Brown 2 Green

Geotechnical and Geo-environmental Consultants

GEO-ENVIRONMENTAL AND GEOTECHNICAL DESK STUDY AND SITE INVESTIGATION REPORT

BARN AT DUCK END FARM
GREEN ROAD
LINDSELL
DUNMOW
CM6 3QH

Reference Number 3293/Rpt 1v1
July 2023

Prepared for

Duck End Farm Limited
Duck End Lane
Lindsell
Dunmow
CM6 3QM

By

Brown 2 Green Associates Ltd
Suite 1, Wenden Court
Station Road,
Wendens Ambo
Saffron Walden, Essex
CB11 4LB

Tel: 01799 542473
Web address: www.brown2green.co.uk

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Client Address	Duck End Lane Lindsell Dunmow CM6 3QM
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Reference Number	3293/Rpt 1v1
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Reviewed and Approved By	Philip Miles BSc, MSc, C Geol (Director)

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EXECUTIVE SUMMARY

This report describes the findings of a combined geotechnical and geo-environmental desk study and site investigation of two barns at Duck End Farm, Green Road, Lindsell, Dunmow, CM6 3QH. It is proposed to redevelop the site for residential usage.

At the time of the walk-over the site was a farmyard by 1876. The site walk-over identified sources of potential contamination.

The review of the historical maps identified that the site was developed as a farmyard. A backfill pond was noted. The review of the historical land use of the site identified sources of potential contamination.

The review of the industrial setting did not identify any sources of potential contamination.

A review of the environmental setting indicated the site to be underlain superficial deposits consisting of clay of the Lowestoft Formation. The solid geology is the London Clay Formation. The London Clay is classified as a non-productive aquifer. The superficial deposits are classified as a Secondary (Undifferentiated) aquifer. No surface water features were identified within the vicinity of the site. The environmental sensitivity of the site is classified as Low.

The conceptual model prepared for the site did identify potentially active pollution linkages between the historical land use, backfilled pond and above ground storage tank and the future use as residential.

The investigation consisted of the drilling of boreholes. During the drilling soil samples were obtained and submitted for chemical analysis.

The following conclusions were made:

Geoenvironmental

The Tier I Human Health Risk Assessment has identified concentrations of individual PAHs at levels above the generic assessment criteria with made ground that has been used to backfill a pond that was formally located on the site. As this part of the site will become the rear garden of the proposed house, pollution pathways will be created. It is therefore considered that the concentrations will pose an unacceptable level of risk to human health of future site users. The concentrations will not pose an unacceptable level of risk to neighbours or construction workers.

The Tier I Controlled Water Risk Assessment has determined that there are no unacceptable concentrations of potential contaminants within the underlying soils that would pose a potential risk to controlled waters.

The risk assessment for bio-genic ground gas concluded that there is no risk from ground gas.

The risk assessment in respect to the future planting and towards sensitive ecological receptors identified that the determinants at the site would not pose a potential risk.

The risk assessment in respect to water supply infrastructure identified that the determinants at the site would not pose a potential risk to the integrity of PE or PVC pipework.

Recommendations for remediation have been made.

Geotechnical

It is considered that conventional strip foundations maybe used constructed at least 150mm in to the underlying firm clay with an allowable bearing capacity of 100kN/m² at a minimum depth of 1m bgl. Settlement is estimated to be less than 25mm.

The clay has a moderate has a moderate volume change potential.

It is recommended that suspended floor slabs are used.

Based on this it is considered that a CBR of 2% is likely to be required.

1 INTRODUCTION

1.1 Background

Brown 2 Green Associates Ltd have been commissioned by Duck End Farm Limited to undertake a Phase I Geo-environmental Desk Study and a combined Geotechnical and Phase 2 Geo-environmental Site Investigation of barns at Duck End Farm, Green Road, Lindsell, Dunmow, CM6 3QH. The site is located at National Grid Reference 564060, 228880. The site location is presented in Figure 1.

1.2 Proposed Development

It is proposed to redevelop the site for residential usage consisting of a detached house with a private garden. The proposed development is shown on drawing number 5757/03 prepared by Andrew Stevenson Associates. The proposed development layout is presented in Appendix II.

1.3 Objectives

The objectives of the geo-environmental site investigation are to provide an environmental risk assessment to inform about potential re-development of the site, address the requirements of the National Planning Policy Framework[1] and Planning Practice Guidance. These objectives are achieved by:

- Undertaking a site inspection to identify any current areas of potential environmental concern;
- Reviewing historical plans, geology, hydrogeology, site sensitivity, flood-plain issues, mining records and any local authority information available in order to complete a Desk Study in line with Environment Agency Contaminated Land Risk Management.
- Investigation of any identified pollution linkages to determine any potential environmental risks, liabilities and development constraints associated with the site in relation to the future use of the site and in relation to off-site receptors; and,
- Provide a factual and interpretive report and recommendations on any potential development issues.

The information obtained in this study has been used to develop an initial Conceptual Site Model (CSM) and outline potential risks from contamination at the site. This CSM examines potential Source-Pathway-Receptor contaminant linkages in relation to identified or potential contamination issues at the site and vicinity, incorporating them into a Preliminary Risk Assessment. This report has been completed in accordance with Environment Agency Contaminated Land Risk Management.

The Preliminary Risk Assessment seeks to establish firstly whether unacceptable risk as defined in Part 2A of the Environmental Protection Act 1990 is present and secondly whether a possibility of harm to controlled waters, human health or property is present and further investigation is therefore needed to better inform about risk assessment.

The objective of the geotechnical site investigation is to assessment the geological conditions beneath the site to provide geotechnical recommendations in relation to foundation and

[1] National Planning Policy Framework, Department for Communities and Local Government, July 2021.

infrastructure

1.4 Sources of Information

Background information relating to the site was acquired and referenced from the following sources:

- Historical mapping (Appendix IV);
- Environmental Database Search. All relevant data is summarised in the text of the report. A full copy is presented in Appendix V;
- On-line planning records held by Uttlesford District Council;
- British Geological Survey website (www.bgs.ac.uk).

A site walkover was carried out by a Geo-environmental Consultant from Brown 2 Green Associates on the 24th May 2023.

2 SITE LOCATION AND DESCRIPTION

2.1 Site Location and Surrounding Area

The site is in a rural area at the eastern end of Duck End Farm Lane. The land uses immediately adjacent to the site are summarised below:

Direction	Land Use
North	Duck End Farm Lane and residential
East	Duck End Farm (residential)
South	Agricultural
West	Agricultural

The topography of the surrounding area slopes down towards Daisyley Brook, located to the south-east.

The site location is presented in Figure 1.

2.2 Site Descriptions and Observations

The site layout is presented in Figure 2. A photographic record of the site is included in Appendix III.

The subject parcel of land is irregular in shape and covers 0.33 hectares. Access to the site is from Duck End Farm Lane, located along the northern end of the site.

At the time of the site walk-over the site was being used as a farmyard. The site contains two interconnected barns. The larger barn that occupies the majority of the northern part of the site is constructed of corrugated metal sheeting, with a roof of corrugated cement sheeting suspected to contain asbestos. The floor is constructed of concrete. The barn is used for the stored or a tractor, a telehandler, domestic items, wood, building materials, a disused tank that would formally have been used for the storage of oil/diesel and general scrap metal and other dry waste. Adjacent to the eastern external wall there is an empty above ground storage tank with a dispensing pump and a grain drying unit. The tank is constructed of metal and sited on stanchions. The tank would have been used for the storage of diesel to refuel farm machinery. The ground beneath the tank is unpaved. No staining or evidence of fuel spillage was noted.

The second barn is located in the north-west corner of the site. This barn is constructed of brick with a corrugated cement roof suspected to contain asbestos. At the time of the site visit, this barn was empty.

The ground surrounding the barns is unpaved, except along the norther end of the site, where the hardstanding provides access to the barns. In the open area south of the barns, there is a stockpile of wood chippings that is partly overgrown.

The topography of the site slopes down towards the east.

2.3 Storage of Chemicals and Hazardous Substances

Above Ground Storage Tanks (ASTs)

Two above ground storage tanks (ASTs) were observed at the site. These being a decommissioned tank that was being stored in the large barn and an empty tank that was located adjacent to the

western side of the large barn.

Underground Storage Tanks (USTs)

No underground storage tanks (USTs) or evidence of USTs were observed at the site.

Other Chemical Storage

No significant storage of chemicals was noted at the time of the walkover.

Polychlorinated Biphenyls

No equipment that may potentially contain polychlorinated biphenyls (PCBs) was observed at the site.

Asbestos Containing Materials

During the inspection materials suspected to contain asbestos were noted within the construction of the barns. No fragments were noted across the ground surface.

Site Drainage

No foul water or trade effluent is generated by the site.

No oil/water interceptors were identified.

No soakaways were identified.

Rainwater will either infiltrate into the ground or is lost through surface water run-off or evapotranspiration.

2.4 Visual and Olfactory Evidence of Contamination

Minor staining from oil was observed on the floor of the large barn. No specific visual or olfactory evidence of contamination was noted.

2.5 Potential Sources of Contamination

During the site walk-over the following plausible potential sources of contamination were identified:

- Use of the site for agricultural and storage of machinery.
- Above ground storage tanks.

3 SITE HISTORY

3.1 Historical Maps

The maps at scales of 1: 2,500, 1:10,000 and 1:10,560 were reviewed to determine the history of the site. A summary of the site history is presented below. The historical maps are included in Appendix IV.

Date	Site	Surrounding Area
1876 1:2,500	A barn is in the centre of the site. A pond is located adjacent to the western boundary.	The surrounding area is agricultural. Duck End Farm is located to the north-east. A road/track is present along the northern boundary
1897 1:2,500	Additional buildings have been constructed on the northern end of the site.	No relevant changes noted.
1921 1:2,500	One of the buildings along the northern boundary has been removed. Two small rectangles, possible buildings or pens are located on the southeastern part of the site.	No relevant changes noted.
1951 1:2,500	Most of the buildings shown on the site have been removed and replaced with the existing building layout.	No relevant changes noted.
1977 1:2,500	As 1951.	No relevant changes noted.
1981-1983 1:10,000	As 1951.	No relevant changes noted.
1993 1:2,500	As 1951.	No relevant changes noted.
1999 1:10,000	As 1951.	No relevant changes noted.

3.2 Listed Buildings and Historical Sites

No world heritage site, scheduled monuments or registered battlefields are present within a 250m radius the site.

The nearest listed buildings are a barn and Duck End Farmhouse is which is Grade II listed and located 120m to the north and north-west.

3.3 Local Authority – Planning

A review of on-line planning records from Uttlesford District Council was completed on 11th July 2023.

No additional relevant information was identified.

3.4 Other Sources

A review has been made of satellite photographs contained on Google Earth. The photograph dated 2000 shows the general layout to be the same as observed during the site walkover. The north-

western corner of the site is covered with trees. A number of stockpiles are present on the southern end of the site. The general layout and use of the site remained unchanged after 2000.

3.5 Potential Sources of Contamination

During the review of the historical land use of the site and surrounding area, the following potential sources of contamination were identified where it is considered that there is a plausible pollution pathway:

- Historical use of the site for farming activities.
- Backfilled pond located in north-west corner.
- General quality of made ground and stockpiles.

4 INDUSTRIAL SETTING

4.1 Contemporary Trade Directory Entries

There are no contemporary trade directory entries for the site or within 250m radius of the site.

Within 500m radius of the site there are no entries for filling stations.

4.2 Landfill Sites and Waste Disposal Facilities

There are no historical or operational landfill sites or waste management facilities within 250m radius of the site.

4.3 Environmental Permits, Incidents and Registers

The following information is a summary of the data contained Environmental Database presented in Appendix V.

	On Site	0 – 250m	Details of Nearest	Potential Risk to Site
Authorised industrial processes (IPC/IPPC/LAPPC)	0	0	-	No
Radioactive Substances Authorisations	0	0	-	No
Licensed Discharge Consents	0	1	137m north-west and for the discharge of treated sewage.	No
Consents issued under the Planning (Hazardous Substances) Act 1990	0	0	-	No
Control of Major Accident Hazard (COMAH/NIHHS/Explosive) sites	0	0	-	No
Pollution Incidents	0	0	-	No
Contaminated Land Register Entries and Notices (Part 2A EPA 1990)	0	0	-	No

4.4 Ground Workings, Mining and Natural Cavities

There are no BGS recorded mineral site on or within 250m radius of the subject site.

The database states that the site is not located in a Cheshire Salt Brine Subsidence Compensation Board District.

The database states that the site is not located in an area affected by coal mining.

The data base indicates that the site is not located within an area where there is the potential for mining instability.

The database states that there are no non-coal mining areas within 1000m of the site.

5 ENVIRONMENTAL SETTING

5.1 Geology and Hydrogeology

The British Geological Survey mapping indicates that the site is underlain by the following geology:

Drift/Solid	Geological Unit	Description
Drift/Superficial	Lowestoft Formation	Diamicton
Solid	London Clay Formation	Blue-grey clay

Geological logs held by the British Geological Survey were reviewed. The nearest is located 110m to the north. The log indicates the area is underlain by the following geological conditions:

Unit	Description	Thickness (m)	Depth to base (m)
	Soil and made ground	0.4	0.4
Lowestoft Formation	Clay, silty grey and mottled yellow brown, chalky from 2.1m becoming dark greyish brown from about 5.0m.	9.7	10.1
	Chalk, rafted mass of very soft pug chalk, then brown soft clay	2.6	12.7
Kesgrave Catchment Sub-group	Sands, medium to fine with traces of coarse subangular gravel	4.5+	17.2

Groundwater was recorded at 17.2m bgl.

The Superficial Deposits are classified as a Secondary (Undifferentiated) Aquifer. The solid geology is classified as an unproductive aquifer.

The combined groundwater vulnerability for the site is classified as medium with an intermediate pollutant speed.

There are no licenced groundwater abstraction points within 1km radius of the site. The site is in a Zone III Source Protection Zones.

5.2 Geochemistry

The British Geological Survey estimates of the geochemistry of the soils beneath the site are:

Determinants	Soil Type	Concentration (mg/kg)
Arsenic	Rural	<15
Cadmium		<1.8
Chromium		60 – 90
Nickel		15 – 30
Lead		<100

5.3 Hydrology

The Ordnance Survey Water Network Lines indicates the nearest surface water feature is the Daisyley Brook located 197m to the south-east.

There are no licensed surface water abstraction points within 500m radius of the site.

The database indicates that the site does not lie in a fluvial or tidal floodplain. Flood risk rating from flooding from rivers and the sea (RoFRaS) is Very Low.

5.4 Ecologically Sensitive Areas

There are no ecologically sensitive sites within 250m radius of the site.

5.5 Radon

The site is located in an area where less than 1% of homes are above the Action Levels and Radon protective measures are not necessary in the construction of new dwellings or extensions.

5.6 Natural Hazards

BGS GeoSure Data presented within the Environmental Database presented in Appendix V identifies the following ground conditions:

Hazard	Designation	Hazard
Potential for Shrinking or Swelling of Clays	Low	Ground conditions predominantly medium plasticity
Potential for Landslide Ground	Very Low	Slope instability problems are unlikely to be present
Potential for Ground Dissolution	Negligible	Soluble rocks are present, but unlikely to cause problems except under exceptional conditions
Potential for Compressible Ground	Negligible	No indicators for compressible ground identified
Collapsible Ground	Very low	Deposits with potential to collapse when loaded and saturated are unlikely to be present.
Potential for Running Sands	Very Low	Very low potential for running sand problems if water table rises or if sandy strata are exposed to water.

6 PREVIOUS REPORT

No previous site investigation reports were identified or made available.

7 INITIAL CONCEPTUAL MODEL

Brown 2 Green Associates Ltd has developed a conceptual model to identify potential sources, migration pathways and receptors within the study area. Assuming there is an active pollution pathway linkage between the source and receptor an assessment has been made of the level of risk. The level of risk is a consideration of both:

- the likelihood of an event (probability) [takes into account both the presence of the hazard and receptor and the integrity of the pathway]; and
- the severity of the potential consequence [takes into account both the potential severity of the hazard and the sensitivity of the receptor].

The classifications of the likelihood of an event occurring based on C552 CIRIA, 2001[2] are presented below:

Likelihood		Definition
High Likelihood	> 90% of hazard receptor linkage	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor that there is harm or contamination
Likely	45-90% of hazard receptor linkage	There is a pollution linkage and all the elements are present and in the right place which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term
Low likelihood	10-50% of hazard receptor linkage	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place, and is less likely in the shorter term.
Unlikely	10% of hazard receptor linkage	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long term.

The classification of the severity of an event is presented below:

Severity	Category	Definition	Examples
Severe: It is likely that the hazard source could cause harm to a designated receptor and harm would be significant.	Humans	Short term (acute) risk to human health likely to result in "significant harm" as defined by the Environment Protection Act 1990, Part IIA.	High concentrations of cyanide on the surface of an informal recreation area.
	Controlled Water	Short term risk of pollution of sensitive water resource.	Major spillage of contaminants from site into controlled water.
	Property	Catastrophic damage to building or property	Explosion causing building to collapse.
	Ecological systems	A short term risk to a particular ecosystem, or organism forming part of such an ecosystem.	Loss of ecosystem.
Medium: It is possible that the hazard source could cause harm to a designated receptor, but it is unlikely that the harm would be significant	Humans	Chronic damage to human health ("significant harm" as defined in the DETR, 2000).	Concentrations of a contaminant from site exceeds the generic, or site specific assessment criteria
	Controlled Water	Pollution of sensitive water resources.	Leaching of contaminants from a site to a Principal Aquifer.
	Ecological systems	A significant change in a particular ecosystem, or organism forming part of such an ecosystem.	Death of a species within a designated nature reserve.

[2] Contaminated land risk assessment. A guide to good practice (C552), D J Rudland, R M Lancefield and P N Mayell.

Severity	Category	Definition	Examples
Mild: It is possible that the hazard source could cause significant harm to a designated receptor, however it is likely to be mild	Controlled Waters	Pollution of non-sensitive water resource.	Pollution of non-classified groundwater
	Property	Significant damage to buildings/structures and crops ("significant harm" as defined in the DETR, 2000). Damage to sensitive buildings/structures or the environment.	Damage to building rendering it unsafe to occupy (e.g. foundation damage resulting in instability).
Minor: The potential hazard source cannot cause significant harm to the receptor.	Financial or project	Harm, although not necessarily significant harm, which may result in a financial loss, or an expenditure to resolve.	
	Humans	Non-permanent health effects to human health (easily prevented by means such as Personal Protective Clothing, etc).	The presence of contaminants at such concentrations that protective equipment is required during site works.
	Property	Easily repairable effects of damage to buildings/structures	The loss of plants in landscaping scheme. Discolouration of concrete.

The comparison of Likelihood against Severity is presented below:

		Severity			
		Severe	**Medium**	**Mild**	**Minor**
Likelihood	**High Likelihood**	**Very High Risk**	**High Risk**	**Moderate Risk**	**Moderate / Low Risk**
	Likely	**High Risk**	**Moderate Risk**	**Moderate / Low Risk**	**Low Risk**
	Low Likelihood	**Moderate Risk**	**Moderate / Low Risk**	**Low Risk**	**Very Low Risk**
	Unlikely	**Moderate / Low Risk**	**Low Risk**	**Very Low Risk**	**Very Low Risk**

The potential consequence of risk classifications is presented below:

Very High Risks	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required.
High Risks	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short term and are likely over the longer term.
Moderate Risks	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer term.
Moderate / Low Risks	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be medium to mild and professional judgement is required. Some remediation works may be required in the long term where high sensitivity receptors are involved.
Low Risks	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very Low Risks	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.

7.1 Potential Sources of Contamination

On-site Potential Sources

Based on the findings of the site walk-over and the desk study information review the following potential on-site sources of contaminants that may plausibly impact the site were identified:

- General quality of the made ground and stockpiles.
- Historical use of the site for agricultural activities. Barn used for the storage of machinery and grain storage. No agrichemical storage noted.
- Storage and use of fuel in above ground storage tank.
- Backfilled pond.

Off-site Potential Sources

Based on the findings of the site walk-over and the desk study information review no potentially significant off-site sources of ground contamination have been identified within a 250m radius of the subject site that may plausibly result in impact to the site.

7.2 Potential Pathways

Plausible pathways identified for each contaminant at are presented in the initial conceptual model detailed overleaf.

7.3 Potential Receptors

Brown 2 Green Associates Ltd has identified the following possible receptors:

- Human health - future users of the site (residential with private gardens).
- Human Health – Neighbouring properties.
- Human health - construction workers.
- Controlled water (groundwater and surface water).
- Buildings and construction materials (concrete).
- Water supply pipework.
- Listed buildings and historical sites.

7.4 Discussion of Potential Pollutant Linkages

Potential pollution linkages identified are presented in the initial conceptual model detailed overleaf.

Initial Conceptual Model and Risk Assessment

Potential Contaminant	***Potential migration pathway***	***Potential Receptors***	***Likelihood***	***Severity***	***Risk Class-ification***	***Comments*** ***Active/Inactive***
On-site Sources						
Made ground and stockpiles						
Metals (As, Cd, Cr, Pb, Hg, Se, Ni, V)	Ingestion of contaminated soil and dust by direct contact and soil attached to home grown vegetables. Inhalation of dust (indoor and outdoor).	Future site users and neighbours	Likely	Medium	Moderate	Potentially active in areas of soft landscaping and private gardens. Further assessment required.
	Ingestion of contaminated soils by direct. Inhalation of dust (indoor and outdoor).	Construction workers	Likely	Minor	Low	Potentially active but short term exposure. General site practices and site PPE (gloves) will reduce exposure.
Metals (Cu, Ni, Zn)	Uptake by plants	Planting and soft landscape areas	Likely	Minor	Low	Potentially active in areas to be developed as soft landscaping and gardens. Further assessment required.
PAHs	Ingestion of contaminated soil and dust by direct contact and soil attached to home grown vegetables. Inhalation of dust (indoor and outdoor).	Future site users and neighbours	Likely	Medium	Moderate	Potentially active in areas of soft landscaping and private gardens. Further assessment required.
	Ingestion of contaminated soil and dust by direct contact. Inhalation of dust (indoor and outdoor).	Construction workers	Likely	Minor	Low	Potentially active but short term exposure. General site practices and site PPE (gloves) will reduce exposure.
	Downward and lateral migration.	Groundwater Surface Water	Low	Minor	Very low	Inactive – presence of argillaceous substrate will provide protection and prevent migration.

Potential Contaminant	***Potential migration pathway***	***Potential Receptors***	***Likelihood***	***Severity***	***Risk Class-ification***	***Comments*** ***Active/Inactive***
Asbestos	Inhalation of fibres.	Future site users and construction workers	Likely	Severe	Moderate	Potentially active.
Ground gas	Through soil.	Future users and buildings	Unlikely	Medium	Low	Potentially active should made ground be identified at thickness greater than 2m and with high organic matter content to act as source.
Historical use of site for farming, including fuel storage						
Organic compounds including fuels (diesel and oil)	Ingestion of contaminated soil and dust by direct contact and soil attached to home grown vegetables. Inhalation of dust (indoor and outdoor). Contact with contaminated soils.	Future site users	Likely	Medium	Moderate	Potentially active in areas of soft landscaping and private gardens. Further assessment required.
	Ingestion of contaminated soils by direct contact. Inhalation of dust (indoor and outdoor). Contact with contaminated soils.	Construction workers	Likely	Minor	Low	Potentially active but short term exposure. General site practices and site PPE (gloves) will reduce exposure.
	Downward and lateral migration.	Groundwater Surface Water	Low	Minor	Very low	Inactive – presence of argillaceous substrate will provide protection and prevent migration.
	Contact with contaminated soils.	Water supply infrastructure	Likely	Medium	Moderate	Potentially active.

8 SITE INVESTIGATION

8.1 Exploratory Fieldwork

Exploratory fieldwork was completed on 24th May 2023. The work consisted of the drilling of six boreholes (WS 1 to WS6) to a maximum depth of 5.5m below surface. During the drilling of selected boreholes SPT/CPT were undertaken at 1m intervals to a depth of 5m and then at 1.5m intervals. Disturbed samples were also obtained.

The sample locations were determined to provide a general assessment of the ground quality beneath the site and the potential source areas listed in the table below. The sampling locations are illustrated in Figure 3

Sample Location	Rational/Potential Source Area
WS1	Backfilled pond
WS2, WS3, WS4	General quality of made ground in proposed garden
WS5	Above ground storage tank
WS6	Assessment of sub-base beneath existing barn

Soil samples destined for chemical testing were collected in laboratory prepared jars. Samples for organic analysis were placed in amber glass jars, samples for volatile analysis in vials with septum's and samples for inorganic analysis in plastic tubs. During the site works recovered soils were geologically logged by an experienced Geo-environmental Engineer. The geological logs are presented in Appendix VI.

8.2 Geotechnical Testing

In-Situ Standard Penetration Testing (SPT)

In-situ geotechnical testing was carried out in all exploratory hole locations to provide information on the geotechnical properties of the soils. The testing was conducted using the Split-Spoon Penetration Test.

Laboratory Testing

Selected samples were submitted to Soil Property Testing where the following geotechnical tests were undertaken:

- Atterburg Limits Determinations;
- Natural moisture

8.3 Chemical Analysis

The soil samples were submitted to Eurofins/Chemtest Ltd of Newmarket, Suffolk. The chemical analysis was carried out under UKAS/MCERTS accreditation protocols.

The chemical analysis was carried out in accordance with the findings of the Desk Study and the observations made during the site works. The chemical testing programme included.

- Metals Suite (As, Cd, Cr, Cu, Pb, Hg, Ni, Se, Zn, V);
- Speciated PAH (USEPA 16);

- TPH – CWG;
- BTEX compounds and MTBE
- Total Cyanide;
- pH;
- Soluble Sulphate;
- Soil Organic Matter and
- Asbestos fibres

9 RESULTS

9.1 Summary of Site Investigation Observations

Ground Conditions

The geological logs are presented in Appendix VI.

Top Soil/Disturbed Ground/Made Ground

The boreholes indicate that the site outside of the footprint of the existing barns is underlain by up to 1.1m of top soil/disturbed natural soil or made ground. In WS1, 0.2m of top soil was recorded, which was underlain by 1.0m of made ground consisting of laminated slightly silty, slightly sandy, slightly gravelly clay with occasional fragments of brick. This is suspected to be soil that has been used to backfill the former pond.

In WS2 a 0.05m thick layer of ash/burnt wood with metal and plastic was identified within the made/disturbed ground. The disturbed ground consists of dark brown, silty, slightly sandy and slightly gravelly clay with gravel of flint and rare brick fragments.

Within WS3, WS4, the made ground consist of top soil over disturbed natural soil with rare brick fragments.

In WS5 only 0.1m of made ground was identified consist of a dark brown slightly silty, slightly sandy, silty gravely clay with occasional ash fragments.

In WS6 located within the footprint of the barn, the concrete floor slab is underlain by 0.1m of yellow brown sand sub-base over disturbed natural soil.

Natural Soil

The made ground is underlain by brown with mottled orange brown and brown and blue grey mottled, slightly silty, slightly sandy slightly gravelly clay. The gravels being fine to coarse and occasional cobbles of chalk with occasional flint., fine to coarse sand to the depth of the boreholes.

Soil Density

The density of the underlying soils has been assessed using SPTs undertaken within window sampler boreholes. This shows the natural soil to be soft to stiff.

Visual and Olfactory Evidence of Contamination

No visual or olfactory evidence of contamination was identified.

Groundwater Conditions

During the drilling groundwater all boreholes were dry.

It should be noted that groundwater levels can fluctuate seasonally and therefore, may be encountered at higher or lower elevations than those recorded in this site investigation.

9.2 Geotechnical Laboratory Results

The geotechnical testing of the samples was undertaken by Soil Property Testing Ltd under UKAS accreditation. The test certificates are included in Appendix VII.

9.3 Chemical Laboratory Results

The chemical analysis of the soil samples was undertaken by Eurofins/Chemtest Ltd of Newmarket under MCERT and UKAS accreditation. The test certificates are included in Appendix VIII.

10 GEOTECHNICAL ASSESSMENT

10.1 Proposed Development

It is understood that the proposed development will comprise residential usage consisting of a detached house with a private garden. Details of the proposed loadings are not known and therefore a line loading of 75kN/m has been assumed for preliminary assessment purposes only.

10.2 Ground Conditions

The ground conditions consist of between 0.1m and 1.1m of Made Ground soft to firm becoming stiff with depth gravelly clay.

Groundwater was not encountered.

10.3 Site Preparation

The site should be cleared and any vegetation below areas of proposed development stripped in accordance with Series 200 of the Specification for Highway Works. This should include:

- Roots present below the footprint of proposed structures and infrastructure should be grubbed out and the resulting void infilled with suitable compacted engineered fill;
- Redundant services should be sealed off and grubbed out and replaced with suitable compacted engineered fill; and,
- Buried structures and old foundations should be excavated from below the proposed development foot print with the resulting void backfilled.

10.4 Foundations

It is considered that conventional strip foundations maybe used constructed at least 150mm into the underlying firm clay with an allowable bearing capacity of 100kN/m² at a minimum depth of 1m bgl. Settlement is estimated to be less than 25mm.

Final foundation depths should take account of the presence of existing and proposed trees with foundations deepened locally in accordance with the requirements of NHBC Standards for a clay of moderate volume change potential.

10.5 Ground Floor Slabs

It is recommended that suspended floor slabs are used.

10.6 Pavement Construction

An assessment of the likely California Bearing Ratio (CBR) for the Made Ground has been assessed from the following sources:

- Correlations with undrained shear strength from Black and Lister;
- Correlations with plasticity index from HD25/94; and
- Description of the materials encountered in the exploratory holes.
-

Based on this it is considered that a CBR of 2% may be suitable. Based on the plasticity index the soils are not considered frost susceptible in accordance with Road Note 29 soils are not considered

frost susceptible.

Following excavation the sub formation should be proof rolled and any soft material inspected and removed.

10.7 Buried Concrete

Based upon the results of the chemical analyses it is considered that subsurface concrete can be designed in accordance with Design Sulphate Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with the recommendations provided in BRE Special Digest 1 (2005).

10.8 Excavations

Site observations indicated that excavations should be feasible in the near surface with normal plant. No significant dewatering is anticipated.

11 CONTAMINATED LAND RISK ASSESSMENT

11.1.1 Approach

Brown 2 Green Associates Ltd has undertaken a Tier 1 Human Health Risk Assessment to determine if any potential contaminants within the underlying soil pose an unacceptable level of risk to the identified human health receptors.

At a Tier 1 stage the long term (chronic) human health toxicity of the soil has been assessed with reference to Generic Assessment Criteria (GAC) detailed in Nathanail, C. P., McCaffrey, C., Gillett, A. G., Ogden, R. C. and Nathanail, J. F. 2015. The LQM/CIEH S4ULs for Human Health Risk Assessment. Land Quality Press, Nottingham (Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3086). If no generic GAC (CIEH/LQM) is available, reference has been made to Category 4 Screening Values or GAC have been determined by Brown 2 Green Associates Ltd using CLEA 1.06 with adjustments based on input data used in the calculation of Category 4 Screening Values.

For the assessment of risk to human health from groundwater a qualitative risk assessment has been undertaken. Within this section we have only considered the risk to users of the site. An assessment of risk to human health beyond the boundaries of the site is considered as part of the risk to controlled waters.

11.1.2 Risk from Soil

Risk to Future Site Users

For the purposes of the Tier 1 assessment Brown 2 Green Associates Ltd have initially compared the laboratory test data directly to the relevant Brown 2 Green Associates Ltd Tier 1 human health screening criteria for residential with plant uptake end use with a soil organic matter content of 1%. The results of this direct comparison is presented below:

Determinant	Units	GAC	n	Conc. Above GAC	Locations above GAC	Path-way	Assessment
Arsenic	mg/kg	37	8	13	-	1	No Further Action
Cadmium	mg/kg	11	8	0.42	-	5	No Further Action
Chromium (III)	mg/kg	910	8	32	-	4	No Further Action
Copper	mg/kg	2400	8	23	-	5	No Further Action
Mercury (Inorganic)	mg/kg	40	8	0.16	-	1	No Further Action
Nickel	mg/kg	130	8	33	-	1	No Further Action
Lead *	mg/kg	200	8	160	-	1, 4	No Further Action
Selenium	mg/kg	250	8	0.18	-	1	No Further Action
Vanadium	mg/kg	410	8	51	-	5	No Further Action
Zinc	mg/kg	3700	8	1300	-	5	No Further Action
Cyanide (total)***	mg/kg	791	4	<0.50	-	1	No Further Action
Naphthalene	mg/kg	2.3	8	0.46	-	5, 2	No Further Action
Acenaphthylene	mg/kg	170	8	0.70	-	5	No Further Action
Acenaphthene	mg/kg	210	8	1.3	-	5	No Further Action
Fluorene	mg/kg	170	8	1.5	-	1, 5	No Further Action
Phenanthrene	mg/kg	95	8	17	-	5	No Further Action
Anthracene	mg/kg	2400	8	4.4	-	5	No Further Action
Fluoranthene	mg/kg	280	8	28	-	5	No Further Action
Pyrene	mg/kg	620	8	24	-	1, 5	No Further Action

Determinant	Units	GAC	n	Conc. Above GAC	Locations above GAC	Path-way	Assessment
Benzo(a)anthracene	mg/kg	7.2	8	**11**	WS5 (0.0-0.1)	1	Further Assessment (see below)
Chrysene	mg/kg	15	8	12	-	1	No Further Action
Benzo(b)fluoranthene	mg/kg	2.6	8	**4.6** **5.5** **15**	WS1 (0.1-0.2) WS1 (0.9-1.0) WS5 (0.0-0.1)	1	Further Assessment (see below)
Benzo(k)fluoranthene	mg/kg	77	8	5.6	-	1	No Further Action
Benzo(a)Pyrene	mg/kg	2.2	8	**3.3** **4.4** **12**	WS1 (0.1-0.2) WS1 (0.9-1.0) WS5 (0.0-0.1)	1	Further Assessment (see below)
Indeno(123-cd)pyrene	mg/kg	27	8	7.9	-	1	No Further Action
Dibenz(ah)anthracene	mg/kg	0.24	8	**0.44** **0.45** **1.5**	WS1 (0.1-0.2) WS1 (0.9-1.0) WS5 (0.0-0.1)	1	Further Assessment (see below)
Benzo(ghi)perylene	mg/kg	320	8	7.6	-	1	No Further Action
TPH C_5-C_6 (aliphatic)	mg/kg	42	4	<0.05	-	2	No Further Action
TPH C_6-C_8 (aliphatic)	mg/kg	100	4	<0.05	-	2	No Further Action
TPH C_8-C_{10} (aliphatic)	mg/kg	27	4	<0.5	-	2	No Further Action
TPH C_{10}-C_{12} (aliphatic)	mg/kg	130	4	7.0	-	2	No Further Action
TPH C_{12}-C_{16} (aliphatic)	mg/kg	1100	4	7.8	-	1	No Further Action
TPH C_{16}-C_{35} (aliphatic)	mg/kg	65,000	4	43	-	1	No Further Action
TPH C_{35}-C_{44} (aliphatic)	mg/kg	65,000	4	<10	-	1	No Further Action
TPH C_5-C_7 (aromatic)	mg/kg	70	4	<0.05	-	2	No Further Action
TPH C_7-C_8 (aromatic)	mg/kg	130	4	<0.05	-	2	No Further Action
TPH C_8-C_{10} (aromatic)	mg/kg	34	4	<0.05	-	2	No Further Action
TPH C_{10}-C_{12} (aromatic)	mg/kg	74	4	<1.0	-	2	No Further Action
TPH C_{12}-C_{16} (aromatic)	mg/kg	140	4	18	-	1	No Further Action
TPH C_{16}-C_{21} (aromatic)	mg/kg	260	4	220	-	1	No Further Action
TPH C_{21}-C_{35} (aromatic)	mg/kg	1100	4	630	-	1	No Further Action
TPH C_{35}-C_{44} (aromatic)	mg/kg	1100	4	100	-	1	No Further Action
Benzene	mg/kg	0.087	2	<0.001	-	2	No Further Action
Ethylbenzene	mg/kg	47	2	<0.01	-	2	No Further Action
Toluene	mg/kg	130	2	<0.001	-	2	No Further Action
m&p-xylene	mg/kg	56	2	<0.001	-	2	No Further Action
o-Xylene	mg/kg	60	2	<0.001	-	2	No Further Action
MTBE **	mg/kg	49	2	<0.001	-	2	No Further Action

Notes
Main Exposure Pathways: 1 = Soil and dust Ingestion, 2 = Vapour Inhalation (indoor), 3 = Dermal Contact, 4 = Dust Inhalation, 5 = consumption of home grown produce.

Abbreviations: GAC = General Assessment Criteria, n = number of samples.

Tier 1 GAC are based on Nathanail, C. P., McCaffrey, C., Gillett, A. G., Ogden, R. C. and Nathanail, J. F. 2015. The LQM/CIEH S4ULs for Human Health Risk Assessment. Land Quality Press, Nottingham. **Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3086.**

* - Category 4 Screening Level.
** - EIC/AGS/CL:AIRE Soil Generic Assessment Criteria for Human Health Risk Assessment January 2010.
*** - Brown 2 Green HH-GSV using CLEA V 1.06 and tox data from DEFRA/Environment Agency SGV.

Asbestos was not identified in any of the soil samples submitted for screening analysis.

Within the made ground from WS1 and WS5, concentrations of benzo(b)fluoranthene,

benzo(a)pyrene and dibenzo(a,h)anthracene exceed the relevant GAC of 2.6mg/kg for benzo(b)fluoranthene, 2.2mg/kg for benzo(a)pyrene and 0.24 mg/kg for dibenzo(a,h)anthracene. A concentration of benzo(a)anthracene was also identified in WS5 that exceeds the GAC. WS1 was located within the footprint of the backfilled pond and WS5 is located adjacent to the above ground storage tank located west of the large barn. For the benzo(b)fluoranthene, benzo(a)pyrene, dibenzo(a,h)anthracene and dibenzo(a,h)anthracene (PAHs) the principal exposure pathways are soil and dust ingestion. These pathways would typically be active within areas to be developed as soft landscaping. Within the proposed development the ground that is the footprint of the backfilled pond will become part of the garden and thus within this part of the site the exposure pathways will become active and the concentrations will pose an unacceptable level of risk. The part of the site where WS5 was located will become the garage. The presence of the garage will break the exposure pathways and thus the concentrations identified in WS5 will not pose an unacceptable level of risk to future site users. The approximate extent of the backfilled pond is presented in Figure 2.

Risk to Construction Workers

In respect to the risk to construction workers, this report and the generic assessment criteria (GAC) consider long term and chronic risk to humans based on defined exposure scenarios set out in the CLEA model. In some cases, contaminants may also pose acute hazards to workers at a site, or a worker's exposure scenario may differ from the scenarios considered when deriving the GAC. As exposure times for construction workers are generally short term, risks from site contamination are generally addressed through the use of appropriate working procedures and the use of personal protective equipment (PPE) in line with the Management of Health and Safety at Work Regulations (1999), Construction (Design) Management Regulations (2007) for some sites and the Control of Substances Hazardous to Health Regulations (2002).

11.2 Ground Gas

From the results of the site investigation, no sources of ground gas that would result in the generation of volumes of biogenic gas that would pose an unacceptable level of risk to human health and the proposed development have been identified. The Conceptual Site Model prepared for the Preliminary Risk Assessment did not identify any off- site sources. From the assessment it is considered that ground gas will not pose a significant risk to human health and the development.

11.3 Risk to Controlled Water

To assess risk to controlled waters from the leaching of determinants from soil, a Qualitative Risk Assessment has been made based on the concentrations identified within the soil samples and site conditions. From the results it is considered that concentrations will not be mobilised at concentrations that would pose an unacceptable level of risk to controlled waters.

11.4 Risk to Planting

An assessment of risk to from potentially phytotoxic metal compounds has been completed. In the absence of published assessment criteria specifically for contaminated land, GAC have been obtained from legislation (UK and European) and guidance related to the use of sewage sludge on agricultural fields.

For the assessment values defined in The Sludge (use in Agriculture) Regulations 1989 (Public Health England, Wales and Scotland), as amended in 1990 and The Sludge (use in Agriculture) Regulations (Northern Ireland) SR No, 245, 1990 have been adopted. In addition the Department of Environment (DoE) produced a Code of Practice (CoP) (Updated 2nd Edition) in 2006 which provided guidance on the application of sewage sludge on agricultural land. The specified limits of

concentrations of selected elements in soil are presented in the 2nd Edition of the DoE Code of Practice and are designed to protect plant growth.

As all concentrations are below their respective assessment criteria with the exception of the zinc concentration identified in the sample of made ground from WS1 (0.9-1.0m). As this is only a localised occurrence and the sample of the made ground from 0.1-0.2m contained a concentration that was lower that the GAC, it is considered that the concentration from 0.9m to 1.0m will not pose an unacceptable level of risk to future planting.

11.5 Risk to Construction Materials

The assessment of the risk to concrete from the concentrations of sulphate and the pH in the soil has been made using BRE guidance Special Digest 1:2005 Concrete in Aggressive Ground.

Sulphate concentrations of between <10mg/l and 29mg/l and pH values of 7.9 to 8.3 were recorded in the soils. The site has been assessed as brownfield due to the presence of previous developments and made ground of unknown origin and a static groundwater regime apportioned in view of the findings of the boreholes.

Following the guidance set out in the Digest the characteristic sulphate content is 29mg/l and the characteristic pH is 7.9 in the soil; the Design Sulphate class for the site is DS-1 and the Aggressive Environment for Concrete Class is AC-1. Based on the results of the assessment it is considered that the made ground beneath the site will not pose an unacceptable level of risk to concrete through acid attack.

This recommendation is based on samples taken in the near surface materials on site. If deeper foundations are required additional testing should be undertaken and the conclusions of this section should be re-assessed in light of the additional test results available.

11.6 Risk to Water Supply Pipe

The assessment of risk to pipe work used in the potable water supply has been made using UK Water Industry Research (UKWIR) "Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites" (Ref 10/WM/03/21)" January 2011 and supplement "Contaminated Land Assessment Guidance" dated January 2014. The results from samples of made ground (through which any new water supply pipes are likely to pass) have been compared with the threshold values listed in the UKWIR guidance. It should be noted that the threshold values are for use by designers in the selection of appropriate pipe materials. Exceedance of a threshold value indicates only that there could be a 'water quality issue'. Threshold values are generally protective of taste and odour quality of water in plastic water pipes and only threshold values for benzene and MTBE are protective of human health.

A single sample of the made ground from WS5 contained concentrations of hydrocarbons (C11 to C20) greater than the threshold value. As this is a localised occurrence associated with the above ground storage tank and will be removed for the construction of the garage, it is considered the concentrations will not pose a risk to the integrity of polyethylene pipework. It is therefore considered that polyethylene pipework can be used.

It is recommended that the relevant water supply company be contacted at an early stage to confirm its requirements for assessment, which may not necessarily be the same as those recommended by UKWIR.

11.7 Risk to Sensitive Ecological Receptors

As no receptors were identified, it is considered that contamination will not pose an unacceptable risk to ecological receptors.

11.8 Risk to Historical Structures and Monuments

As no receptors were identified, it is considered that contamination will not pose an unacceptable risk to historical structures and monuments or sites of historical interest.

12 REVISED CONCEPTUAL MODEL

In light of the results of the site investigation, results of the chemical analysis and the risk screening assessment presented in the previous sections the conceptual model developed has been updated. The conceptual model is presented below.

Source	***Potential migration pathway***	***Potential Receptors***	***Discussion, Remedial or Precautionary Measures and Mitigating Factors***
PAHs identified in the made ground used to backfill the pond	Soil and dust ingestion	Future residents	Remove contaminated backfill and placement of a minimum of 600mm of clean soil.

13 GEO-ENVIRONMENTAL CONCLUSIONS AND RECOMMENDATIONS

13.1 Conclusions

The Tier I Human Health Risk Assessment has identified concentrations of individual PAHs at levels above the generic assessment criteria with made ground that has been used to backfill a pond that was formally located on the site. As this part of the site will become the rear garden of the proposed house, pollution pathways will be created. It is therefore considered that the concentrations will pose an unacceptable level of risk to human health of future site users. The concentrations will not pose an unacceptable level of risk to neighbours or construction workers.

The Tier I Controlled Water Risk Assessment has determined that there are no unacceptable concentrations of potential contaminants within the underlying soils that would pose a potential risk to controlled waters.

The risk assessment for bio-genic ground gas concluded that there is no risk from ground gas.

The risk assessment in respect to the future planting and towards sensitive ecological receptors identified that the determinants at the site would not pose a potential risk.

The risk assessment in respect to water supply infrastructure identified that the determinants at the site would not pose a potential risk to the integrity of PE or PVC pipework.

13.2 Recommendations

Based on the findings of the contaminated land assessment, the following recommendations are made:

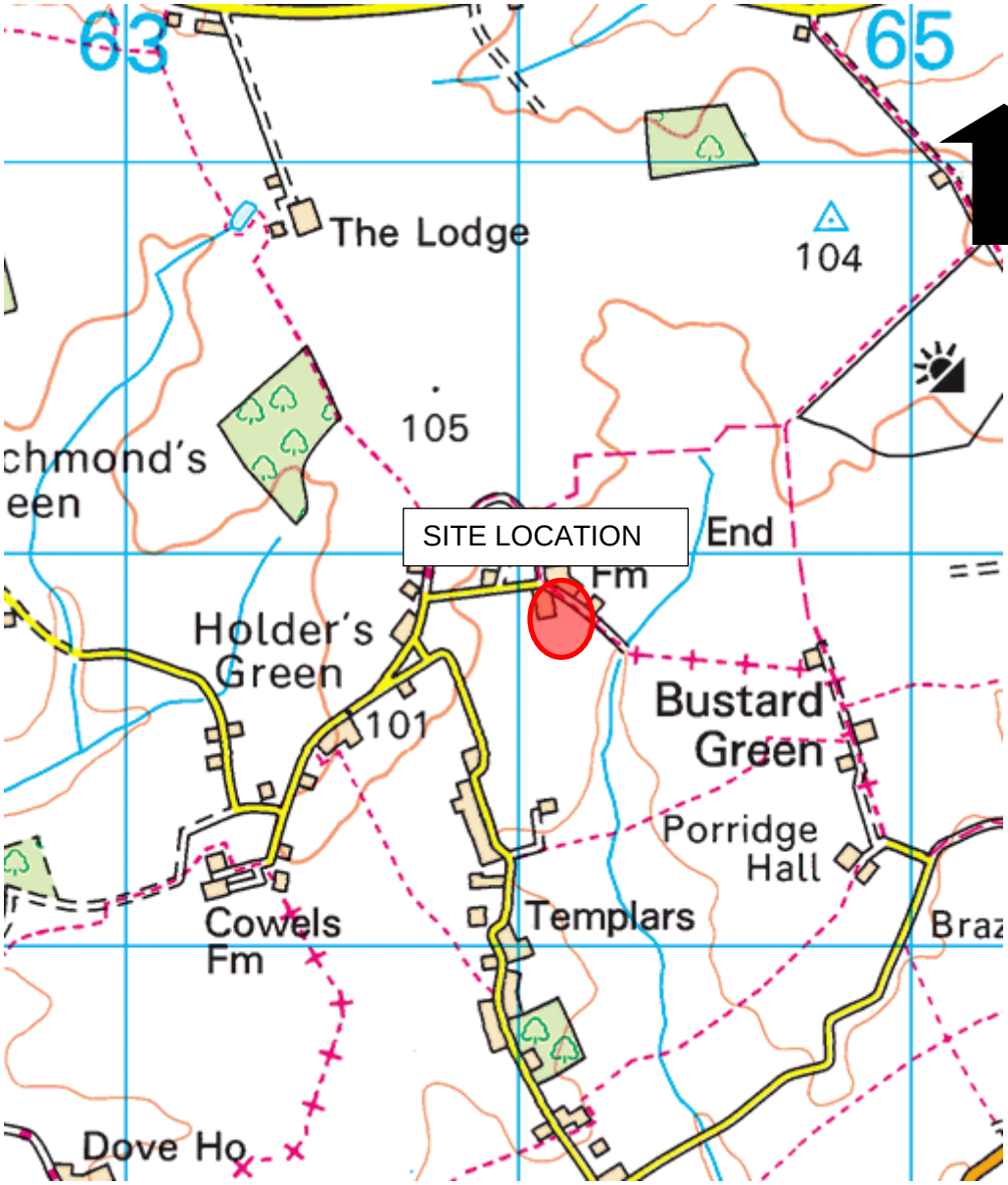
To mitigate the risk posed by the presence of PAHs within the made ground used to backfill the pond, it is recommended that remediation should be undertaken. In summary, the remediation should consist of the removal of the made ground to a maximum depth of 600mm below finished garden level and the placement of clean suitable top and sub soil. The placement of the clean soil will act as a capping layer to break the pollution linkages.

As required by the planning condition, a Remediation Method Statement (RMS) to implement the above measures should be prepared in accordance with the local Environmental Health Department and the Environment Agency. This should be undertaken by a competent person. On completion of the remediation, verification should be undertaken to ensure suitable and sufficient works have been undertaken. The verification work required should be detailed in the Remediation Method Statement.

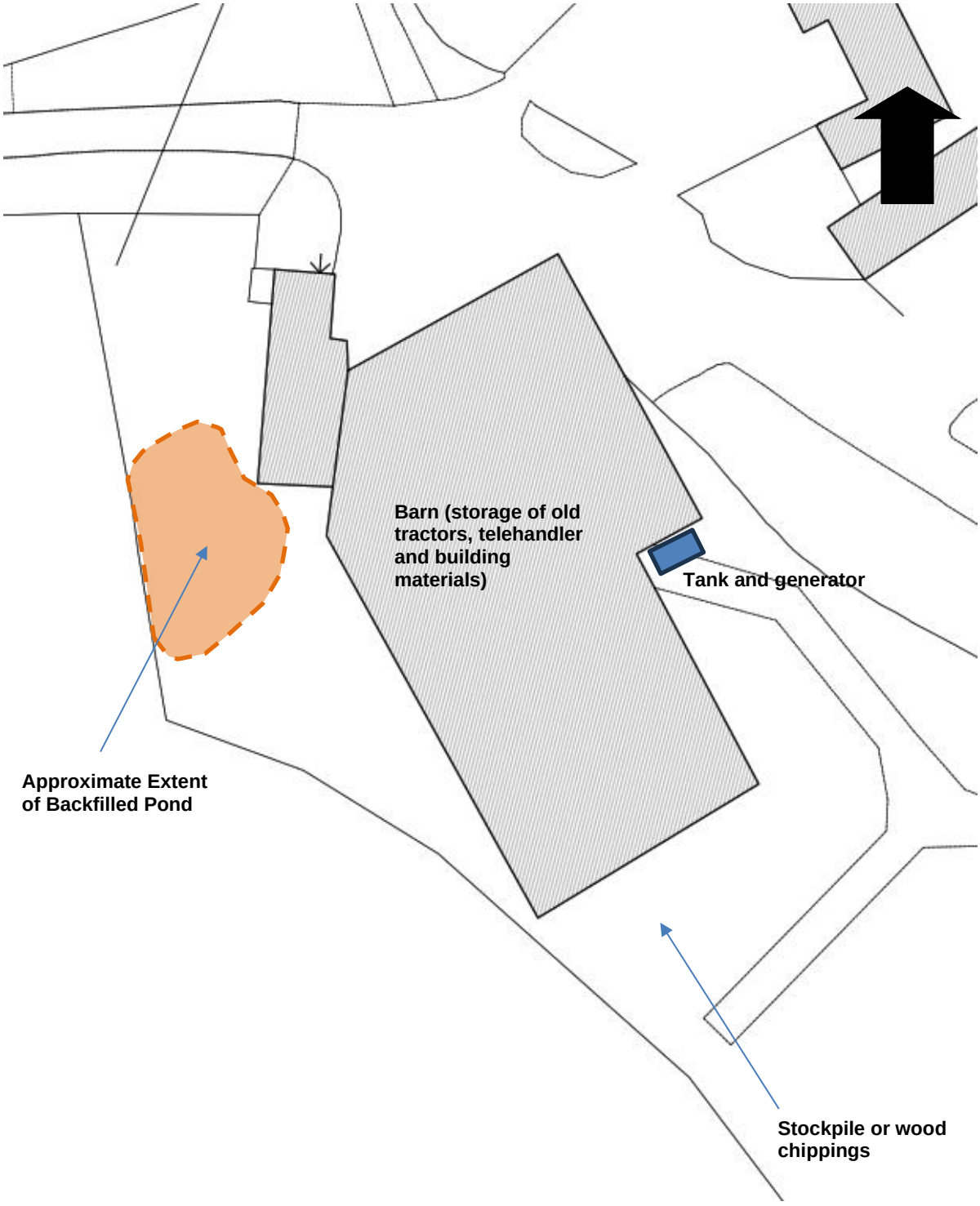
Brown 2 Green Associates consider that polyethylene pipework can be used for the drinking water supply pipework. It is recommended that at an early stage within the project contact should be made with the local water company to the specification of pipework required.

If any suspected contamination, underground storage tanks or chambers not previously identified is revealed during construction contact should be made with an Environmental Consultant to determine suitable action to be undertaken.

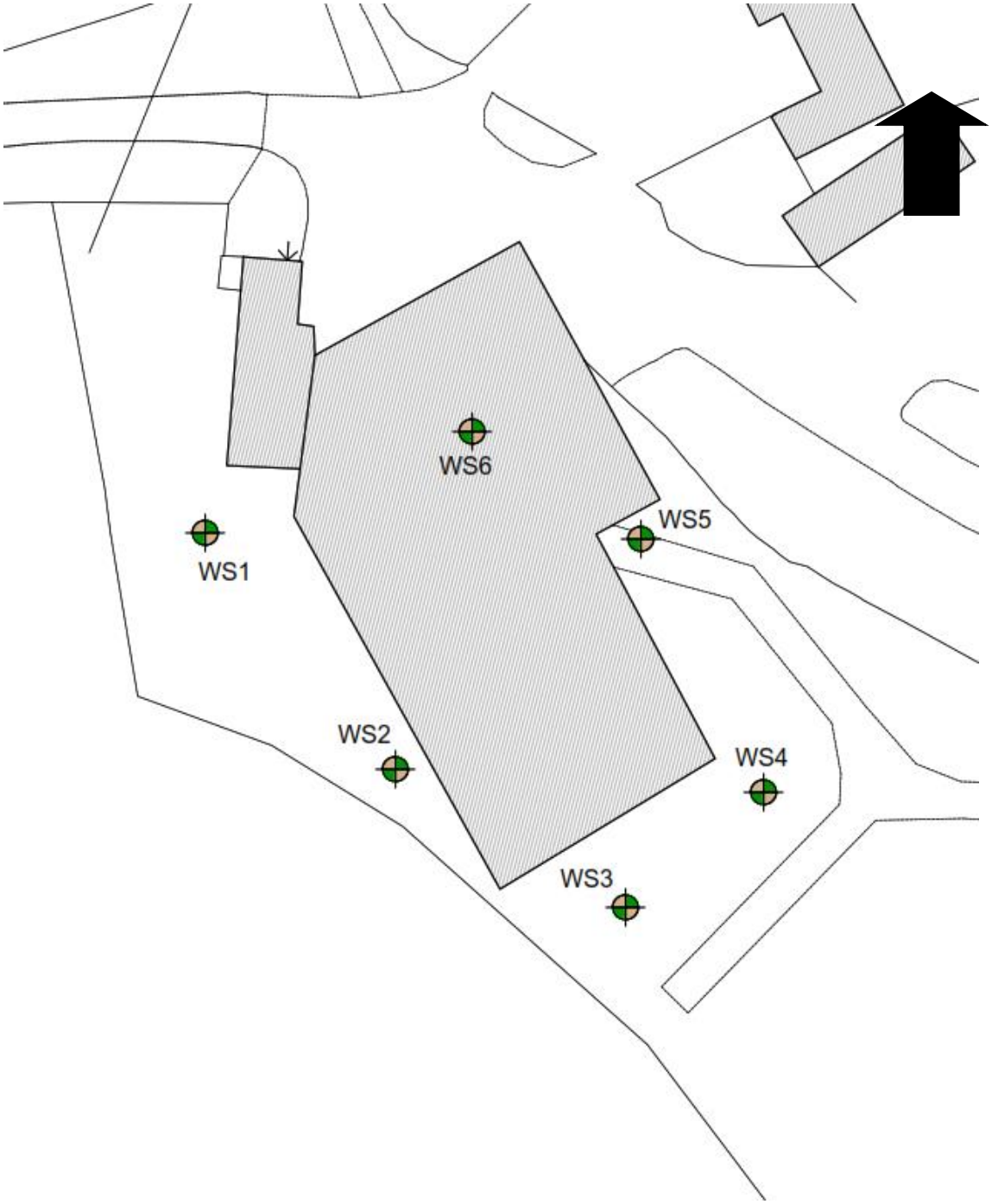
FIGURES



Project Number: 3293	Project: Barn at Duck End Farm, Green Road, Lindsell	Scale: NTS
Figure 1	**Site Location Plan**	Brown 2 Green



Project Number: 3293	Project: Barn at Duck End Farm, Green Road, Lindsell	Scale: 10m I_____I
Figure 2	**Site Layout Plan**	Brown 2 Green



Project Number: 3293	Project: Barn at Duck End Farm, Green Road, Lindsell	Scale: 10m I_____I
Figure 3	**Exploratory Hole Location Plan**	Brown 2 Green

APPENDIX I

LIMITATIONS AND CONSTRAINTS

Brown 2 Green Associates Limited has prepared this report in accordance with our standard Terms and Conditions solely for the use of the Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed and outlined in the body of the report.

Brown 2 Green Associates Ltd cannot be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The client cannot place reliance on the report until full payment has been made. The copyright in this report and other plans and documents prepared by Brown 2 Green Associates Ltd is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of the report may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by Brown 2 Green Associates Ltd in this connection without their explicit written agreement thereto by Brown 2 Green Associates Ltd.

For the work, reliance has been placed on publicly available data obtained from the sources identified and data supplied by other parties. The information is not necessarily exhaustive and further information relevant to the site may be available from other sources. When using the information it has been assumed it is correct. No attempt has been made to verify the information. Brown 2 Green Associates Ltd does not warrant work / data undertaken / provided by others.

Due to the short timescales associated with these projects responses may not have been received from all parties. Brown 2 Green Associates Limited cannot be held responsible for any disclosures that are provided post production of our report and will not automatically update our report.

This report has been produced in accordance with UK policy and legislative requirements for land and groundwater contamination at the time the report was commissioned. Should changes in legislation or policy occur the report findings may need revisiting once the development layout is confirmed.

During the site walkover reasonable effort has been made to obtain an overview of the site conditions. However, during the site walk-over no attempt has been made to enter areas of the site that are unsafe or present a risk to health and safety, are locked, barricaded, overgrown or the location of the area has not been made known, or where access has not been permitted.

Access considerations, the presence of services and the activities being carried out on the site limited the positions where sampling locations could be installed and the techniques that could be used.

This report presents an interpretation of the geo-environmental information established by excavation, observation and testing. It should be noted that when investigating, or developing land it is important to recognise that sub-surface conditions may vary spatially and also with time. Groundwater conditions are dependent on seasonal and other factors. Consequently there may be conditions present not revealed by this investigation. The absence of certain ground, ground gas, and contamination or groundwater conditions at the positions tested is not a guarantee that such conditions do not exist anywhere across the site. Due to the presence of existing buildings and structures access could not be obtained to all areas. Additional contamination may be identified following the removal of the buildings or hard standing.

The scope of any investigation was basis of the specific development and land use scenario proposed by the Client and may be inappropriate to another form of development or scheme. If the development layout was not known at the time of the investigation the report findings may need revisiting once the development layout is confirmed.

Rather, this investigation has been undertaken to provide a characterisation of the existing sub-surface geo-environmental characteristics and make up and the findings of this study are our best interpretation of the data collected, within the scope of work and agreed budget. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.

During any development programme Brown 2 Green Associates Limited should be consulted if alternative ground conditions are encountered. It assumes during any site works that the contractor will use their best endeavours to manage and control groundwater and other unforeseen ground conditions. Brown 2 Green Associates Limited will not be liable for actions taken prior to consultation.

Where mention has been made to the identification of Japanese Knotweed and other invasive plant species and asbestos or asbestos-containing materials, this is for indicative purposes only and does not constitute or replace full and proper surveys.

APPENDIX II

SITE DEVELOPMENT LAYOUT

Circled Numbers:

1. Existing access retained and unaltered.
2. Existing farm building to be demolished shown dotted.
3. Proposed new dwelling.
4. Proposed garage for new dwelling.
5. Parking and turning area for new dwelling finished in self-draining gravel.
6. Adjacent farm building retained.
7. Private garden for new dwelling.
8. Existing trees, hedgerows and other landscaping features to be retained.
9. Boundary enclosures and screening in a mixture of post and rail fencing and willow fencing.
10. Agricultural field.

Scale @ 1:500 0 10m 20m 30m 40m

Andrew Stevenson Associates

ARCHITECTURAL & BUILDING SURVEYING SERVICES

CLIENT
MR & MRS MENHINICK

PROJECT TITLE
PROPOSED NEW DWELLING @ DUCK END FARM,

DUCK END LANE, LINDSELL, DUNMOW, CM63QH

DRAWING TITLE
PROPOSED BLOCK PLAN

PROJECT No	DRAWING	REVISION
5757	03	
SCALE	DATE	DRAWN
1:500 @ A3	DEC '22	KW

BIGODS HALL, BIGODS LANE, GREAT DUNMOW, ESSEX, CM6 3BE
TEL: 01371 874807 EMAIL: design@asarics.co.uk

APPENDIX III

SITE PHOTOGRAPHS

Northern end of barn

Tank stored in barn

Barn in north west corner.

Area of backfilled pond

Southern end of barn with stockpile of wood chippings

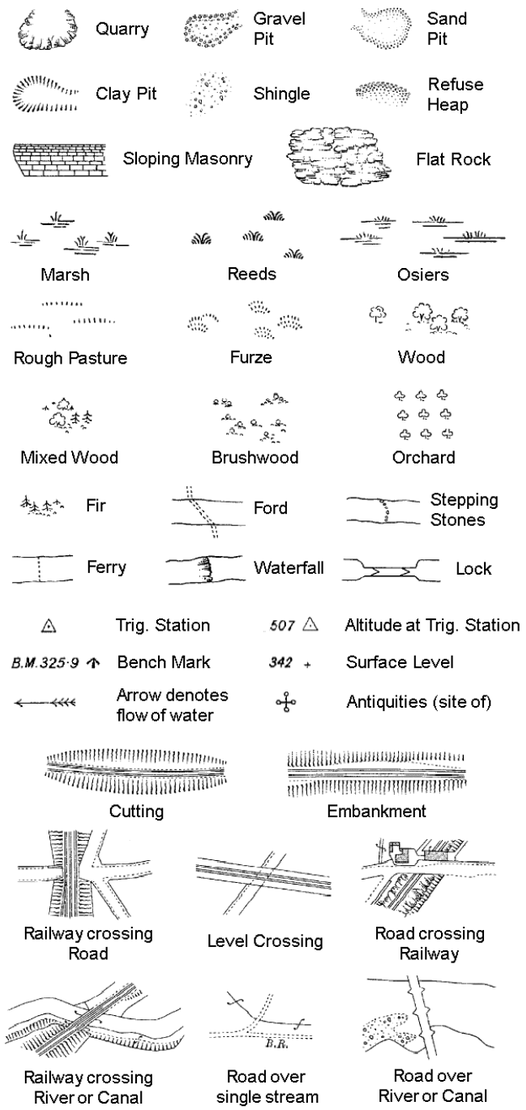
Above ground storage tank and grain dryer unit.

APPENDIX IV

HISTORICAL MAPS

Historical Mapping Legends

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



County Boundary (Geographical)

County & Civil Parish Boundary

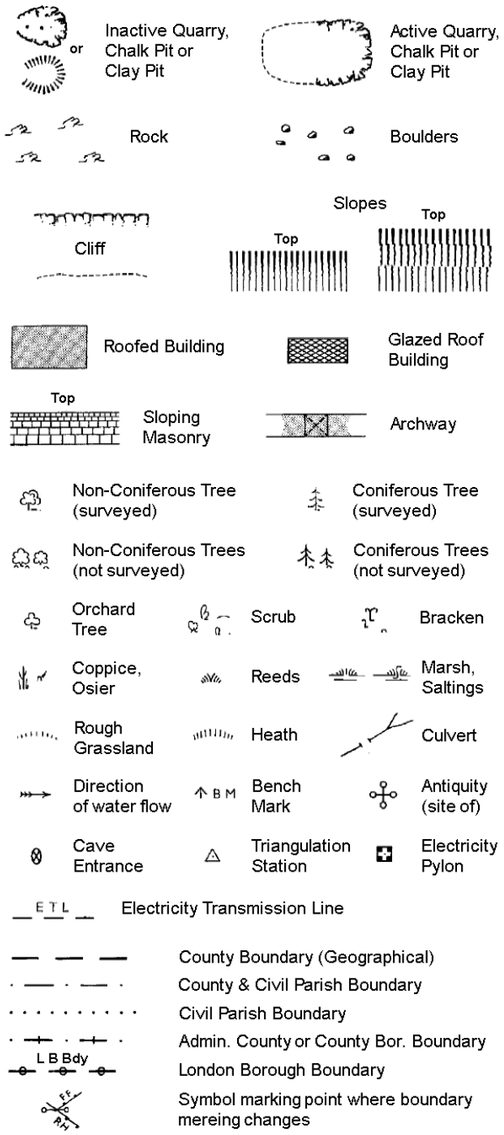
Administrative County & Civil Parish Boundary

Co. Boro. Bdy. County Borough Boundary (England)

Co. Burgh Bdy. County Burgh Boundary (Scotland)

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

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



County Boundary (Geographical)

County & Civil Parish Boundary

Civil Parish Boundary

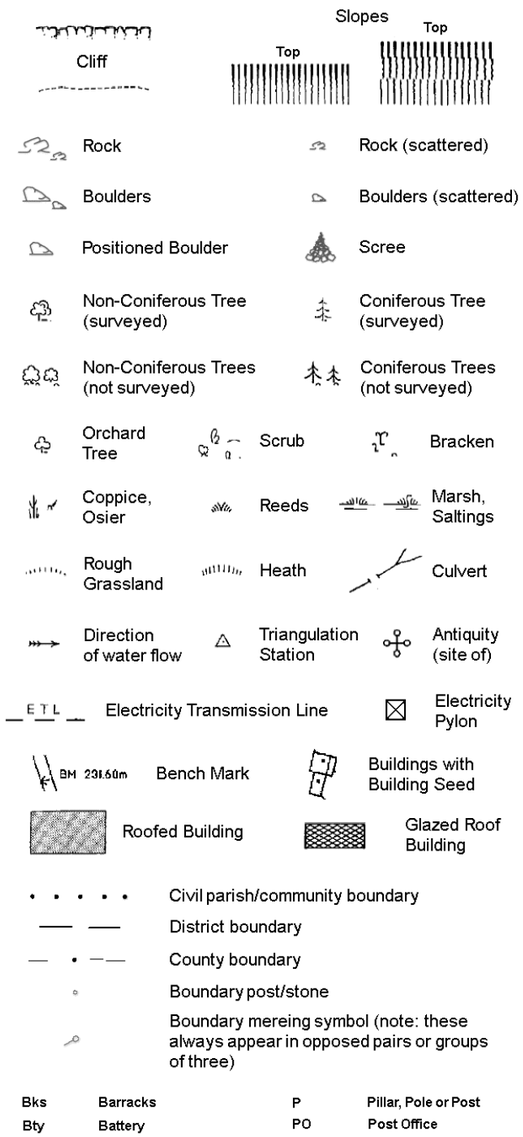
Admin. County or County Bor. Boundary

L B Bdy London Borough Boundary

Symbol marking point where boundary mereing changes

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

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



Civil parish/community boundary

District boundary

County boundary

Boundary post/stone

Boundary mereing symbol (note: these always appear in opposed pairs or groups of three)

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

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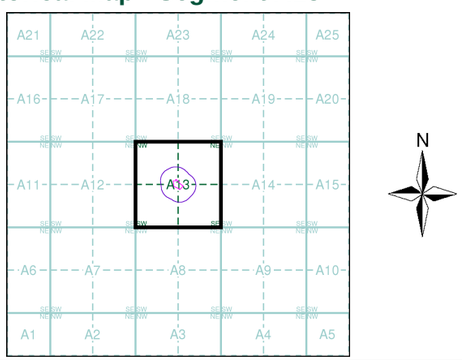
Historical Mapping & Photography included:

Historical Map - Segment A13

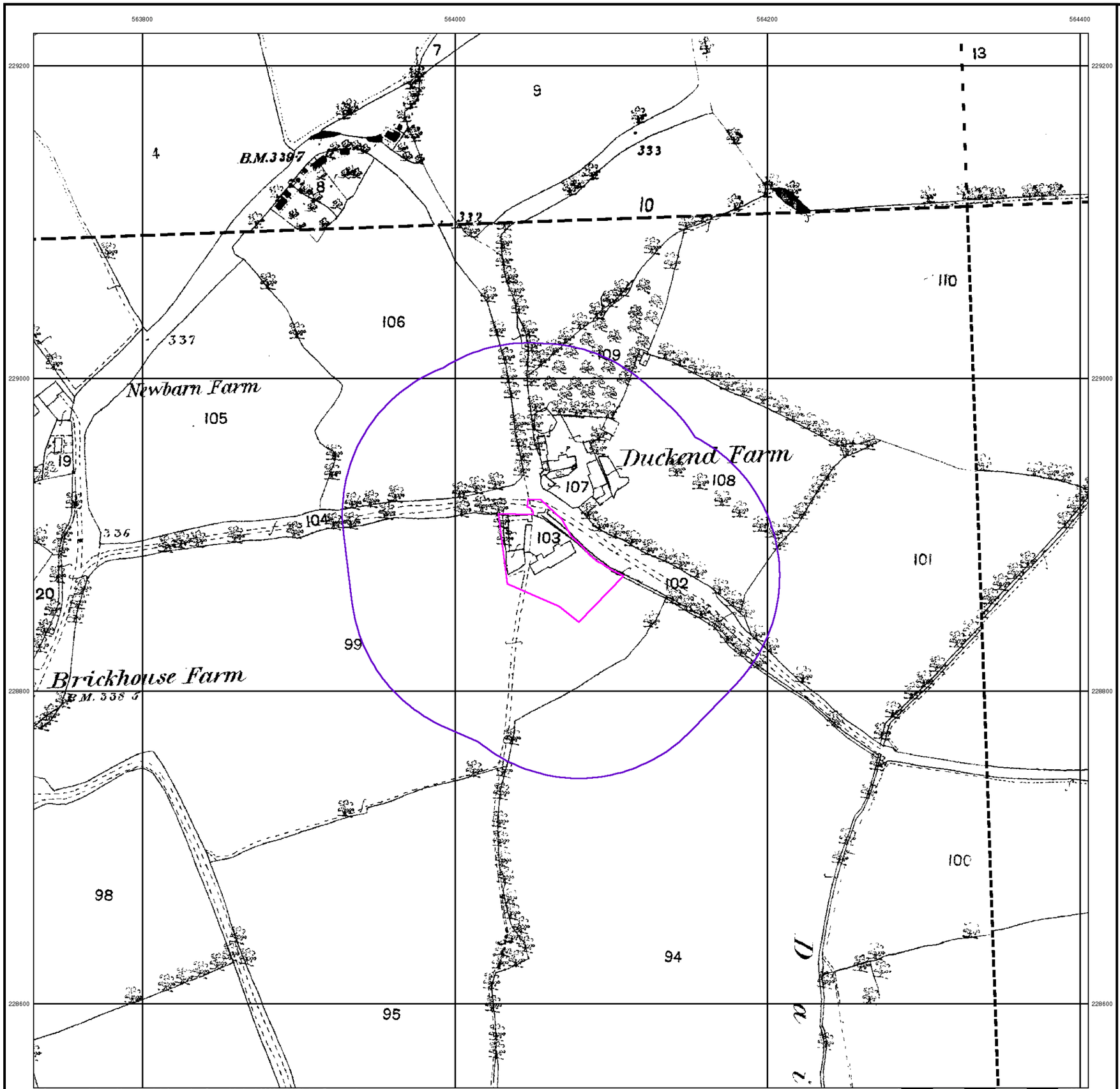


Order Details

Order Number:	313915961_1_1
Customer Ref:	3293
National Grid Reference:	564060, 228880
Slice:	A
Site Area (Ha):	0.33
Search Buffer (m):	100

Site Details

Duck End Farm Ltd, Duck End Farm, Lindsell, DUNMOW, CM6 3QH



0 100 m

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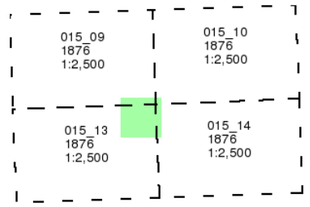
Essex

Published 1876

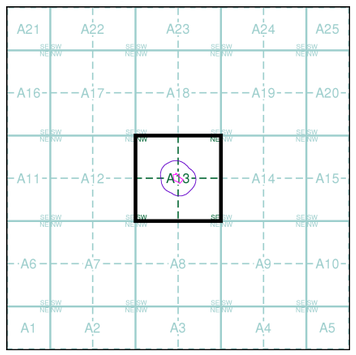
Source map scale - 1:2,500

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

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	313915961_1_1
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Slice:	A
Site Area (Ha):	0.33
Search Buffer (m):	100

Site Details

Duck End Farm Ltd, Duck End Farm, Lindsell, DUNMOW, CM6 3QH

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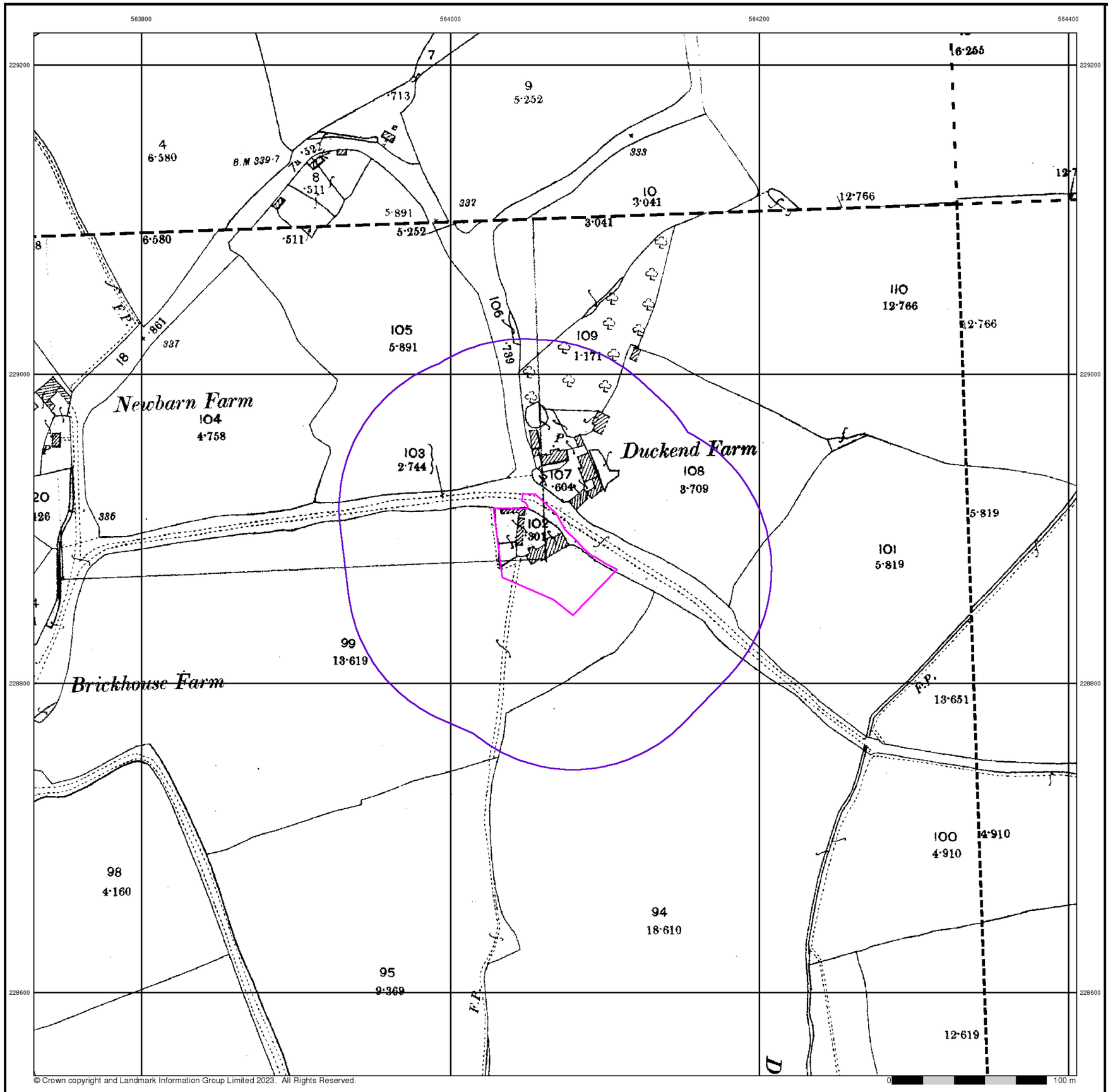
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



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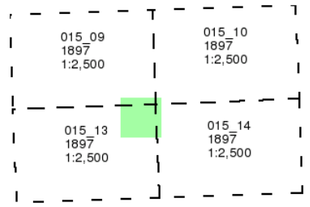
Essex

Published 1897

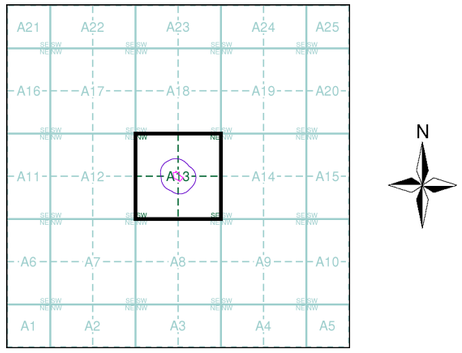
Source map scale - 1:2,500

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:	313915961_1_1
Customer Ref:	3293
National Grid Reference:	564060, 228880
Slice:	A
Site Area (Ha):	0.33
Search Buffer (m):	100

Site Details

Duck End Farm Ltd, Duck End Farm, Lindsell, DUNMOW, CM6 3QH

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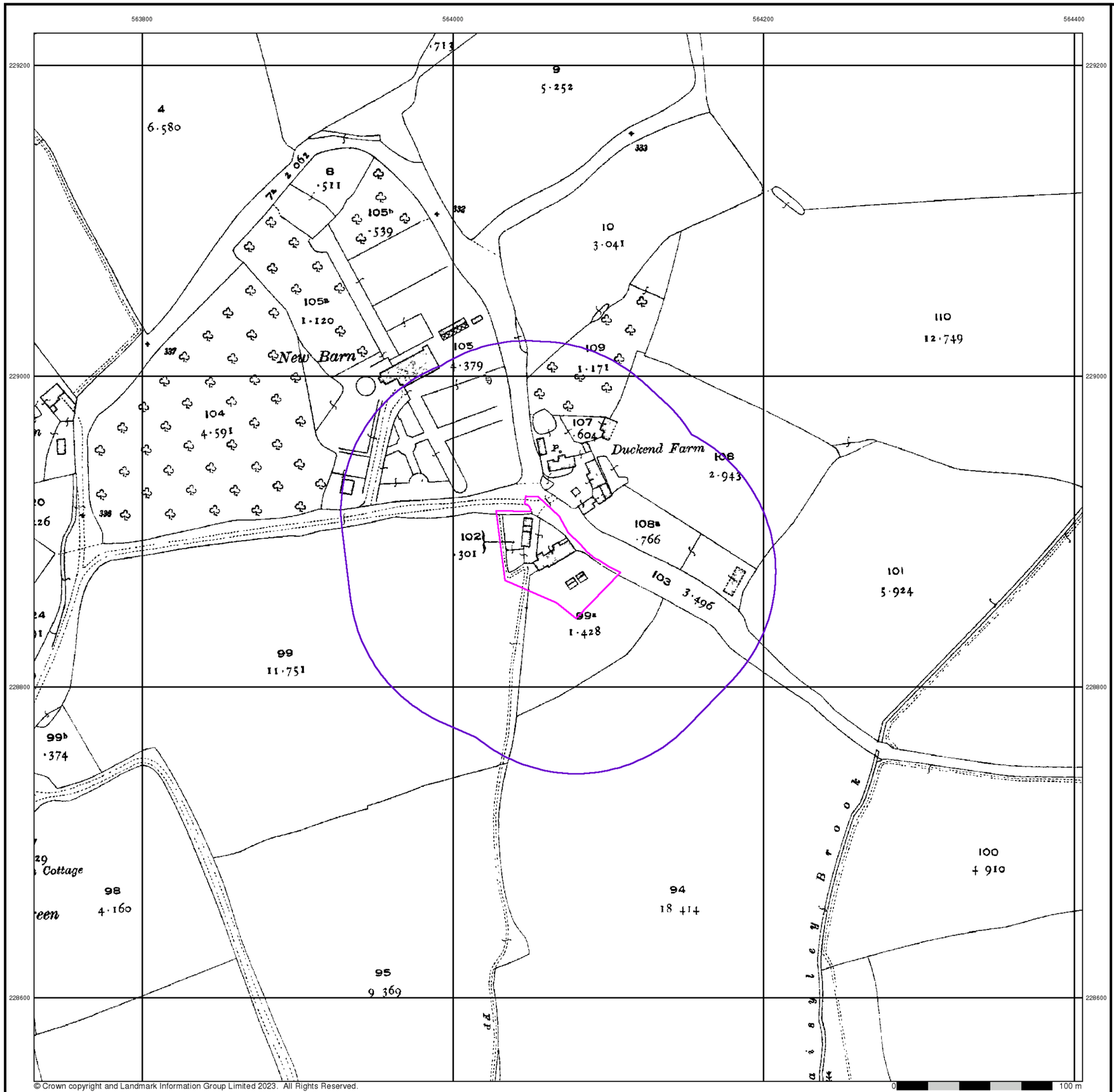

0 100 m

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Essex

Published 1921

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.

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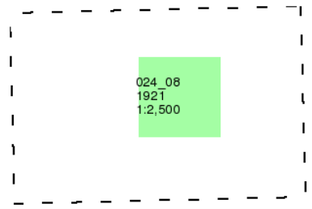
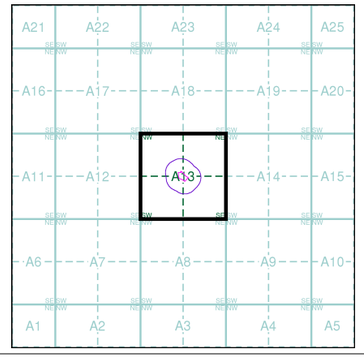


Historical Map - Segment A13



Order Details

Order Number:	313915961_1_1
Customer Ref:	3293
National Grid Reference:	564060, 228880
Slice:	A
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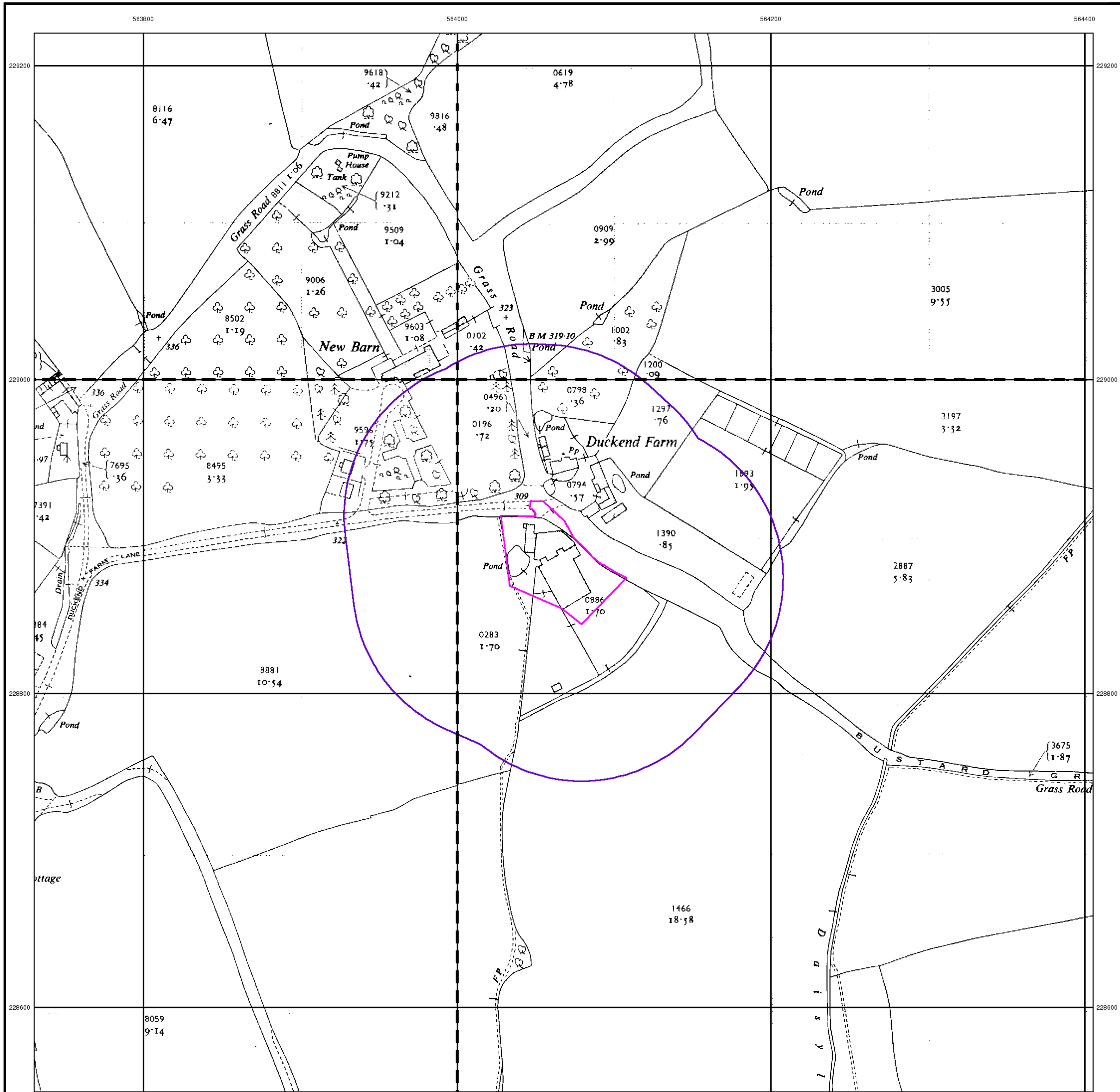

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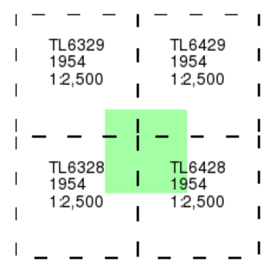
Ordnance Survey Plan

Published 1954

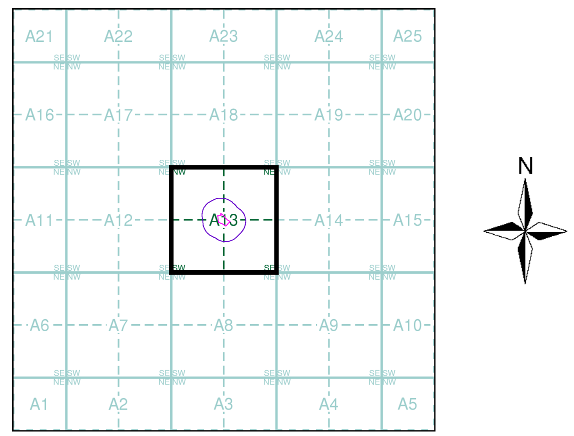
Source map scale - 1:2,500

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

Map Name(s) and Date(s)



Historical Map - Segment A13

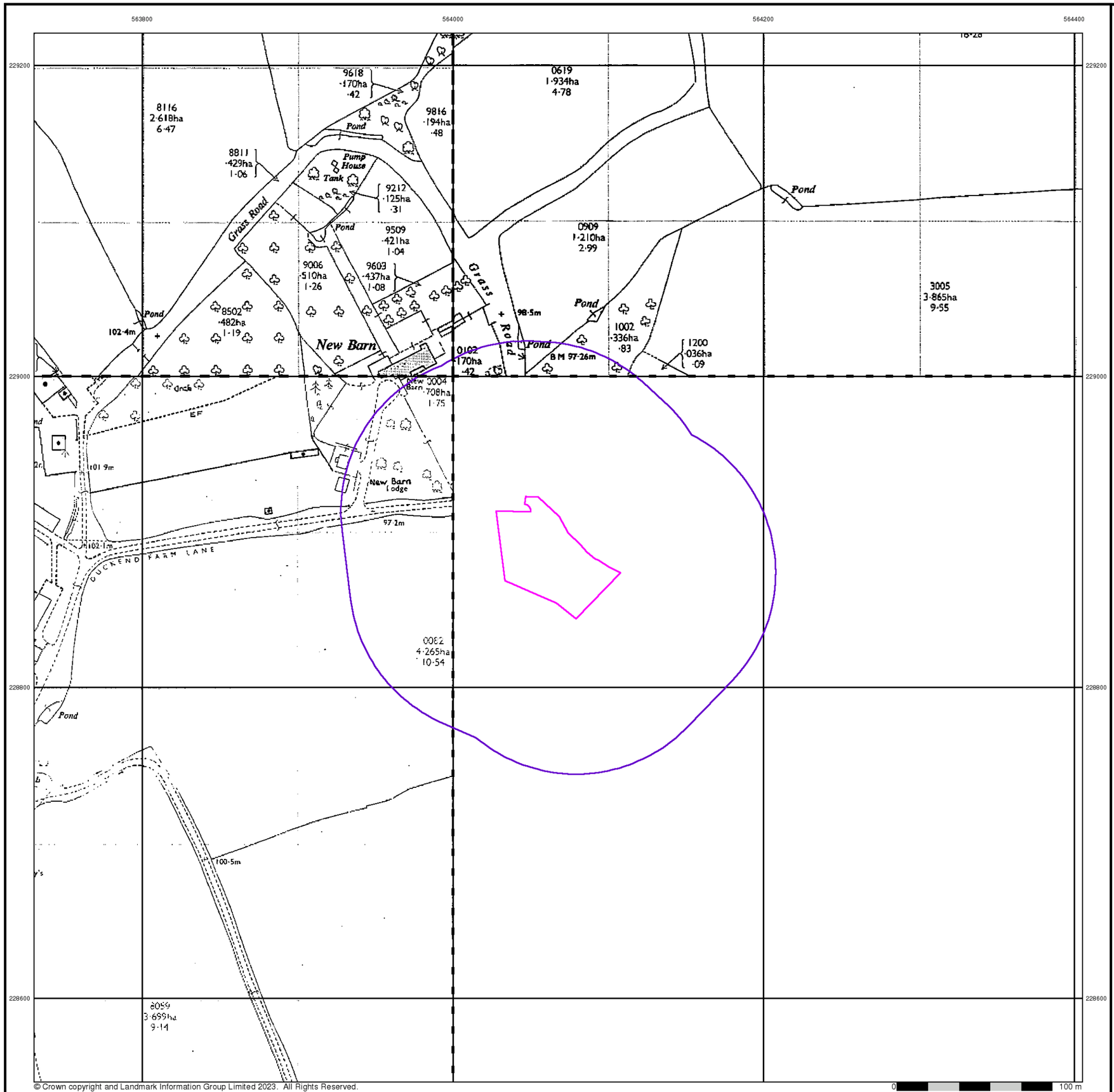


Order Details

Order Number: 313915961_1_1
Customer Ref: 3293
National Grid Reference: 564060, 228880
Slice: A
Site Area (Ha): 0.33
Search Buffer (m): 100

Site Details

Duck End Farm Ltd, Duck End Farm, Lindsell, DUNMOW, CM6 3QH



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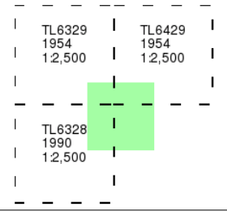
Additional SIMs

Published 1954 - 1990

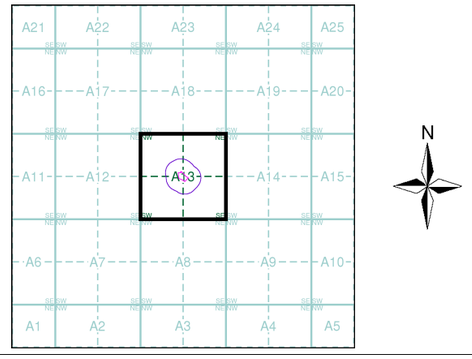
Source map scale - 1:2,500

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:	313915961_1_1
Customer Ref:	3293
National Grid Reference:	564060, 228880
Slice:	A
Site Area (Ha):	0.33
Search Buffer (m):	100

Site Details

Duck End Farm Ltd, Duck End Farm, Lindsell, DUNMOW, CM6 3QH

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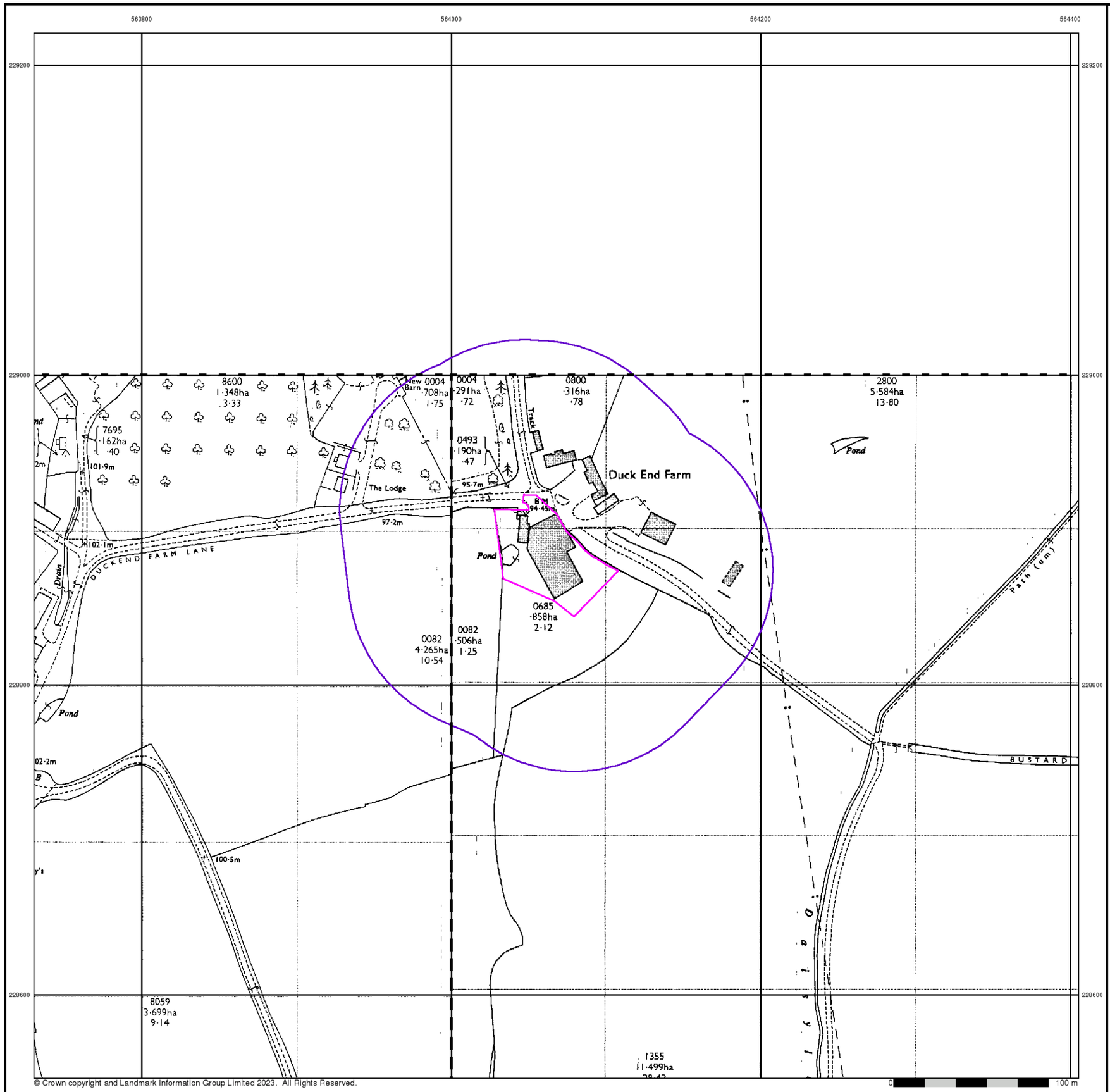

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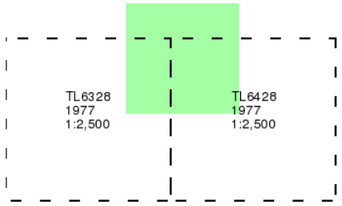
Ordnance Survey Plan

Published 1977

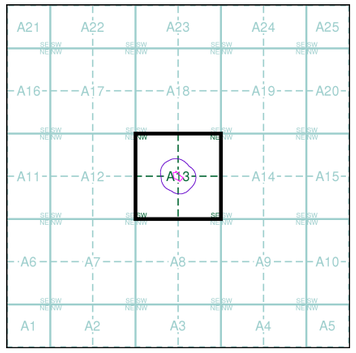
Source map scale - 1:2,500

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:	313915961_1_1
Customer Ref:	3293
National Grid Reference:	564060, 228880
Slice:	A
Site Area (Ha):	0.33
Search Buffer (m):	100

Site Details

Duck End Farm Ltd, Duck End Farm, Lindsell, DUNMOW, CM6 3QH

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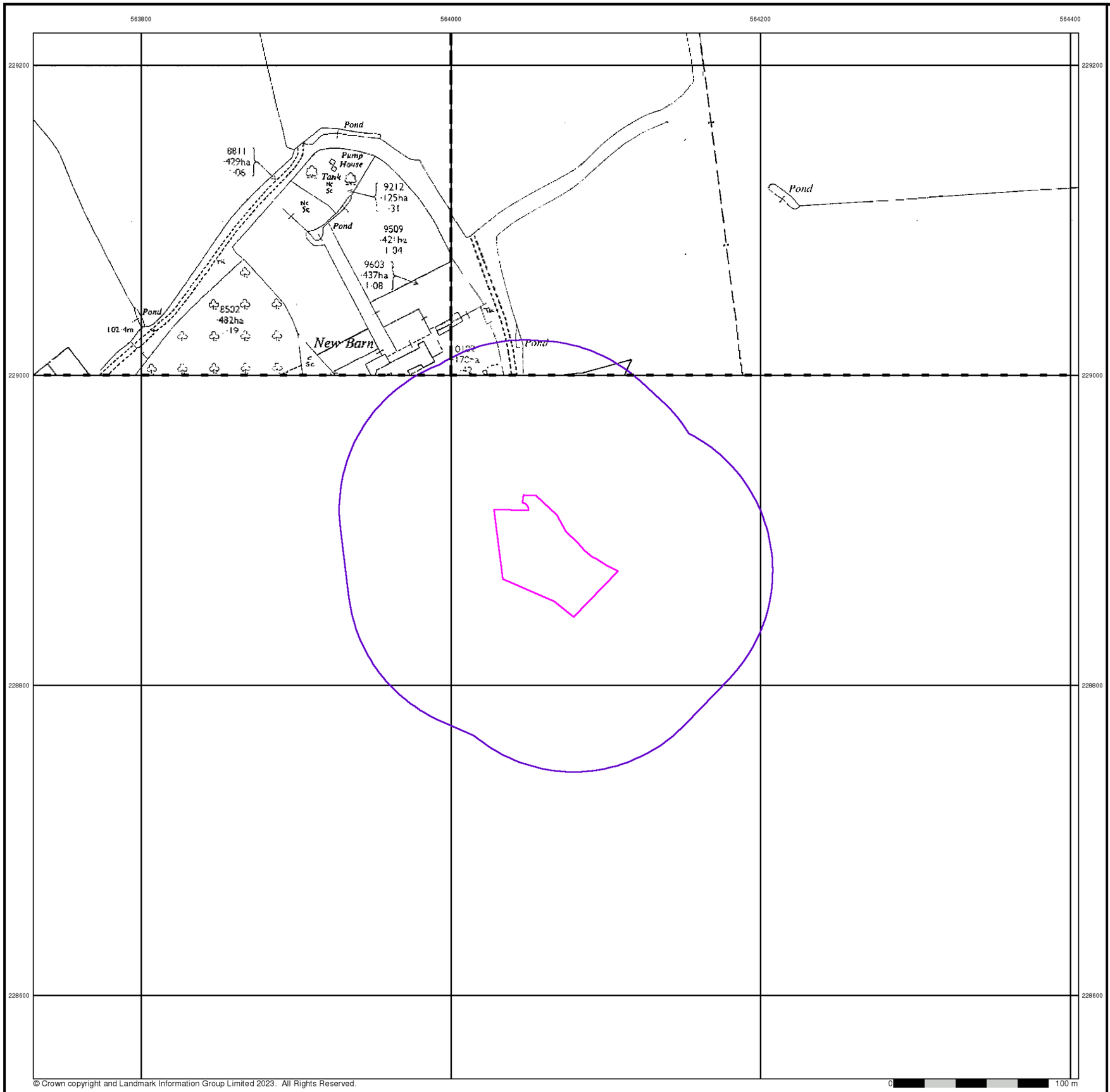

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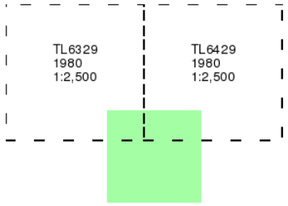
Additional SIMs

Published 1980

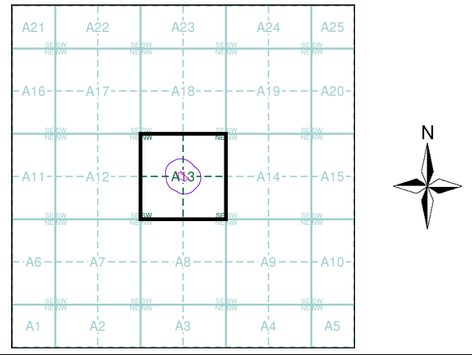
Source map scale - 1:2,500

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:	313915961_1_1
Customer Ref:	3293
National Grid Reference:	564060, 228880
Slice:	A
Site Area (Ha):	0.33
Search Buffer (m):	100

Site Details

Duck End Farm Ltd, Duck End Farm, Lindsell, DUNMOW, CM6 3QH

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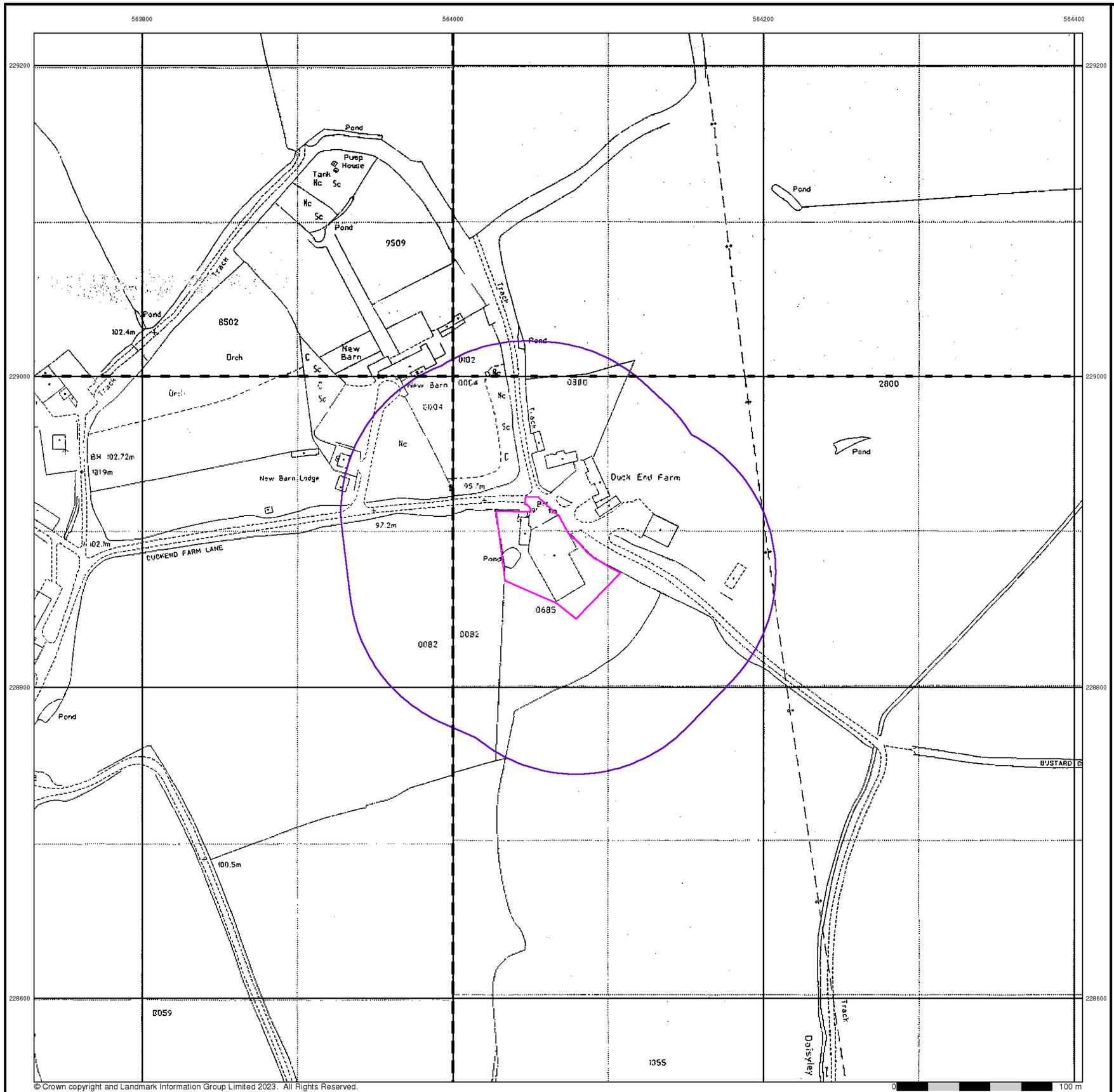

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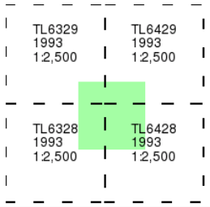
Large-Scale National Grid Data

Published 1993

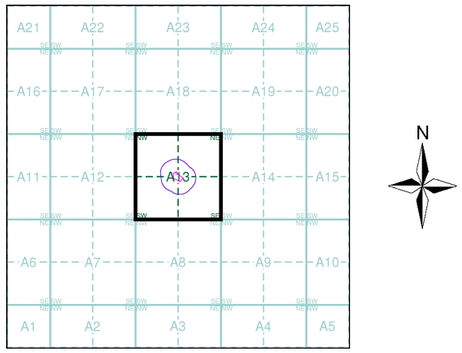
Source map scale - 1:2,500

'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:	313915961_1_1
Customer Ref:	3293
National Grid Reference:	564060, 228880
Slice:	A
Site Area (Ha):	0.33
Search Buffer (m):	100

Site Details

Duck End Farm Ltd, Duck End Farm, Lindsell, DUNMOW, CM6 3QH

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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
Fenced
Un-Fenced
Minor Roads
Fenced
Un-Fenced
Sunken Road
Raised Road
Road over Railway
Railway over River
Railway over Road
Level Crossing
Road over River or Canal
Road over Stream
Road over Stream
County Boundary (Geographical)
County & Civil Parish Boundary
Administrative County & Civil Parish Boundary
Co. Boro. Bdy. County Borough Boundary (England)
Co. Burgh Bdy. County Burgh Boundary (Scotland)
R.D. Bdy. Rural District Boundary
Civil Parish Boundary

Ordnance Survey Plan 1:10,000

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

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

1:10,000 Raster Mapping

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

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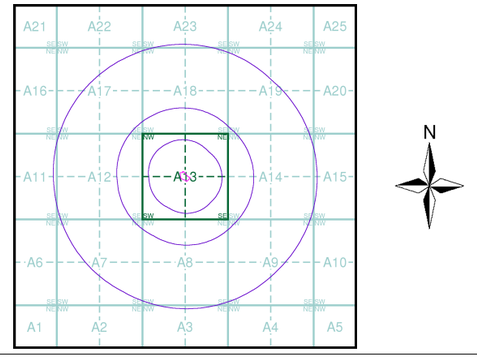
Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Essex	1:10,560	1881	2
Essex	1:10,560	1898	3
Essex	1:10,560	1923 - 1924	4
Essex	1:10,560	1951	5
Ordnance Survey Plan	1:10,000	1955	6
Ordnance Survey Plan	1:10,000	1960	7
Ordnance Survey Plan	1:10,000	1981 - 1983	8
Ordnance Survey Plan	1:10,000	1982	9
10K Raster Mapping	1:10,000	1999	10
Street View	Variable		11

Historical Map - Slice A



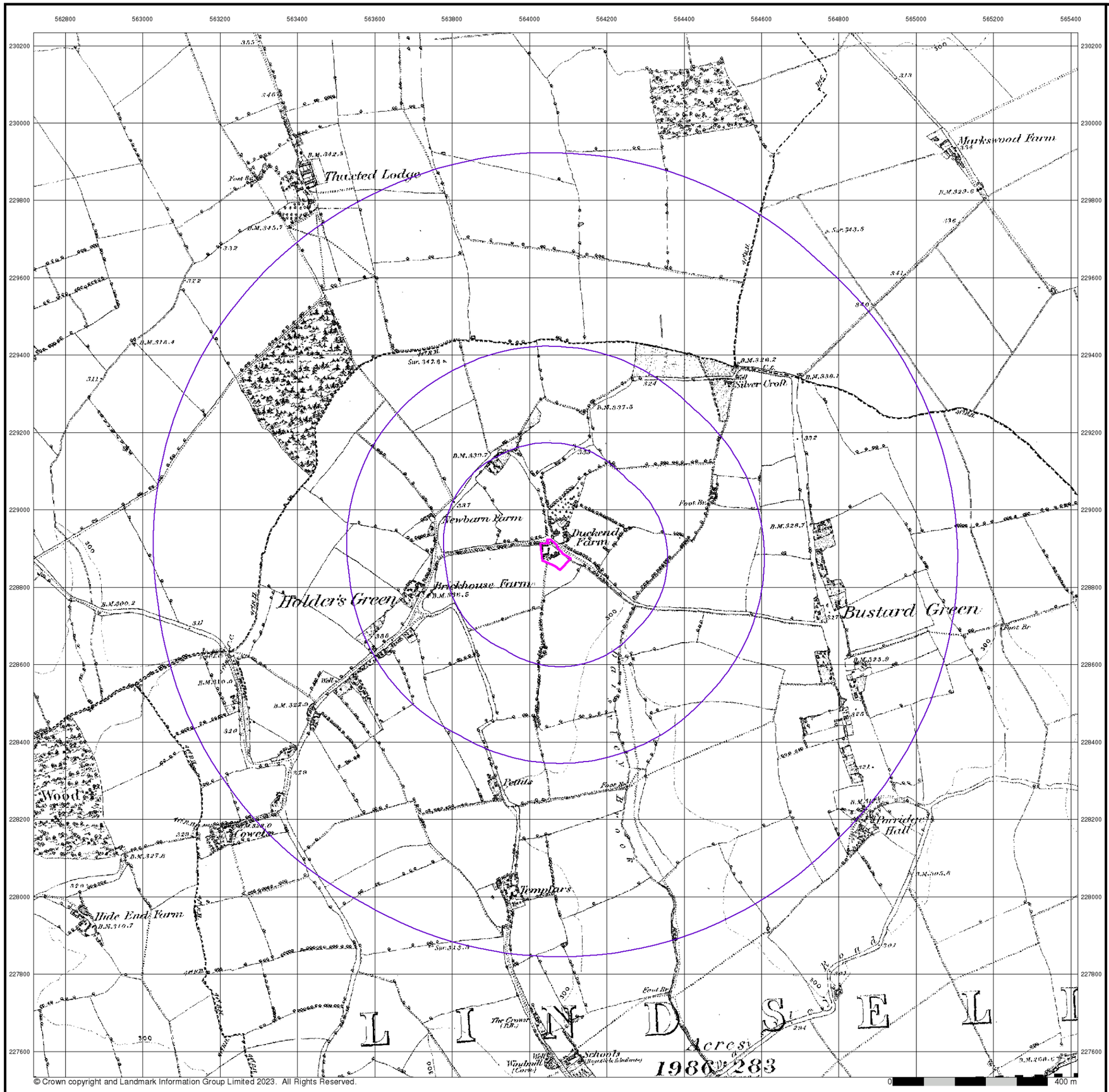
Order Details

Order Number: 313915961_1_1
Customer Ref: 3293
National Grid Reference: 564060, 228880
Slice: A
Site Area (Ha): 0.33
Search Buffer (m): 1000

Site Details

Duck End Farm Ltd, Duck End Farm, Lindsell, DUNMOW, CM6 3QH

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



Envirocheck®

LANDMARK INFORMATION GROUP®

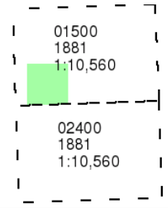
Essex

Published 1881

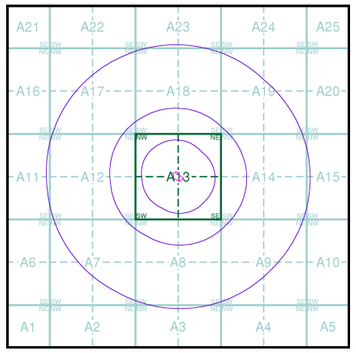
Source map scale - 1:10,560

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)



Historical Map - Slice A

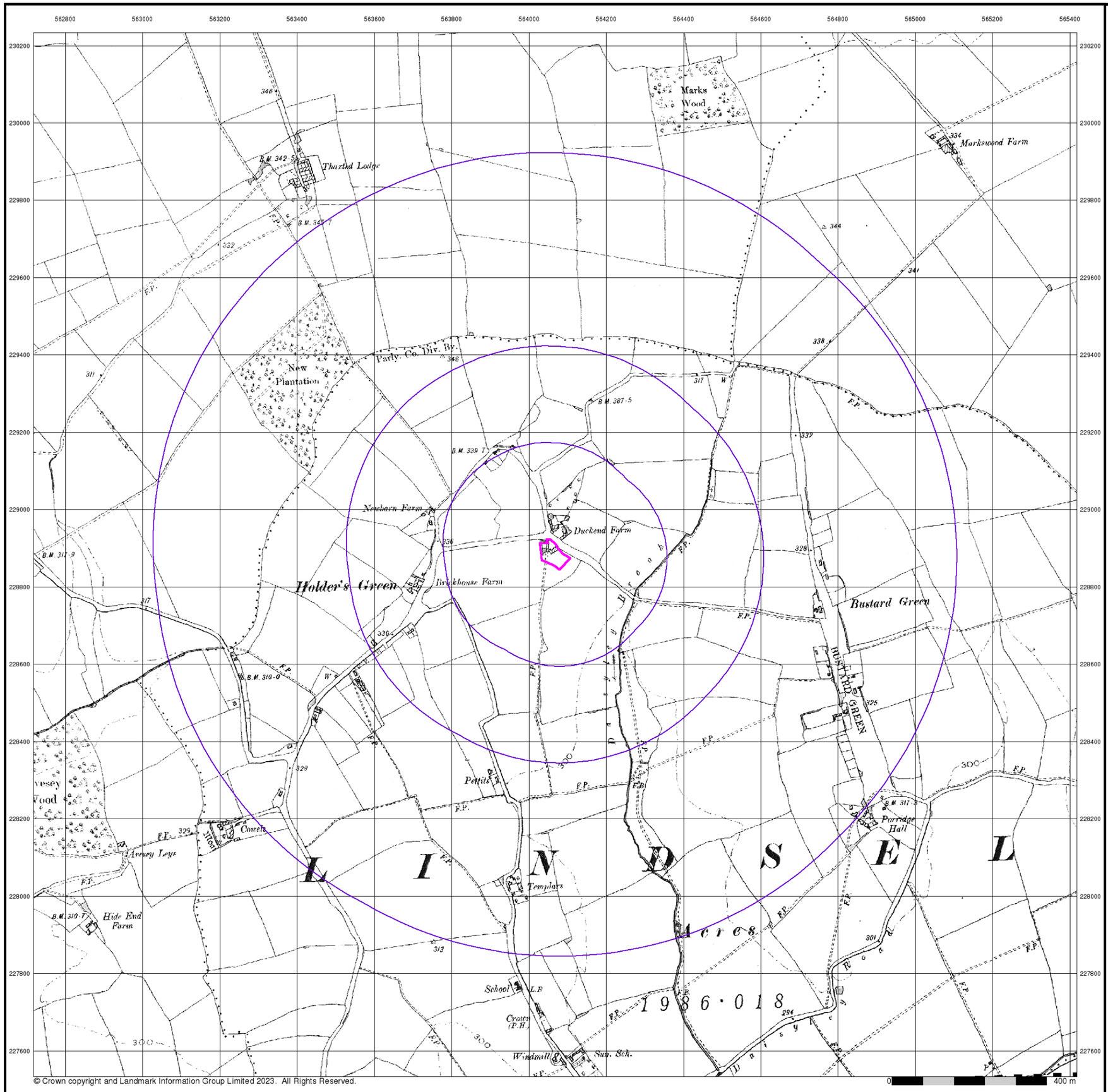


Order Details

Order Number:	313915961_1_1
Customer Ref:	3293
National Grid Reference:	564060, 228880
Slice:	A
Site Area (Ha):	0.33
Search Buffer (m):	1000

Site Details

Duck End Farm Ltd, Duck End Farm, Lindsell, DUNMOW, CM6 3QH



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Essex

Published 1898

Source map scale - 1:10,560

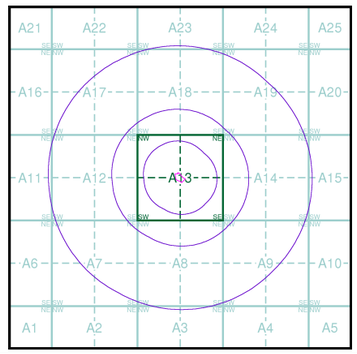
The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some 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)

015SW
1898
1:10,560

024NW
1898
1:10,560

Historical Map - Slice A



Order Details

Order Number:	313915961_1_1
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Slice:	A
Site Area (Ha):	0.33
Search Buffer (m):	1000

Site Details

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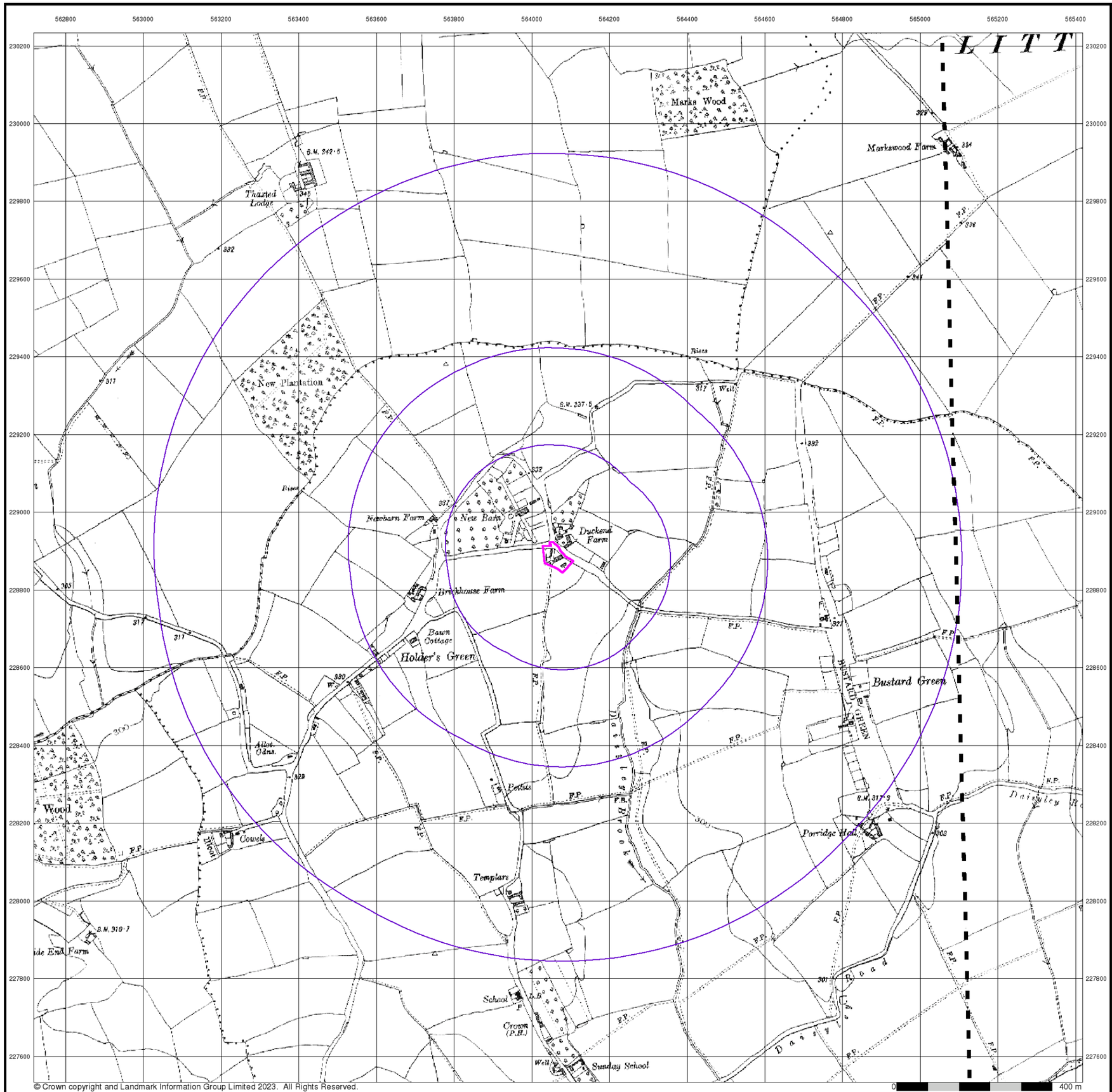

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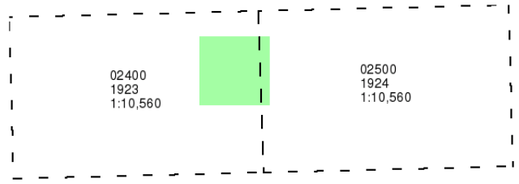
Published 1923 - 1924

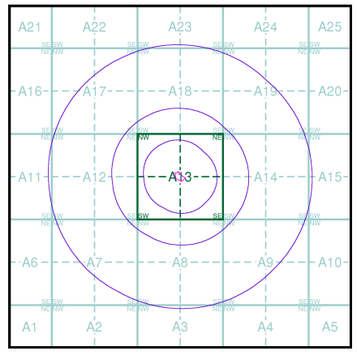
Source map scale - 1:10,560

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)



Historical Map - Slice A



Order Details

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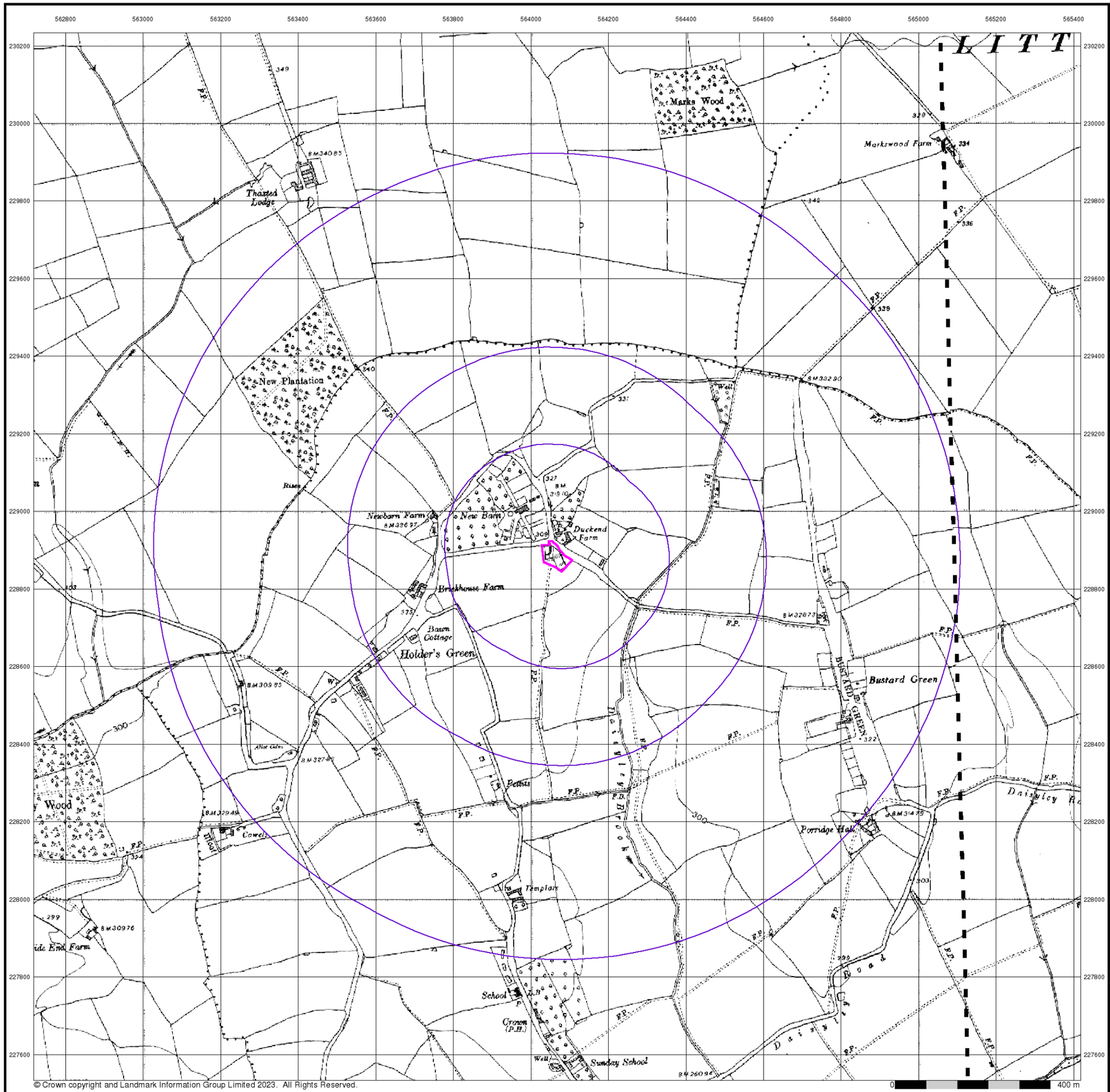

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Essex

Published 1951

Source map scale - 1:10,560

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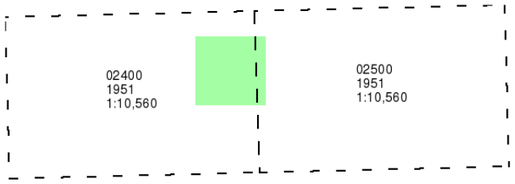
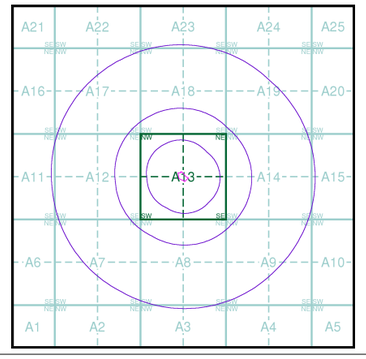
Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

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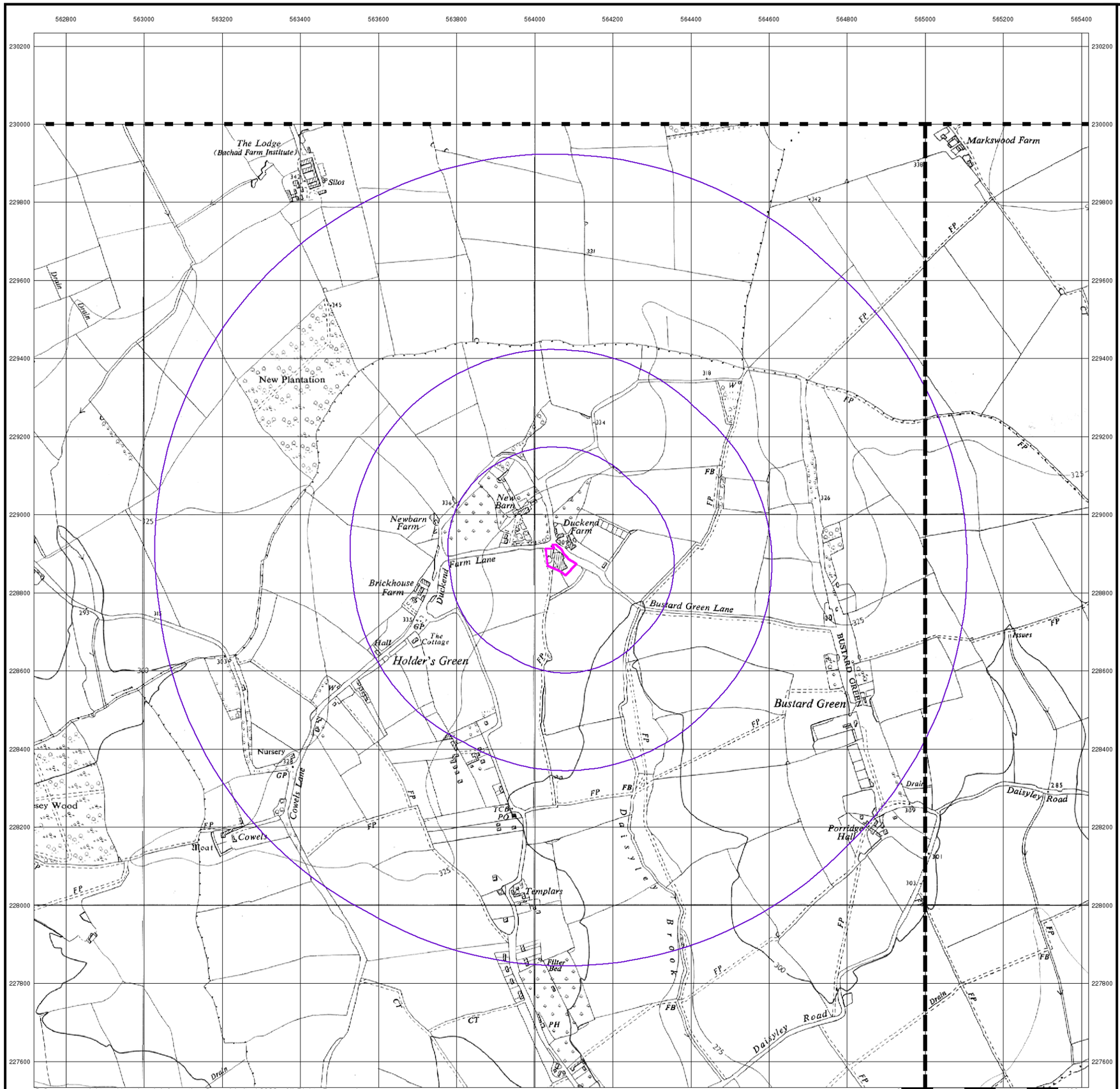

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Ordnance Survey Plan

Published 1955

Source map scale - 1:10,000

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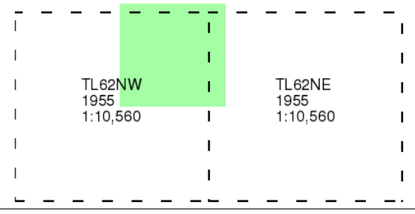
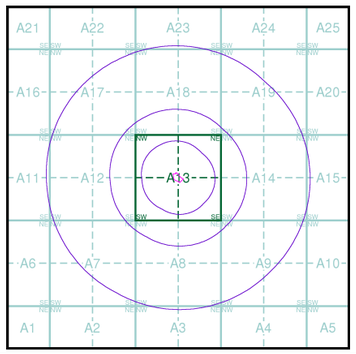


Historical Map - Slice A



Order Details

Order Number:	313915961_1_1
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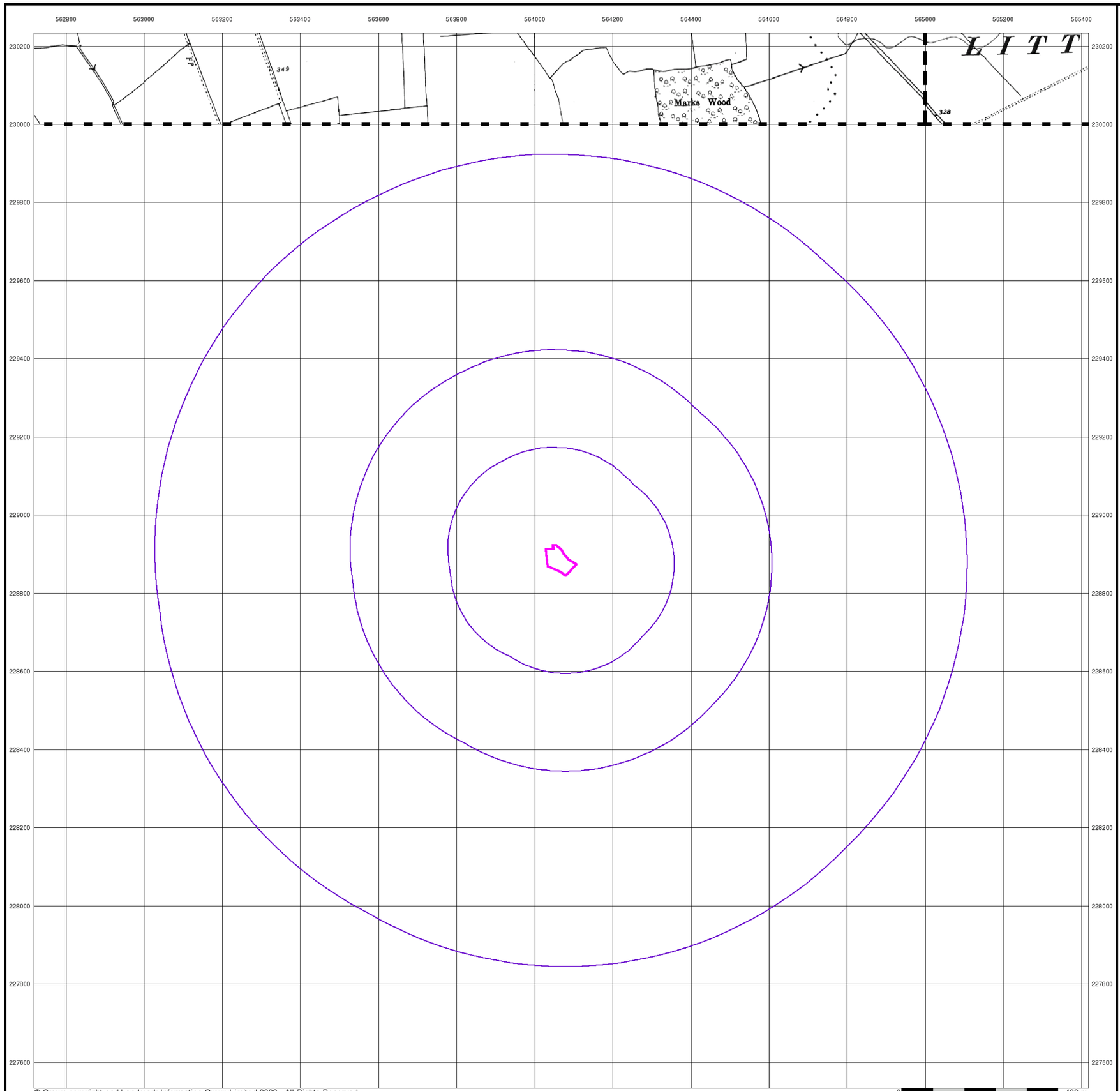

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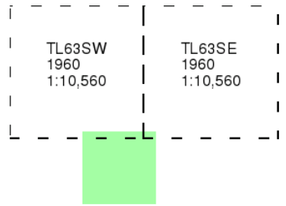
Ordnance Survey Plan

Published 1960

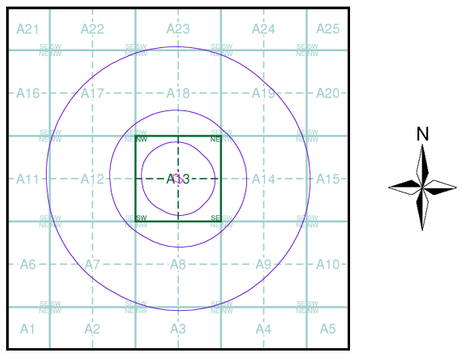
Source map scale - 1:10,000

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



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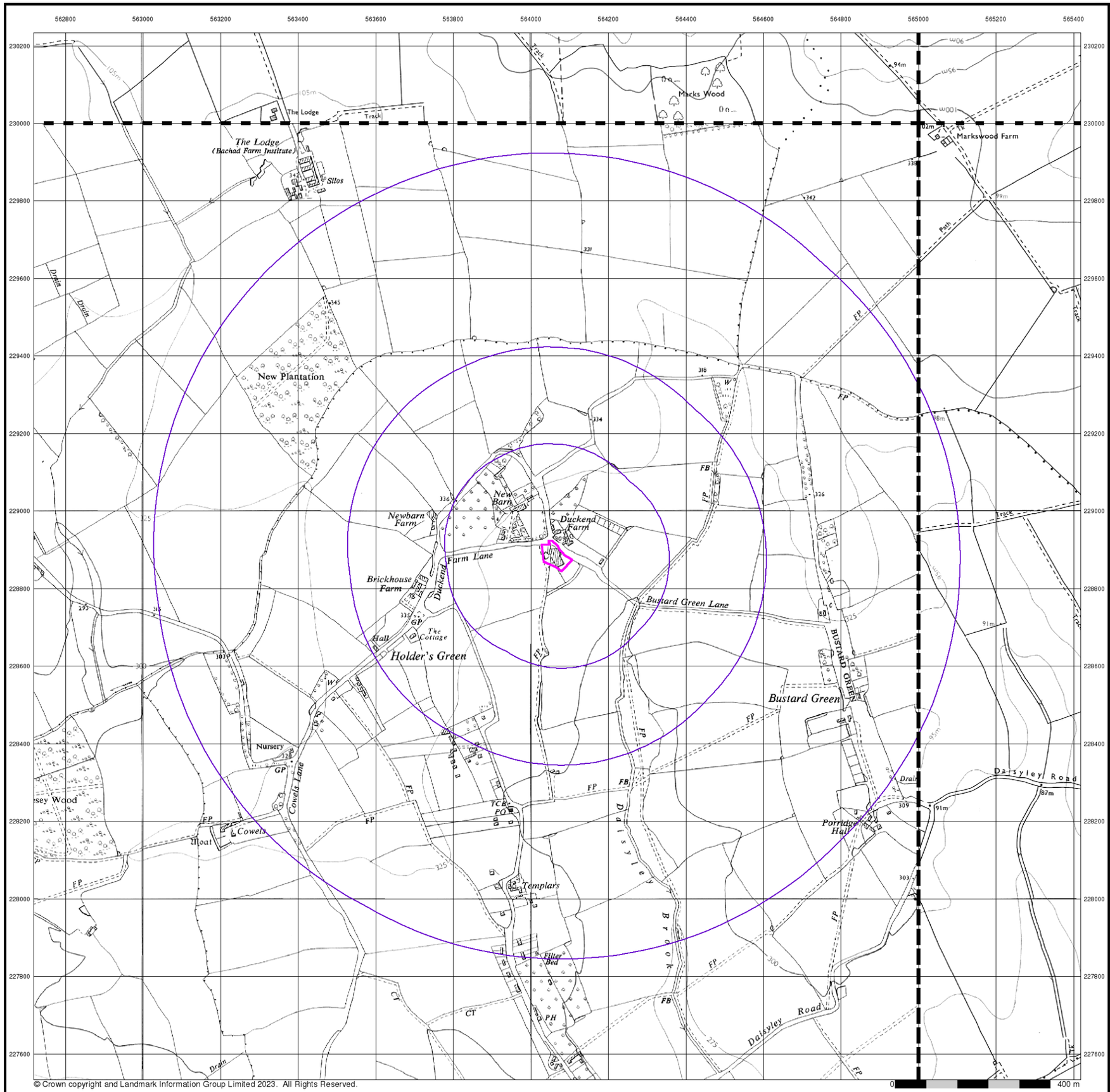

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Ordnance Survey Plan

Published 1981 - 1983

Source map scale - 1:10,000

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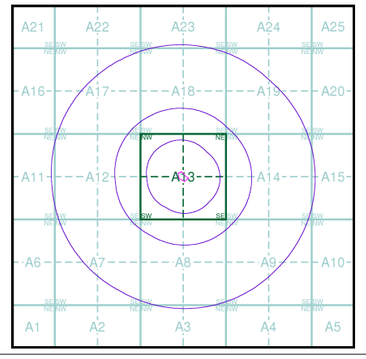
Map Name(s) and Date(s)

TL63SW 1983 1:10,000	TL63SE 1983 1:10,000
TL62NW 1981 1:10,560	TL62NE 1983 1:10,000

Historical Map - Slice A



Order Details

Order Number:	313915961_1_1
Customer Ref:	3293
National Grid Reference:	564060, 228880
Slice:	A
Site Area (Ha):	0.33
Search Buffer (m):	1000

Site Details

Duck End Farm Ltd, Duck End Farm, Lindsell, DUNMOW, CM6 3QH

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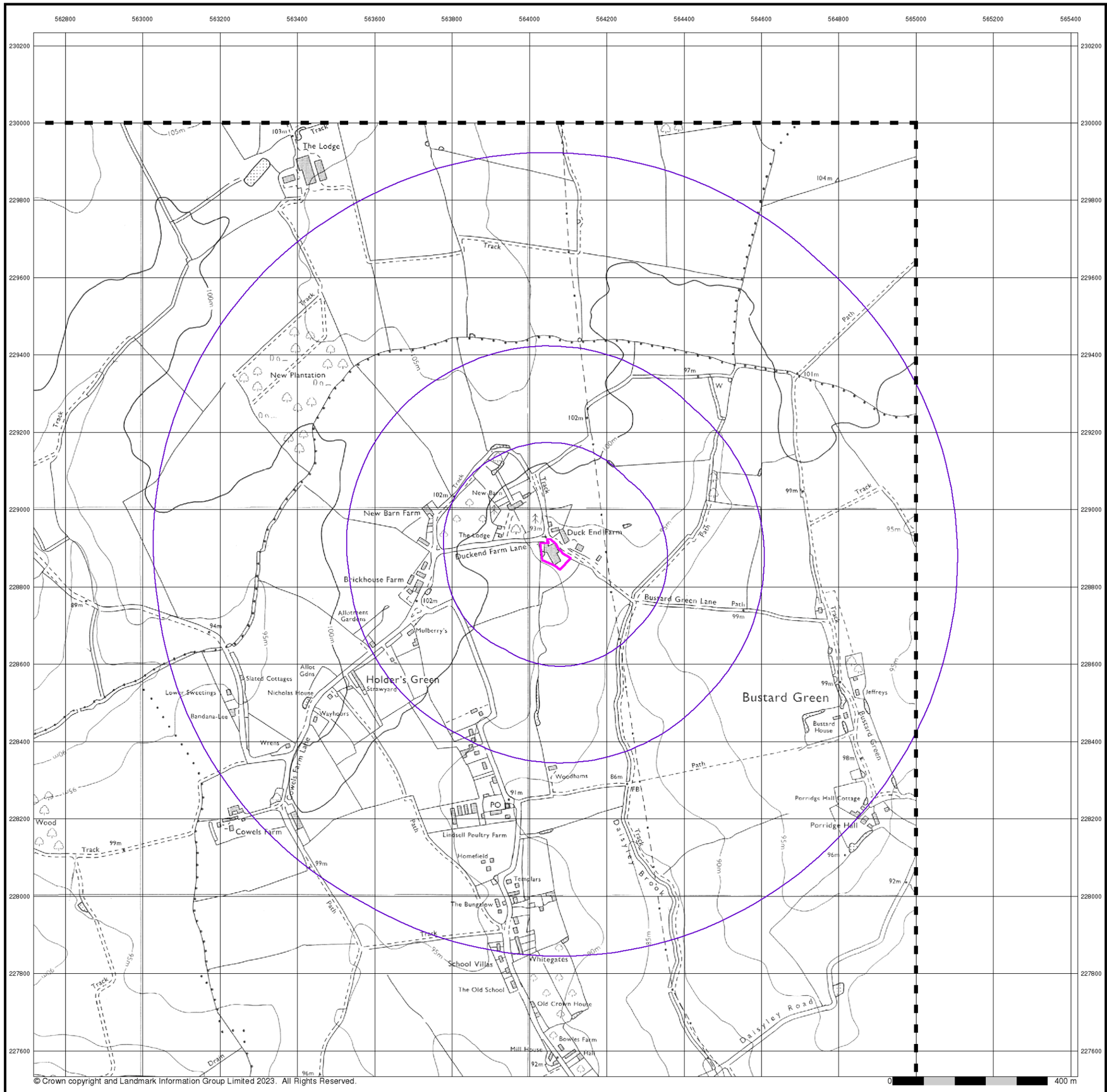

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Ordnance Survey Plan

Published 1982

Source map scale - 1:10,000

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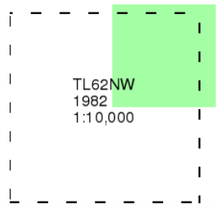
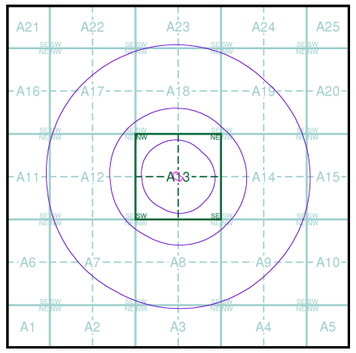
Map Name(s) and Date(s)



Historical Map - Slice A



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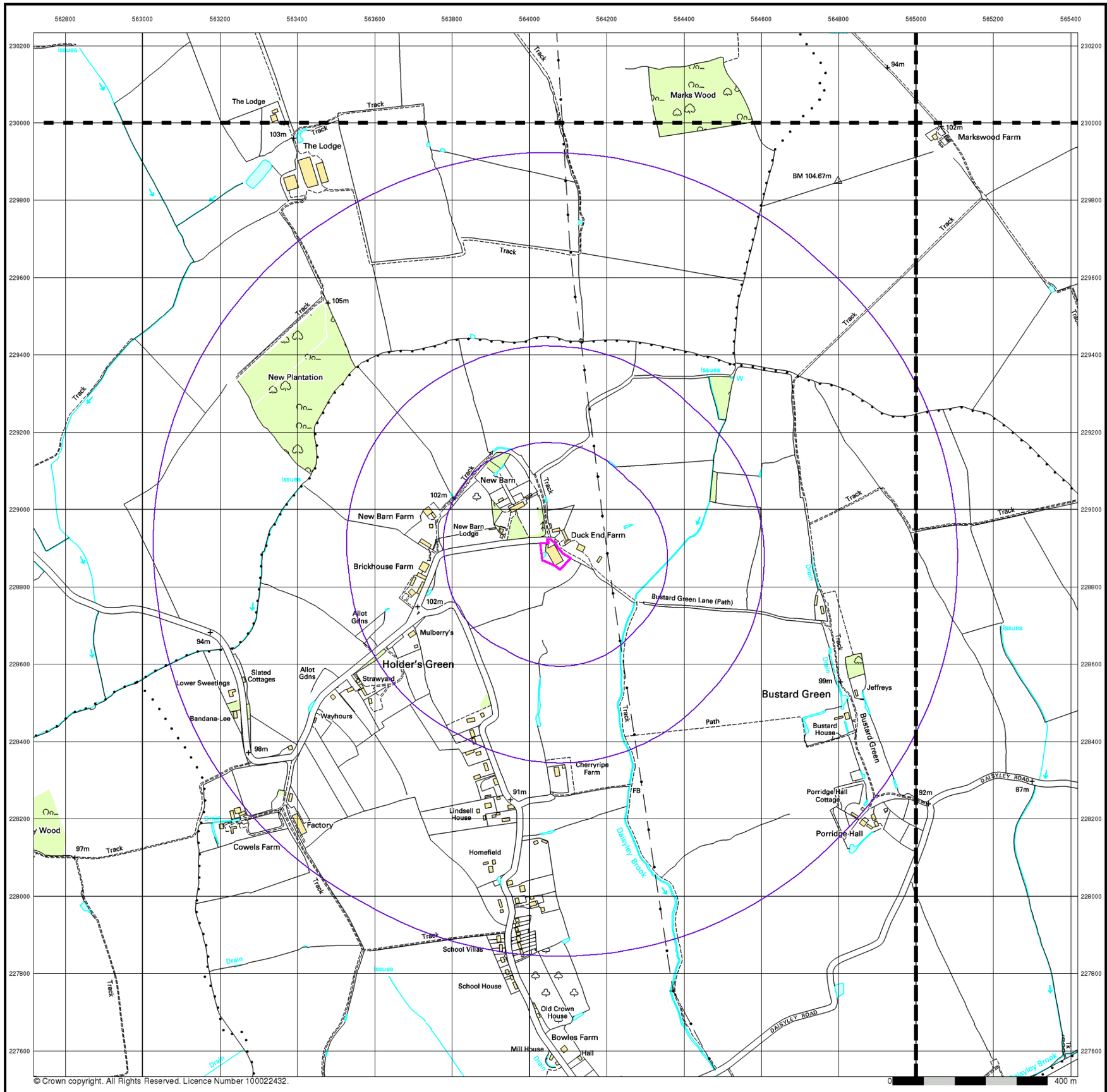

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10k Raster Mapping

Published 1999

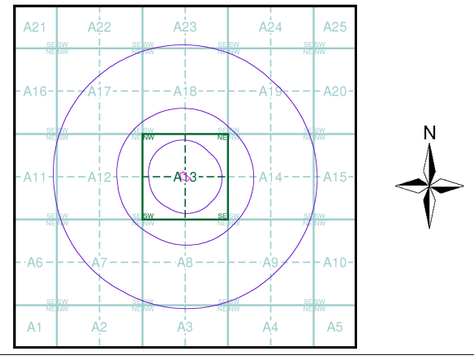
Source map scale - 1:10,000

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)

TL63SW 1999 1:10,000	TL63SE 1999 1:10,000
TL62NW 1999 1:10,000	TL62NE 1999 1:10,000

Historical Map - Slice A



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Order Number:	313915961_1_1
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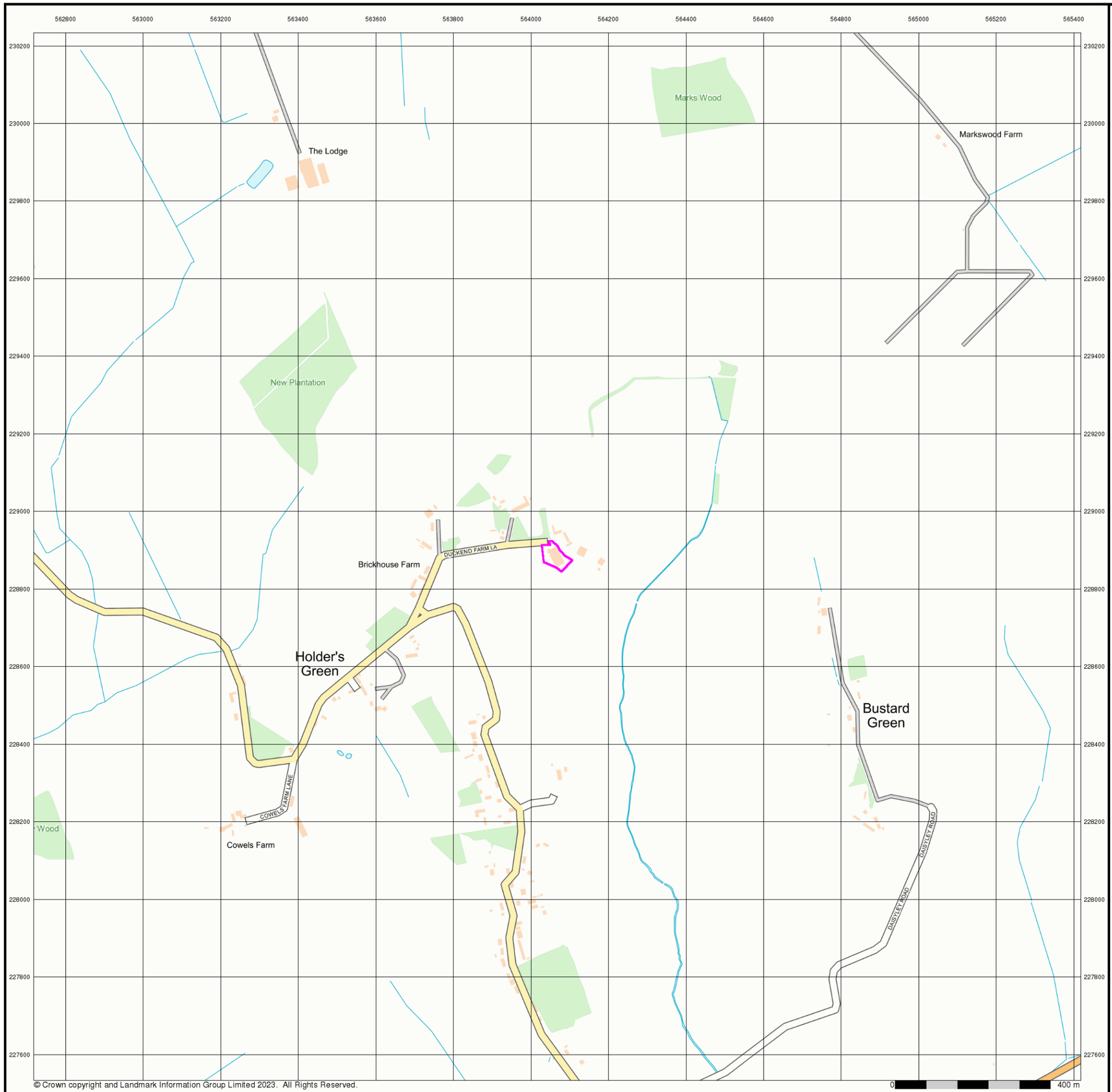

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Street View

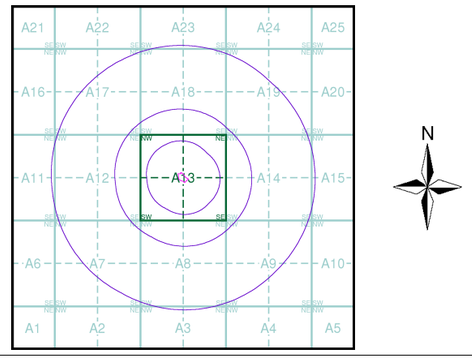
Published 2023

Source map scale - 1:10,000

Street View is a street-level map for the whole of Great Britain produced by the Ordnance Survey. These maps are provided at a nominal scale of 1:10,000

Map Name(s) and Date(s)

Street View Map - Slice A



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