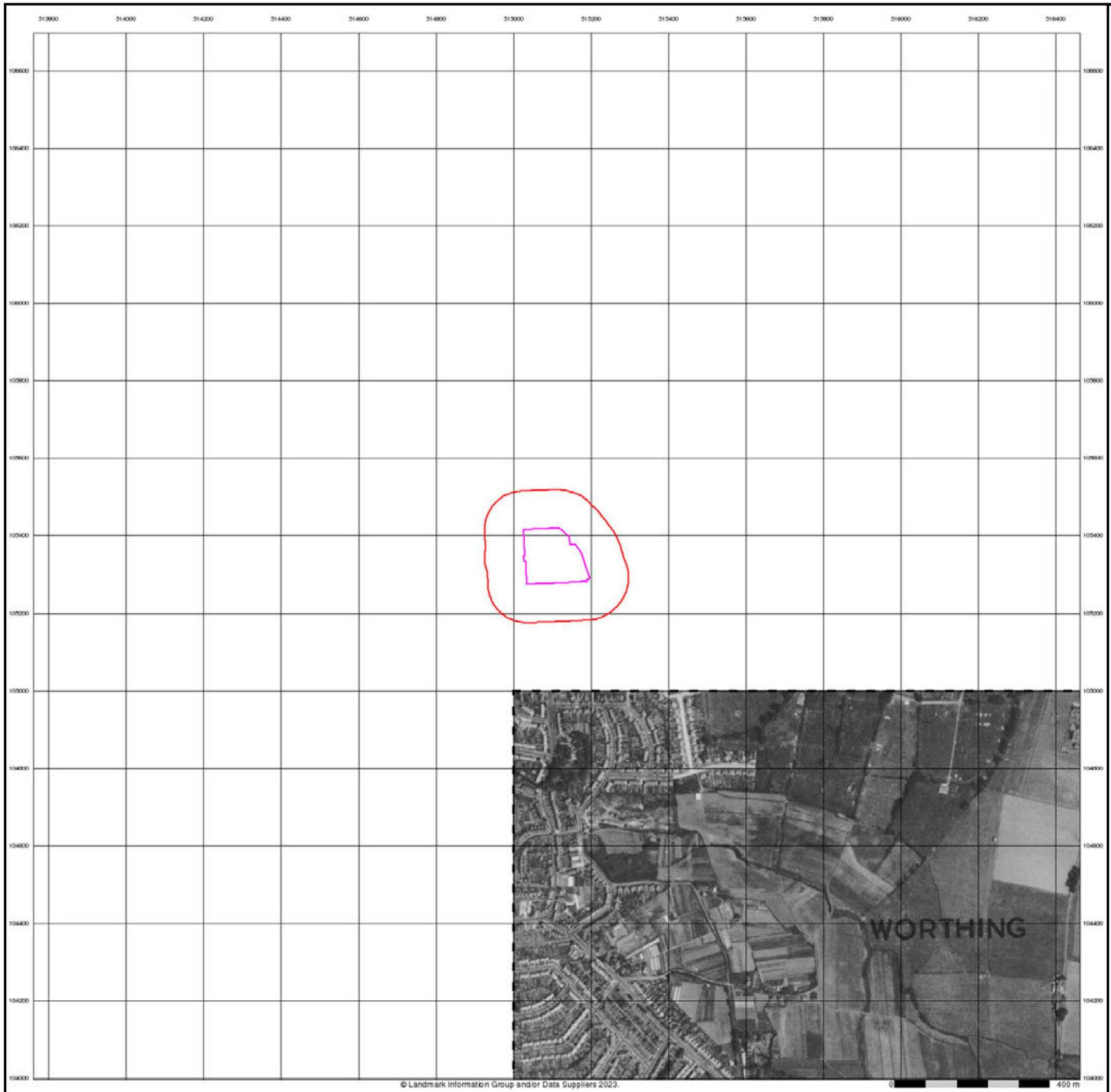

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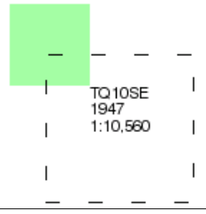
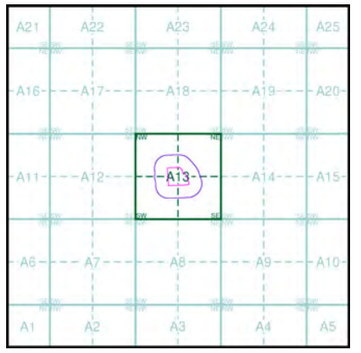


Historical Aerial Photography - Slice A



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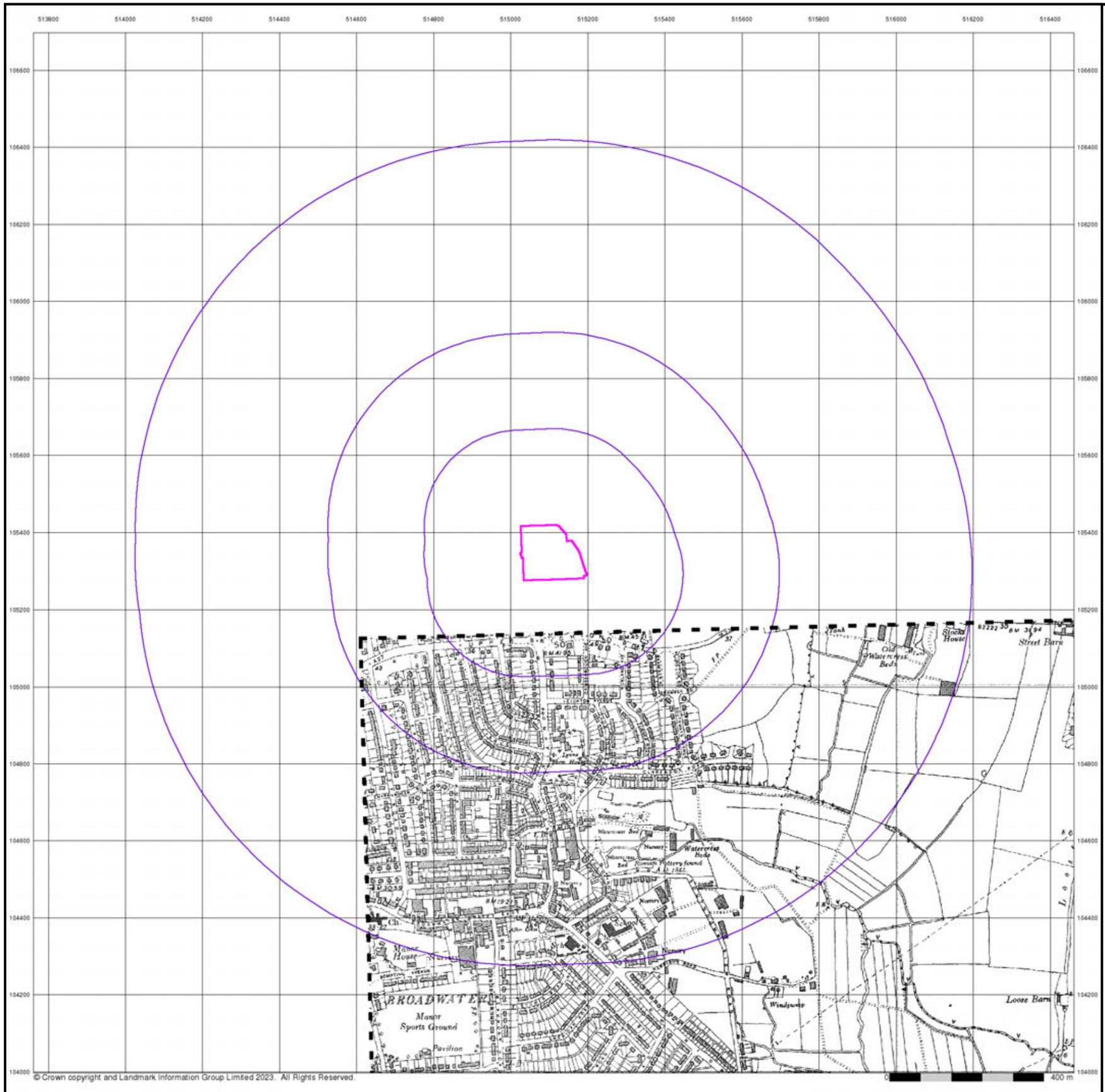

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Sussex

Published 1952

Source map scale - 1:10,560

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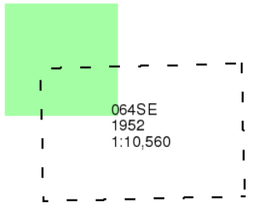
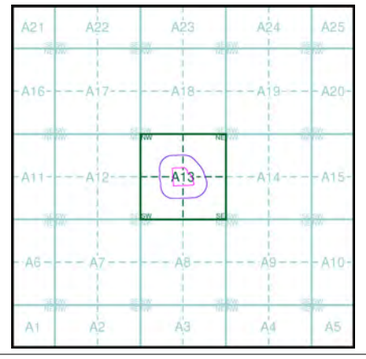
Map Name(s) and Date(s)



Historical Map - Slice A



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Ordnance Survey Plan

Published 1961 - 1963

Source map scale - 1:10,000

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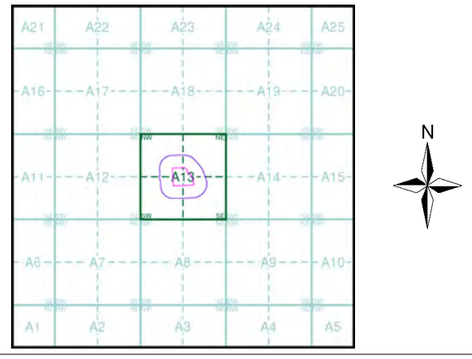
Map Name(s) and Date(s)

TQ10NW 1963 1:10,560	TQ10NE 1961 1:10,560
TQ10SW 1962 1:10,560	TQ10SE 1962 1:10,560

Historical Map - Slice A



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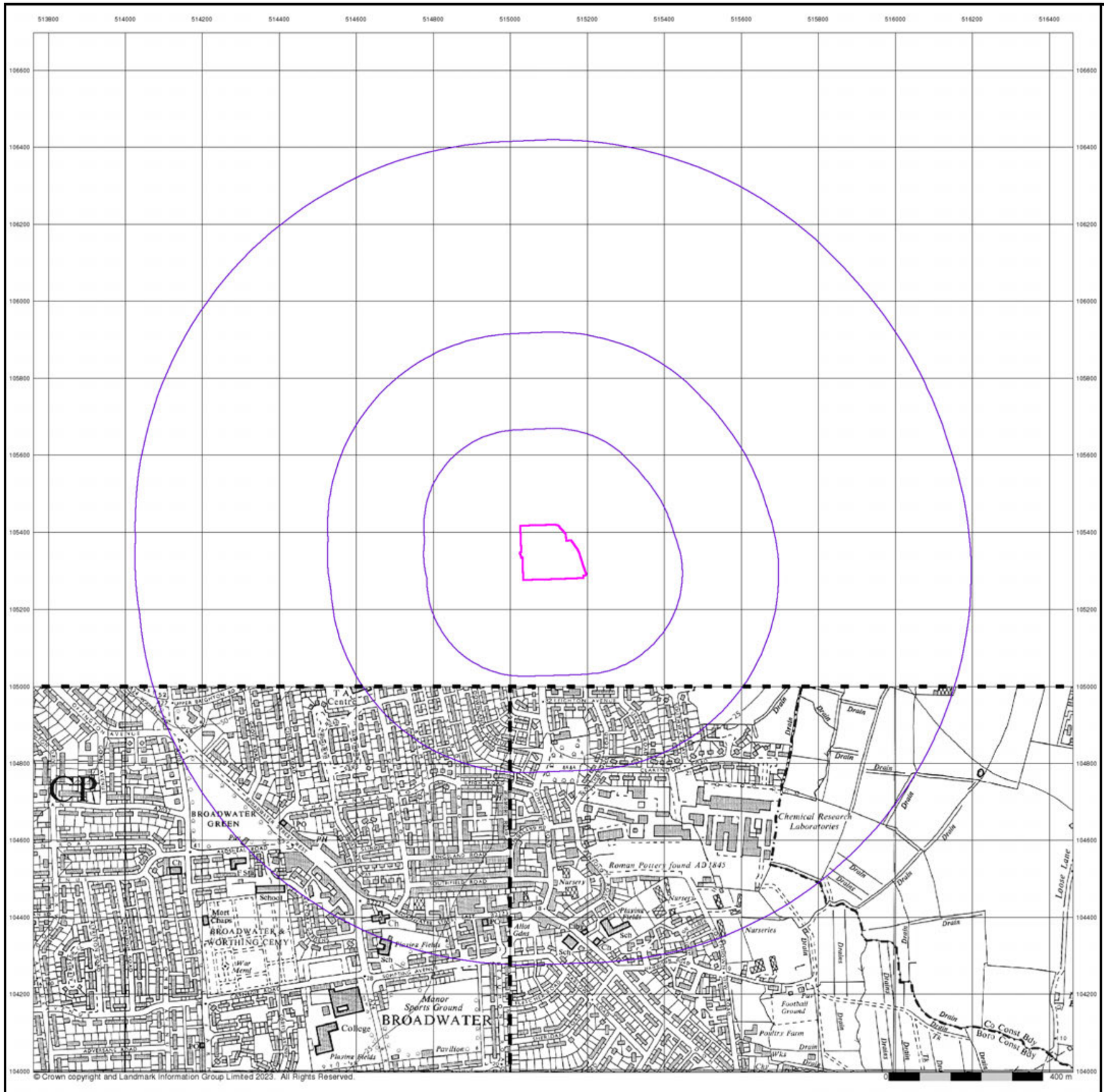

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Ordnance Survey Plan

Published 1969

Source map scale - 1:10,000

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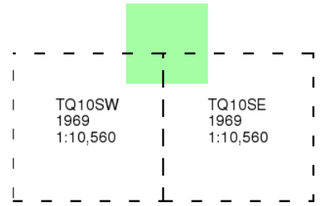
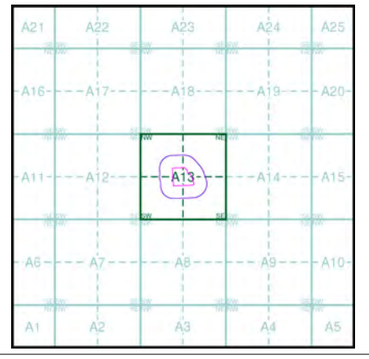
Map Name(s) and Date(s)



Historical Map - Slice A



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Ordnance Survey Plan

Published 1971 - 1975

Source map scale - 1:10,000

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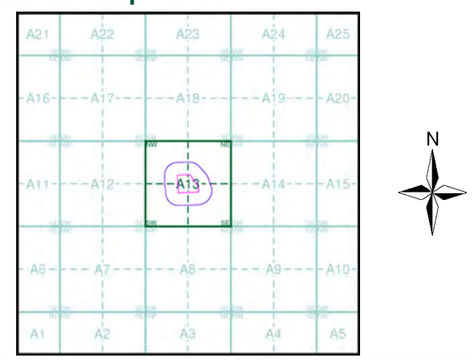
Map Name(s) and Date(s)

TQ10NW 1974 1:10,000	TQ10NE 1975 1:10,000
TQ10SW 1971 1:10,000	TQ10SE 1971 1:10,000

Historical Map - Slice A



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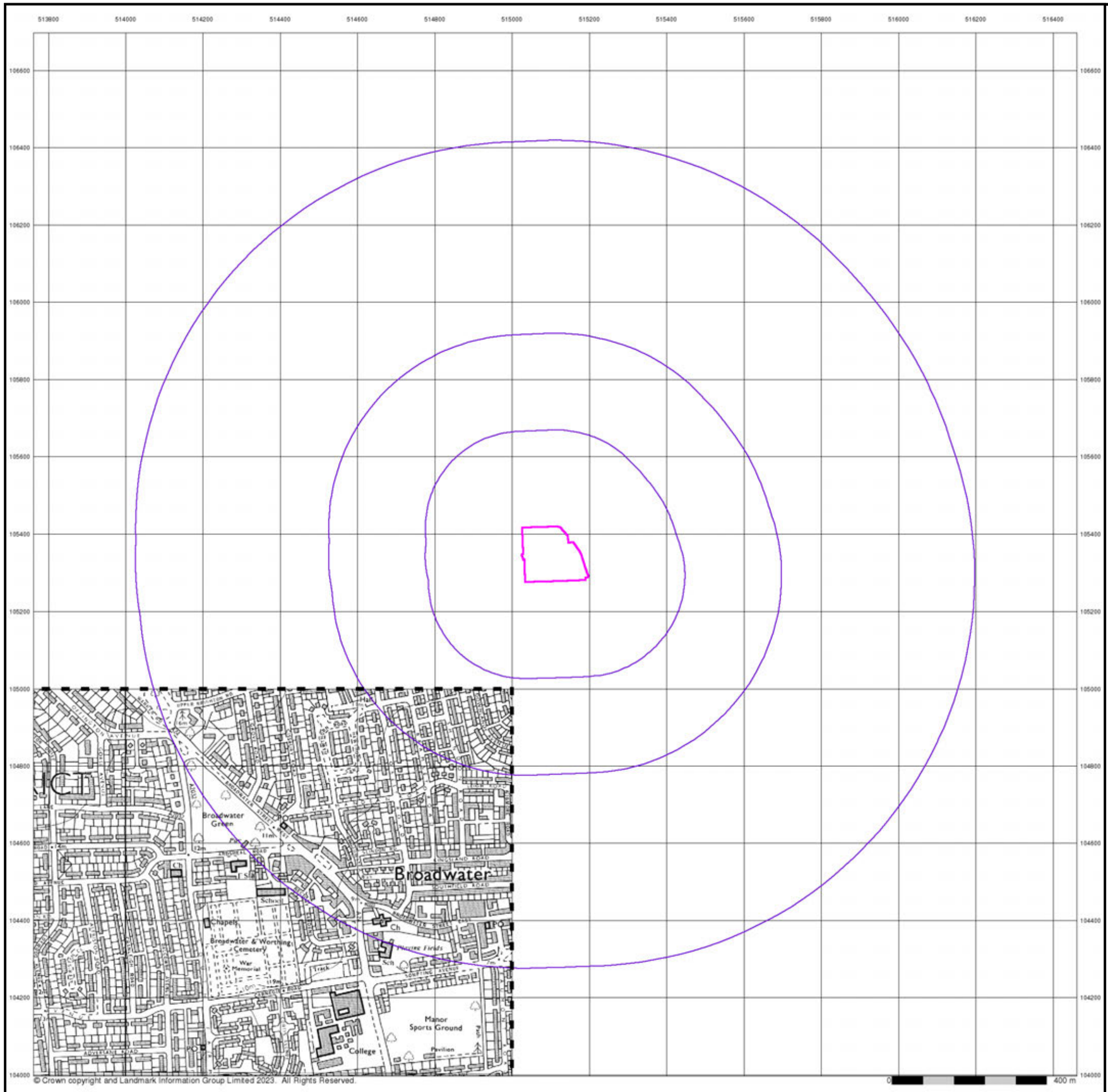

Ordnance Survey Plan

Published 1979

Source map scale - 1:10,000

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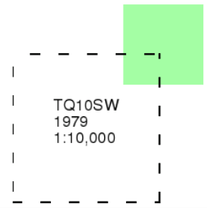
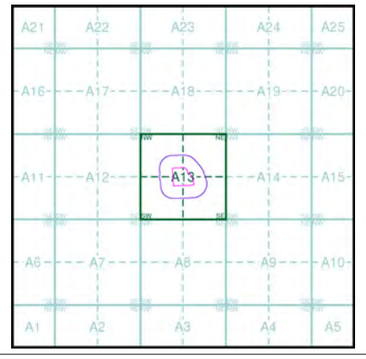
Map Name(s) and Date(s)



Historical Map - Slice A



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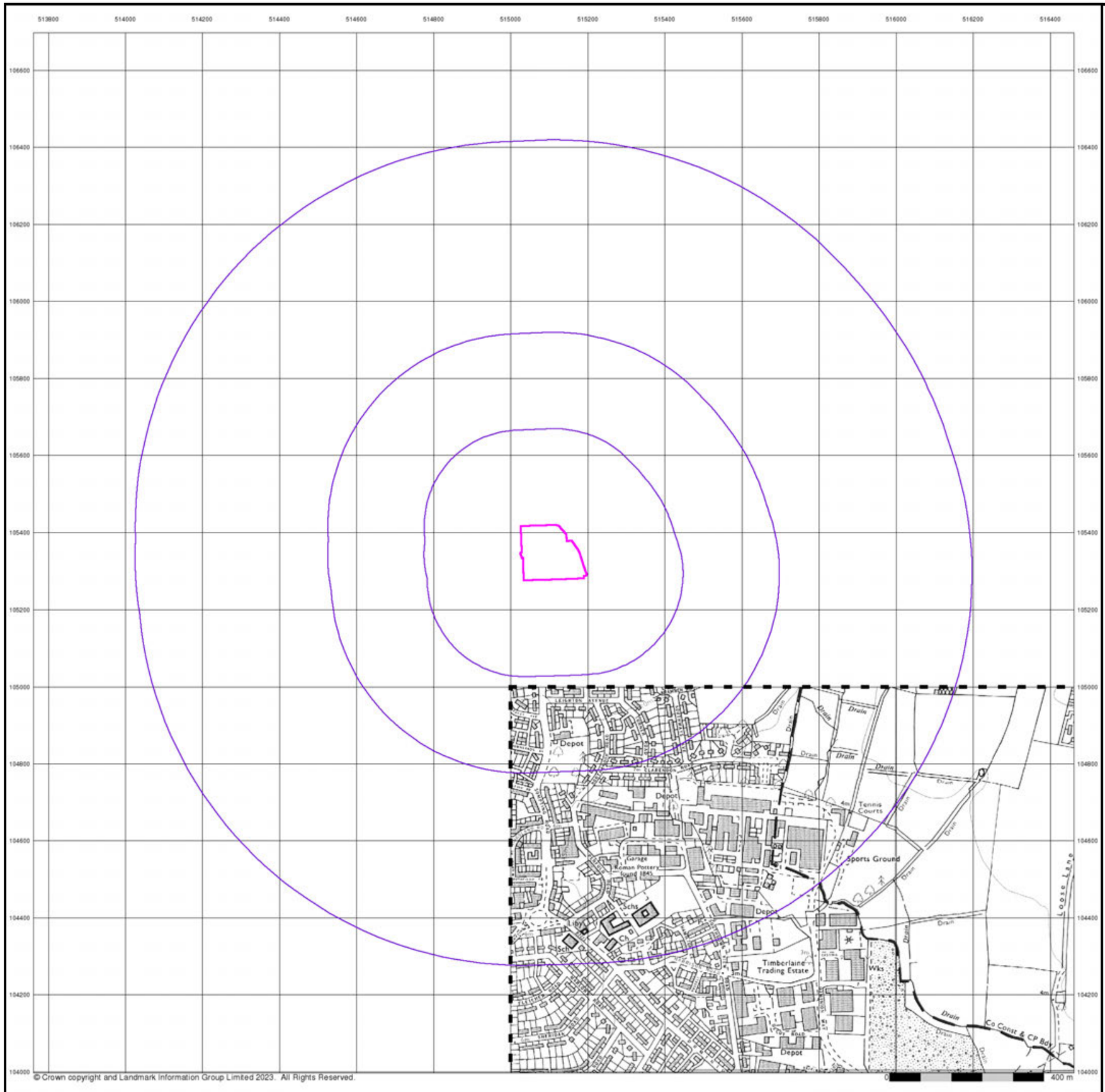

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Ordnance Survey Plan

Published 1983

Source map scale - 1:10,000

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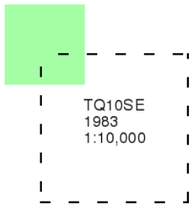
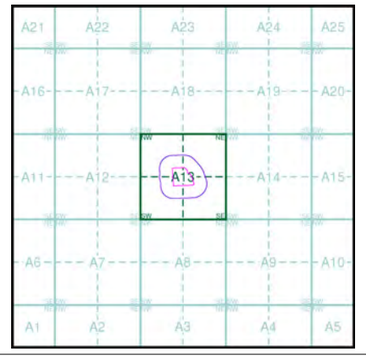


Historical Map - Slice A



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