



Sempra Homes Ltd

Car Park 14, Basildon

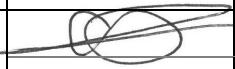

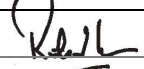
Desk Study and Ground Investigation Report



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Car Park 14, Basildon

Desk Study and Ground Investigation Report

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TEC is ISO 9001:2015 and ISO 14001:2015 certified by Advanced Certification Limited, a UKAS Accredited Certification Body number 8872 for the scope of 'Specialist consultancy services across the UK in contaminated land assessment, ground engineering, waste management and construction phase monitoring'.

TEC
The Old Chapel
35a Southover
Wells
Somerset
BA5 1UH
Tel: 01749 677760
Email: info@tecon.co.uk

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EXECUTIVE SUMMARY

SITE INFORMATION	Client	Sempra Homes Ltd
	Site Details	Car Park 14, Basildon
	Current Land Use and Description	The site comprises a disused carpark located at the junction of Laindon Link (B1007) and Nether Mayne. the centre of the site is situated at approximate National Grid reference 569850, 188340 and covers an area of approximately 2.38 hectares. The nearest registered postcode is SS15 5AA.
	Proposed Development	The proposed development is understood to comprise the construction of 16No. two to three bed houses and up to 217No. flats within structures up to 10 storeys in height, with associated soft landscaping and hard infrastructure.
BACKGROUND INFORMATION	Geology	The BGS mapping records the site to be underlain by the solid geology of the London Clay Formation. Superficial Head Deposits are recorded in the Northwest of the site.
	Hydrogeology	The limited superficial Head Deposits is designated as a Medium Vulnerability/ Secondary A Aquifer, while the London Clay Formation is designated as Unproductive Strata. No groundwater abstractions or Source Protection Zones are recorded within 1km of the site.
	Hydrology	The nearest surface water feature is a surface water drain present along the southern boundary of the site, running adjacent to the rail embankment. The closest named water feature is the Gloucester Park Fishing Lake located 380 m north of the site.
	Site History	Earliest available mapping depicts the site as undeveloped farmland with a surface water drain/stream flowing north. A number of medium sized buildings were recorded on maps until 1976. Thick vegetation is recorded as present on site from 1968, with the site becoming a car park from 1987.
	Environmental Sensitivity	The site is considered to be of low to medium overall sensitivity.
GROUND INVESTIGATION	Ground Investigation Rationale	The exploratory ground investigation was designed to provide general information regarding site conditions including an assessment of the potential presence of contaminants of potential concern; ground gas characterisation for the site; and to provide general ground engineering recommendations. Notwithstanding this, due to ecological constraints, investigation was restricted within the west of the site. In addition, due to vagrants, 2No. dynamic sample boreholes were not possible within the east of the site.
	Scope of Works	The exploratory ground investigation was undertaken in general accordance with the scope of investigation outlined by Tully De' Ath within the document titled 'Specification for Desk Study and Desk Study – Car Park 14, Basildon' dated 18 August 2020 and further depicted in Drawing Ref. CP14-TDA-XX-XX-DR-S-20001. It should be noted that due to ecological constraints within the west of the site, restrictions were placed upon the intrusive works within this area in advance of the works. In addition, exploratory works within a number of areas of the main car park was not possible due to the presence of vagrants within the investigation area. Therefore, supplementary assessment will be required within these areas in due course.
	Ground Conditions	Made ground was observed across the site to a maximum depth of 1.6mbgl (BH06) and was generally noted to comprise tarmacadam hardstanding underlain by sandy/ gravelly clay and clayey sandy gravel. The gravel component within the made ground was recorded to comprise concrete, brick, mudstone, tarmac and mixed igneous lithologies. Localised superficial deposits were recorded within BH04 and BH05 at depths of between 0.3mbgl and 1.5mbgl and were recorded to comprise soft becoming firm, blueish grey mottled slightly gravelly, sandy clay. Gravel was observed to comprise subangular to subrounded, fine to medium claystone. The London Clay Formation was encountered from depths of 0.15mbgl (BH01) and was generally observed to comprise firm, medium strength becoming stiff, high strength, orangish brown to brown, locally mottled, slightly sandy, slightly gravelly silty clay with occasional sand lenses throughout (Distinctly weathered London Clay Formation). Gravel was generally recorded to comprise fine to medium, subangular to rounded claystone with rare to occasional pyrite and selenite crystals to observed depths of between 6.8mbgl and 10.0mbgl.

		This in turn was observed to be underlain by stiff becoming very stiff, high to very high strength blueish grey, locally mottled orangish brown slightly sandy clay with occasional pyrite and selenite crystals (Partially weathered London Clay Formation) to the base of the excavations.
LAND CONTAMINATION	Contamination Characterisation	No visual or olfactory evidence of potential contamination was recorded during intrusive works. A single marginal exceedance of the GAC for Barium was recorded on site. Notwithstanding this, given the highly localised and very marginal nature of the exceedance of GAC identified, a significant risk to site end users is not considered to be present. The site is reported to be located within a Lower Radon affected Area. (less than 1% of homes affected). No radon protection measures are reported to be required for new developments.
	Identified Pollutant Linkages	No potential significant pollutant linkages recorded during the current phase of investigation. This will be reassessed following completion of the final investigation.
	Remediation Appraisal / Likely Remedial Approach	No remedial requirements identified as part of the assessment undertaken to date.
GROUND ENGINEERING	Foundations	<i>Two Storey Two to Three Bedroom Houses – Western Section of the Site</i> Conventional foundations may be suitable for the proposed development within the western section of the site. A minimum founding depth of 0.9m would be recommended where outside the influence of existing or proposed trees/ planting. At this depth, the encountered materials are considered to be able to provide an allowable bearing resistance in the region of 100kN/m ² . Given the presence of soils of medium volume change potential, appropriate voids will be required as outlined within the NHBC Standards. Ground bearing slabs may be appropriate for the proposed development within the west of the site, where foundations are less than 1mbgl. Notwithstanding this, exploratory holes were restricted within this area due to ecological constraints. Therefore, additional investigation is recommended within this area to confirm the preliminary founding recommendations within this area. <i>Five to Twelve Storey Apartment Blocks – Central and Eastern Section of the Site</i> Based upon the assumed loads associated with the proposed five to twelve storey structures within the eastern section of the site, it is considered unlikely that conventional foundations would be suitable for the proposed development within this area. Therefore, a piled foundation solution should be utilised within the proposed development. For budgetary and indicative purposes only, when utilising a single 450mm pile to depths of between 15mbgl and 25mbgl, a bearing resistance in the region of 845kN – 1425kN is considered appropriate. When utilising a single 600mm to the same depths a bearing resistance in the region of 1150kN – 1900kN would be appropriate, while a single 750mm diameter pile would provide a bearing resistance in the region of 1450kN – 2240kN. Given the presence of shrinkable soils and the proposed foundation solution within this area of the site, the use of suspended floor slabs may be appropriate for the scheme, which should incorporate the minimum void dimensions as outlined in the NHBC Standards.
	Ground Floor Slabs	Ground bearing slabs may be appropriate for the proposed development within the west of the site, where foundations are less than 1mbgl. Given the presence of shrinkable soils and the proposed foundation solution within the central and eastern section of the site, the use of suspended floor slabs may be appropriate for the scheme, which should incorporate the minimum void dimensions as outlined in the NHBC Standards.
	Preliminary Pavement Design	A preliminary design CBR value in the region of 2.5% has been derived based on the test data to-date. CBR values of the subgrade should be confirmed by in situ testing when final formation levels are known.
	Buried Concrete	Field observations indicated the potential presence of pyrite and selenite crystals within a number of locations across the site. In addition, the results of the sulphate and pH testing from the soils at the site yield an aggressive chemical environment class (ACEC) of between AC-2 and AC-4, requiring a design sulphate class of DS-4.



RECOMMENDED FURTHER WORKS		<p>Due to ecological constraints within the west of the site, restrictions were placed upon the intrusive works within this area in advance of the works. In addition, exploratory works within a number of areas of the main car park was not possible due to the presence of vagrants within the investigation area.</p> <p>Therefore, supplementary assessment within the areas not previously accessible would be recommended to confirm the preliminary findings and recommendations obtained to date.</p>
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1 INTRODUCTION

1.1 Terms of Reference

1.1.1 TEC has been appointed by Tully De'Ath (Consultants) on behalf of Sempra Homes Ltd to undertake a preliminary land contamination and geotechnical assessment of Car Park 14, Basildon. All works were undertaken in accordance with our proposal letter dated 09 September 2020 and referenced CH.2009004.001.

1.2 Background

1.2.1 The site comprises a disused carpark located at the junction of Laindon Link (B1007) and Nether Mayne (Figure 1). the centre of the site is situated at approximate National Grid reference 569850, 188340 and covers an area of approximately 2.38 hectares. The nearest registered postcode is SS15 5AA.

1.2.2 The proposed development is understood to comprise the construction of 16No. two to three bed houses and up to 217No. flats within structures up to 10 storeys in height, with associated soft landscaping and hard infrastructure (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 2020), BS10175+A2 (2017) and, where appropriate NHBC and 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 26 October 2020. A summary of the observations is 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 comprises a disused car park within the central and eastern section of the site, while the western section comprises an area of green space with thick vegetation running parallel along Laindon Link.	
Site Context	The site is located with a mixed-use commercial / residential area.	
Site Boundary Features	North	Laindon Link (B1007) with residential properties beyond.
	East	Nether Mayne (A176) with retail park and industrial units beyond.
	South	Railway line with residential properties beyond.
	West	Area of green space along Laindon Link.
Site Topography	The site was noted to generally slope from the vegetated area in the west down to the car park in the centre/east of the site, which was noted to be generally flat. Available Ordnance Survey Mapping indicates the western section of the site is situated at an approximate elevation of 33m Above Ordnance Datum (AOD) sloping down to approximately 29m AOD in the east.	
Hard and Soft Landscaping	The central and eastern section of the site is predominantly laid to tarmacadam hardstanding in varying condition. Site access is via a tarmacadam road leading from Laindon Link in the north of the site. To the west of the site, an area of thick vegetation and green space run parallel to Laindon Link road.	
Trees	A large number of mature trees and shrubs are present within flower beds within the car park. The grassland area to the west of the site contains a large number of mature trees and shrubs.	
Fuel, Hazardous Chemicals and Waste Materials Storage	No hazardous chemicals or waste storage was noted during the site reconnaissance.	
Asbestos Containing Materials	Potential ACM was noted on the ground surface in the north-east of the site during the site walkover.	
Site Drainage	Several manhole covers associated with drainage were noted on site. No areas of standing water were noted during the site reconnaissance. A surface water drainage ditch was recorded along the southern boundary of the site adjacent to the rail embankment.	

Feature	Description
Evidence of Potential Contamination	No visual or olfactory evidence of potentially gross contamination was recorded on site.
Ground Stability Hazards	No visual evidence of ground subsidence/ movement observed.

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 depicts the site as undeveloped with a surface water drain/stream present in the centre of the site flowing north. These are no longer shown on the maps from 1976. The wooded area present on site is shown from 1968 onwards.			1868 - 1976
From 1922, a number of buildings are depicted in the eastern area of the site, together with a small orchard within the south-east corner from 1939.			1922 - 1973
The car park is first depicted in mapping from 1987 in the current layout.			1987 – 2020
Surrounding Features	Distance	Direction	OS Dates
The London, Tilbury and Southend Railway	Adjacent	South	1898 - 2020
Garage; <i>later filling station</i>	~50m	East	1968 – 2003
Depot	~60m	East	1968-2003
Electrical Substation	~100m	South-east	1968-1993
	~150m	South	1968-1992
	~150m	South-west	1970 – 1992

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 (Ref. Solid and Drift 1:50,000 map – Southend & Foulness, Sheet 258/259)		
Geological Unit	Thickness	BGS Description
Made Ground	Variable	Not recorded on geological mapping but may be present on site.
Superficial Deposits: Head Deposit (<i>Northern Section of the Site</i>)	Variable	Clay, silt, and sand, locally with lenses of gravel.
Solid Geology: London Clay Formation	Up to 150m	Bioturbated or poorly laminated, blue-grey or grey-brown, slightly calcareous, silty to very silty clay, clayey silt and sometimes silt, with some layers of sandy clay.

BGS Borehole Records			
BGS Reference	Distance/ Direction	Depth (mbgl)	Recorded Strata
TQ68NE552	~40m/ North	0.0 - 1.8	Possible Head Deposit described as topsoil.
		1.8 – 6.0	London Clay described as firm brown clay.
BGS Estimated Soil Chemistry			
Element		Estimated Concentration	
Arsenic		<15 mg/kg	
Chromium		90 - 120 mg/kg	
Cadmium		<1.8 mg/kg	
Lead		<100 mg/kg	
Nickel		15 - 45 mg/kg	
Radon			
Radon Potential		Radon Protection Requirement	
Lower Probability Radon Area (less than 1% of homes are estimated to be at or above the Action Level)		None 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
Head Deposits (Northern section of the site)	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.	North – Following local topography of surrounding area.
London Clay Formation	Unproductive Strata	These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.	-
Source Protection Zones			
No Source Protection Zones are located within a 1km radius of the site.			
Groundwater Abstractions			
There are no abstractions are recorded within 1km.			

Discharge Consents to Groundwater
There are no discharge consents within 750m of the site.
BGS Groundwater Flooding Susceptibility
There is limited potential for groundwater flooding to occur at the surface.

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
Surface drainage ditch	-	~5m south adjacent to rail embankment
Fishing Lake	-	~380m / North
Surface Water Abstractions		
No entries are recorded within 500m of the site.		
Licensed Discharge Consents		
There are no active discharge consents within 1km of the site.		
Pollution Incidents		
1No. recorded within 500m of the site.		
Receiving Water	Pollutant/ Incident	Distance/ Direction from Site
Freshwater stream/river	Category 3- Minor incident relating to an accidental spillage/leakage.	~145m north-east
Flooding from Rivers or Seas		
On Site Designation	Off Site Areas of Flooding	
Flood Zone 1	-	

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 registered or historic landfill sites recorded within a 500m radius of the site.		
Potentially Infilled Land (Water) within 500m		
10No. recorded within 500m		
Type	Distance/ Direction from Site	Date on Mapping
Unknown Filled Ground (Pond, marsh, river, stream, dock etc)	10m north-west	1960
	15m west	1960
	145m north	1960

	180m south	1960
	240m north	1960
	310m north	1960
	330m east	1960
	400m south-west	1960
	410m east	1960
	450m north-east	1960
Commercial/ Industrial Land Use (Active Contemporary Trade Directories)		
5No. significant land uses identified within a 500m radius of the site.		
Classification	No. within 500m	Distance/ Direction from Site
Petrol filling stations	1	~65m east
Manufacturers (soft furnishings)	1	~310m north-east
Pet Supplies	1	~380m west
Pest and Vermin Control	1	~415m east
Commercial cleaning services	1	~430m south-west
Hazardous Substances (Authorisations, Consents, Incidents)		
2No. recorded within 500m		
Category	Details	Distance / Direction from Site
Local Authority Integrated Pollution Prevention and Control	~55m East	PG1/14 – Petrol filling station
	~495m East	PG6/46 – Dry cleaners
Sensitive Land Uses		
3No. recorded within 500m of the site.		
Category	Details	Distance/ Direction from Site
Nitrate Vulnerable Zones	Crouch NVZ	On site
Area of Adopted Green Belt	Basildon District Local Plan	490m west
Area of Unadopted Green Belt	Basildon District Local Plan	490m west

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						
No entries were recorded within a 500m radius of the site.						

2.9 Regulatory Consultations

2.9.1 Regulatory consultations were undertaken with the relevant departments at Basildon District 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/ Contaminated Land – Basildon Council	<ul style="list-style-type: none"> The Council hold no records of pre-licensed landfills within 500m of the site. Records dating back to the early 1990's disclose no occurrences of pollution events within 500m of the site. Notwithstanding this, The Council holds 5No. records of potentially contaminative land uses within 500m of the site. 4No. of the records relate to areas of infilled land while 1No. relates to the nearby garage approximately 100m east of the site. 1No. Part B APC authorisation record is held within 500m of the site, approximately 100m east of the site, known to be a BP Fuel garage. No records are held regarding private water supplies, storage of petroleum hydrocarbons or unexploded ordnance within 500m of the site. The council are not aware of any known problems of ground gas within the site area.
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2.10 Outline Conceptual Model

2.10.1 In accordance with the Environment Agency Land contamination: risk management guidance, potential source-pathway-receptor pollutant 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; and
- Historic use of the site as a car park.

Off Site Sources

- Potentially contaminative land uses including the adjacent railway line to the south and garage to the east have been identified in proximity to the site.
- 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;
- Controlled Waters (underlying Secondary Aquifer);
- Ecological receptors;
- Construction workers;
- 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.	Low Risk
	Controlled waters (Secondary Aquifer)	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 superficial deposits within the north of the site (Secondary Aquifer), a potential risk to controlled waters, whilst likely to be low, 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. In addition, the bedrock (London Clay Formation) is classified as Unproductive Strata.	Low Risk
	Current and future site users, construction workers and proposed development	Migration, ingress and accumulation of ground gasses.	Medium	Low Likelihood: Made ground, if present, may act as a potential source of ground gas, subject to thickness and chemical composition. Therefore, the risk cannot be discounted at this stage.	Low Risk
Potentially contaminative current and historic processes – off site	Current and future site users, construction workers and controlled waters	Potential for on-site contaminants from off-site sources (Rail line, fuel garage). 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. Therefore, the potential for significant contaminant migration from off-site sources cannot be fully discounted at this stage.	Low to Moderate Risk

3 GROUND INVESTIGATION METHODOLOGY

3.1 Background

3.1.1 The exploratory ground investigation was undertaken in general accordance with the scope of investigation outlined by Tully De'Ath within the document titled 'Specification for Desk Study and Desk Study – Car Park 14, Basildon' dated 18 August 2020 and further depicted in Drawing Ref. CP14-TDA-XX-XX-DR-S-20001.

3.1.2 It should be noted that due to ecological constraints within the west of the site, restrictions were placed upon the intrusive works within this area in advance of the works. In addition, exploratory works within a number of areas of the main car park was not possible due to the presence of vagrants within the investigation area. Therefore, supplementary assessment will be required within these areas in due course.

3.1.3 All site works were undertaken in accordance with BS5930:2015, 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, WS06, WS07, WS10, WS11	02/11/20 – 03/11/20	Positioned within locations specified by Tully De'Ath	Characterisation and description of underlying ground materials; Collection of geotechnical and geotechnical samples for analysis
Cable Percussive Borehole	BH01, BH03-BH07	26/10/20 – 03/11/20	Positioned within locations specified by Tully De'Ath	Characterisation of deeper ground conditions Collection of geochemical and geotechnical samples for analysis Installation of groundwater monitoring well
Dynamic Cone Penetrometer	DCP01 – DCP05	30/10/20 – 03/11/20	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 2. A detailed description 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

Field Test	Purpose
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 <i>in situ</i> densities of granular deposits
Photo-Ionisation Detector (PID)	Indication of the presence/concentrations of volatile organic compounds (VOCs)

3.4 Chemical Testing

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

3.4.2 Representative soil and groundwater samples were collected and chemically tested at i2 Analytical Ltd, a UKAS/MCERTS accredited laboratory, for a selection of the following parameters:

Soils (Totals and Leachate)

- 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.

3.4.3 Geochemical certificates of analysis are presented Appendix G.

3.5 Geotechnical Testing

3.5.1 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;
- Multistage undrained triaxial tests; and
- BRE SD1 Suite B – Water soluble and acid soluble sulphates, total sulphur and pH.

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

3.6 General Sampling

3.6.1 Samples were collected in accordance with the following guidance;

- BS5930:2020 – 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.

4.1.2 Detailed descriptions of encountered ground conditions are shown on exploratory hole logs presented in Appendix F. Photographs of the materials encountered are presented within Appendix A.

Made Ground

4.1.3 Made ground was observed across the site to a maximum depth of 1.6mbgl (BH06) and was generally noted to comprise tarmacadam hardstanding underlain by sandy/ gravelly clay and clayey sandy gravel. The gravel component within the made ground was recorded to comprise concrete, brick, mudstone, tarmac and mixed igneous lithologies.

Superficial Deposits – Head Deposits

4.1.4 Localised superficial deposits were recorded within BH04 and BH05 at depths of between 0.3mbgl and 1.5mbgl and were recorded to comprise soft becoming firm, blueish grey mottled slightly gravelly, sandy clay. Gravel was observed to comprise subangular to subrounded, fine to medium claystone.

Solid Geology – London Clay Formation

4.1.5 The London Clay Formation was encountered from depths of 0.15mbgl (BH01) and was generally observed to comprise firm, medium strength becoming stiff, high strength, orangish brown to brown, locally mottled, slightly sandy, slightly gravelly silty clay with occasional sand lenses throughout (Distinctly weathered London Clay Formation). Gravel was generally recorded to comprise fine to medium, subangular to rounded claystone with rare to occasional pyrite and selenite crystals to observed depths of between 6.8mbgl and 10.0mbgl.

4.1.6 This in turn was observed to be underlain by stiff becoming very stiff, high to very high strength blueish grey, locally mottled orangish brown slightly sandy clay with occasional pyrite and selenite crystals (Partially weathered London Clay Formation) to the base of the excavations.

4.2 Generalised Ground Profile

4.2.1 The general ground profile encountered at the site is summarised in Table 4.1 below.

Table 4.1: Generalised Ground Profile

Depth (mbgl)	Encountered Material
MADE GROUND	
0.0 – 0.05 / 0.2	Black bituminous bound tarmacadam.
0.0 / 0.05 – 0.15 / 0.9	Orangish brown / reddish brown slightly sandy slightly gravelly clay. Gravel of mudstone and brick.
0.05 / 0.2 – 0.2 / 1.60	Light brown slightly clayey sandy gravel / gravelly sand. Gravel of mudstone, limestone, tarmac, red brick and mixed igneous lithologies.
SUPERFICIAL DEPOSITS – HEAD DEPOSITS	
0.3 / 0.45 – 1.0 / 1.5	Soft becoming firm slightly gravelly sandy clay. Gravel of claystone.
SOLID GEOLOGY – DISTINCTLY WEATHERED LONDON CLAY FORMATION	
0.15 / 1.6 – 6.8 / 10.0	Firm medium strength, becoming stiff high strength, orangish brown to brown locally mottled, slightly sandy, slightly gravelly silty clay with occasional sand lenses throughout

Depth (mbgl)	Encountered Material
SOLID GEOLOGY – PARTIALLY WEATHERED LONDON CLAY FORMATION	
6.8 / 10.0 – 10.5 / >35.0	Stiff becoming very stiff blueish grey locally mottled orangish brown sandy becoming slightly sandy clay.
SOLID GEOLOGY – UNWEATHERED LONDON CLAY FORMATION	
10.5 / 15.0 - >35.0	Very stiff, very high strength blueish grey clay with localised lenses of fine sand.

4.3 Groundwater

4.3.1 Groundwater observations recorded during the ground investigation works and standing depths within the boreholes recorded as part of subsequent monitoring visits are summarised in Table 4.2 below. Groundwater strikes/ observations are also shown on the exploratory hole logs in Appendix F.

Table 4.2: Summary of Groundwater Conditions

Location	Groundwater Strike (mbgl)	Strata
BH04	Seepage at 2.4	Weathered London Clay Formation
BH07	Seepage at 3.5	
WS07	Seepage at 3.5	

4.3.2 Minor groundwater seepages were identified in 3No. locations across the site at depths of between 2.4mbgl and 3.5mbgl. Groundwater level gauging undertaken in installed monitoring wells within exploratory location BH03 and BH06 following completion of the works recorded both locations to be dry.

4.3.3 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.

4.4 Contamination Observations

4.4.1 No visual or olfactory evidence of potentially gross contamination was recorded during the ground investigation. Screening of soil samples with a photo-ionisation detector (PID) recorded concentrations of volatile organic compounds (VOCs) to be less than the instrument level of detect 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 I.

5.2.2 The standard land use for the site, for use in this generic assessment, has been defined as "residential with homegrown produce" 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.

Summary of Results

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

Made Ground / Shallow Soils

5.2.4 The results of the assessment recorded a single localised exceedance of Barium in WS01 at a depth of 0.45mbgl when considering a residential site end use.

5.2.5 An asbestos screen completed on samples of the made ground 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 significant contaminants of potential concern were recorded within the sampled made ground/ shallow soils;
- The site is underlain by cohesive strata, which would restrict migration of any potential leachable contaminants;
- No consistent groundwater body was recorded during the ground investigation works; and
- There are no reported groundwater abstractions within 1km and the site is not reported to be located within an Environment Agency Source Protection Zone.

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

5.4.1 In accordance with BS8485:2019 and CL:AIRE RB17, an assessment of the risk posed by ground gases at the site has been undertaken based on the findings of the desk study and ground investigation and the conceptual side model. The following site-specific information has been considered as part of the assessment;

- No landfills, areas of potentially significant infilled ground or mine openings/ workings have been identified within proximity to the site;
- A shallow thickness of made ground has been recorded at the site (Maximum 1.6mbgl), which was recorded to be of low organic composition;
- The natural soils were recorded to comprise cohesive deposits associated with superficial Head Deposits and the London Clay Formation both of which are of typically low organic content; and
- The site is not located within a radon affected area.

5.4.2 No credible source or pathway for ground gas has been identified at the site as part of these works. Therefore, no further ground gas monitoring or assessment is considered to be required and no specific ground gas protection measures are considered necessary for the proposed development and the potential pollutant linkages have not been considered further within this assessment.

5.5 Updated Conceptual Model

5.5.1 The findings of the site investigation and the GORA 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 identified on and within the vicinity of the site are summarised below:

On Site Sources

- Made ground;

Off Site Sources

- Potentially contaminative land uses including adjacent railway and nearby garage/petrol filling station.

Identified Receptors

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

- Current/future site users; and
- Construction workers;

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; and
- Inhalation – inhalation of soil, dust or vapours;

5.5.5 The updated conceptual model is presented in Table 5.1. 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 5.1: 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: Made ground was recorded across the site to a maximum observed depth of 1.6mbgl. While laboratory analysis recorded the exceedance of the GAC for barium in a single location, given the highly localised and very marginal nature of the exceedances of GAC identified; and the proposal to import appropriate topsoil material into proposed areas of soft landscaping and gardens, the risk to human health is considered to be low and no further remedial works would be considered to be required in relation to this identified potential risk.	Low Risk
Potentially Contaminative land uses - off-site	Current and future site users, construction workers and proposed development	Localised exposure to potential contaminants through ingestion, inhalation, and dermal contact.	Severe	Unlikely: While a number of potentially contaminative current and historic process have been recorded in close proximity to the site, no visual or olfactory evidence of potentially significant contamination was observed within the ground materials encountered at the site.	Low Risk

6 LAND CONTAMINATION - CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

- 6.1.1 Made ground was recorded across the site to depths of up to 1.6mbgl. No visual or olfactory evidence of significant contamination was recorded during the ground investigation.
- 6.1.2 Laboratory analysis of the encountered near surface materials reported both organic and inorganic contaminants to be generally below the relevant GAC for a residential site end use with homegrown produce. Notwithstanding this, a single localised exceedance of the GAC for Barium was recorded within WS04 at 0.45mbgl.
- 6.1.3 Given the highly localised and very marginal nature of the exceedance of GAC identified, a significant risk to site end users is not considered to be present.
- 6.1.4 Based on the conceptual site model, the site is considered to be representative of Characteristic Situation 1. Therefore, no gas protection measures are considered necessary within the proposed development. In addition, no radon protective measures are considered necessary.

6.2 Remedial Appraisal

- 6.2.1 Given the highly localised and very marginal nature of the exceedance of GAC identified; and the proposal to import appropriate topsoil material into proposed areas of soft landscaping and gardens, no further remedial works would be considered to be required in relation to this identified potential risk.

6.3 General Considerations

- 6.3.1 It should be noted that due to ecological constraints within the west of the site, restrictions were placed upon the intrusive works within this area in advance of the works. In addition, exploratory works within a number of areas was not possible due to the presence of vagrants within the investigation area. Therefore, supplementary assessment will be required within these areas in due course to confirm the preliminary recommendations detailed above.
- 6.3.2 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.
- 6.3.3 Given the presence of general made ground, good brownfield site working practices should be adopted by construction workers to mitigate against potential risks.
- 6.3.4 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.

7 GROUND ENGINEERING

7.1 Proposed Development

7.1.1 The site comprises a disused car park over most the site. The remaining area to the west is a green space with thick vegetation running parallel along Laindon Link.

7.1.2 The proposed development is understood to comprise the construction of 16No. two to three bed houses and up to 217No. flats within structures up to 10 storeys in height, with associated soft landscaping and hard infrastructure (Figure 2).

7.1.3 Although no details have been provided to TEC, line loads of up to 75kN per metre run have been assumed for the 2 storey residential development, and column loads of up to 2500kN per metre run have been assumed for the 10 storey 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 underground services are noted to be present within the general site area. Consideration and the possible removal/re-routing of these features will be required during the construction process.

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 12no. cohesive samples associated with the underlying London Clay Formation, 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⁾
26 – 32	29 – 35	100	29 – 35	Medium

Note 1: Based on recommendations provided in the NHBC Standard

Soil Strength

7.3.3 A summary of the geotechnical field test data is provided in Table 7.2 below.

Table 7.2: Summary of Geotechnical Field Test Data

<i>SPT 'N' Values</i>			
Strata (depth)	Number of Tests	Range of Results, 'N' Values Ranges	Equivalent Undrained Shear Strength (Su, kPa) ⁽¹⁾
Head Deposits: Soft to firm slightly gravelly sandy clay (0.3 -1.5m)	1	5	~25
Distinctly Weathered London Clay Formation: Firm to stiff slightly sandy, slightly gravelly silty clay with occasional sand lenses (0.15 – 10.0m)	67	10 – 35	45 - 155

SPT 'N' Values			
Strata (depth)	Number of Tests	Range of Results, 'N' Values Ranges	Equivalent Undrained Shear Strength (Su, kPa)⁽¹⁾
Partially Weathered London Clay Formation: Stiff becoming very stiff slightly sandy clay. (6.8 - >35.0m)	43	19 - >50	85 - >225
Unweathered London Clay Formation: Stiff becoming very stiff slightly sandy clay (10.5 - >35.0m)	27	26 - >50	115 - >225
Hand Shear Vane Results			
Strata (depth)	Number of Tests	Range of Results (Cu, kPa)	Undrained Strength Classification ⁽²⁾
Distinctly Weathered London Clay Formation: Firm to stiff slightly sandy, slightly gravelly silty clay with occasional sand lenses (0.15 - 10.0m)	19	68 - 160	Medium to high strength
Partially Weathered London Clay Formation: Stiff becoming very stiff slightly sandy clay. (6.8 - >35.0m)	8	102 - 150	High strength
Unweathered London Clay Formation: Stiff becoming very stiff slightly sandy clay (10.5 - >35.0m)	1	138 - 140	High strength
Pocket Penetrometer Results			
Strata (depth)	Number of Tests	Range of Results (kg/cm²)	Equivalent Undrained Shear Strength Classification
Distinctly Weathered London Clay Formation: Firm to stiff slightly sandy, slightly gravelly silty clay with occasional sand lenses (0.15 - 10.0m)	14	1.6 - 3.4	Medium to high strength
Partially Weathered London Clay Formation: Stiff becoming very stiff slightly sandy clay. (6.8 - >35.0m)	5	3.5 - 4.0	High Strength
Unweathered London Clay Formation: Stiff becoming very stiff slightly sandy clay (10.5 - >35.0m)	3	3.8 - 5.0	High to very high strength
Undrained Triaxial Results			
Strata (depth)	Number of Tests	Range of Results (Cu, kPa)	Undrained Strength Classification ⁽²⁾
Distinctly Weathered London Clay Formation (0.15 - 10.0m)	1	57	Medium strength
Partially Weathered London Clay Formation 6.8 - >35.0m)	5	138 - 258	High to very high strength
Unweathered London Clay Formation (10.5 - >35.0m)	4	89 - 308	High to very high strength

Note 1: Based on published correlations (Stroud, 1975)

Note 2: BS5930:2015/ BS EN ISO 14688-2:2004

7.4 Foundations

Two Storey Two to Three Bedroom Houses – Western Section of the Site

- 7.4.1 It is considered that conventional foundations may be suitable for the proposed two storey, two to three bedroom, low rise houses proposed within the west of the site. The underlying soils have been recorded to be of medium volume change potential, requiring a minimum founding depth of 0.9mbgl to be adopted within the design, where foundations are judged to be beyond the influence of proposed, existing, or historic planting (NHBC/ LABC).
- 7.4.2 When founding at this depth, the generally firm to stiff, medium to high strength clay deposits of the weathered London Clay Formation are considered to provide an allowable bearing resistance of 100kN/m², with total settlements of less than 25mm anticipated at this assumed pressure.
- 7.4.3 Notwithstanding this, exploratory holes were restricted within this area due to ecological constraints. Therefore, additional investigation is recommended within this area to confirm the preliminary founding recommendations within this area.
- 7.4.4 Given the reported medium volume change potential of the underlying ground materials, suitable voids may be required against the foundations and below and against the sides of ground beams, as outlined in the NHBC/LABC Standards.

Five to Ten Storey Apartment Blocks – Central and Eastern Section of the Site

- 7.4.5 Based upon the assumed loads associated with the proposed five to ten storey structures within the eastern section of the site, it is considered unlikely that conventional foundations would be suitable for the proposed development within this area.
- 7.4.6 Therefore, a piled foundation solution should be utilised within the proposed development. Given the likely variation in column loads for the proposed structures, *for budgetary and indicative purposes only*, a range of pile resistances has been provided in Table 7.3 below for a number of assumed pile diameters and length.
- 7.4.7 The proximity of adjacent structures 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, it is considered that a CFA pile system may be most suitable.

Table 7.3: Indicative Pile Bearing Resistance

Depth (mbgl)	Pile Diameter		
	450mm	600mm	750mm
15	845kN	1150kN	1450kN
20	1100kN	1525kN	1950kN
25	1425kN	1900kN	2400kN

- 7.4.8 The underlying cohesive deposits have been recorded to be of medium volume change potential and therefore suitable voids may be required below and against the sides of ground beams subject to the final design.

7.5 Ground Floor Slabs

Two Storey Two to Three Bedroom Houses – Western Section of the Site

- 7.5.1 Based on the ground condition encountered during the investigation to date, ground bearing slabs may be appropriate for the proposed development within the west of the site, where foundations are less than 1.5mbgl.

Five to Ten Storey Apartment Blocks – Central and Eastern Section of the Site

7.5.2 Given the presence of shrinkable soils and the proposed foundation solution within this area of the site, the use of suspended floor slabs may be appropriate for the scheme, which should incorporate the minimum void dimensions as outlined in the NHBC 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 J.

Table 7.4: Summary of CBR Data

Stratum	Method	Derived CBR Values (%)	Recommended CBR for Preliminary Design (%)
Made Ground at assumed formation level >500mmbgl	DCP ⁽¹⁾	1.3 - >20	2.5
	Correlations with plasticity indices ⁽²⁾	3 – 6	

(1) Jones CR and R Jolt (1991)

(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 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.

7.6.3 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 for conventional foundations may be achievable using conventional equipment., although it is anticipated that breakers may be required at relatively shallow depth should excavation encounter significant

7.7.2 Groundwater seepages were recorded at depths between 2.4mbgl and 3.5mbgl. Based on observations made during the ground investigations, groundwater ingress into excavations is considered unlikely to be significantly problematic although some dewatering may be required, particularly where excavations are left open for any length of time. It would be recommended that formation levels are protected to mitigate against softening associated with any such water ingress.

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 BRE SD1 Suite B testing was undertaken on 4no. samples of the encountered ground materials.

7.8.2 The results of the testing, 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 G and Appendix H.

Table 7.5: Summary of ACEC

Stratum	No. of tests	pH	Water Soluble Sulphate (mg/l)	Oxidisable Sulphides (%)	Total Potential Sulphates (%)	ACEC	DS
Made Ground	8	8.2 – 9.2	21 – 740	-	-	AC-2	DS-2
London Clay Formation	11	8.0 – 9.4	120 – 2540	0.03 – 1.31	0.18 – 2.22	AC-4	DS-4

8 GROUND ENGINEERING - CONCLUSIONS AND RECOMMENDATIONS

Two Storey Two to Three Bedroom Houses – Western Section of the Site

- 8.1.1 Conventional foundations may be suitable for the proposed development within the western section of the site. A minimum founding depth of 0.9m would be recommended where outside the influence of existing or proposed trees/ planting. At this depth, the encountered materials are considered to be able to provide an allowable bearing resistance in the region of 100kN/m². Given the presence of soils of medium volume change potential, appropriate voids will be required as outlined within the NHBC Standards.
- 8.1.2 Ground bearing slabs may be appropriate for the proposed development within the west of the site, where foundations are less than 1mbgl.
- 8.1.3 Notwithstanding this, exploratory holes were restricted within this area due to ecological constraints. Therefore, additional investigation is recommended within this area to confirm the preliminary founding recommendations within this area.

Five to Ten Storey Apartment Blocks – Central and Eastern Section of the Site

- 8.1.4 Based upon the assumed loads associated with the proposed five to ten storey structures within the eastern section of the site, it is considered unlikely that conventional foundations would be suitable for the proposed development within this area.
- 8.1.5 Therefore, a piled foundation solution should be utilised within the proposed development. For budgetary and indicative purposes only, when utilising a single 450mm pile to depths of between 15mbgl and 25mbgl, a bearing resistance in the region of 845kN – 1425kN is considered appropriate. When utilising a single 600mm to the same depths a bearing resistance in the region of 1150kN – 1900kN would be appropriate, while a single 750mm diameter pile would provide a bearing resistance in the region of 1450kN – 2240kN.
- 8.1.6 Given the presence of shrinkable soils and the proposed foundation solution within this area of the site, the use of suspended floor slabs may be appropriate for the scheme, which should incorporate the minimum void dimensions as outlined in the NHBC Standards.
- 8.1.7 A preliminary design CBR value in the region of 2.5% has been derived based on the test data to-date. CBR values of the subgrade should be confirmed by in situ testing when final formation levels are known.
- 8.1.8 Field observations indicated the potential presence of pyrite and selenite crystals within a number of locations across the site. In addition, the results of the sulphate and pH testing from the soils at the site yield an aggressive chemical environment class (ACEC) of between AC-2 and AC-4, requiring a design sulphate class of DS-4.

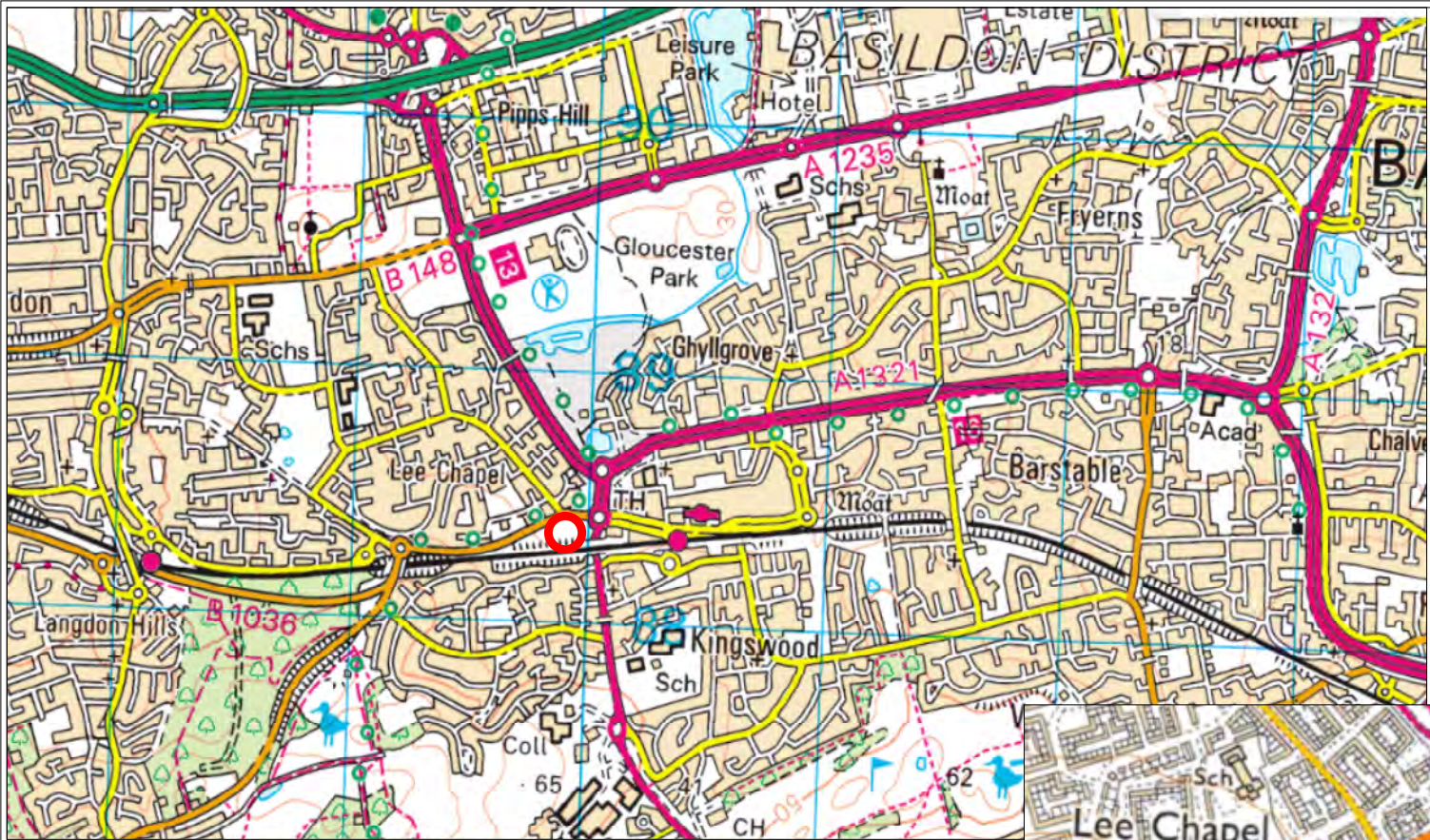
9 RECOMMENDED FURTHER WORKS

9.1.1 Due to ecological constraints within the west of the site, restrictions were placed upon the intrusive works within this area in advance of the works. In addition, exploratory works within a number of areas of the main car park was not possible due to the presence of vagrants within the investigation area.

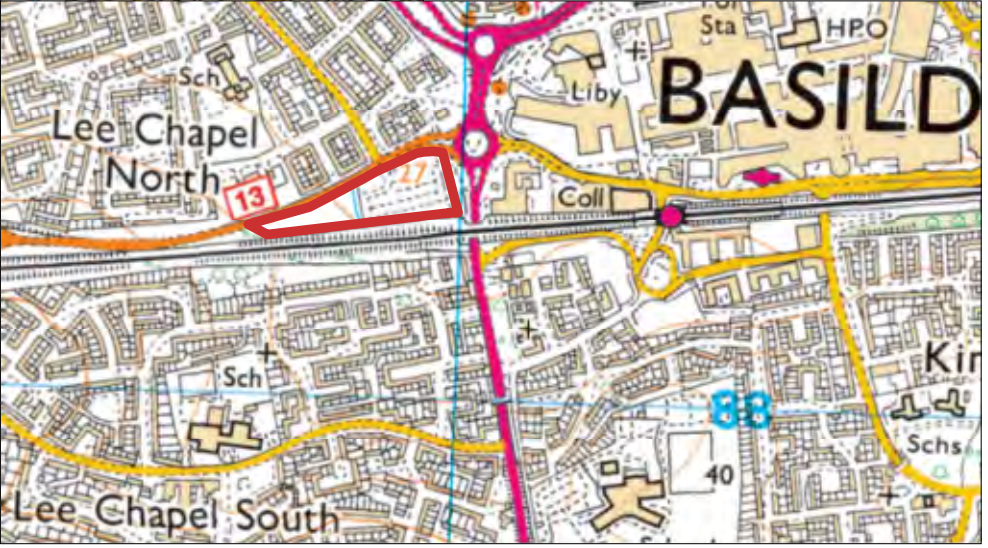
9.1.2 Therefore, supplementary assessment within the areas not previously accessible would be recommended to confirm the preliminary findings and recommendations obtained to date.

TEC

FIGURES AND DRAWINGS

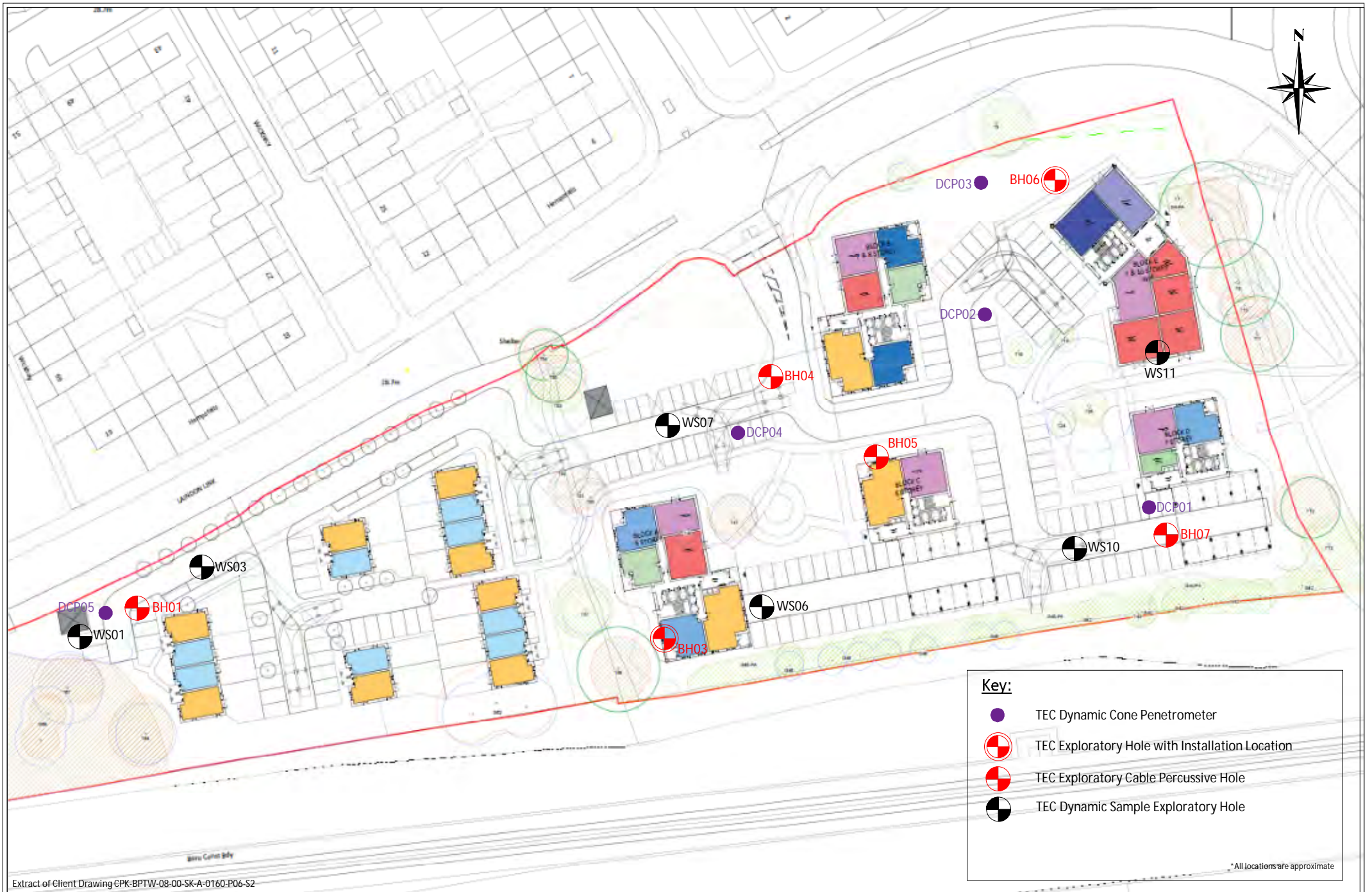


Approximate Site Location:



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	<p>TEC The Old Chapel 35a Southover Wells, Somerset BAS 1UH</p>	<p>Tel: 01749 67760 Email: info@tecon.co.uk Web: www.tecon.co.uk</p>	<p>Site Name: Car Park 14, Basildon</p>	<p>Drawing Name: Site Location Plan</p>	<p>Client Name: Sempra Homes Ltd</p>	<p>Project No: 2009004.001</p>	<p>Figure No: 1</p>	<p>Date: December 2020</p>	<p>Scale: NTS</p>
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Extract of Client Drawing GPK-BPTW-08-00-SK-A-0160-P06-S2

	<p>TEC The Old Chapel 35a Southover Wells, Somerset BA5 1UH</p> <p>Tel: 01749 677760 Email: info@tecon.co.uk Web: www.tecon.co.uk</p>	<p>Site Name: Car Park 14, Basildon</p>	<p>Drawing Name: Proposed Development and Exploratory Hole Location Plan</p>	<p>Client Name: Sempra Homes Ltd</p>	<p>Project No: 2009004.001</p>	<p>Figure No: 2 Revision A</p>	<p>Date: March 2021</p>	<p>Scale: NTS</p>
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Appendix A
Site Photographs

Car Park 14, Basildon



Photograph 1: View of western section of the site facing north-west.



Photograph 2: Entrance to site via Laindon Link.

Car Park 14, Basildon



Photograph 3: Example of waste on surface at site.



Photograph 4: View of car park facing south.



Photograph 5: View of encountered ground conditions.



Photograph 6: View of encountered ground conditions.

Appendix B
Historical Maps

Historical Mapping Legends

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

Quarry **Gravel Pit** **Sand Pit**
Clay Pit **Shingle** **Refuse Heap**
Sloping Masonry **Flat Rock**
Marsh **Reeds** **Osiers**
Rough Pasture **Furze** **Wood**
Mixed Wood **Brushwood** **Orchard**
Fir **Ford** **Stepping Stones**
Ferry **Waterfall** **Lock**
Trig. Station **Altitude at Trig. Station**
B.M. 325.9 **Bench Mark** **Surface Level**
Arrow denotes flow of water **Antiquities (site of)**
Cutting **Embankment**
Railway crossing Road **Level Crossing** **Road crossing Railway**
Railway crossing River or Canal **Road over single stream** **Road over River or Canal**
County Boundary (Geographical)
County & Civil Parish Boundary
Administrative County & Civil Parish Boundary
County Borough Boundary (England)
County Burgh Boundary (Scotland)
Co. Boro. Bdy.
Co. Burgh Bdy.
Boundary Post or Stone **Police Call Box**
B.R. **Bridle Road** **P** **Pump**
E.P. **Electricity Pylon** **S.P.** **Signal Post**
F.B. **Foot Bridge** **Sl.** **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

Inactive Quarry, Chalk Pit or Clay Pit **Active Quarry, Chalk Pit or Clay Pit**
Rock **Boulders**
Cliff **Slopes** **Top**
Roofed Building **Glazed Roof Building**
Sloping Masonry **Archway**
Non-Coniferous Tree (surveyed) **Coniferous Tree (surveyed)**
Non-Coniferous Trees (not surveyed) **Coniferous Trees (not surveyed)**
Orchard Tree **Scrub** **Bracken**
Coppice, Osier **Reeds** **Marsh, Saltings**
Rough Grassland **Heath** **Culvert**
Direction of water flow **Bench Mark** **Antiquity (site of)**
Cave Entrance **Triangulation Station** **Electricity Pylon**
Electricity Transmission Line
County Boundary (Geographical)
County & Civil Parish Boundary
Civil Parish Boundary
Admin. County or County Bor. Boundary
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**
EI 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

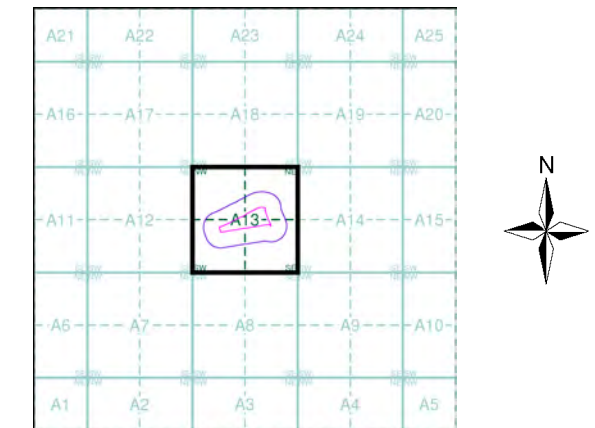
Cliff **Slopes** **Top**
Rock **Rock (scattered)**
Boulders **Boulders (scattered)**
Positioned Boulder **Scree**
Non-Coniferous Tree (surveyed) **Coniferous Tree (surveyed)**
Non-Coniferous Trees (not surveyed) **Coniferous Trees (not surveyed)**
Orchard Tree **Scrub** **Bracken**
Coppice, Osier **Reeds** **Marsh, Saltings**
Rough Grassland **Heath** **Culvert**
Direction of water flow **Triangulation Station** **Antiquity (site of)**
Electricity Transmission Line **Electricity Pylon**
B.M. 231.60m **Bench Mark** **Buildings with Building Seed**
Roofed Building **Glazed Roof Building**
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**
EI Gen Sta **Electricity Generating Station** **Sewage Ppg Sta** **Sewage Pumping Station**
EI P **Electricity Pole, Pillar** **SB, S Br** **Signal Box or Bridge**
EI 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 Governor** **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**



TWEEDIE EVANS CONSULTING
Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Essex	1:2,500	1868	2
Essex	1:2,500	1896	3
Essex	1:2,500	1922	4
Essex	1:2,500	1939	5
Ordnance Survey Plan	1:2,500	1956	6
Ordnance Survey Plan	1:1,250	1968 - 1969	7
Ordnance Survey Plan	1:2,500	1968 - 1970	8
Supply of Unpublished Survey Information	1:1,250	1973	9
Ordnance Survey Plan	1:1,250	1976	10
Additional SIMs	1:1,250	1990 - 1992	11
Large-Scale National Grid Data	1:1,250	1992 - 1993	12
Additional SIMs	1:1,250	1992	13
Large-Scale National Grid Data	1:1,250	1995	14
Large-Scale National Grid Data	1:1,250	1996	15
Historical Aerial Photography	1:2,500	2003	16

Historical Map - Segment A13



Order Details

Order Number: 259013368_1_1
Customer Ref: 2009004
National Grid Reference: 569850, 188340
Slice: A
Site Area (Ha): 2.48
Search Buffer (m): 100

Site Details

1, Hempstalls, BASILDON, SS15 5AA



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



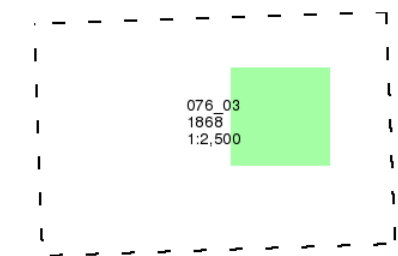
TWEEDIE EVANS CONSULTING
Essex

Published 1868

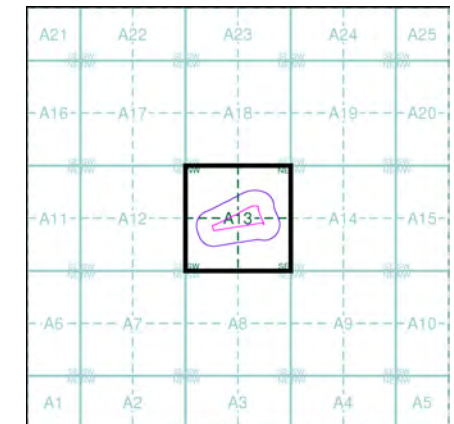
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The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered 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

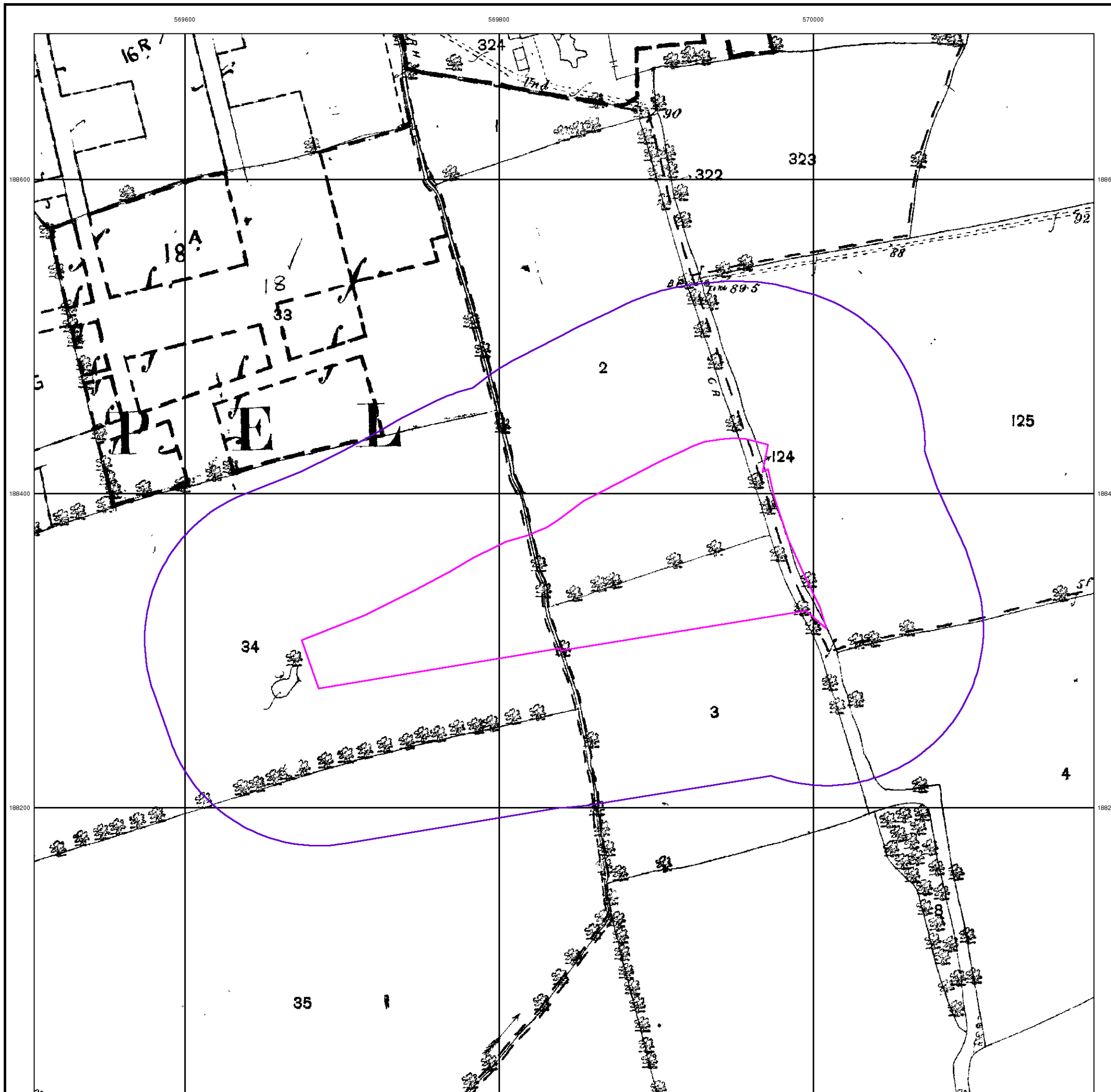
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Customer Ref: 2009004
National Grid Reference: 569850, 188340
Slice: A
Site Area (Ha): 2.48
Search Buffer (m): 100

Site Details

1, Hempstalls, BASILDON, SS15 5AA



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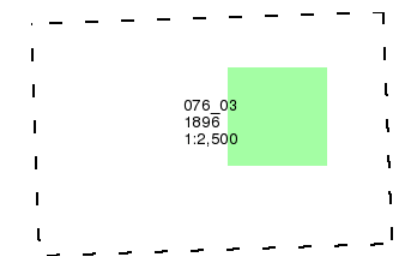
TWEEDIE EVANS CONSULTING
Essex

Published 1896

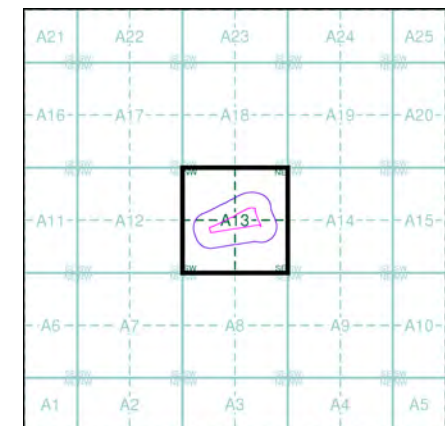
Source map scale - 1:2,500

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

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

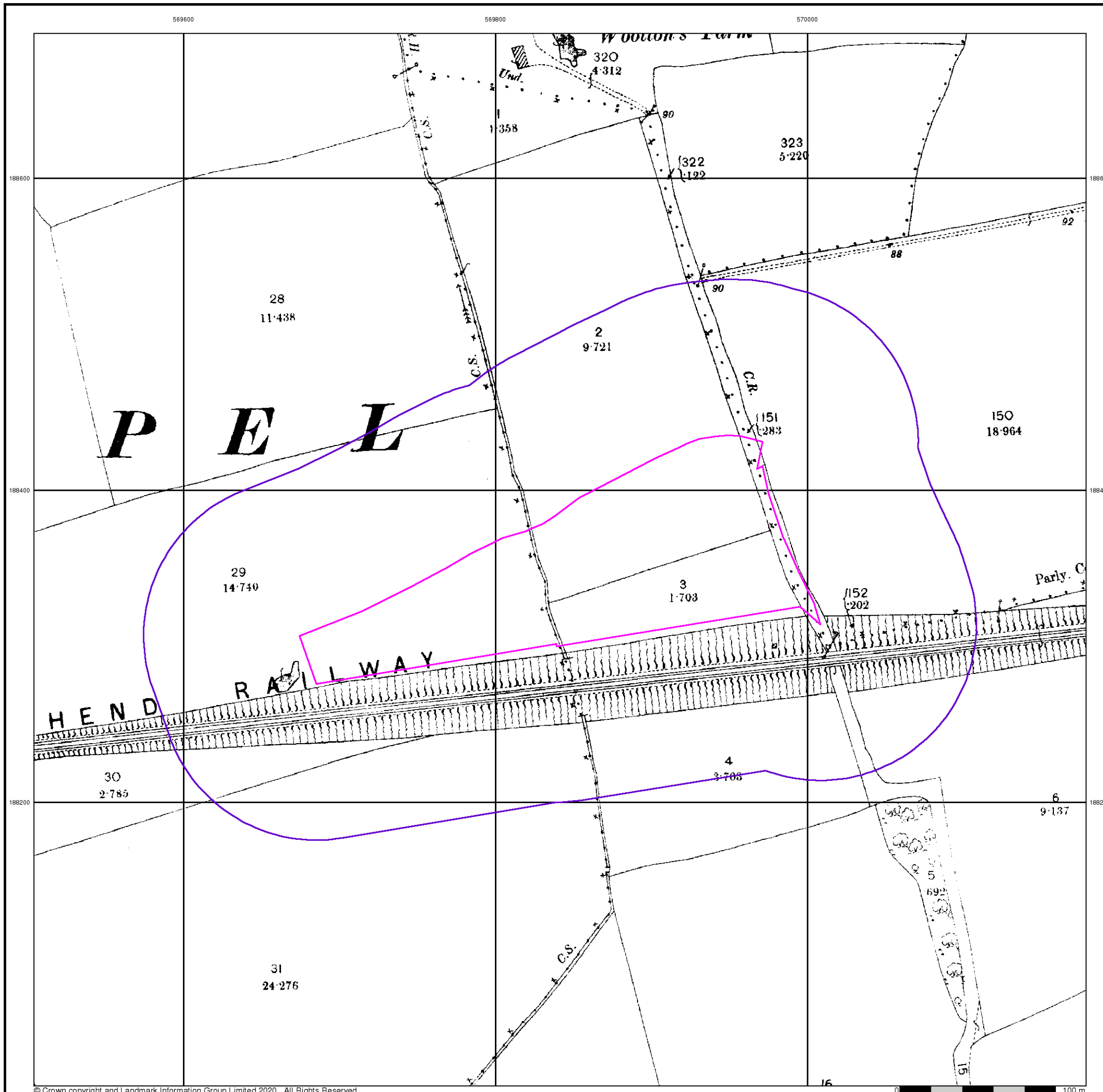
Order Number: 259013368_1_1
Customer Ref: 2009004
National Grid Reference: 569850, 188340
Slice: A
Site Area (Ha): 2.48
Search Buffer (m): 100

Site Details

1, Hempstalls, BASILDON, SS15 5AA



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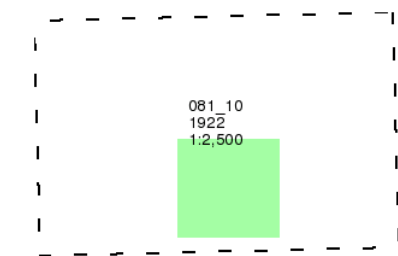
TWEEDIE EVANS CONSULTING
Essex

Published 1922

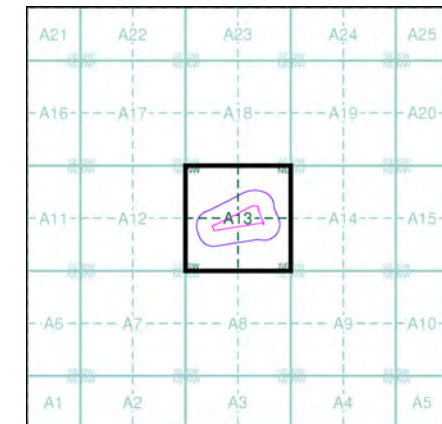
Source map scale - 1:2,500

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

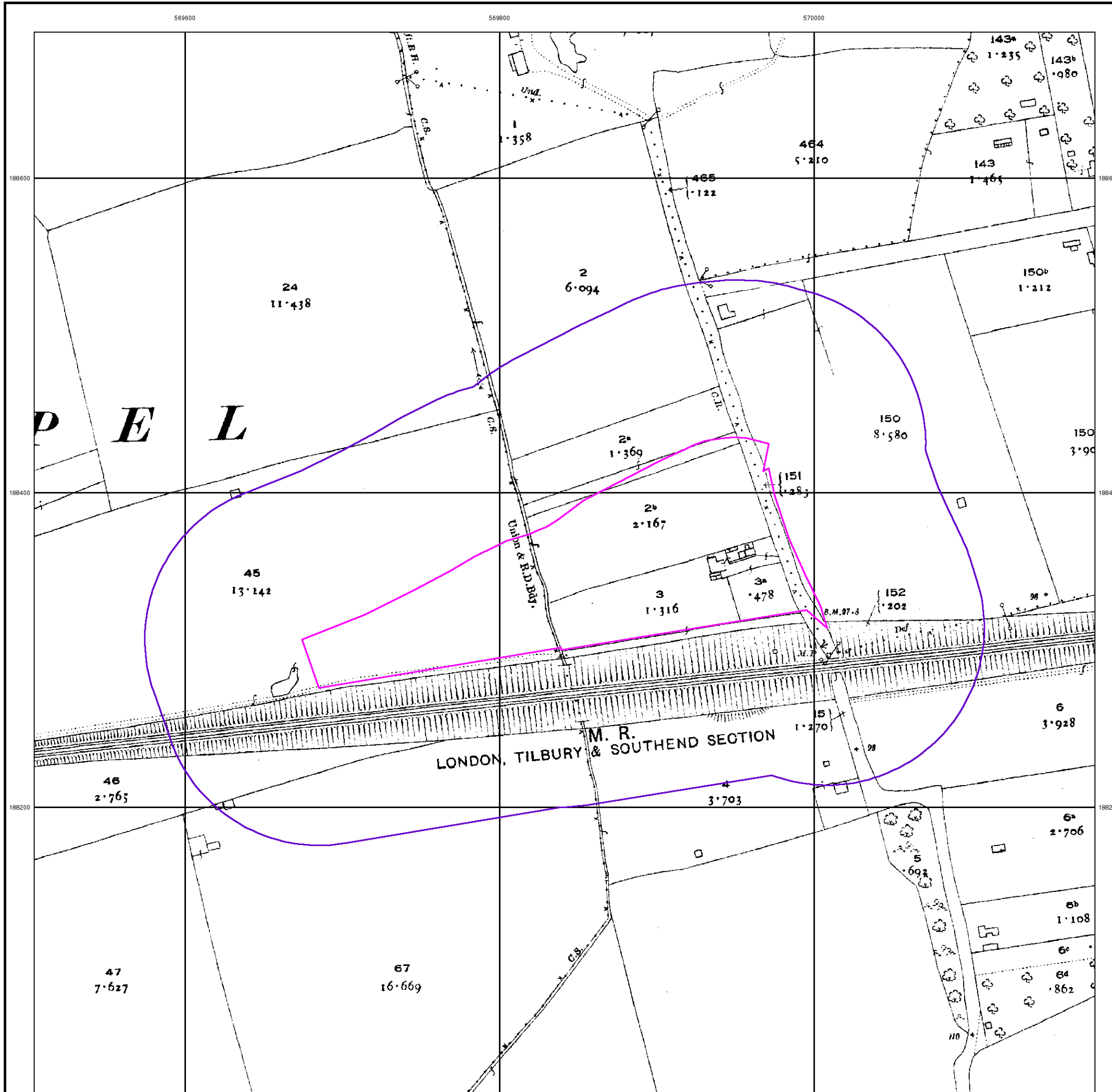
Order Number: 259013368_1_1
Customer Ref: 2009004
National Grid Reference: 569850, 188340
Slice: A
Site Area (Ha): 2.48
Search Buffer (m): 100

Site Details

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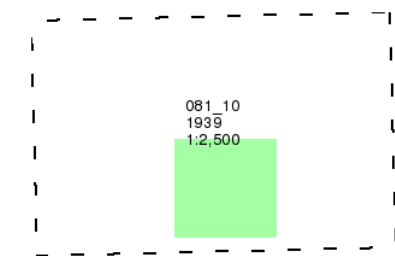
TWEEDIE EVANS CONSULTING
Essex

Published 1939

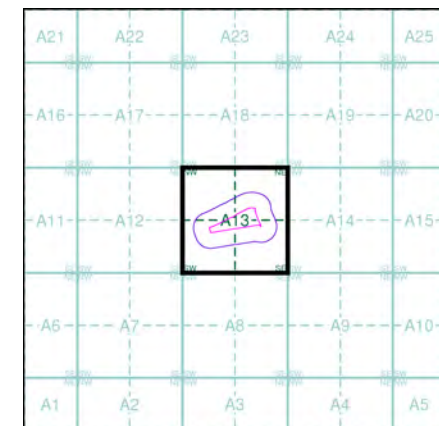
Source map scale - 1:2,500

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

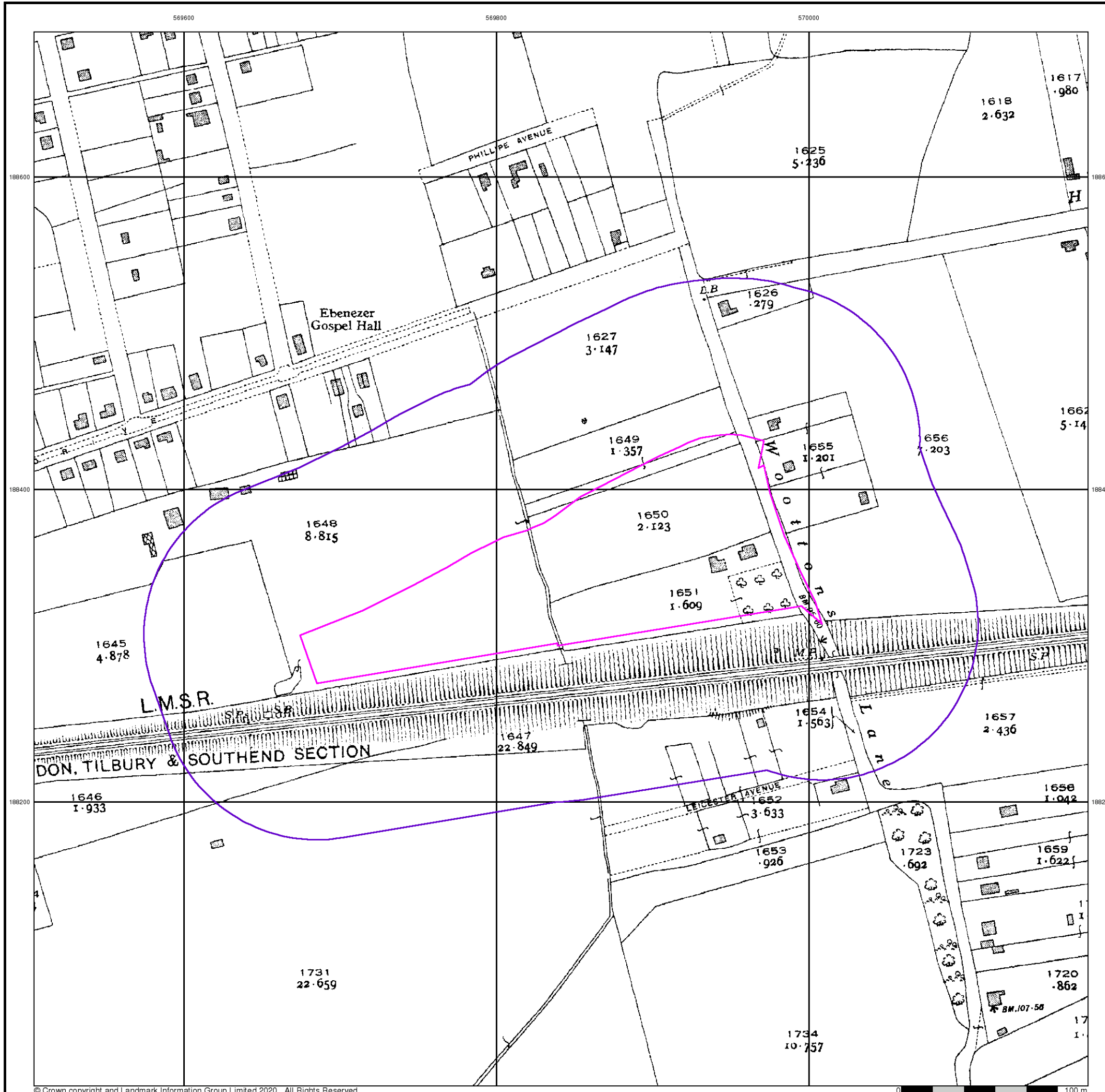
Order Number: 259013368_1_1
Customer Ref: 2009004
National Grid Reference: 569850, 188340
Slice: A
Site Area (Ha): 2.48
Search Buffer (m): 100

Site Details

1, Hempstalls, BASILDON, SS15 5AA



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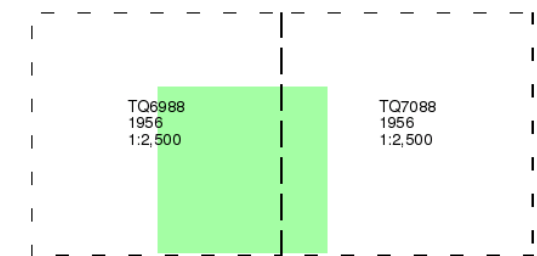
TWEEDIE EVANS CONSULTING Ordnance Survey Plan

Published 1956

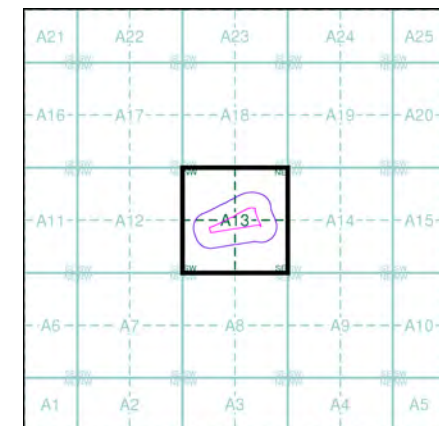
Source map scale - 1:2,500

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

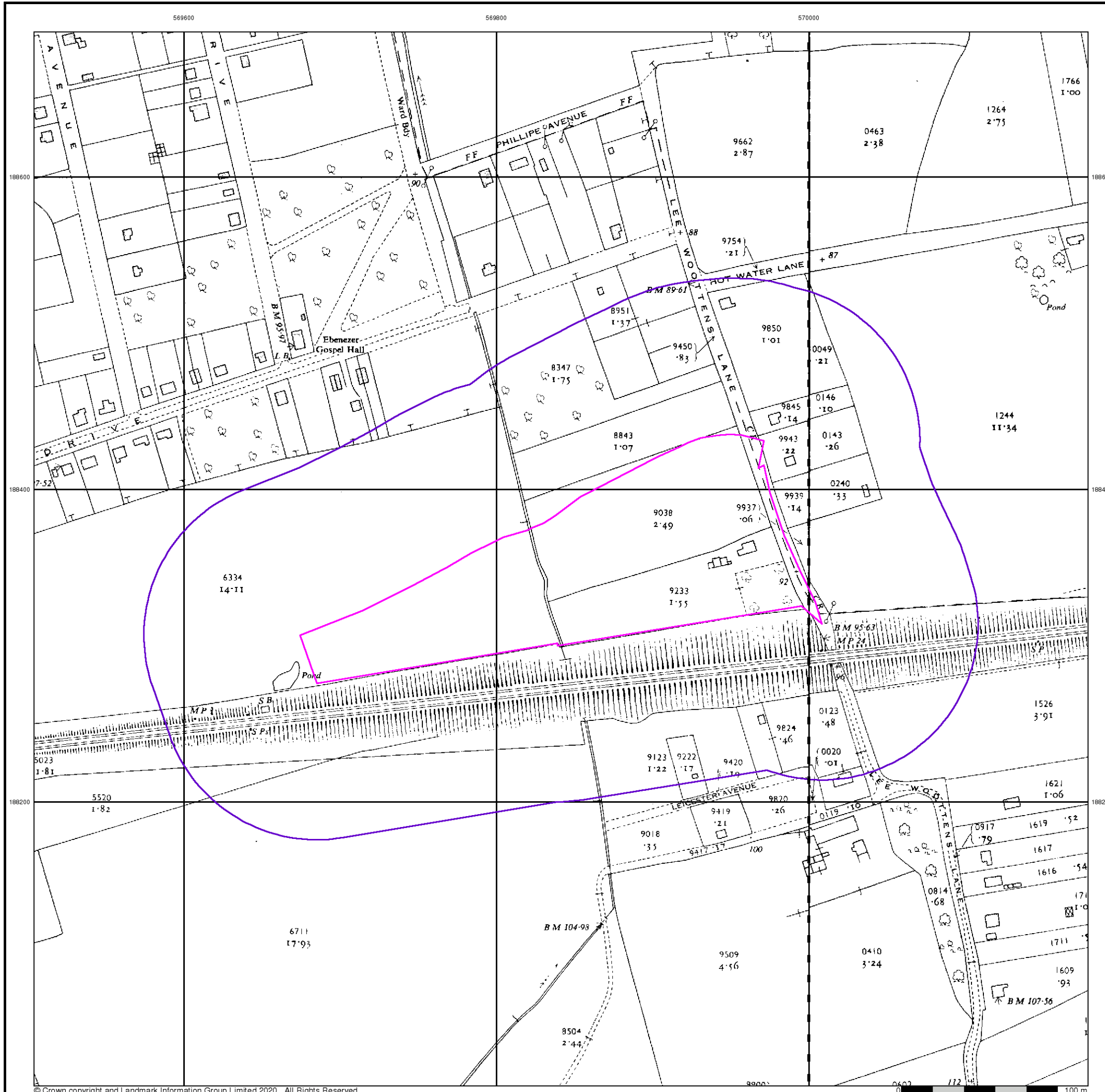
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Customer Ref: 2009004
National Grid Reference: 569850, 188340
Slice: A
Site Area (Ha): 2.48
Search Buffer (m): 100

Site Details

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Ordnance Survey Plan

Published 1968 - 1969

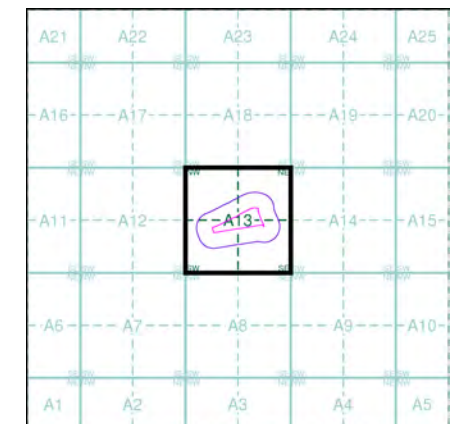
Source map scale - 1:1,250

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)

TO6988NE 1969 1:1,250	TO7088NW 1968 1:1,250
TO6988SE 1969 1:1,250	TO7088SW 1968 1:1,250

Historical Map - Segment A13



Order Details

Order Number: 259013368_1_1
 Customer Ref: 2009004
 National Grid Reference: 569850, 188340
 Slice: A
 Site Area (Ha): 2.48
 Search Buffer (m): 100

Site Details

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TWEEDIE EVANS CONSULTING

Ordnance Survey Plan

Published 1968 - 1970

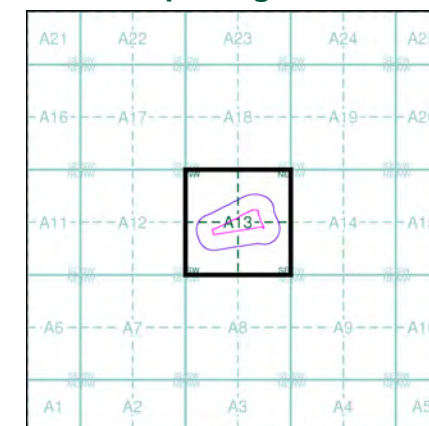
Source map scale - 1:2,500

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)

TO6988 1970 1:2,500	TO7088 1968 1:2,500
---------------------------	---------------------------

Historical Map - Segment A13



Order Details

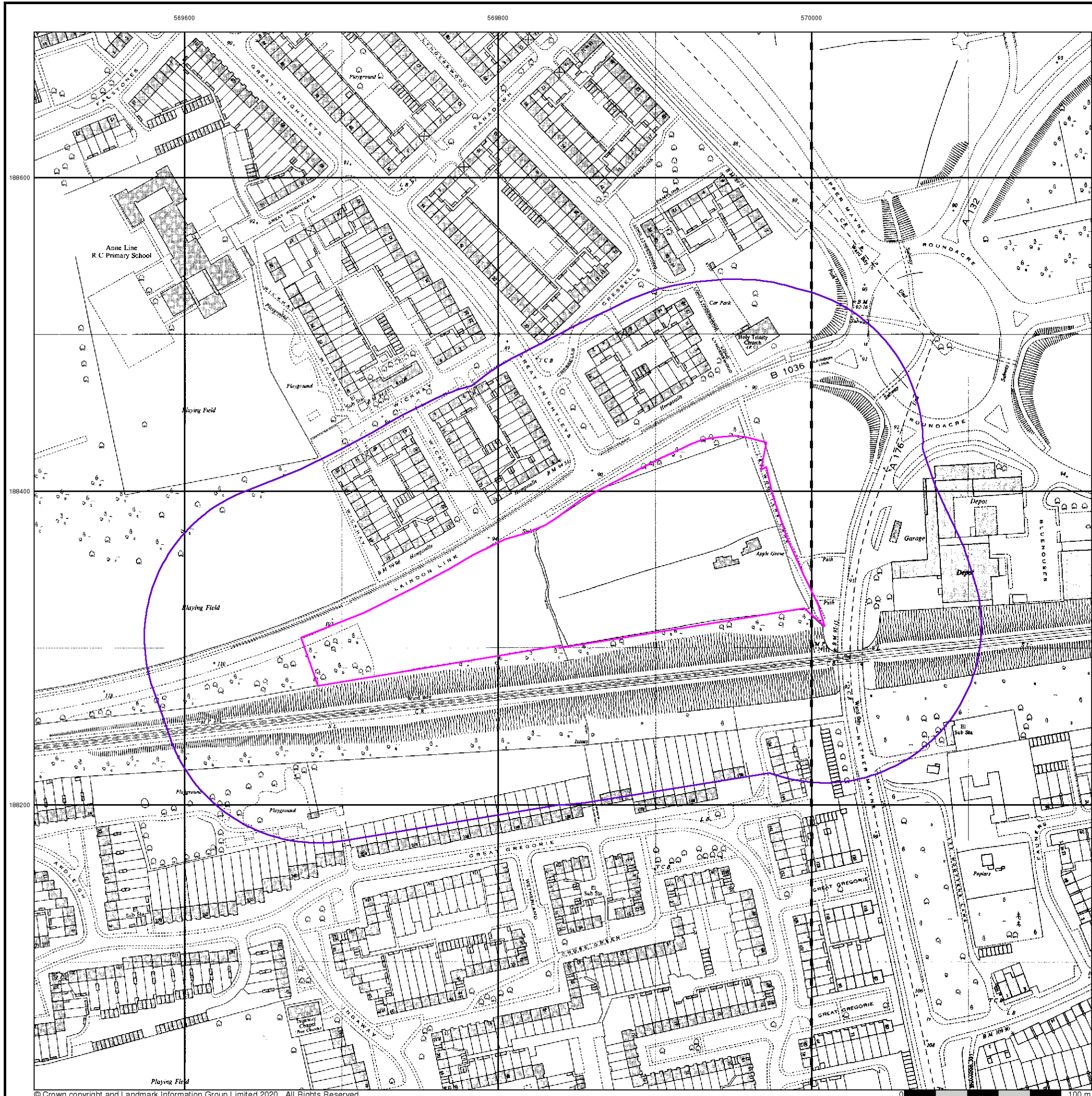
Order Number: 259013368_1_1
 Customer Ref: 2009004
 National Grid Reference: 569850, 188340
 Slice: A
 Site Area (Ha): 2.48
 Search Buffer (m): 100

Site Details

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TWEEDIE EVANS CONSULTING
Supply of Unpublished Survey Information

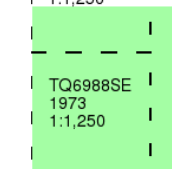
Published 1973

Source map scale - 1:1,250

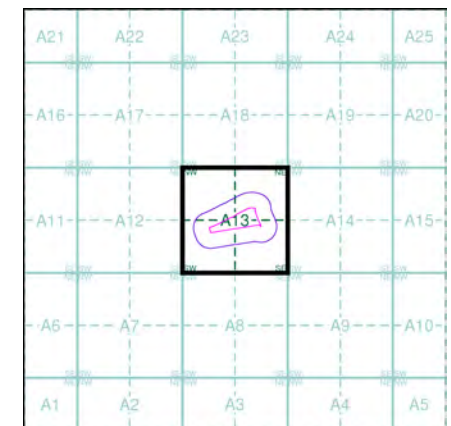
SUSI maps (Supply of Unpublished Survey Information) were produced between 1972 and 1977, mainly for internal use at Ordnance Survey. These were more of a 'work-in-progress' plan as they showed updates of individual areas on a map. These maps were unpublished, and they do not represent a single moment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

Map Name(s) and Date(s)

TQ6988NE
1973
1:1,250



Historical Map - Segment A13



Order Details

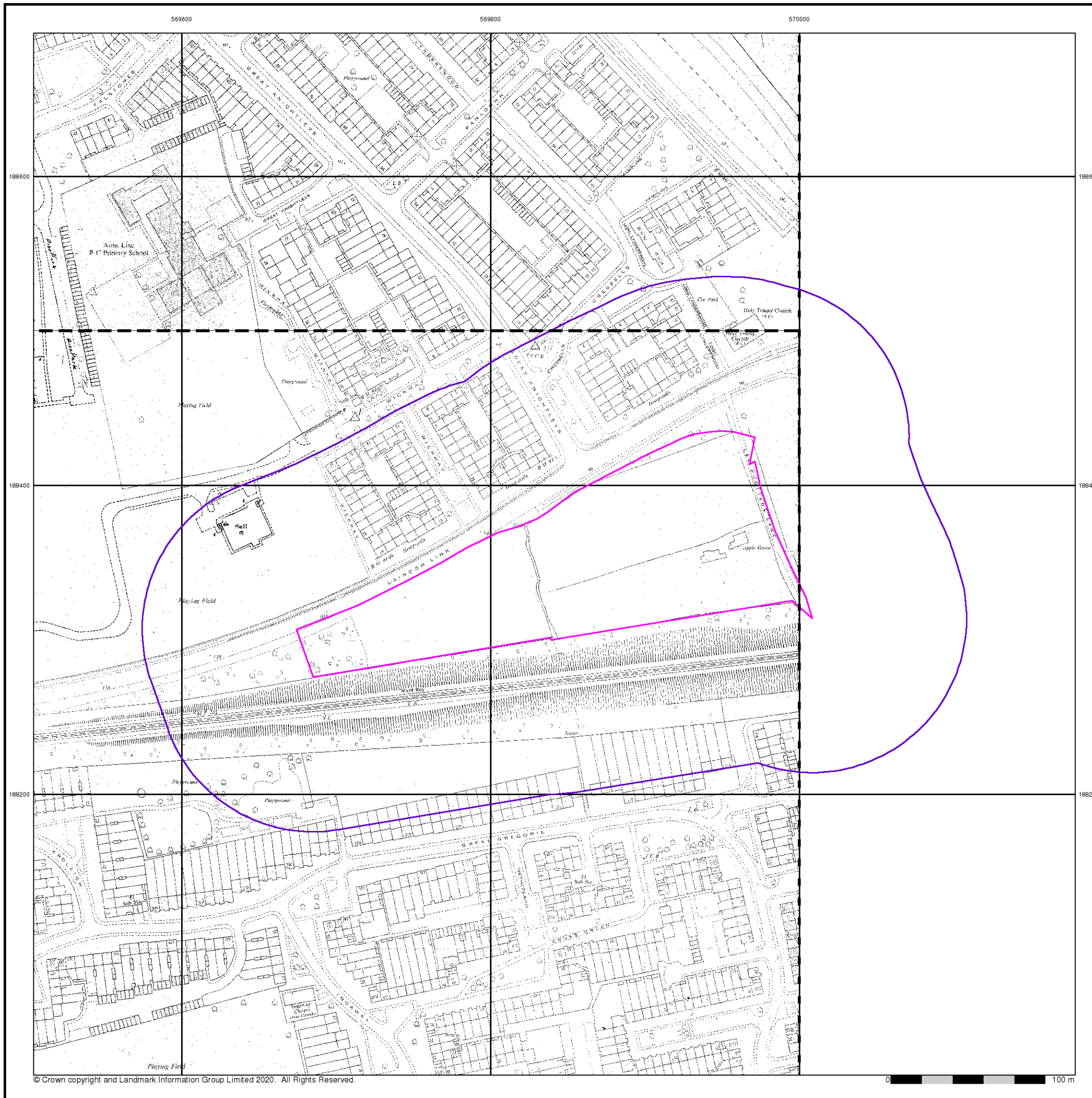
Order Number: 259013368_1_1
Customer Ref: 2009004
National Grid Reference: 569850, 188340
Slice: A
Site Area (Ha): 2.48
Search Buffer (m): 100

Site Details

1, Hempstalls, BASILDON, SS15 5AA



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TWEEDIE EVANS CONSULTING
Ordnance Survey Plan

Published 1976

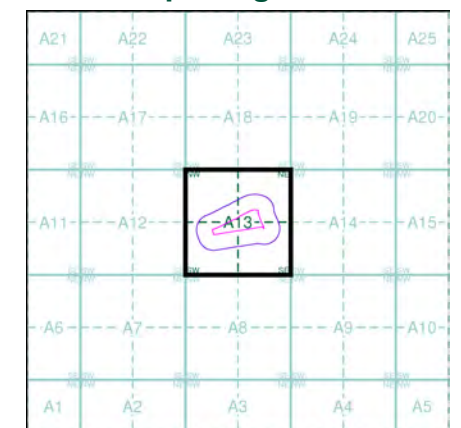
Source map scale - 1:1,250

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)

---	---	TQ7088NW	1976	1:1,250
---	---	TQ6988SE	1976	1:1,250
---	---	TQ7088SW	1976	1:1,250

Historical Map - Segment A13



Order Details

Order Number: 259013368_1_1
 Customer Ref: 2009004
 National Grid Reference: 569850, 188340
 Slice: A
 Site Area (Ha): 2.48
 Search Buffer (m): 100

Site Details

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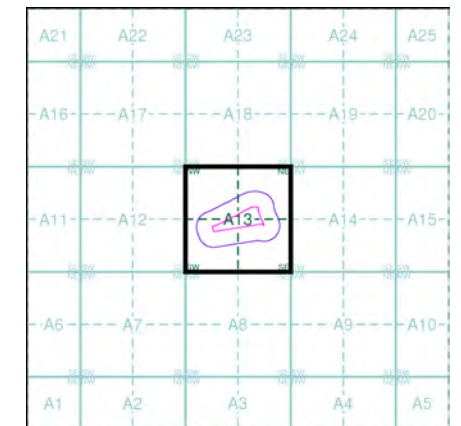
TWEEDIE EVANS CONSULTING
Additional SIMs
Published 1990 - 1992
Source map scale - 1:1,250

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)

TQ7088NW	1990	1:1,250
TQ6988SE	1992	1:1,250
TQ7088SW	1990	1:1,250

Historical Map - Segment A13



Order Details

Order Number: 259013368_1_1
 Customer Ref: 2009004
 National Grid Reference: 569850, 188340
 Slice: A
 Site Area (Ha): 2.48
 Search Buffer (m): 100

Site Details

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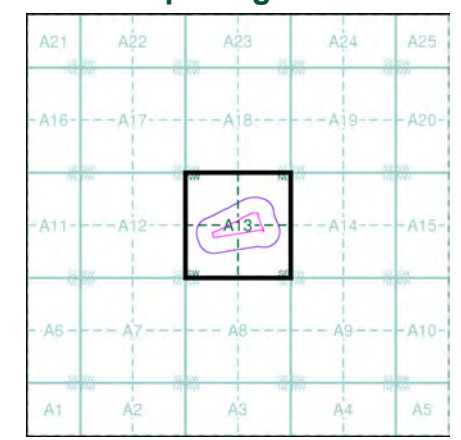
TWEEDIE EVANS CONSULTING
Large-Scale National Grid Data
Published 1992 - 1993
Source map scale - 1:1,250

'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)

TQ6988NE 1992 1:1,250	TQ7088NW 1993 1:1,250
TQ6988SE 1992 1:1,250	TQ7088SW 1993 1:1,250

Historical Map - Segment A13



Order Details

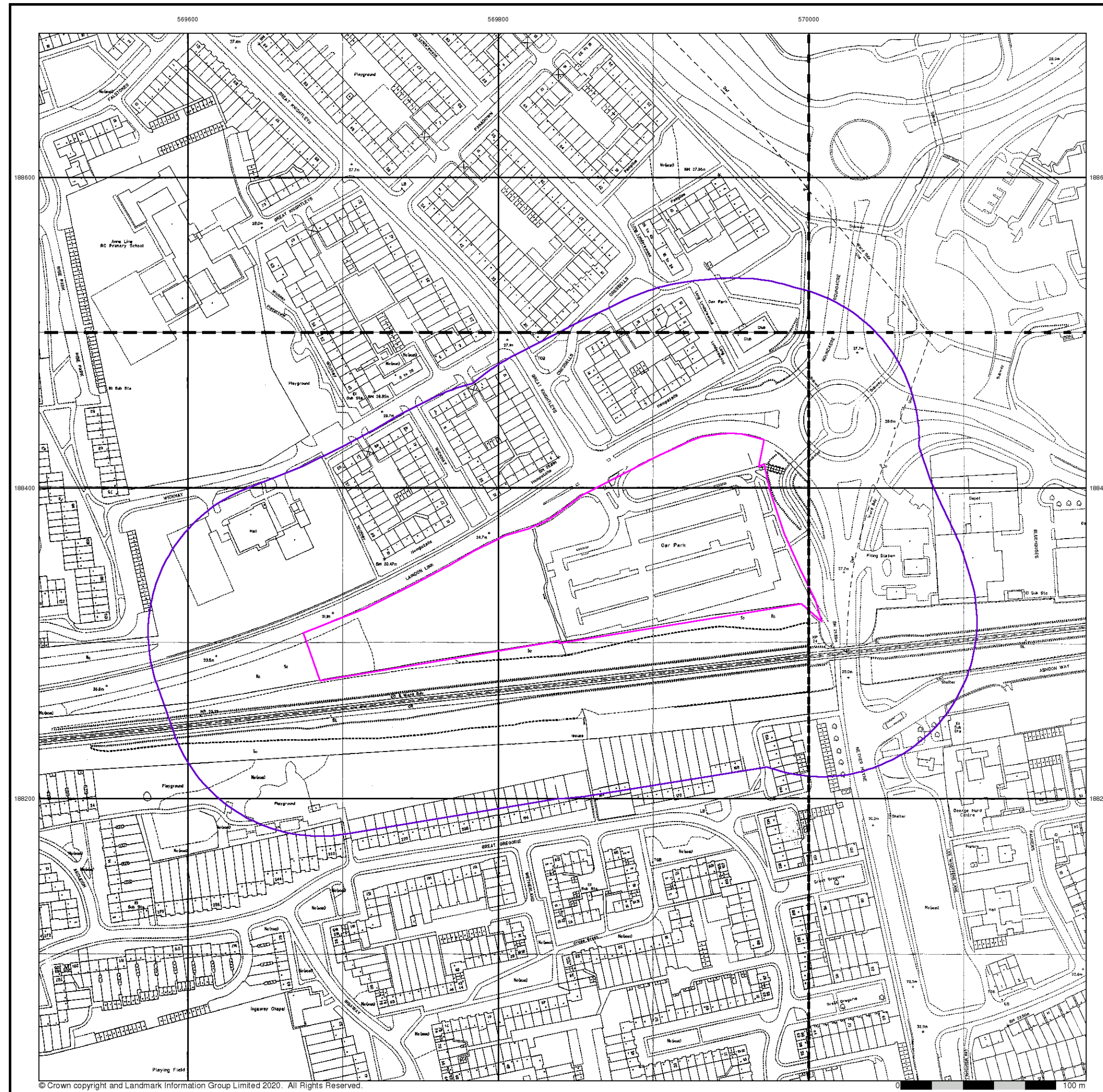
Order Number: 259013368_1_1
 Customer Ref: 2009004
 National Grid Reference: 569850, 188340
 Slice: A
 Site Area (Ha): 2.48
 Search Buffer (m): 100

Site Details

1, Hempstalls, BASILDON, SS15 5AA



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TWEEDIE EVANS CONSULTING

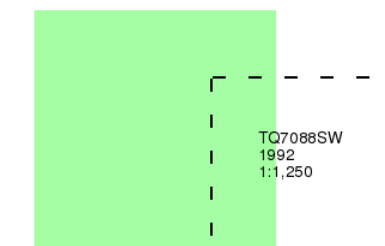
Additional SIMs

Published 1992

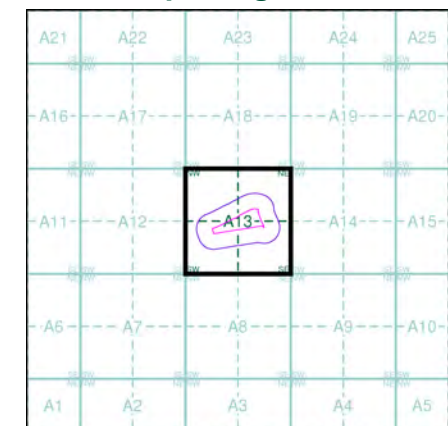
Source map scale - 1:1,250

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



Order Details

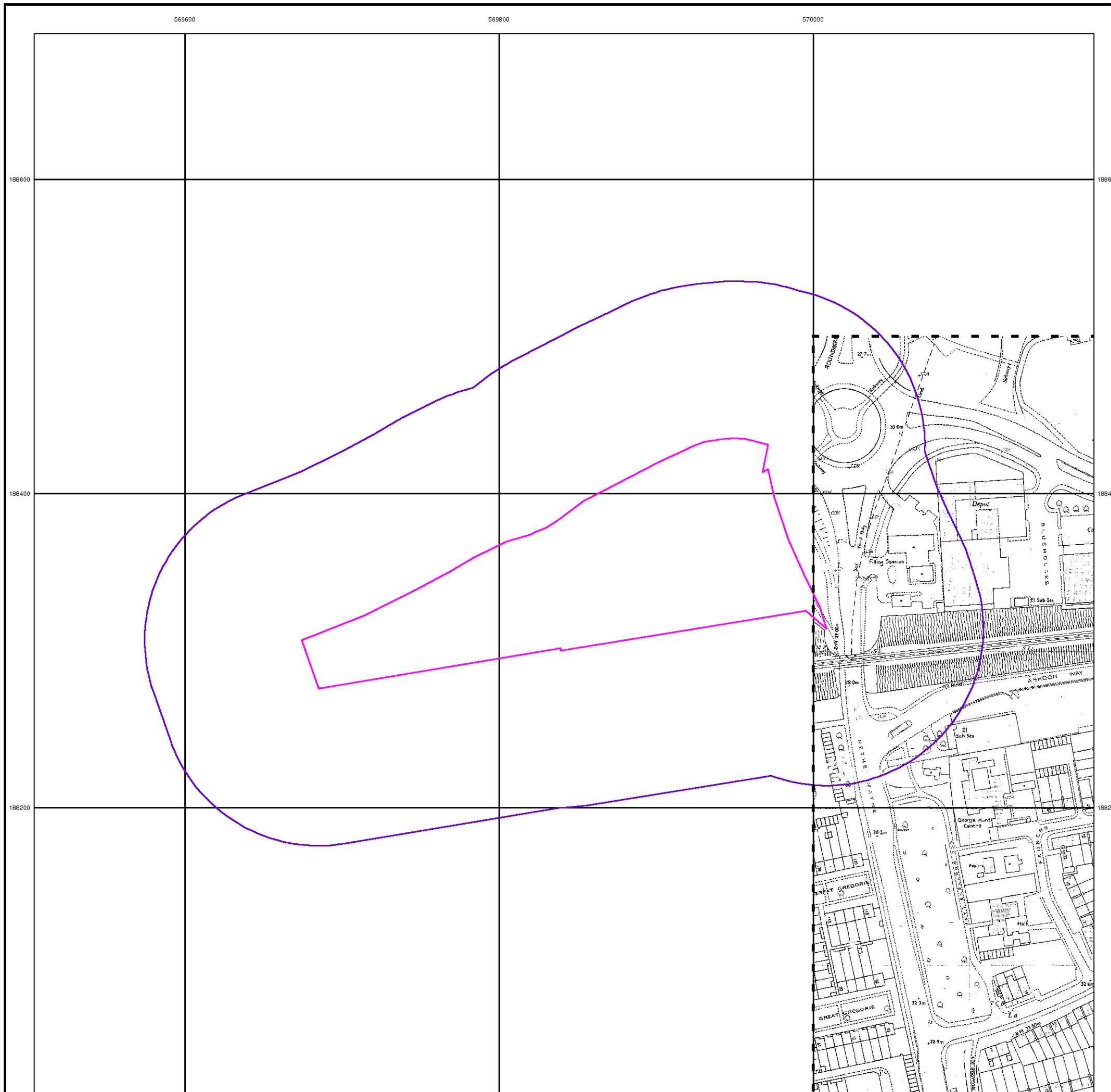
Order Number: 259013368_1_1
Customer Ref: 2009004
National Grid Reference: 569850, 188340
Slice: A
Site Area (Ha): 2.48
Search Buffer (m): 100

Site Details

1, Hempstalls, BASILDON, SS15 5AA



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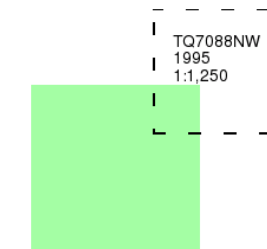
TWEEDIE EVANS CONSULTING
Large-Scale National Grid Data

Published 1995

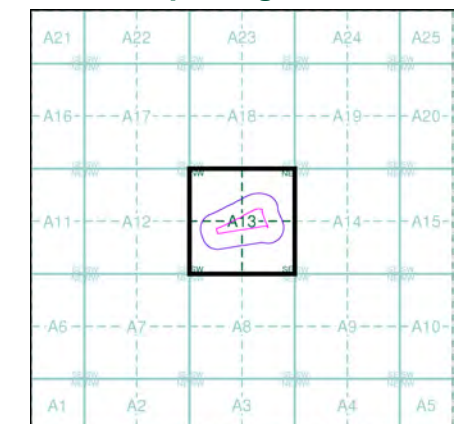
Source map scale - 1:1,250

'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



Order Details

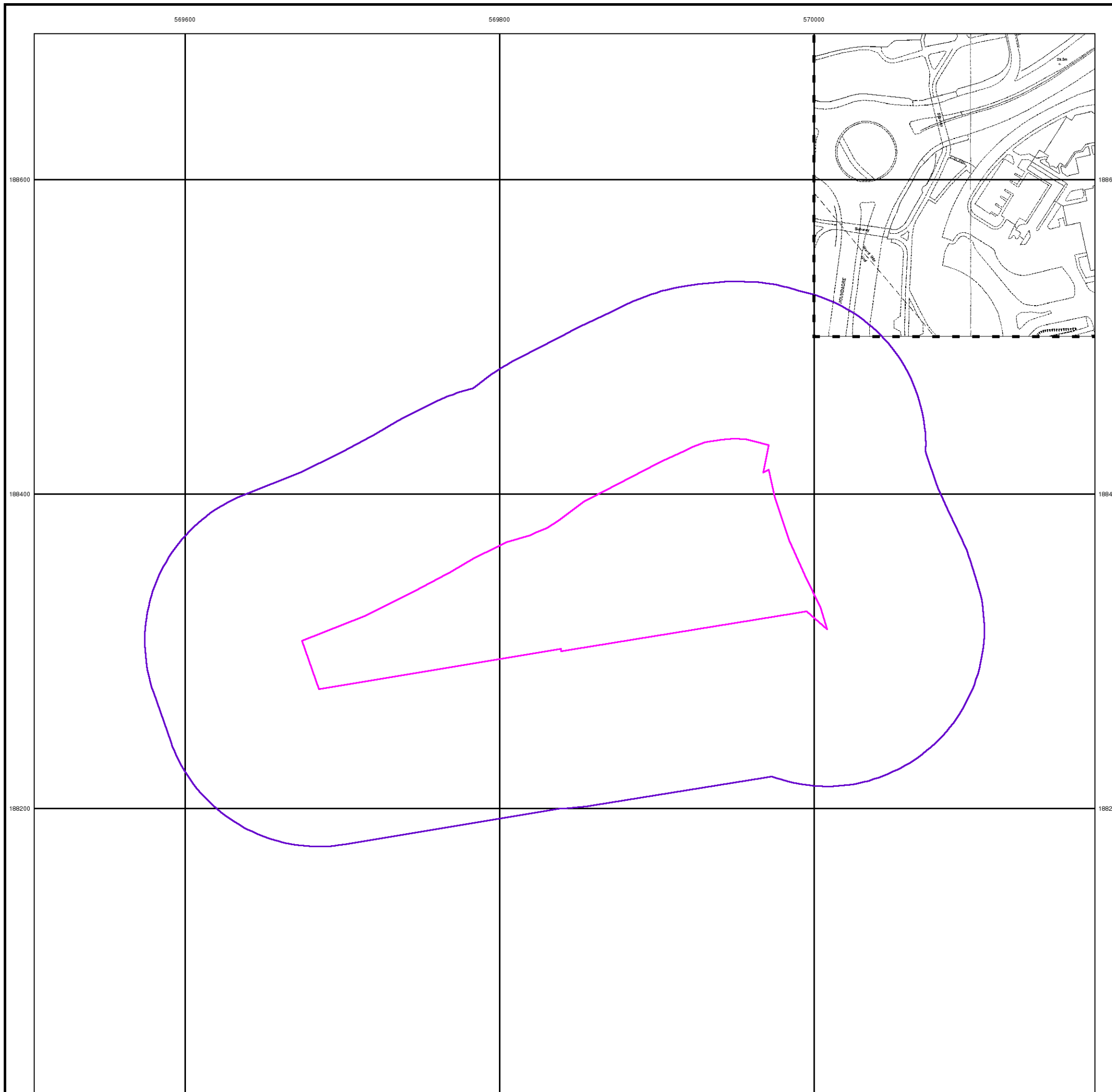
Order Number: 259013368_1_1
Customer Ref: 2009004
National Grid Reference: 569850, 188340
Slice: A
Site Area (Ha): 2.48
Search Buffer (m): 100

Site Details

1, Hempstalls, BASILDON, SS15 5AA



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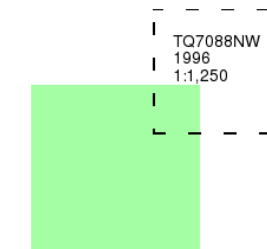
TWEEDIE EVANS CONSULTING
Large-Scale National Grid Data

Published 1996

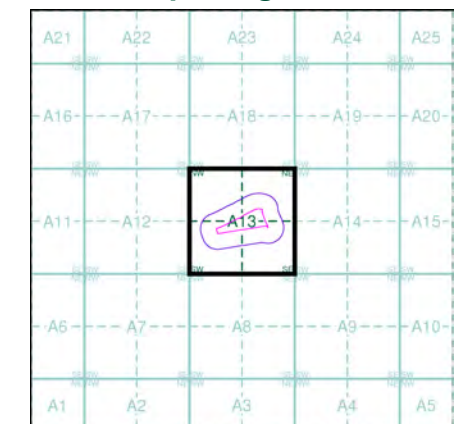
Source map scale - 1:1,250

'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



Order Details

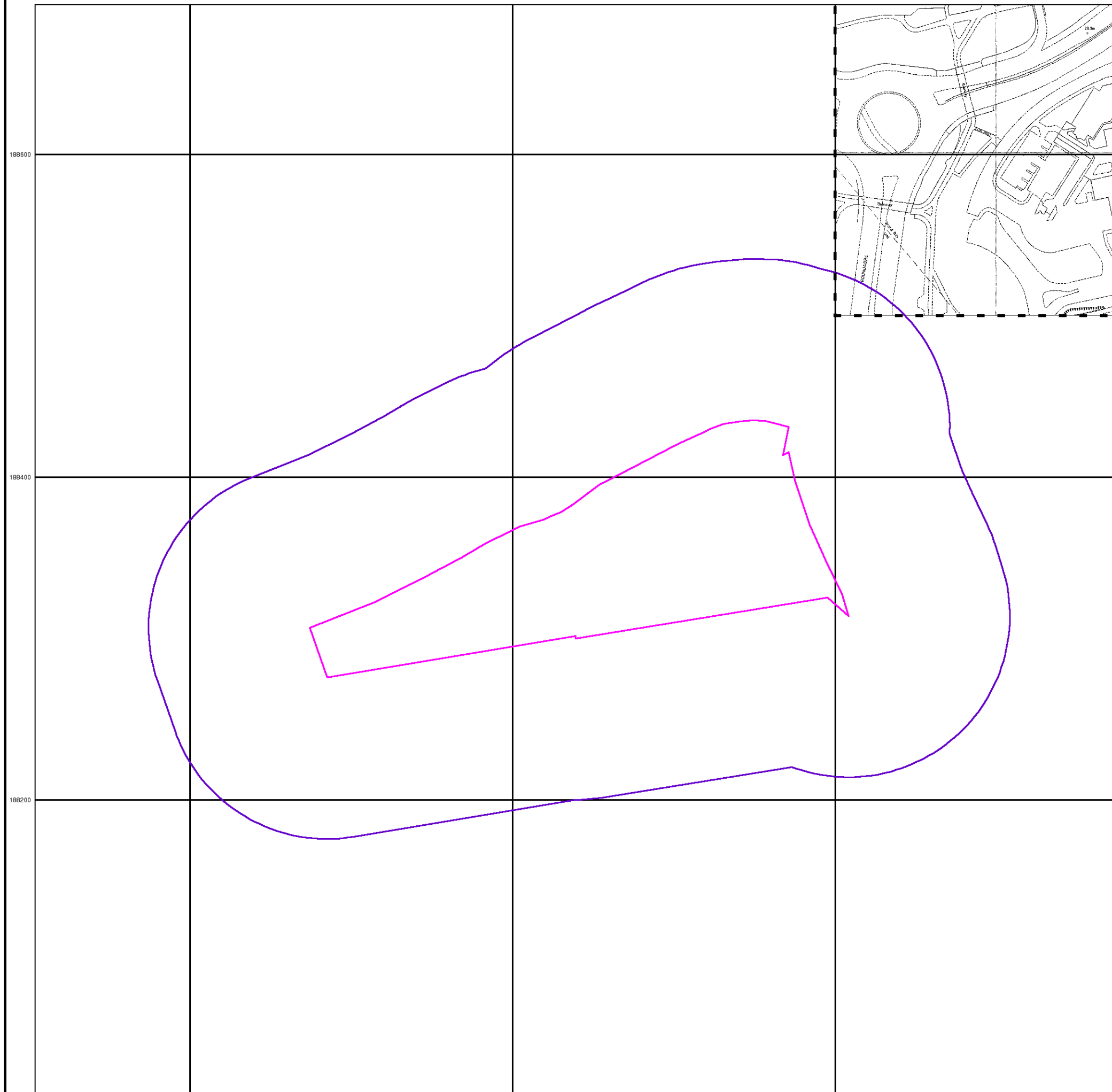
Order Number: 259013368_1_1
Customer Ref: 2009004
National Grid Reference: 569850, 188340
Slice: A
Site Area (Ha): 2.48
Search Buffer (m): 100

Site Details

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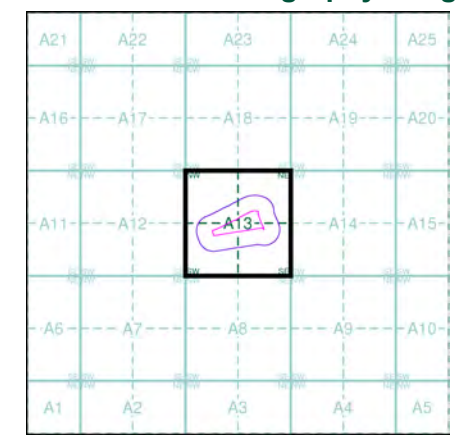
569600 569800 570000



TWEEDIE EVANS CONSULTING
Historical Aerial Photography
Published 2003

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: 259013368_1_1
Customer Ref: 2009004
National Grid Reference: 569850, 188340
Slice: A
Site Area (Ha): 2.48
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Site Details

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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		Minor Roads		
	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				
	County Borough Boundary (England)				
	County Burgh Boundary (Scotland)				
	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		Heath
	Rough Grassland		Marsh
	Reeds		Saltings
	Building		Glasshouse
	Sloping Masonry		Pylon
	Electricity Transmission Line		Pole
	Cutting		Embankment
	Standard Gauge Multiple Track		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

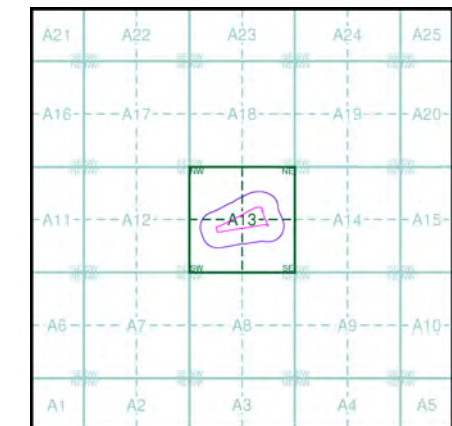
	Gravel Pit		Refuse tip or slag heap
	Rock		Rock (scattered)
	Boulders		Boulders (scattered)
	Shingle		Mud
	Sand		Sand Pit
	Slopes		Top of cliff
	General detail		Underground detail
	Overhead detail		Narrow gauge railway
	Multi-track railway		Single track railway
	County boundary (England only)		Civil, 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)
	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



TWEEDIE EVANS CONSULTING
Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Essex	1:10,560	1876 - 1881	2
Essex	1:10,560	1898	3
Essex	1:10,560	1924	4
Essex	1:10,560	1938	5
Historical Aerial Photography	1:10,560	1947	6
Historical Aerial Photography	1:10,560	1947	7
Ordnance Survey Plan	1:10,000	1960	8
Ordnance Survey Plan	1:10,000	1972	9
Ordnance Survey Plan	1:10,000	1975 - 1978	10
Ordnance Survey Plan	1:10,000	1980 - 1985	11
Ordnance Survey Plan	1:10,000	1987	12
10K Raster Mapping	1:10,000	1999	13
10K Raster Mapping	1:10,000	2006	14
VectorMap Local	1:10,000	2020	15

Historical Map - Slice A



Order Details

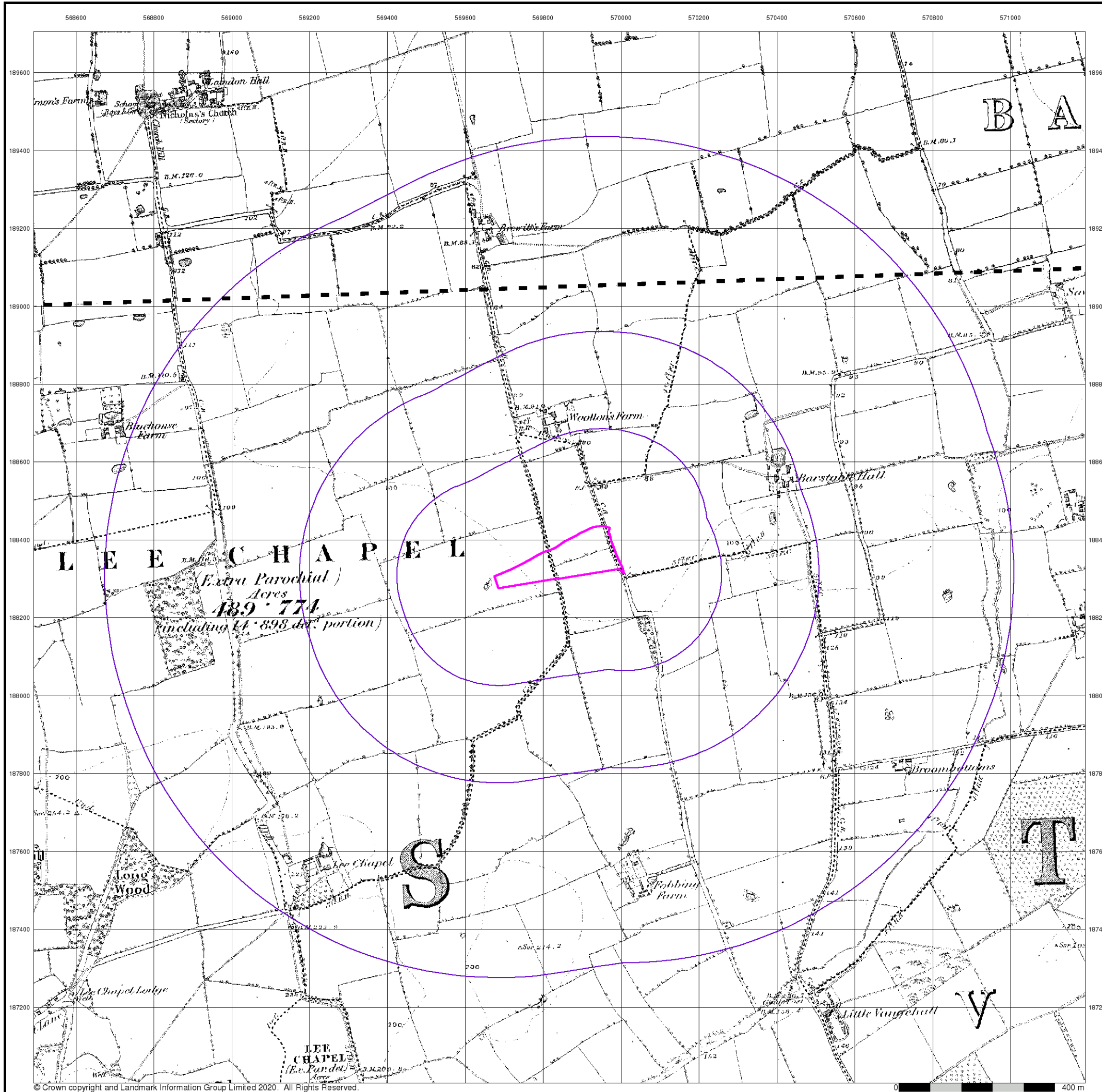
Order Number: 259013368_1_1
Customer Ref: 2009004
National Grid Reference: 569850, 188340
Slice: A
Site Area (Ha): 2.48
Search Buffer (m): 1000

Site Details

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TWEDIE EVANS CONSULTING
Essex

Published 1876 - 1881

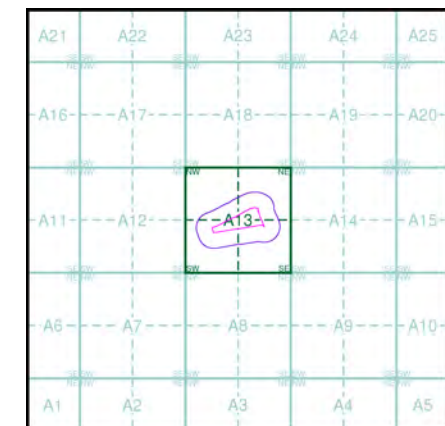
Source map scale - 1:10,560

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; these maps were used to update the 1:10,560 maps. The published date given therefore 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. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)

06800	1881	1:10,560
07600	1876	1:10,560

Historical Map - Slice A



Order Details

Order Number: 259013368_1_1
 Customer Ref: 2009004
 National Grid Reference: 569850, 188340
 Slice: A
 Site Area (Ha): 2.48
 Search Buffer (m): 1000

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TWEEDIE EVANS CONSULTING
Essex

Published 1898

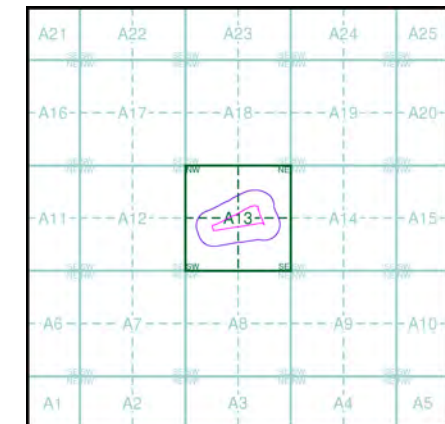
Source map scale - 1:10,560

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; these maps were used to update the 1:10,560 maps. The published date given therefore 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. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)

068SE	1898	1:10,560
076NE	1898	1:10,560

Historical Map - Slice A



Order Details

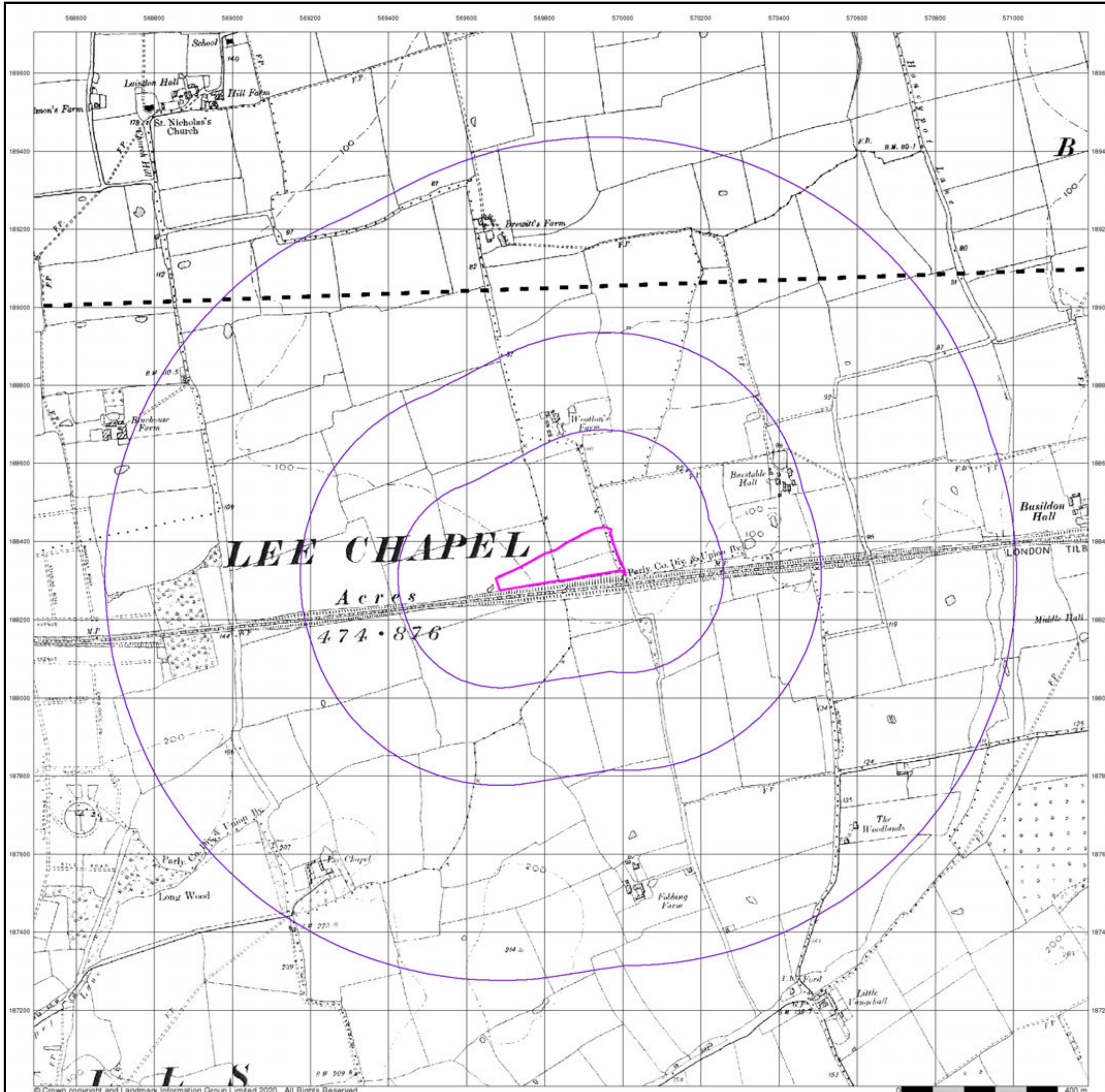
Order Number: 259013368_1_1
 Customer Ref: 2009004
 National Grid Reference: 569850, 188340
 Slice: A
 Site Area (Ha): 2.48
 Search Buffer (m): 1000

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TWEEDIE EVANS CONSULTING

Essex

Published 1924

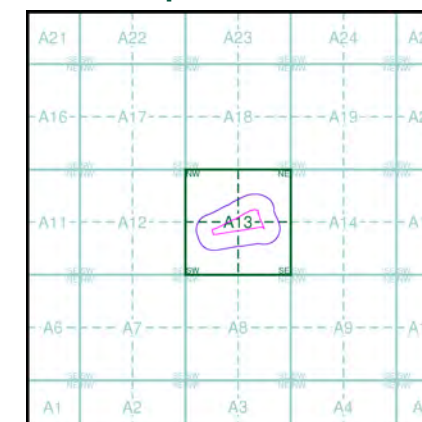
Source map scale - 1:10,560

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; these maps were used to update the 1:10,560 maps. The published date given therefore 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. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)

081NW 1924 1:10,560	081NE 1924 1:10,560
081SW 1924 1:10,560	081SE 1924 1:10,560

Historical Map - Slice A



Order Details

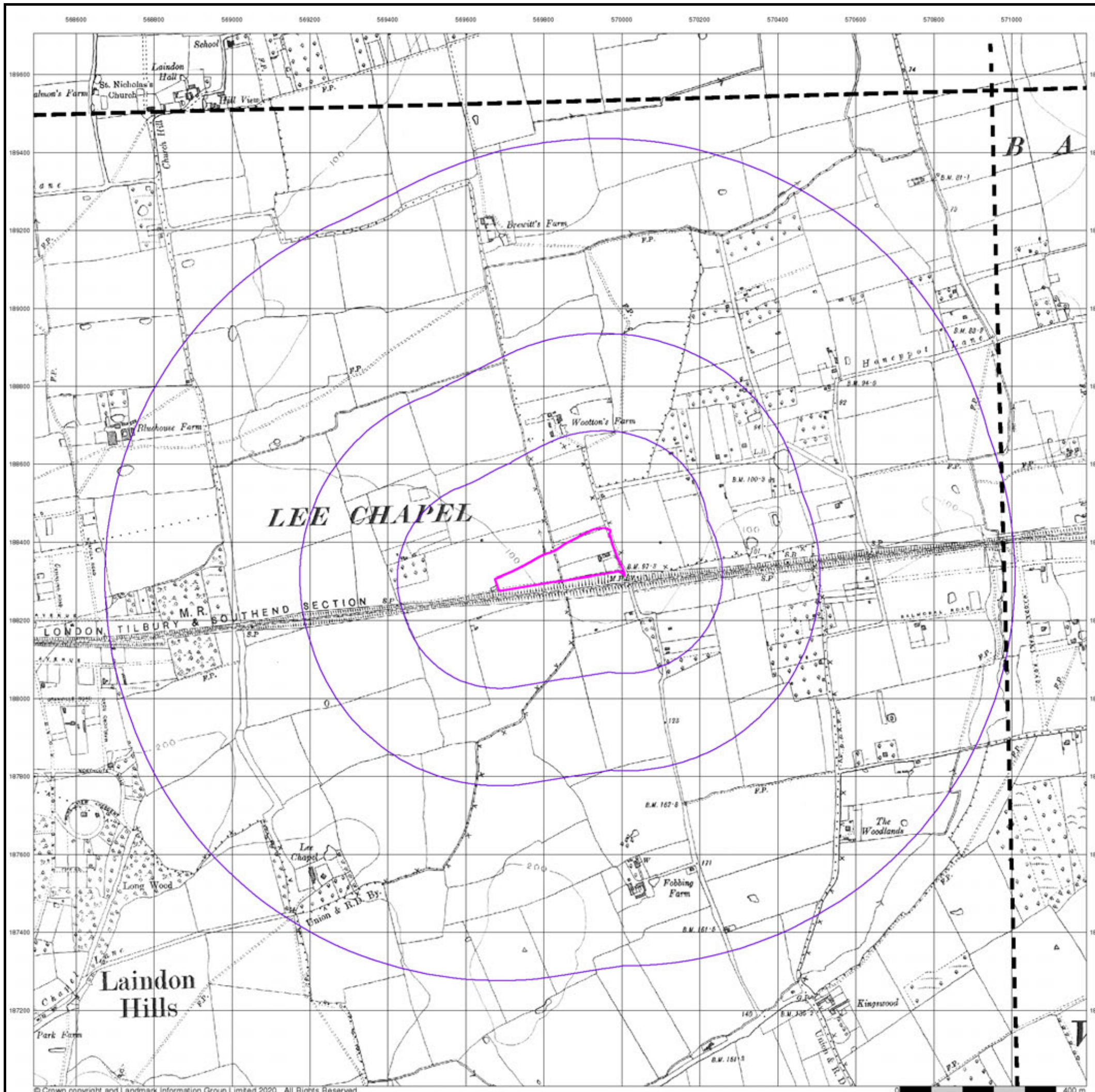
Order Number: 259013368_1_1
 Customer Ref: 2009004
 National Grid Reference: 569850, 188340
 Slice: A
 Site Area (Ha): 2.48
 Search Buffer (m): 1000

Site Details

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TWEEDIE EVANS CONSULTING
Essex

Published 1938

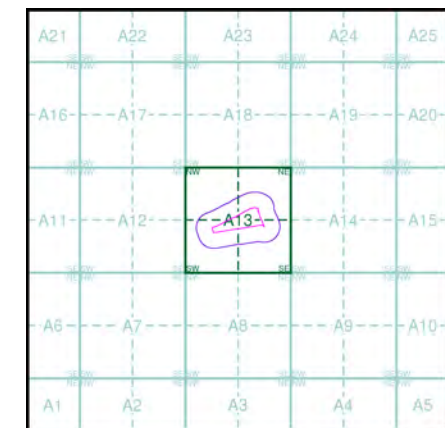
Source map scale - 1:10,560

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; these maps were used to update the 1:10,560 maps. The published date given therefore 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. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)

081NW 1938 1:10,560	081NE 1938 1:10,560
081SW 1938 1:10,560	081SE 1938 1:10,560

Historical Map - Slice A



Order Details

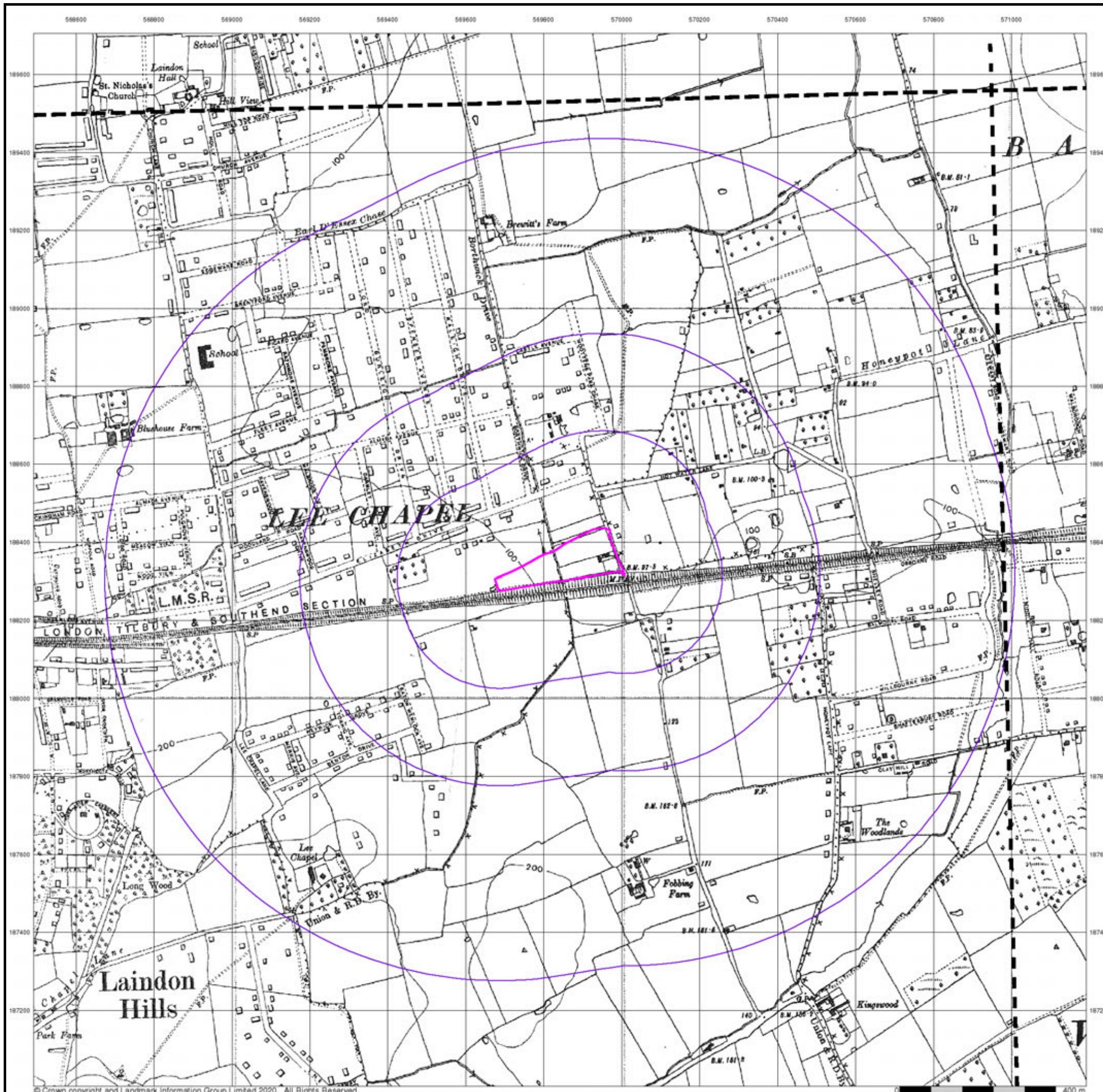
Order Number: 259013368_1_1
Customer Ref: 2009004
National Grid Reference: 569850, 188340
Slice: A
Site Area (Ha): 2.48
Search Buffer (m): 1000

Site Details

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TWEEDIE EVANS CONSULTING
Historical Aerial Photography

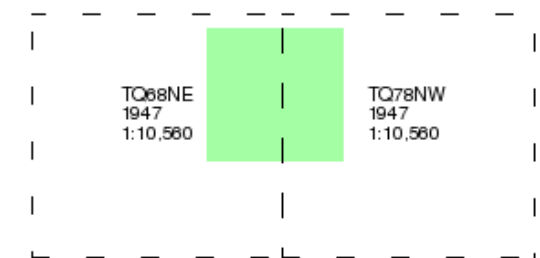
Published 1947

Source map scale - 1:10,560

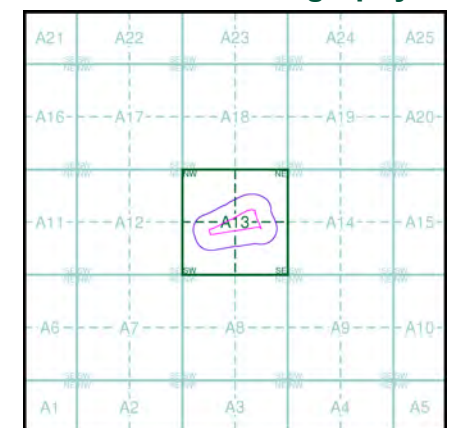
The Historical Aerial Photos were produced by the Ordnance Survey at a scale of 1:1,250 and 1:10,560 from Air Force photography. They were produced between 1944 and 1951 as an interim measure, pending preparation of conventional mapping, due to post war resource shortages. New security measures in the 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



Order Details

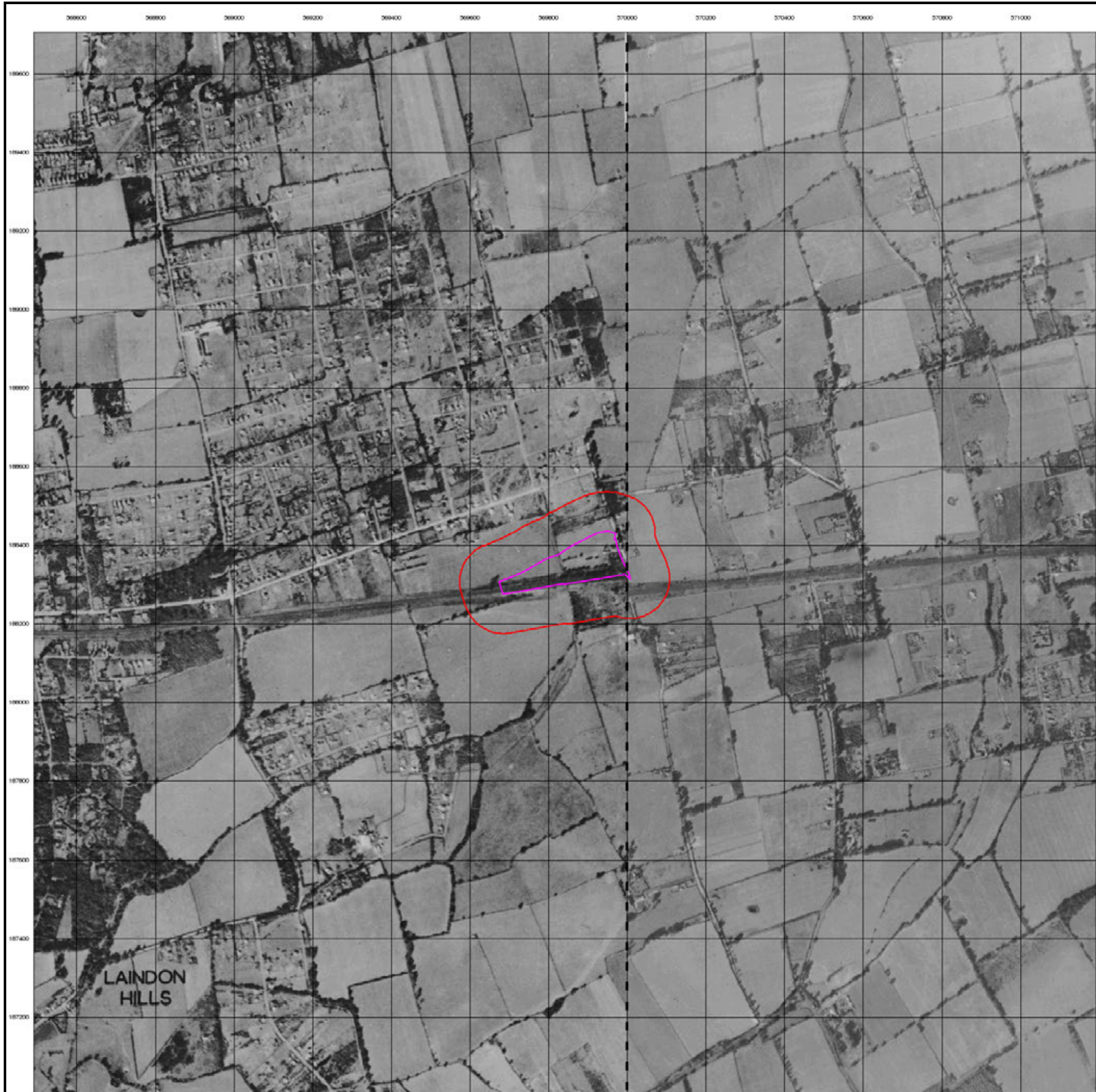
Order Number: 259013368_1_1
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National Grid Reference: 569850, 188340
Slice: A
Site Area (Ha): 2.48
Search Buffer (m): 1000

Site Details

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0 400 m

LAINDON
HILLS



TWEEDIE EVANS CONSULTING Historical Aerial Photography

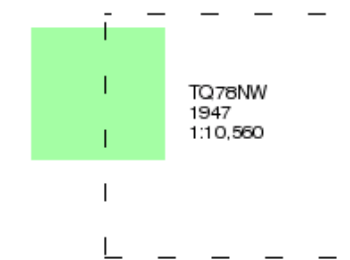
Published 1947

Source map scale - 1:10,560

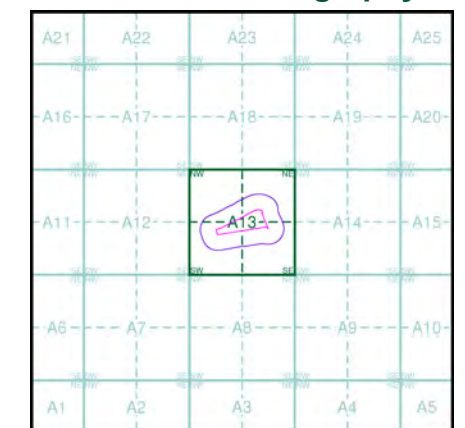
The Historical Aerial Photos were produced by the Ordnance Survey at a scale of 1:1,250 and 1:10,560 from Air Force photography. They were produced between 1944 and 1951 as an interim measure, pending preparation of conventional mapping, due to post war resource shortages. New security measures in the 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



Order Details

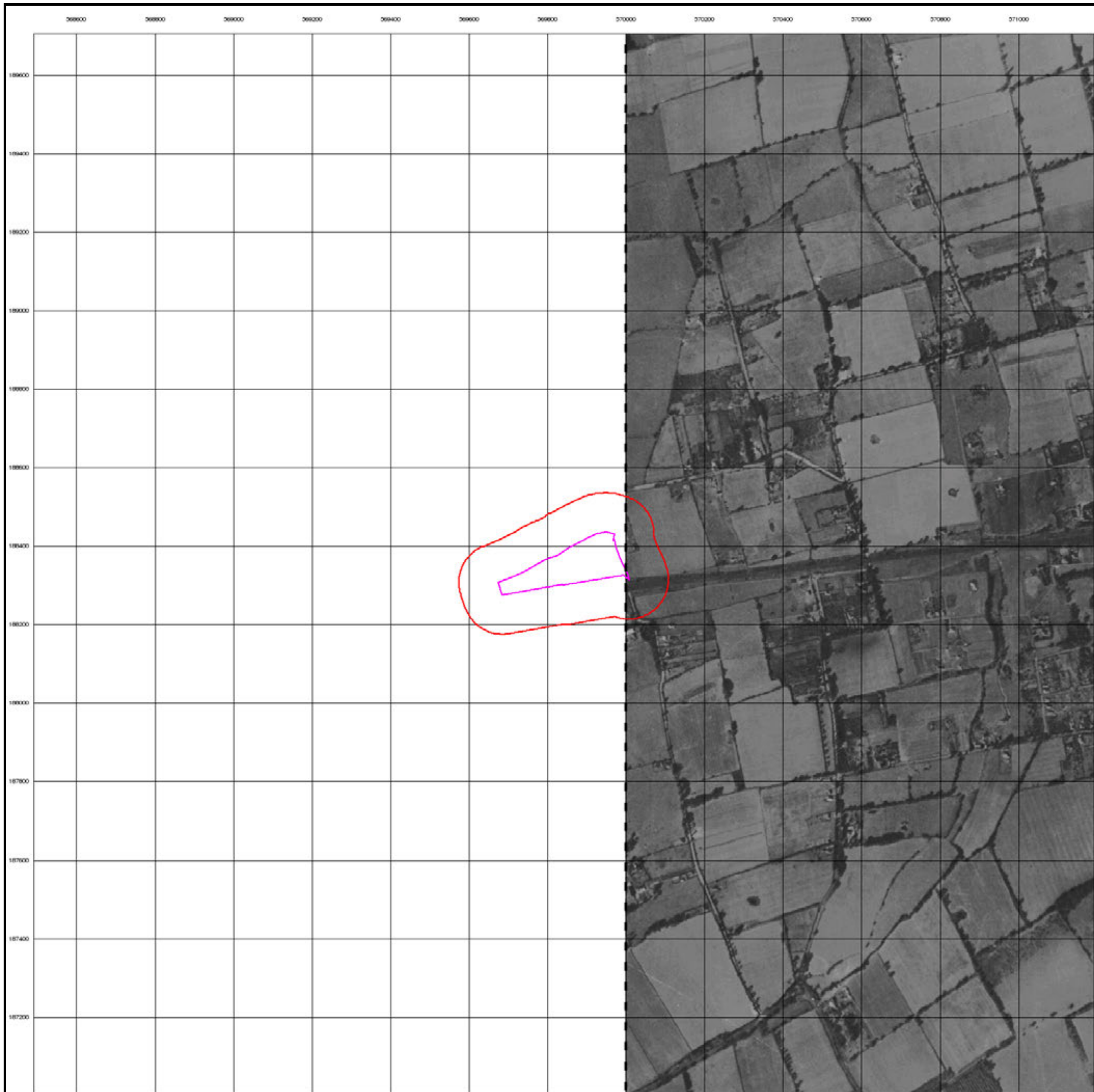
Order Number: 259013368_1_1
Customer Ref: 2009004
National Grid Reference: 569850, 188340
Slice: A
Site Area (Ha): 2.48
Search Buffer (m): 1000

Site Details

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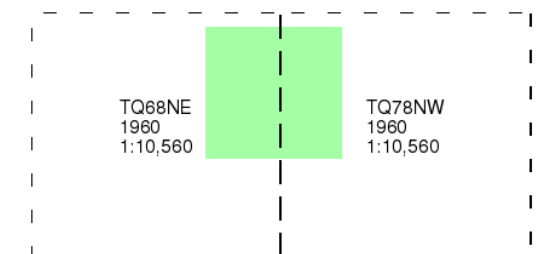
TWEEDIE EVANS CONSULTING Ordnance Survey Plan

Published 1960

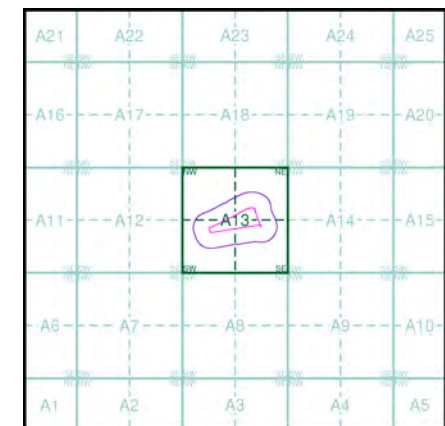
Source map scale - 1:10,000

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; these maps were used to update the 1:10,560 maps. The published date given therefore 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. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

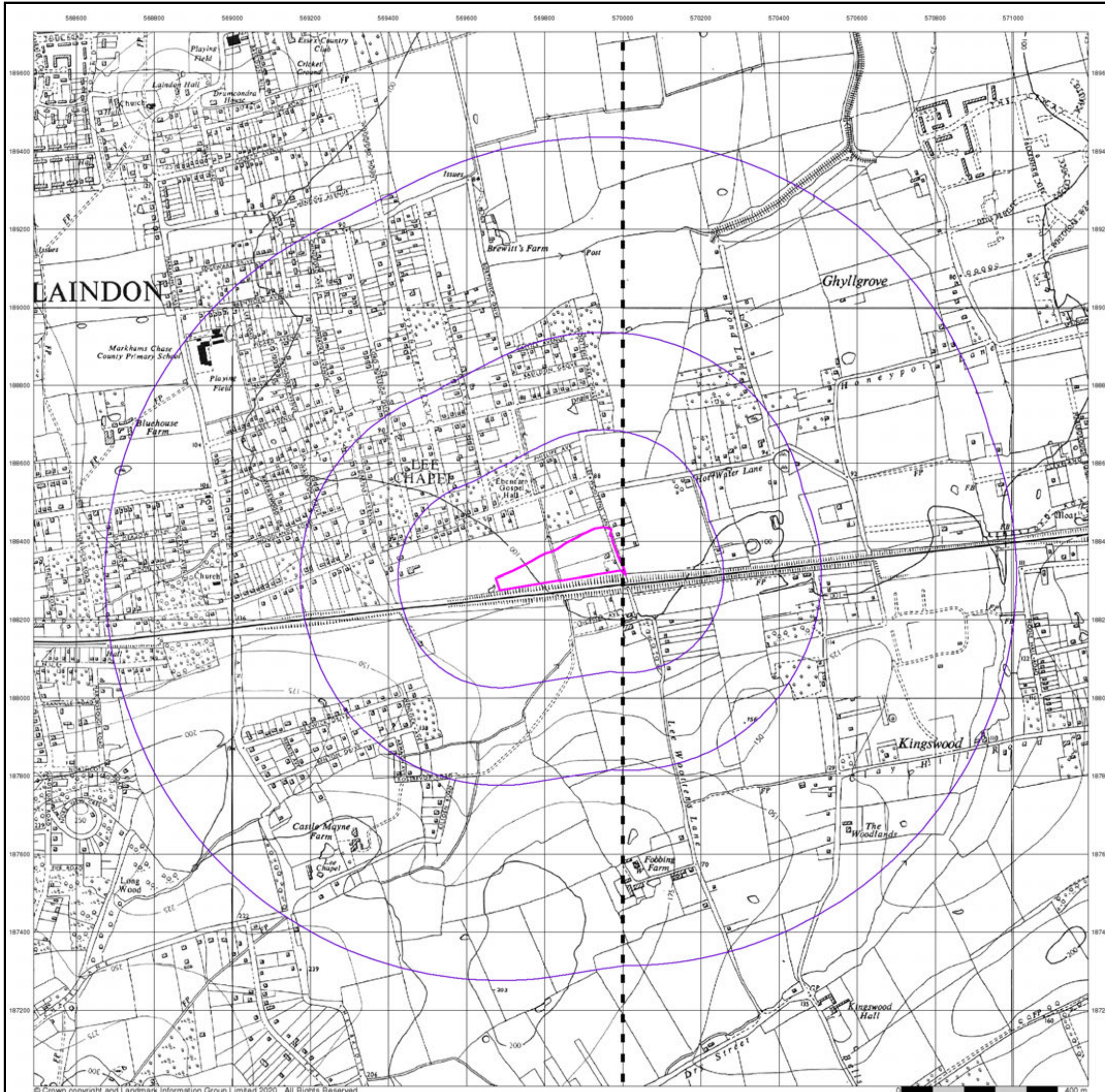
Order Number: 259013368_1_1
Customer Ref: 2009004
National Grid Reference: 569850, 188340
Slice: A
Site Area (Ha): 2.48
Search Buffer (m): 1000

Site Details

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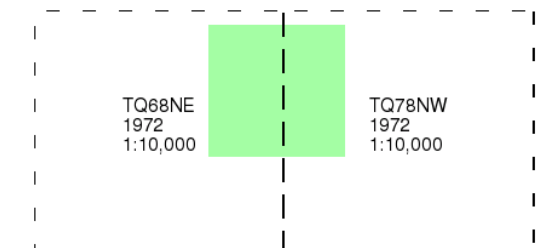
TWEEDIE EVANS CONSULTING Ordnance Survey Plan

Published 1972

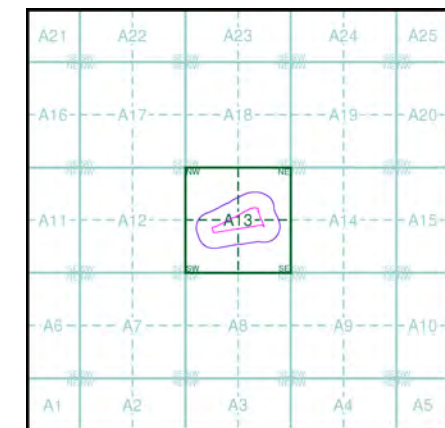
Source map scale - 1:10,000

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Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

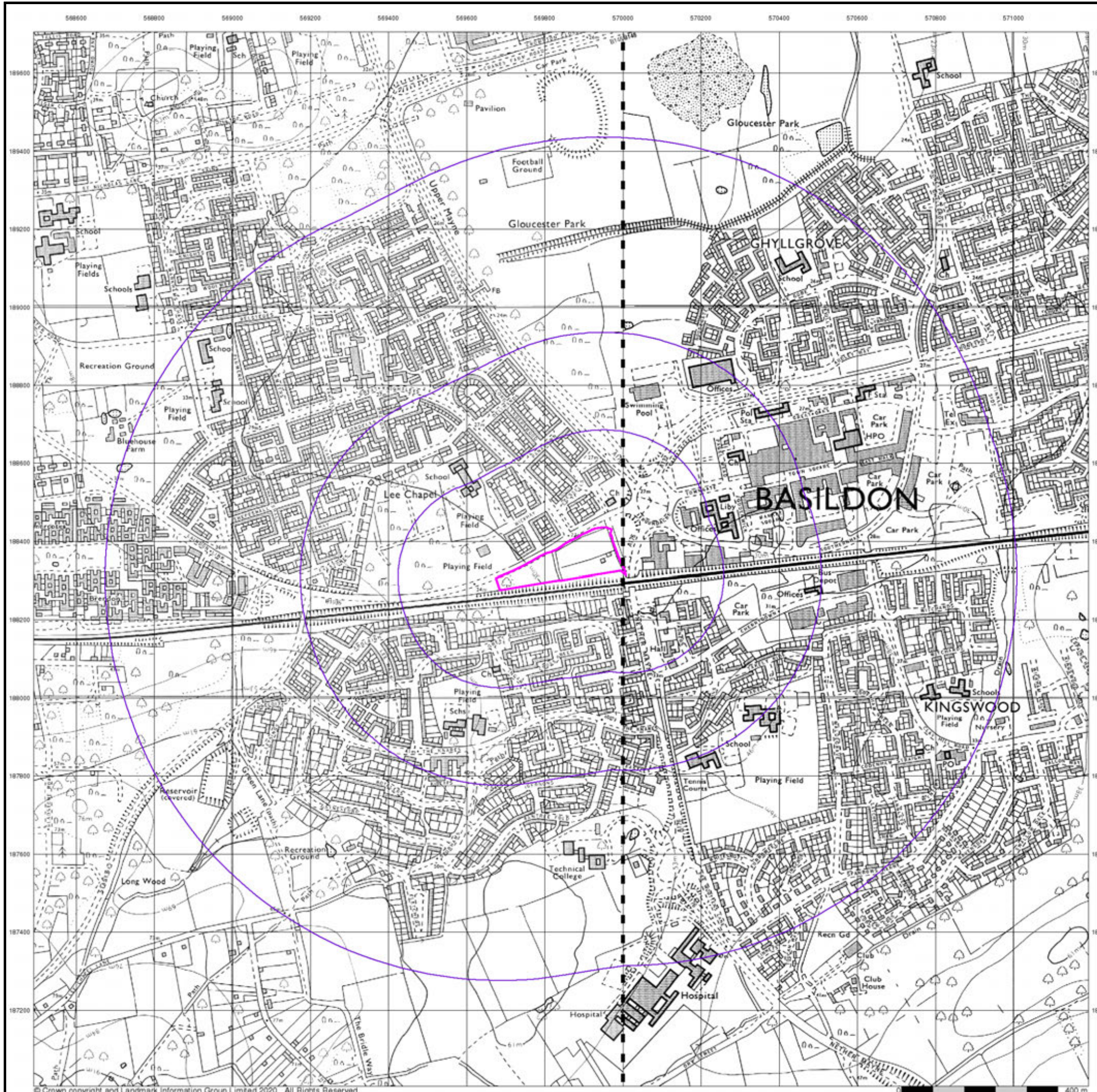
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Customer Ref: 2009004
National Grid Reference: 569850, 188340
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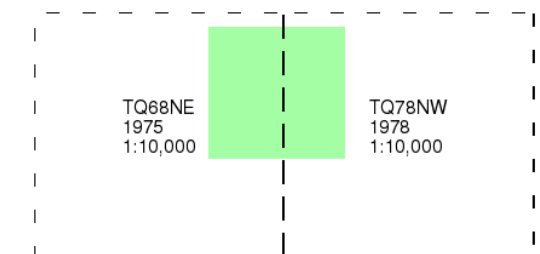
TWEEDIE EVANS CONSULTING Ordnance Survey Plan

Published 1975 - 1978

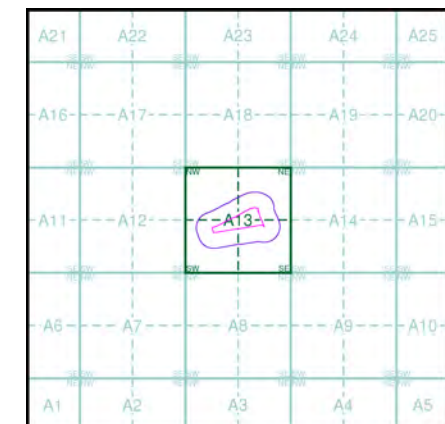
Source map scale - 1:10,000

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; these maps were used to update the 1:10,560 maps. The published date given therefore 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. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

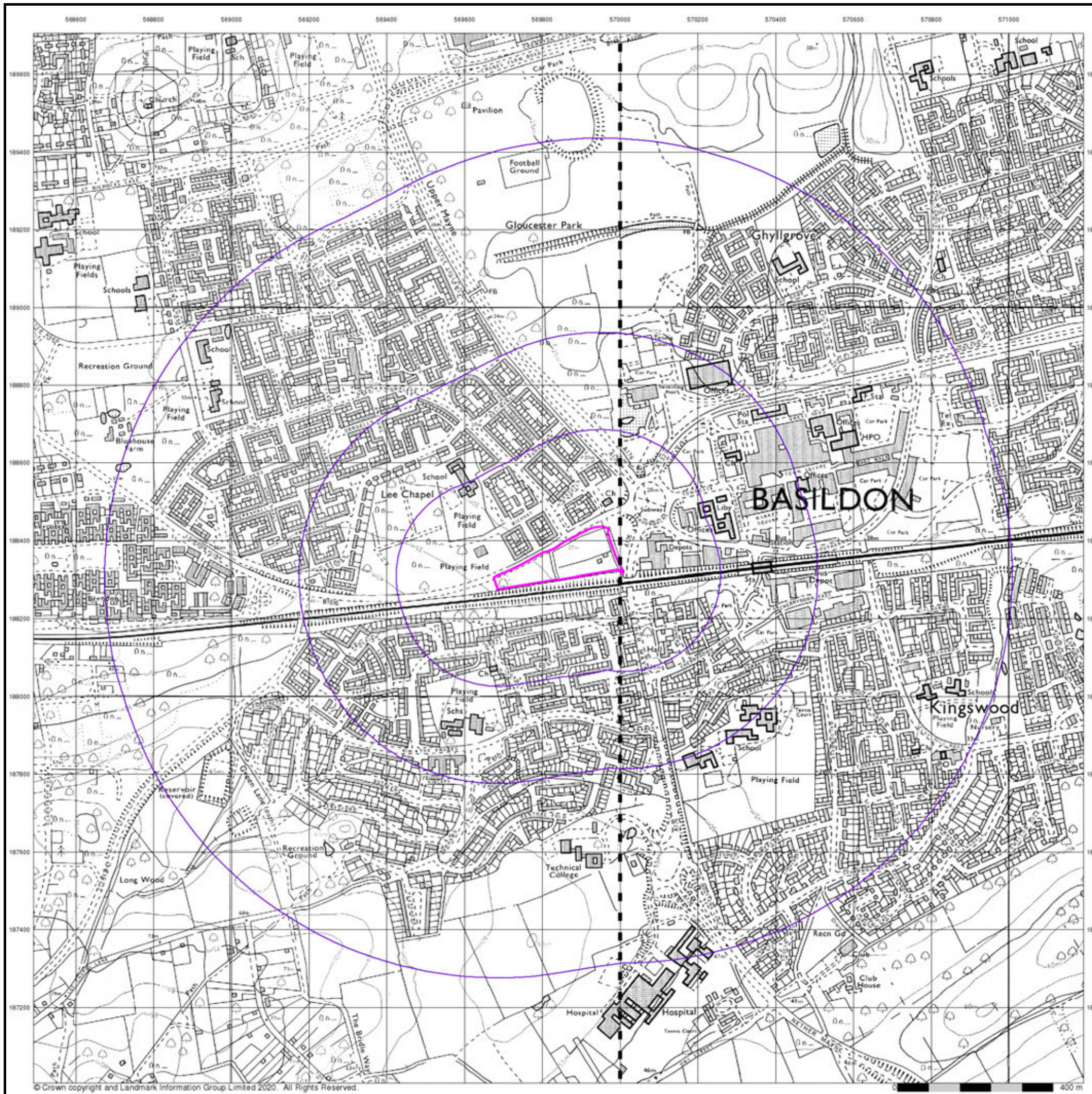
Order Number: 259013368_1_1
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Site Area (Ha): 2.48
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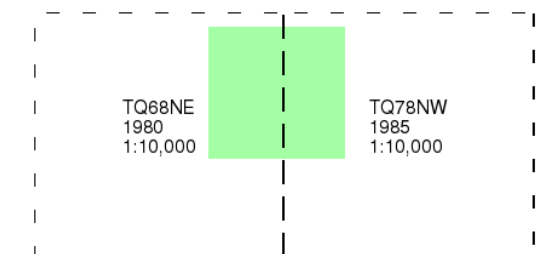
TWEEDIE EVANS CONSULTING Ordnance Survey Plan

Published 1980 - 1985

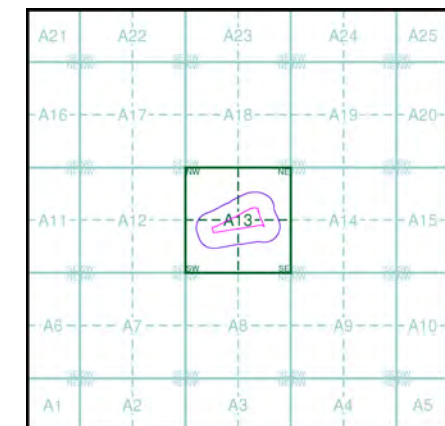
Source map scale - 1:10,000

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; these maps were used to update the 1:10,560 maps. The published date given therefore 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. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

Order Number: 259013368_1_1
 Customer Ref: 2009004
 National Grid Reference: 569850, 188340
 Slice: A
 Site Area (Ha): 2.48
 Search Buffer (m): 1000

Site Details

1, Hempstalls, BASILDON, SS15 5AA



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





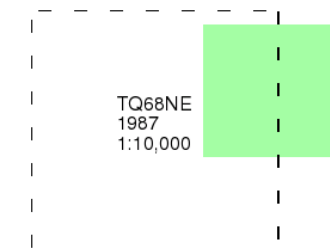
TWEEDIE EVANS CONSULTING Ordnance Survey Plan

Published 1987

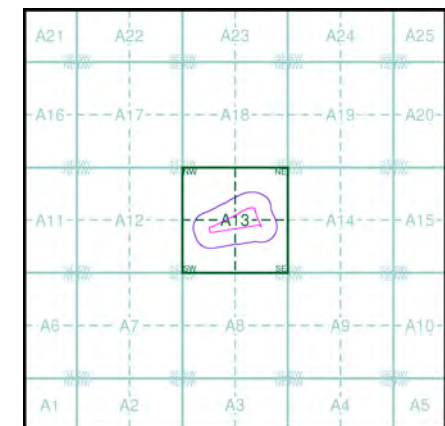
Source map scale - 1:10,000

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; these maps were used to update the 1:10,560 maps. The published date given therefore 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. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

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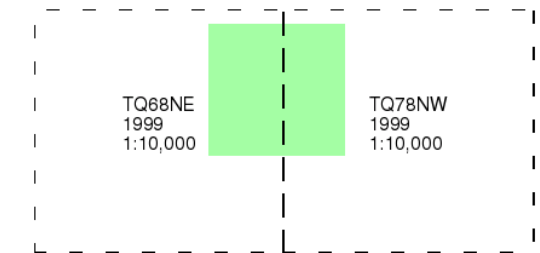
TWEEDIE EVANS CONSULTING
10k Raster Mapping

Published 1999

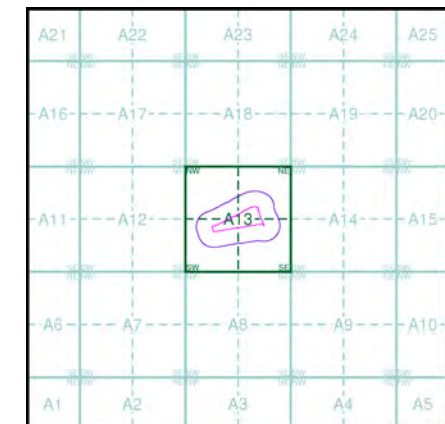
Source map scale - 1:10,000

The historical maps shown were produced from the Ordnance Survey's 1:10,000 colour raster mapping. These maps are derived from Landplan which replaced the old 1:10,000 maps originally published in 1970. The data is highly detailed showing buildings, fences and field boundaries as well as all roads, tracks and paths. Road names are also included together with the relevant road number and classification. Boundary information depiction includes county, unitary authority, district, civil parish and constituency.

Map Name(s) and Date(s)



Historical Map - Slice A



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