



Geotechnical &  
Environmental  
Consultants

Hinckley Phase 4  
Leicestershire

**Combined Phase I Desk Study and  
Phase II Exploratory Investigation  
For  
Bloor Homes East Midlands**



**GeoDyne Limited**  
9 Brunel Parkway, Pride Park  
Derby DE24 8HR

Tel: 01332 290 798 email: [info@geodyne.co.uk](mailto:info@geodyne.co.uk)

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|---------------------------|---------------------------------------------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------------|
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| Issue/revision            | Prepared by                                                                                 | Checked By                                                           | Approved By                                                          |
|                           | <b>Stephen Sellers BSc (Hons)</b><br><b>MSc FGS</b><br>Principal Geo-Environmental Engineer | <b>Paul Kershaw BSc (Hons)</b><br><b>PGDip CGeol FGS</b><br>Director | <b>Paul Kershaw BSc (Hons)</b><br><b>PGDip CGeol FGS</b><br>Director |
|                           |                                                                                             |                                                                      |                                                                      |
|                           |                                                                                             |                                                                      |                                                                      |
| Comments                  |                                                                                             |                                                                      |                                                                      |

## EXECUTIVE SUMMARY

| GEOTECHNICAL CONSIDERATIONS  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ground Conditions            | Very clayey topsoil to depths of between 0.25m and 0.35m begl. Made Ground was not encountered within any of the exploratory holes. The Natural Strata typically comprised stiff silty CLAY with sand / silt pockets, overlying very stiff CLAY with mudstone lithorelicts. Localised soft spots encountered in one location.                                                                                                                                                                                                                                                                                                                                               |
| Foundation Design            | Foundations for the proposed residential dwellings are likely to comprise traditional strip or trench fill. The natural near surface (Clay) soils underlying the site appear suitable to support a nett allowable ground bearing pressure of up to 120kN/m <sup>2</sup> . Foundations should be advanced to a minimum founding depth of 1.00m below existing or proposed ground level (whichever being the deeper) and founded within undisturbed suitably competent natural soils. Should any Made Ground or soft spots be encountered at founding depth, foundations will require further deepening to encounter underlying undisturbed suitably competent natural soils. |
| Floor Slab Design            | Ground bearing floor slabs may be adopted provided that there is less than 0.60m of suitably compacted geotechnically competent sub-slab fill beneath proposed slabs and subject to the requirements of NHBC Standards Chapter 4.2 'Building Near Trees'. Where in excess of 0.60m of sub-slab fill is present, a suspended slab may be adopted, which may be either cast in-situ or a pre-cast suspended floor with a clear ventilated void.                                                                                                                                                                                                                               |
| Ground Gas Precautions       | No precautions required.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Radon                        | No precautions required.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Building Near Trees          | Foundation designs may require adjusting in accordance with NHBC Standards Chapter 4.2, when building near trees / hedgerows, based on the presence of shrinkable soils of a high volume change potential.                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Water                        | Dewatering of excavations during development is considered unlikely to be necessary, assuming that an effective drainage strategy can be implemented to deal with any surface water prior to development.                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Excavations / Stability      | It is considered that the majority of excavations are unlikely to require trench support other than for health and safety reasons. The assessment of excavations and provision of support will be the responsibility of the contractor on site.                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Sulphate Classification      | Design Sulphate Class DS-1 and an Aggressive Chemical Environment for Concrete classification of AC-1s.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Coal Mining                  | No precautions required.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| CBRs                         | A CBR value of between less than 2% and 4% can be anticipated within the shallow Natural Strata, subject to confirmation by in-situ testing.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Surface Water Drainage       | It is considered that the use of soakaways is unlikely to be feasible.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| ENVIRONMENTAL CONSIDERATIONS |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Contamination Assessment     | The topsoil and Natural Strata may be considered to be uncontaminated in the context of the proposed end-use.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Remediation Proposals        | No specific remediation works will be required other than the provision of topsoil in proposed gardens and areas soft landscape.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| GENERAL CONSIDERATIONS       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Construction Workers         | It is recommended that construction personnel involved with direct contact with the soils at the site use appropriate PPE equipment together with hygiene facilities in accordance with general health and safety guidelines.                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Utilities                    | Prior to development of the site, we would recommend that a copy of this report is supplied to utility companies, and that their recommendations relating to appropriate supply pipes are adhered to.                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Unforeseen Circumstances     | Should any areas of potentially contaminated soil be encountered during site construction works we would recommend consultation with GeoDyne to ensure that our recommendations continue to apply.                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Licenses etc                 | The Contractor / Developer is responsible for, and must ensure that, all necessary licenses, permits, plans, registrations and approvals are in place prior to commencing with the construction works at the site.                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Statutory Consultation       | In accordance with normal planning requirements, we would recommend that a copy of our report is issued by the Client to the Local Authority (and NHBC or other Warranty Provider, if necessary) for review / comment and approval prior to commencing with the development of the site.                                                                                                                                                                                                                                                                                                                                                                                    |

## **1.0 INTRODUCTION**

### **1.1 Introduction**

GeoDyne Limited has been appointed by the Client, Bloor Homes East Midlands, to undertake a combined Phase I Desk Study & Phase II Exploratory Investigation on a parcel of land located to the west of Normandy Way (A47), Hinckley, Leicestershire. The site, known colloquially as Hinckley Phase 4, comprises an extension to the adjacent Bloor Homes site, currently under construction to the immediate northwest.

A site location plan (Figure No. D42153/01) is included in Appendix I.

### **1.2 Project Understanding**

We understand that it is proposed to develop the site with low-rise residential properties, incorporating private gardens and public open space. We further understand that a proposed site layout has not been determined at this stage.

The foregoing understanding has formed the basis of our assessment. Where the proposed site end-use is not consistent with our current understanding, it would be necessary to review our assessment to ensure it continues to apply.

### **1.3 Objectives**

The scope of works detailed herein have been designed to ascertain the key geotechnical and environmental issues pertaining to the proposed development.

### **1.4 Scope of Works**

Based on the defined objectives of the works (detailed in Section 1.3), the scope of the Phase I Desk Study included the following:

- A site walkover.
- Review of available historical and contemporary Ordnance Survey publications relating to the site.
- Review of the sites geology, hydrology, hydrogeology and groundwater vulnerability.
- Review of the sites coal mining status.
- Review of the sites radon status.
- Commission of a full detailed Landmark Envirocheck Report relating to the site.
- Commission of Landmark geological mapping data.
- Production of a preliminary Conceptual Site Model (pCSM).

Phase II Exploratory Investigation works comprised:

- A sub-contracted sub-surface utility scan of proposed exploratory hole locations.
- A series of mechanically excavated trial pits across the site.
- A series of window sampling boreholes across the site.
- Geotechnical and environmental soil testing.
- Revision of the pCSM.

### **1.5 Limitations**

The conclusions and recommendations made in this report are limited to those that can be made based on the findings of the investigation.

Where comments are made based on information obtained from third parties, GeoDyne Limited assumes that all third party information is true and correct. No independent action has been undertaken to validate the findings of third parties.

This report has been prepared in accordance with our understanding of current good practice. However, changes to good practice, guidance or legislation may necessitate revision of this report after the date of issue.

GeoDyne Limited has prepared this report for the sole use and reliance of Bloor Homes East Midlands, in accordance with our standard Conditions & Limitations (included in Appendix XII). This report may not be used or relied upon by any unauthorised third party without the explicit written agreement of GeoDyne Limited. Reliance may not be placed on our report until all invoices associated with the project have been paid.

## 2.0 SITE DESCRIPTION & HISTORY

### 2.1 Site Description

The site comprises an irregular shaped parcel of land located to the west of Normandy Way, Hinckley. The site may be located centred around approximate Ordnance Survey National Grid Reference 440720E, 294400N. The site covers an area of approximately 4.18 hectares.

At the time of our walkover (November 2022), the majority of the site comprised the southeastern extent of a sensibly level larger grass field which was overgrown with weeds. Stubble was noted locally, indicative of the field having formerly been used for arable farming. The site was waterlogged with standing water observed across much of its extent.

A field boundary ran across the strip of land which forms the northern corner of the site. This boundary was demarcated by a shallow open drain which was heavily overgrown with brambles / scrub. The dense vegetation prevented observation of any water which may have been present within the drain. The field boundary / drain continued beyond the site to its west.

The northern corner of the site (i.e. the thin strip of land to the north of the field boundary / drain) was occupied by recently created soft landscape associated with a housing development, currently under construction to the sites northwest. The soft landscape sloped moderately up towards the north.

The topographical survey dated March 2014, and earlier reviewed historical mapping (discussed in more detail in Section 2.2), show overhead electricity cables running through eastern areas of the site almost parallel to Normandy Way. No evidence of these cables was observed during our walkover indicating their recent removal. Further overhead electricity cables (partially removed / diverted by ongoing development works) ran through the fields to the west of the site.

Wooden fencing and hedgerows bordered the site to the south and east. A gypsy bund was present immediately beyond a wooden gate within the fencing along the eastern site boundary. Metal security fencing bordered the majority of the remainder of the site, preventing unauthorised access to the housing development under construction to the sites northwest.

Further open fields, now overgrown but with evidence of recent farming activity, were located to the sites west. A former field boundary (substantially removed) was located immediately beyond the western site boundary.

A traffic roundabout to the sites south connected Normandy Way with the access road to the Triumph Motorcycle Factory (located to the sites southwest). An existing housing estate was located beyond Normandy Way to the sites east.

An annotated site plan showing the main features of the site and the immediate surrounding area is included in Appendix II of this report (Figure No. D42153/02). A plan showing general views of the site is included in Appendix III (Figure No. D42153/03).

An aerial photograph of the site, obtained from the Landmark Analysis tool commissioned as part of our works, is presented in Figure 1 on the next page, with the current OS mapping plan for the site and surrounding area presented in Figure 2.

**Figure 1:** Aerial photograph of the site (2022 image)



**Figure 2:** Current OS Mastermap Plan



## 2.2 Site History

The historical and contemporary Ordnance Survey publications included within the Landmark Envirocheck Report have been reviewed by GeoDyne to establish the history of the site and its environmental setting. The historical Ordnance Survey maps are included in Appendix IV of this report. We would note that the boundary marked on the historical sheets within the Envirocheck Report appears to 'shift' on several of the maps due to scaling inaccuracies between maps of differing dates. This is a function of Envirocheck transposition algorithms.

The key findings of the historical search are summarised in Table 1.

| TABLE 1 – HISTORICAL PUBLICATION DATA |                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Date                                  | Features on Site                                                                                                                                                                                                                                                                                                                                                                                                            | Features off Site                                                                                                                                                                                                                                                                                                                                               |
| 1880s                                 | <ul style="list-style-type: none"> <li>The site comprises undeveloped agricultural fields with trees shown along some field boundaries.</li> <li>An open drain comprises the field boundary which cuts across the northern corner of the site. The water within the drain is shown to flow towards the west.</li> <li>A track runs through the southern half of the site, in an approximate east west direction.</li> </ul> | <ul style="list-style-type: none"> <li>The site is generally surrounded by further agricultural fields.</li> <li>A small cluster of buildings ('Tithe Farm') surrounded by trees, a small pond and enclosures is located to the immediate north of the site.</li> <li>Two small ponds are shown from approximately 40m to the northeast of the site.</li> </ul> |
| 1890s                                 | <ul style="list-style-type: none"> <li>No maps available for viewing.</li> </ul>                                                                                                                                                                                                                                                                                                                                            | <ul style="list-style-type: none"> <li>No maps available for viewing.</li> </ul>                                                                                                                                                                                                                                                                                |
| 1900s                                 | <ul style="list-style-type: none"> <li>The site remains essentially unchanged, although the trees are no longer shown along the field boundaries.</li> </ul>                                                                                                                                                                                                                                                                | <ul style="list-style-type: none"> <li>The area surrounding the site remains essentially unchanged.</li> </ul>                                                                                                                                                                                                                                                  |
| 1910s                                 | <ul style="list-style-type: none"> <li>No maps available for viewing.</li> </ul>                                                                                                                                                                                                                                                                                                                                            | <ul style="list-style-type: none"> <li>No maps available for viewing.</li> </ul>                                                                                                                                                                                                                                                                                |
| 1920s                                 | <ul style="list-style-type: none"> <li>The site remains essentially unchanged, although the track is no longer shown running through the southern half of the site.</li> </ul>                                                                                                                                                                                                                                              | <ul style="list-style-type: none"> <li>Two new outbuildings have been constructed at Tithe Farm to the north of the site.</li> </ul>                                                                                                                                                                                                                            |
| 1930s                                 | <ul style="list-style-type: none"> <li>The site remains essentially unchanged.</li> </ul>                                                                                                                                                                                                                                                                                                                                   | <ul style="list-style-type: none"> <li>The area surrounding the site remains essentially unchanged.</li> </ul>                                                                                                                                                                                                                                                  |
| 1940s                                 | <ul style="list-style-type: none"> <li>No maps available for viewing.</li> </ul>                                                                                                                                                                                                                                                                                                                                            | <ul style="list-style-type: none"> <li>No maps available for viewing.</li> </ul>                                                                                                                                                                                                                                                                                |
| 1950s                                 | <ul style="list-style-type: none"> <li>The site remains essentially unchanged.</li> </ul>                                                                                                                                                                                                                                                                                                                                   | <ul style="list-style-type: none"> <li>The buildings which comprised Tithe Farm to the north of the site are no longer identified (presumed demolished).</li> </ul>                                                                                                                                                                                             |
| 1960s                                 | <ul style="list-style-type: none"> <li>The site remains essentially unchanged.</li> </ul>                                                                                                                                                                                                                                                                                                                                   | <ul style="list-style-type: none"> <li>Localised regrading activity (possibly associated with a landfill site) is evident from approximately 65m to the northeast of the site.</li> <li>One of the small ponds to the northeast of the site is no longer identified (presumed infilled).</li> </ul>                                                             |
| 1970s                                 | <ul style="list-style-type: none"> <li>An overhead electricity cable is shown to run through the east of the site in an approximate north south direction.</li> </ul>                                                                                                                                                                                                                                                       | <ul style="list-style-type: none"> <li>The small pond to the north of the site is no longer identified (presumed infilled).</li> </ul>                                                                                                                                                                                                                          |
| 1980s                                 | <ul style="list-style-type: none"> <li>The site remains essentially unchanged, although the field boundaries appear to have been reconfigured.</li> </ul>                                                                                                                                                                                                                                                                   | <ul style="list-style-type: none"> <li>Towards the end of the 1980s, a large housing estate has been constructed from approximately 70m to the south of the site.</li> <li>'Dodwells Road' runs to the immediate east of the site, partially atop a slight embankment.</li> </ul>                                                                               |
| 1990s                                 | <ul style="list-style-type: none"> <li>The aerial photography dated 1999 shows the open drain cutting across the northern corner of the site to be the only internal field boundary left within the site boundary.</li> </ul>                                                                                                                                                                                               | <ul style="list-style-type: none"> <li>The road to the east of the site has been upgraded and is now call 'Northern Perimeter Road West'. A traffic roundabout has been constructed to the immediate south of the site.</li> <li>The housing estate has expanded and is now present to the east of the site beyond the road.</li> </ul>                         |

| TABLE 1 – HISTORICAL PUBLICATION DATA |                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                 |
|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Date                                  | Features on Site                                                                                                                                                                               | Features off Site                                                                                                                                                                                                                                                                                               |
| 2006                                  | <ul style="list-style-type: none"> <li>An open drain to the west of the site appears to cross the northern boundary to the southern area of the site.</li> </ul>                               | <ul style="list-style-type: none"> <li>The grounds to a large factory building, associated with Triumph Motorcycles, have been expanded and now lie to the immediate southwest of the site.</li> <li>The housing estate beyond the road to the east of the site has been expanded towards the north.</li> </ul> |
| 2021                                  | <ul style="list-style-type: none"> <li>The site remains essentially unchanged, although the drain which appeared to cross the site boundary on the 2006 mapping is no longer shown.</li> </ul> | <ul style="list-style-type: none"> <li>The housing estate beyond the road to the east of the site has again been expanded towards the north.</li> <li>A 'Recreation Ground' is shown to the northeast of the site in the area formerly anticipated to comprise a landfill.</li> </ul>                           |

### 2.3 Aerial Photography & Historical Map Overlays

As part of the commissioned Landmark Report, the use of the Landmark Envirocheck Analysis tool was purchased to provide site specific aerial photographic imagery, and to provide the ability to undertake limited historical map overlay manipulation.

The following pictures (Figures 3 to 5) show overlays of the historical map publications, as shown on current aerial imagery.

**Figure 3:** Current Aerial Imagery Overlain with 1888 Historical Map Data.

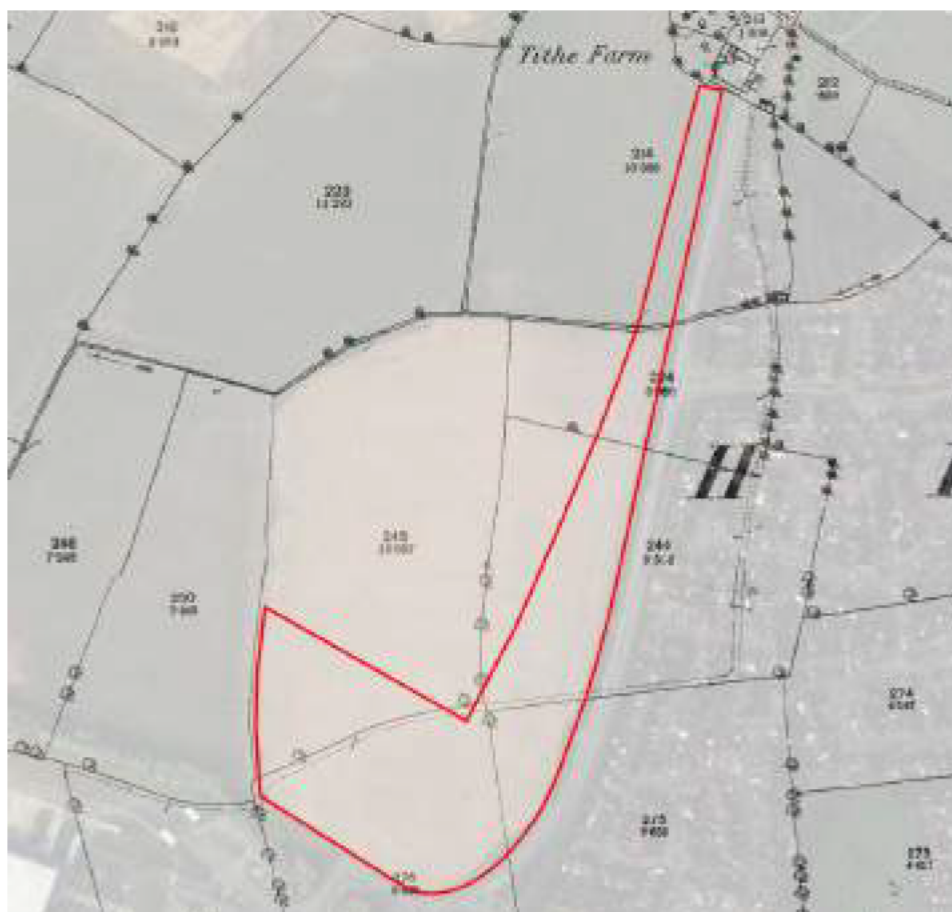


Figure 3 shows the site to essentially comprise undeveloped agricultural fields. The open drain (flowing towards the west) can be seen cutting across the strip of land which forms the northern corner of the site. Tithe Farm is located to the immediate north of the site.

**Figure 4:** Current Aerial Imagery Overlain with 1963 Historical Map Data.



Figure 4 shows the site and its surrounding area to remain essentially unchanged. The cluster of buildings which comprise Tithe Farm are no longer shown to the north of the site.

**Figure 5:** Current Aerial Imagery Overlay with 1993 Historical Map Data.

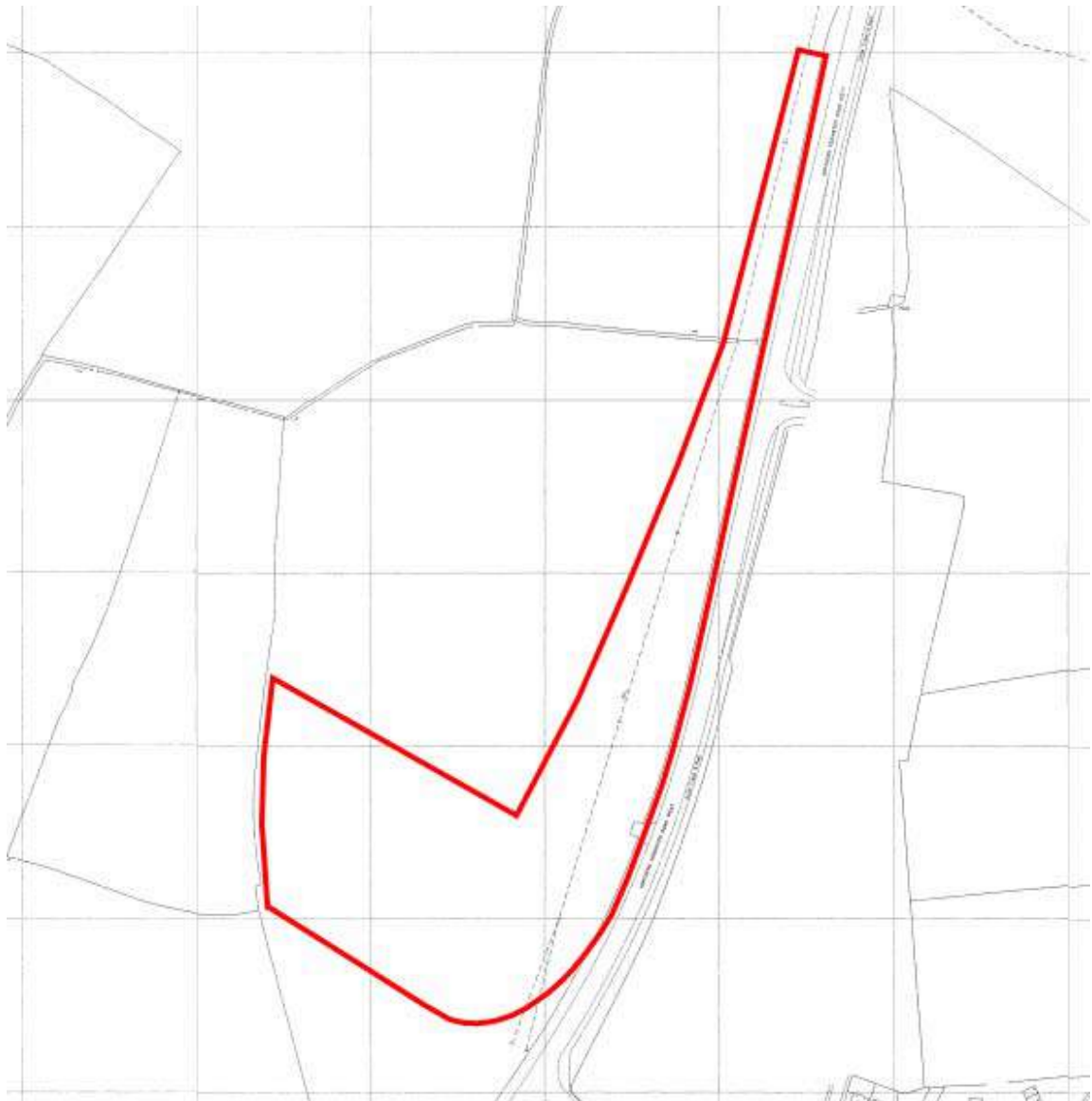


Figure 5 shows the site to remain essentially unchanged, although the majority of the field boundaries appear to have been removed. An overhead electricity cable is shown to run through the east of the site in an approximate north south direction. A road has been constructed to the immediate east of the site, beyond which the housing estate can be seen in the southeastern corner of the image expanding towards the north.

## 3.0 GEOLOGY & ENVIRONMENTAL SETTING

### 3.1 Geological References

The following geological publications were referred to:

- BGS 1:50000 Series Sheet 169 'Coventry' (1994).
- Landmark geological map sheets (included in Appendix V).
- The BGS online interactive map viewer and Lexicon of Named Rock Units.
- The Coal Authority online interactive map viewer.

### 3.2 Geology

#### Superficial Drift Deposits

The reviewed geological publications indicate the site to be underlain by drift deposits of the Bosworth Clay Member. These strata date from the Quaternary and are described on the reviewed mapping as 'Clay & Silt'.

A tongue of Alluvium is shown cutting across the site where it narrows towards its northern corner. Where present, the Alluvium (also dating from the Quaternary) is indicated to overlie the Bosworth Clay Member and is described on the reviewed mapping as 'Clay, Silt, Sand & Gravel'.

Drift deposits can vary rapidly in geotechnical competence and consistency both laterally and vertically over relatively short distances and have the potential to be water bearing. Furthermore, fluvial drift deposits may contain peat either as discrete lenses or discontinuous layers.

#### Bedrock Geology

The drift deposits are indicated to be underlain by strata of the Mercia Mudstone Group. The Mercia Mudstone Group is Triassic in age and is described in the referenced geological publications as '*...red-brown silty mudstone with grey siltstone and sandstone beds*'. The mudstone may weather to clay in the near surface horizons.

### 3.3 Faults

No surface faults are indicated to be present within the boundary of the site or within the immediate vicinity of the site, on the geological maps viewed.

### 3.4 Man-Made Deposits

The geological publications do not show the presence of any man-made deposits (i.e. Made Ground, Worked Ground or Landscaped Ground for example) beneath the site.

The geological publications indicate an area of Made Ground, variously described as '*undivided*' or '*former sand workings*', beyond Normandy Way to the northeast of the site and within potentially influencing distance (i.e. <250m) of the site boundary. This Made Ground corresponds with what is anticipated to comprise a former landfill feature based on the evidence of reviewed historical mapping and is considered to represent a potential source of hazardous ground gas (i.e. carbon dioxide and methane) that may, under the right circumstances, affect the proposed development site.

### 3.5 Landmark Envirocheck Report

A Landmark Envirocheck Report was commissioned to assist in ascertaining the environmental setting of the site. The full Envirocheck Report is presented in Appendix VI and has revealed the following key relevant information (details are only listed where they are within potential influencing distance of the site).

No comments have been made in our report with respect to potential flooding issues. Advice from a qualified drainage consultant should be sought by the Client with respect to this matter.

#### 3.5.1 Agency and Hydrological

##### Aquifer Status

The aquifer designation maps are presented in Appendix VI and are based on geological mapping provided to Landmark by the British Geological Survey. Different aquifer classifications may be applied to superficial (drift) deposits (typically forming shallow perched groundwater units where present) and bedrock aquifers (which may contain regional groundwater units). Possible aquifer designations comprise Principal Aquifers, Secondary (A, B or Undifferentiated) Aquifers and Unproductive Strata.

The drift deposits underlying the site are typically classified as Unproductive Strata (i.e. the Bosworth Clay Member). The localised Alluvium is classified as a Secondary A Aquifer.

Unproductive strata is described by the Environment Agency as *'...rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow'*. Secondary A Aquifers are described by the Environment Agency as *'Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers'*.

The bedrock indicated to underlie the site (i.e. strata of the Mercia Mudstone Group) is classified as a Secondary B Aquifer.

Secondary B Aquifers are described by the Environment Agency as *'Predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers'*.

##### Source Protection Zone Status

The site is not shown to lie within a Source Protection Zone (SPZ), as designated by the Environment Agency. SPZs relate to the protection of groundwater resources principally for public drinking water supply.

##### Groundwater Abstractions

No entries are listed within 250m of the site boundary in the Envirocheck report.

##### Discharge Consents

One consent is shown to have been issued within 250m of the site, 180m to the sites east. The consent, relating to discharge to a stream (Harrow Brook), was issued in 1972; no revocation date given. No further significant details are stated within the Envirocheck report other than the positional accuracy only being to within 100m.

### Surface Water

The nearest surface water feature is indicated to be on-site and appears to relate to the shallow open drain (heavily overgrown) which crosses the sites northern corner, as evidenced from our recent site walkover.

### **3.5.2 Waste**

There are no waste sites (i.e. current or historic landfills, waste transfer stations etc) identified on the site. The Envirocheck report shows a historical, and BGS / Local Authority recorded, landfill site from approximately 47m to the northeast of the site. Deposited waste types are described as inert, industrial, commercial and household waste, and liquid sludge. Input dates are stated as being between 1966 and 1986. The registered landfill site recorded 173m to the northeast of the site appears to relate to the same tipping facility.

The landfill appears to be located in the approximate location of where regrading activity, indicative of a landfill operation, was noted on the reviewed historical mapping from circa the 1960s (see Table 1).

### **3.5.3 Hazardous Substances**

There are no entries associated with hazardous substances (i.e. sites dealing with explosives etc) within a 250m radius of the site, identified in the Envirocheck report.

### **3.5.4 Geological Issues**

#### BGS Soil Chemistry

The BGS has prepared estimated soil concentration maps for several metals (including Arsenic, Lead, Nickel, Chromium and Cadmium), which are extrapolated from records available for use within their assessments.

Whilst potentially useful for the inference of Natural Metal Enrichment (NME) of the natural soils in a general locale, the data should not be used to inform any detailed decisions with regards to the chemistry of a particular site as it does not allow for anthropogenic effects. Estimates of the soil chemistry at the site indicate anticipated concentrations of Arsenic of <15mg/kg, Cadmium of <1.8mg/kg, Chromium of 40-60mg/kg, Lead <100mg/kg and Nickel of 15-30mg/kg.

Based on the information supplied within the Envirocheck report, the site is not shown to be located within an area where Natural Metal Enrichment of the underlying natural soils is likely to be present. However, this is only applicable to the specific determinands listed above.

#### Ground Stability Hazards

No significant ground stability hazards have been identified by the Envirocheck report that relate to the site (including from collapsible, dissolution, landslide, running sand and shrinking or swelling clay ground stability hazards). We would comment that the site has a moderate risk rating for compressible ground stability hazards.

The site does not lie within an area requiring a coal mining report from the Coal Authority.

### Radon

The Envirocheck Report identifies that the site lies within a lower probability Radon area and no Radon protective measures are necessary in the construction of new dwellings or extensions.

### BGS Borehole Records

There are several BGS borehole records shown across the Triumph factory grounds to the southwest of the site. However, all of these boreholes are confidential / restricted access and no details are currently available for public viewing.

## **3.5.5 Industrial Land Use**

### Contemporary Trade Directory Entries

There are four contemporary trade directory entries recorded within 250m of the site, one active and three inactive. The only active entry relates to a fork-lift truck business 228m to the south of the site. The inactive entries relate to former businesses dealing with pest control, tarpaulins and garage services, all to the south of the site, the closest 204m from the site boundary.

### Commercial Services

Four commercial service entries are recorded within 250m of the site. These include a mobile vehicle servicing business 149m to the east of the site, with the remaining three entries also listed as contemporary trade directory entries (see above).

## **3.5.6 Sensitive Land Use**

The site is identified as being within a Nitrate Vulnerable Zone. In our experience the majority of this area of the country is defined as a Nitrate Vulnerable Zone and this classification is considered not to present a potential risk to the site.

## **3.6 Land Use Assessment**

As part of the land use assessment, reference has been made to the '*Desk Reference Guide to potentially Contaminative Land Uses*' produced by Mr P Syms and published jointly by the ISVA (The professional Society for Valuers and Auctioneers) in association with The Royal Institution of Chartered Surveyors (RICS) and the Chartered Institute of Environmental Health (CIEH).

We have also made reference to the Department for Environment, Food and Rural Affairs and the Environment Agency Contaminated Land Report CLR8 '*Potential Contaminants for the Assessment of Land*' (March 2002). Although now formally withdrawn, this document identifies key contaminants which may potentially be present at a site as a result of a given historical land use and is considered useful as a desk based ready reference guide.

### **3.6.1 On Site Assessment**

At the time of our walkover (November 2022), the majority of the site comprised the southeastern extent of a sensibly level larger grass field which was overgrown with weeds. The site was waterlogged with standing water observed across much of its extent. The northern corner of the site was occupied by recently created soft landscape associated with a housing development, currently under construction to the sites northwest.

Historically, with the exception of the former overhead electricity cables which previously crossed the field, the site is indicated to have remained essentially undeveloped and in agricultural use since the earliest reviewed mapping circa the 1880s.

The site is not identified in any of the land-use categories adopted in the above publications. Based on the information obtained from our desk study enquiries, our walkover of the site and experience of similar sites, potential general soil contamination that may be present could include:

- Metals and metalloids associated with any potential Made Ground beneath the site.
- Polycyclic Aromatic Hydrocarbons (PAHs) from any ashy inclusions and / or carbonaceous inclusions in the near surface soils.
- Pesticides associated with the historical agricultural use of the site.

### **3.6.2 Off Site Assessment**

With regards to potential sources of chemical contamination, based on the findings of the Phase I Desk Study enquiries, there are no significant potentially contaminative land uses known to be present within close proximity to the site.

The Desk Study enquiries have revealed the presence of a former landfill to the northeast of the site. The infill materials to this feature may be considered to represent a potential source of hazardous ground gases (i.e. methane and carbon dioxide) which may, under certain circumstances migrate to the site.

## 4.0 PRELIMINARY CONCEPTUAL SITE MODEL

### 4.1 General

The DEFRA publication '*Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance*' (dated April 2012) states the following with regards to the production of a Conceptual Site Model (CSM) for a site:

*'The process of risk assessment involves understanding the risks presented by land, and the associated uncertainties. In practice, this understanding is usually developed and communicated in the form of a "conceptual model"'. The development of a CSM is typically undertaken in an iterative process, reflecting the changes in understanding as more detailed site information becomes available.*

In developing a CSM, and specifically in the context of land contamination, consideration needs to be given to three essential elements; which form the basis of any risk present. The statutory guidance sections 3.8 and 3.9 (April 2012) states the following:

- (a) *'A "contaminant" is a substance which is in, on or under the land and which has the potential to cause significant harm to a relevant receptor, or to cause significant pollution of controlled waters.*
- (b) *A "receptor" is something that could be adversely affected by a contaminant, for example a person, an organism, and ecosystem, property, or controlled waters...*
- (c) *A "pathway" is a route by which a receptor is or might be affected by a contaminant.*

*The term "contaminant linkage" means the relationship between a contaminant, a pathway and a receptor'. For a contaminant linkage to be plausible, all three elements need to be present.*

In undertaking a risk assessment and deriving a CSM for the purposes of the redevelopment of a site (i.e. planning and development control) reference has been made to both the Model Procedures for the Management of Land Contamination, as well as the National Planning Policy Framework (NPPF, dated July 2018).

The preliminary CSM should identify the hazards (source of potential contamination) and should set out the potential pollutant linkages with a view to identifying the nature and magnitude of the potential risks to receptors.

In order to undertake the foregoing assessment, consideration is required with respect to the probability or likelihood of the linkage occurring and the severity and significance of the potential consequences; taking account the nature of the pollutant linkage and the potential severity of the hazard and the sensitivity of the receptor within the context of the proposed land use (in consideration of the planning regime).

Consideration of consequence / severity, probability/likelihood and risk has been based on the following guidance documentation:

- CIRIA C552 '*Contaminated Land Risk Assessment, A Guide to Good Practice*', 2001.
- EA R&D publication 66 '*Guidance for the Safe Development of Housing on Land Affected by Contamination*', 2008.

## 4.2 Classification of Consequences

In order to apply a consequence classification to a particular potential pollutant linkage, it is first necessary to define the terminology used within the classification system. The following terminology and definitions detailed in Table 2 have been adopted within our assessment, based on the guidance referenced in Section 4.1.

| TABLE 2 – CLASSIFICATION OF CONSEQUENCES |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Classification                           | Definition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Severe                                   | <ul style="list-style-type: none"> <li>Acute risks to human health.</li> <li>Short-term risk of pollution of controlled waters or significant impact on controlled waters; e.g. large-scale pollution or very high levels of contamination.</li> <li>Catastrophic damage to buildings or property (such as building explosion causing collapse).</li> <li>Ecological system effects – immediate risks of major damage which is likely to result in irreversible substantial adverse changes in the functioning of the ecosystem or harm to a species of special interest that endangers the long-term maintenance of the population.</li> </ul>                                                                                                                                                                                       |
| Medium                                   | <ul style="list-style-type: none"> <li>Chronic risks to human health.</li> <li>Pollution of sensitive water resources (such as leaching of contaminants into controlled waters) causing a significant effect on water quality.</li> <li>Ecological system effects – Immediate risks of significant damage which may result in substantial adverse changes to the ecosystems functioning or harm to a species of special interest that may endanger the long-term maintenance of the population.</li> <li>Significant damage to buildings, structures and services (for example foundation damage or rendering the building unsuitable for habitation).</li> </ul>                                                                                                                                                                     |
| Mild                                     | <ul style="list-style-type: none"> <li>Non-permanent health effects to human health (i.e. exposure is unlikely to lead to 'significant harm' in the context of Part 2A of the Environmental Protection Act 1990).</li> <li>Pollution of controlled waters or non-sensitive water resources (for example non-classified groundwater) that results in a short-lived effect to water quality or a marginal effect on amenity value, agriculture or commerce.</li> <li>Minor damage to buildings, structures and services.</li> <li>Ecological system effects – Minor or short-term damage which is unlikely to result in substantial adverse changes to the ecosystems functioning or harm to a species of special interest.</li> <li>Substantial damage to non-sensitive environments (such as arable farmland for example).</li> </ul> |
| Minor                                    | <ul style="list-style-type: none"> <li>No measurable effects on human health including non-permanent health effects to human health that are easily preventable by appropriate use of PPE/RPE.</li> <li>Minor pollution of controlled waters including non-sensitive water resources with no discernible effects on water quality or ecosystems.</li> <li>Minor damage to non-sensitive environments (including arable farmland for example).</li> <li>Easily repairable effects of damage to buildings, structures, services or the environment (for example discolouration of concrete, loss of plants in a landscaping scheme etc.).</li> </ul>                                                                                                                                                                                    |

## 4.3 Classification of Probability

Once the possibility of a pollutant linkage has been established (noting that probability classification does not apply when there is no possibility of a linkage being present), the probability should be classified in accordance with Table 3.

| TABLE 3 – CLASSIFICATION OF PROBABILITY |                                                                                                                                                                                                                           |                                              |
|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| Classification                          | Definition                                                                                                                                                                                                                | Likelihood                                   |
| High Likelihood                         | There is a pollutant linkage and an event is highly likely to occur in the short-term, and is almost inevitable over the long-term OR there is evidence at the receptor of harm or pollution occurring.                   | >95% likelihood of Consequence Occurring     |
| Likely                                  | There is a pollutant linkage and it is probable that an event will occur. It is not inevitable, but possible in the short-term and likely over the long-term.                                                             | 50 – 95% likelihood of Consequence Occurring |
| Low Likelihood                          | There is a pollutant linkage and circumstances are possible under which an event could occur. It is by no means certain that even over a longer period such an event would take place, and less likely in the short-term. | 5 – 49% likelihood of Consequence Occurring  |
| Unlikely                                | There is a pollutant linkage and it is improbable that an event would occur even in the very long-term.                                                                                                                   | <5% likelihood of Consequence Occurring      |

#### 4.4 Classification of Risk

In order to establish the relevant risk term applicable to the identified pollutant linkage, one of the risk phrases identified within Table 4 must be adopted, with the definitions of each risk term detailed within Table 5.

| TABLE 4 - RISK CLASSIFICATION MATRIX (BASED ON C552 CIRIA, 2001) |                 |                     |              |              |                                 |
|------------------------------------------------------------------|-----------------|---------------------|--------------|--------------|---------------------------------|
|                                                                  |                 | Consequence of Risk |              |              |                                 |
|                                                                  |                 | Severe              | Medium       | Mild         | Minor                           |
| Probability (Likelihood)                                         | High Likelihood | Very High           | High         | Moderate     | Moderate/Low                    |
|                                                                  | Likely          | High                | Moderate     | Moderate/Low | Low                             |
|                                                                  | Low Likelihood  | Moderate            | Moderate/Low | Low          | Negligible                      |
|                                                                  | Unlikely        | Moderate/Low        | Low          | Negligible   | Negligible or No Potential Risk |

| TABLE 5 - RISK CLASSIFICATION DEFINITIONS (BASED ON C552 CIRIA, 2001) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Very High                                                             | There is a high probability that severe harm will 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                                                                  | 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                                                              | It is possible that harm could arise to a designated receptor from an identified hazard. However, there is a low likelihood that such harm would be severe, or if any harm were to occur it is more likely that the harm would be 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                                                          | It is possible that harm could arise to a receptor. However, a combination of likelihood and consequence results in a risk that is above low but is not of sufficient concern to be classified as moderate. It can be driven by cases where there is an acute risk which carries a severe consequence, but where the exposure is unlikely. Such harm would at worst normally be mild. The risk is unlikely to present a substantial liability. Some limited further investigation may be required to clarify the risk and any associated liability. If subsequent remediation works are necessary, they are likely to be limited in extent. |
| Low                                                                   | 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Negligible                                                            | There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is unlikely to be any worse than mild. No liability would be associated with such risks.                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| No Potential Risk                                                     | There is no potential risk or liability where no pollutant linkage has been established.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

#### 4.5 Contaminant [C] - Pathway [P] - Receptor [R] Considerations

The following CPR assessment has been undertaken based on the assumption of a residential end-use incorporating private gardens and public open space.

#### 4.6 Consideration of Potential Sources of Contamination [C]

Based on the findings of our desk study works, the potential key sources of contamination at the site that would require consideration for the derivation of a preliminary CSM would be the following:

| TABLE 6 – SUMMARY OF POTENTIAL CONTAMINANT SOURCES   |                                                                                                             |
|------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
| Areas of Potential Concern (APCs)                    | Associated Contaminants                                                                                     |
| Near Surface Soils (including potential Made Ground) | <ul style="list-style-type: none"> <li>Metals &amp; Metalloids</li> <li>PAHs</li> <li>Pesticides</li> </ul> |
| Off-Site Historical Landfill                         | <ul style="list-style-type: none"> <li>Ground gases (including methane and carbon dioxide)</li> </ul>       |

#### 4.7 Consideration of Potential Pathways [P]

The potential pathways at the site are primarily:

- Direct ingestion of soil (either directly or as soil particles attached to produce).
- Inhalation of fugitive dust and vapours.
- Direct skin contact with the ground.
- Direct ingestion of home-grown produce.
- Direct ground contact with construction materials (including supply pipes).
- Vertical and lateral migration of contamination.
- Vertical and lateral migration of potentially hazardous ground gases / vapours.

#### 4.8 Consideration of Potential Receptors [R]

The potential receptors at the site are:

- The final end users (residents – typically long term (chronic) exposure) and site visitors – (typically short term (acute) exposure).
- The construction personnel (i.e. site workers) involved with the development of the site (typically short term (acute) exposure).
- Neighbouring properties (off-site receptors).
- Controlled Waters (i.e. underlying groundwater and nearby surface waters).
- Buildings and construction materials (including buried utilities).

In preparing this CSM, it has been assumed that construction personnel involved with the development of the site (typically short term (acute) exposure) will adopt all necessary personal protective equipment (PPE and RPE etc.) and conform to health and safety requirements of their site-specific Risk Assessments and Method Statements (RAMS). Site workers have therefore not been included within the following table, as the adoption of these appropriate mitigation measures will result in an overall low risk of exposure to the C-P-R linkages identified.

#### 4.9 Preliminary Risk Assessment / Conceptual Site Model

Our preliminary conceptual model of possible pollutant linkages, applicable to the proposed site usage and based on our current understanding, is summarised in Table 7.

| TABLE 7 – PRELIMINARY RISK ASSESSMENT SUMMARY TABLE<br>DESK STUDY |                                                                                         |                           |                               |                                  |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------------------------------------------------------------|-----------------------------------------------------------------------------------------|---------------------------|-------------------------------|----------------------------------|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Potential Contaminant Source<br>[C]                               | Potential Pathway(s)<br>[P]                                                             | Potential Receptor<br>[R] | Probability of<br>CPR Linkage | Consequence<br>of<br>CPR Linkage | Risk Level | Comments / Justification                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Near Surface Soils (including potential Made Ground)              | Direct contact, ingestion or inhalation of fugitive dust and vapours                    | End users                 | Low Likelihood                | Mild                             | Low        | No Made Ground is indicated from geological mapping to be present on the site.<br>No potentially significant historical contaminative land uses have been identified at the site.<br>End users are likely to come into contact with the in-situ soils within gardens and areas of soft landscape.<br>Further consideration of this potential linkage should be provided during the course of the Phase II Exploratory Investigation works.                                                                                                                                                                       |
|                                                                   | Plant uptake / soil attached to home grown produce                                      | End users                 | Low Likelihood                | Mild                             | Low        | No Made Ground is indicated from geological mapping to be present on the site.<br>No potentially significant historical contaminative land uses have been identified at the site.<br>Growing vegetables for private consumption may be anticipated at the site.<br>Further consideration of this potential linkage should be provided during the course of the Phase II Exploratory Investigation works.                                                                                                                                                                                                         |
|                                                                   | Vertical and lateral migration                                                          | Neighbouring properties   | Low Likelihood                | Mild                             | Low        | No Made Ground is indicated from geological mapping to be present on the site.<br>No potentially significant historical contaminative land uses have been identified at the site.<br>No significant sources of potentially mobile contamination have been identified.<br>Further consideration of this potential linkage should be provided during the course of the Phase II Exploratory Investigation works.                                                                                                                                                                                                   |
|                                                                   | Leaching of contaminants through unsaturated zone and/or vertical and lateral migration | Controlled Waters         | Low Likelihood                | Mild                             | Low        | No Made Ground is indicated from geological mapping to be present on the site.<br>No potentially significant historical contaminative land uses have been identified at the site.<br>No significant sources of potentially mobile contamination have been identified.<br>The site does not lie within a SPZ.<br>The site is immediately underlain by Unproductive Strata and locally by a Secondary A Aquifer. The site is underlain at depth by a Secondary B Aquifer.<br>Further consideration of this potential linkage should be provided during the course of the Phase II Exploratory Investigation works. |

**TABLE 7 – PRELIMINARY RISK ASSESSMENT SUMMARY TABLE  
DESK STUDY**

| Potential Contaminant Source<br>[C]                  | Potential Pathway(s)<br>[P]                                  | Potential Receptor<br>[R]                                                         | Probability of<br>CPR Linkage | Consequence<br>of<br>CPR Linkage | Risk Level | Comments / Justification                                                                                                                                                                                                                                                                                             |
|------------------------------------------------------|--------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------|----------------------------------|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Near Surface Soils (including potential Made Ground) | Direct contact or contact with vapours                       | Plastic buildings products (e.g. water supply pipes) and buried concrete          | Low Likelihood                | Mild                             | Low        | No Made Ground is indicated from geological mapping to be present on the site. No potentially significant historical contaminative land uses have been identified at the site. Further consideration of this potential linkage should be provided during the course of the Phase II Exploratory Investigation works. |
| Off-Site Historical Landfill                         | Vertical and lateral migration of ground gases to indoor air | End users of new buildings (asphyxiation) or new buildings (damage via explosion) | Low Likelihood                | Severe                           | Moderate   | The Desk Study enquiries have revealed the presence of a historical landfill in close proximity to the site. Further consideration of this potential linkage (including a programme of ground gas monitoring) should be provided during the course of the Phase II Exploratory Investigation works.                  |

The foregoing preliminary conceptual model highlights the potential plausible pollutant linkages that may relate to the site and would therefore require addressing by appropriate Phase II Exploratory Works. The information contained within the conceptual model should be confirmed and revised upon completion of an appropriate intrusive investigation, as detailed in the following sections.

## **5.0 GROUND INVESTIGATION**

### **5.1 Introduction**

#### Sub-Surface Utility Avoidance Scan

Prior to the commencement of our intrusive works at the site, a sub-contracted sub-surface utility scan was undertaken to attempt to avoid buried services during the intrusive works. Based on the results of the service scan and taking account of the requirement to avoid buried services, the exploratory holes were positioned to maximise the amount of information obtained at the site.

#### Trial Pits

Fourteen mechanically excavated trial pits (TP1 to TP14) were excavated at the site on 16<sup>th</sup> and 17<sup>th</sup> November 2022. The trial pits were excavated to depths of between 3.10m and 3.40m below existing ground level (begl).

#### Window Sampling Boreholes

Five window sampling boreholes (WS1 to WS5) were advanced at the site on 18<sup>th</sup> November 2022. All of the boreholes were advanced to a depth of 4.00m begl and were installed with water / ground gas monitoring wells to facilitate a programme of monitoring.

#### Exploratory Hole Locations / Logs

The approximate locations of the exploratory holes are indicated on the plan presented in Appendix VII of this report (Figure No. D42153/04). The exploratory hole logs are presented in Appendix VIII of this report.

### **5.2 Ground Conditions**

The general ground conditions encountered across the site may be summarised as follows.

#### **5.2.1 Topsoil**

Very clayey topsoil was encountered in all of the exploratory holes to depths of between 0.25m and 0.35m begl.

#### **5.2.2 Made Ground**

Made Ground was not encountered within any of the exploratory holes advanced at the site.

#### **5.2.3 Natural Strata**

##### Superficial Drift Deposits

The Natural Strata typically comprised stiff silty CLAY, which became very stiff with increased depth.

The Clay was locally firm near surface and within approximately half of the exploratory holes was slightly gravelly to a depth of approximately 0.60m begl. Within the majority of the exploratory holes (12No.) the Clay contained various sized pockets of sand which typically became smaller and less prevalent with increased depth. The sand pockets were encountered to depths of up to approximately 1.65m begl.

Silt pockets, also of various sizes, were encountered within the Clay in four of the exploratory holes from depths in excess of 1.70m begl. The silt pockets were generally firm with the exception of some very soft to soft clayey silt pockets between 1.70m and 2.60m begl in one location (TP8).

The drift deposits are considered to be typically representative of both the Bosworth Clay Member and the more localised Alluvium which are indicated within the reviewed geological publications to underlie the site.

### Bedrock Geology

The drift deposits were underlain by typically very stiff (locally stiff) CLAY with mudstone lithorelicts. These strata were generally encountered from depths in excess of 2.45m begl (shallower in one location; WS5 from 1.55m begl).

These strata are considered to be typically representative of the Mercia Mudstone Group, which is indicated within the reviewed geological publications to underlie the drift deposits at the site.

## **5.3 Visual & Olfactory Evidence of Soil Contamination**

We would note that no obvious visual or olfactory evidence of significant soil contamination was identified in the soils during the course of the site works (such as hydrocarbons or visible fragments of asbestos, for example).

## **5.4 Water**

Water seepages were not encountered within any of the exploratory holes during their advancement.

However, we would note that at the time of our works the majority of the site was waterlogged which resulted in slight, locally steady, water ingress into the majority of the exploratory holes from ground level.

## **5.5 Stability**

The trial pits generally remained stable during their excavation and for the short period of time they remained open following completion. Localised collapsing of trial pit walls was recorded within TP8, between 1.70m and 2.60m begl, where the soft silt pockets were encountered.

The boreholes generally remained stable during their advancement with the exception of WS1 which required casing to its full depth to enable the installation of the monitoring well. The remainder of the boreholes were cased to a depth of 2.00m begl as a precautionary measure.

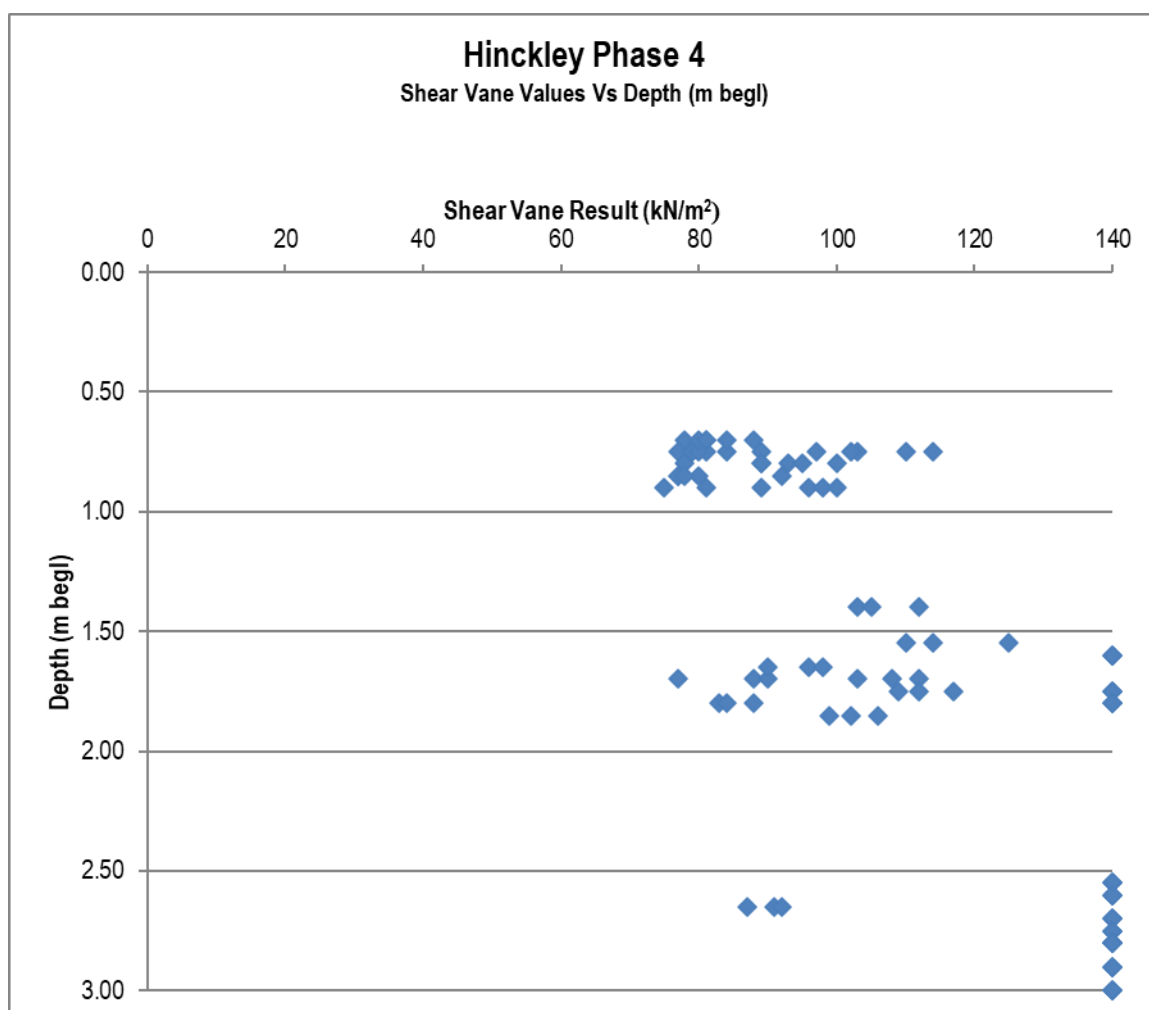
## **5.6 Plates**

A photographic record of the exploratory investigation was obtained during the intrusive works. Selected photographs of the intrusive works are presented on the plates presented in Appendix IX of this report (Plate Nos. 1 to 19).

## 5.7 Shear Vane Values

Shear vane testing was undertaken within the visually cohesive natural soils encountered within selected exploratory holes. The results revealed typical soil shear strength values of between 75kN/m<sup>2</sup> and in excess of 140kN/m<sup>2</sup>, at depths of between 0.70m and 3.20m begl. In general, the results also show a typical increase in soil shear strength with increased depth.

It should be noted that shear vane testing undertaken at depths greater than 1.00m was carried out ex-situ for health and safety reasons. The shear vane values are detailed on the logs presented in Appendix VIII. A graph showing shear vane results in relation to depth is presented below.



## 5.8 Standard Penetration Test (SPT) Data

To assist with establishing a strength / depth profile, SPT testing was undertaken within borehole WS1.

SPT 'N' values, recorded at 1m intervals within the natural Clay soils, were as follows:

- 1.00m begl = 'N' value of 7.
- 2.00m begl = 'N' value of 8.
- 3.00m begl = 'N' value of 9.
- 4.00m begl = 'N' value of 11.

## 6.0 LABORATORY TESTING & CONTAMINATION ASSESSMENT

### 6.1 Introduction

As part of our works a suite of geotechnical laboratory soils testing has been undertaken, which comprised the following:

- 12No. Plasticity Index tests.
- 8No. Water soluble sulphate tests.
- 10No. pH tests.

In addition, environmental soil testing was carried out on visually representative samples recovered from the exploratory holes. The testing strategy was based on the land use assessment and preliminary CSM derived by the desk study works, and was considered sufficient to enable an assessment of the chemical status of the soils at the site. The following testing has been undertaken as part of our works:

- 10No. Contamination suites (including metals, speciated Polycyclic Aromatic Hydrocarbons and Total Organic Carbon).
- 5No. Pesticide suites (OCP & OPP).

All laboratory soil test results are included in Appendix X.

### 6.2 Geotechnical Soil Test Results

#### Water Soluble Sulphate / pH

Water soluble sulphate testing was undertaken on 8No. samples recovered from the Natural Strata obtained during the site works. The testing revealed water soluble sulphate concentrations of between 30mg/l SO<sub>4</sub> and 260mg/l SO<sub>4</sub> within each of the samples tested. The pH values of the soil samples analysed (excluding topsoil) ranged between 8.45 and 8.96.

In accordance with the Building Research Establishment publication Special Digest 1 '*Concrete in Aggressive Ground*' (2005), the mean of the highest two sulphate results should be used to indicate the Design Sulphate Class (i.e. 195mg/l SO<sub>4</sub>), together with the mean of the lowest two pH values (8.65).

Therefore, in accordance with Special Digest 1:2005, the site falls into Design Sulfate Class DS-1 and an Aggressive Chemical Environment for Concrete (ACEC) classification of AC-1s. This classification has been made based on the assumption of natural ground conditions with static groundwater conditions beneath the site.

#### Plasticity Index Tests

A total of 12No. Plasticity Index (PI) tests have been undertaken on selected samples of the near surface Natural Strata obtained during the site works. In accordance with NHBC standards Chapter 4.2 '*Building Near Trees*', the reported PI values may be modified based on the portion of the sample passing the 425µm sieve.

The results of the PI analysis are summarised in Table 8.

| TABLE 8 – SUMMARY OF PLASTICITY INDEX (PI) DATA |                |        |                       |                    |                       |                         |
|-------------------------------------------------|----------------|--------|-----------------------|--------------------|-----------------------|-------------------------|
| Sample Ref.                                     | Depth (m begl) | Strata | Reported PI Value (%) | Portion <425µm (%) | Modified PI Value (%) | Volume Change Potential |
| TP1                                             | 0.70           | CLAY   | 30                    | 100                | 30                    | Medium                  |
| TP2                                             | 1.00           | CLAY   | 27                    | 100                | 27                    | Medium                  |
| TP3                                             | 1.30           | CLAY   | 39                    | 100                | 39                    | Medium                  |
| TP4                                             | 1.60           | CLAY   | 36                    | 100                | 36                    | Medium                  |
| TP5                                             | 1.90           | CLAY   | 39                    | 100                | 39                    | Medium                  |
| TP6                                             | 2.20           | CLAY   | 31                    | 100                | 31                    | Medium                  |
| TP7                                             | 2.50           | CLAY   | 32                    | 100                | 32                    | Medium                  |
| TP8                                             | 2.85           | CLAY   | 22                    | 100                | 22                    | Medium                  |
| TP9                                             | 0.85           | CLAY   | 38                    | 100                | 38                    | Medium                  |
| TP10                                            | 1.15           | CLAY   | 37                    | 100                | 37                    | Medium                  |
| TP12                                            | 1.75           | CLAY   | 40                    | 100                | 40                    | High                    |
| TP14                                            | 2.35           | CLAY   | 28                    | 100                | 28                    | Medium                  |

In accordance with NHBC Guidance, Table 8 reveals that the visually cohesive natural soils analysed (i.e. Clay) may be regarded as being of medium to high volume change potential. We would therefore recommend that soils of high volume change potential are assumed for design purposes, where applicable.

### 6.3 Contamination Assessment Rationale

We understand that it is proposed to redevelop the site with low-rise residential properties incorporating private gardens and public open space.

#### 6.3.1 Assessment Methodology

In order to undertake a Generic Quantitative Risk Assessment (GQRA) we have adopted the Suitable for Use Levels (S4ULs) published by LQM/CIEH in their publication referenced: 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. All rights reserved.'* In the absence of an S4UL screening value, we have made reference to the Category 4 Screening Levels (C4SLs) published by DEFRA.

In consideration of the available generic land uses utilised in the derivation of the adopted screening criteria, we have adopted a residential end-use with plant uptake scenario for the purposes of our assessments.

For assessment purposes, we have adopted a policy whereby determinands within the dataset are individually compared to the relevant screening value (i.e. individual S4ULs). Where determinands within the dataset are less than the appropriate screening value, the determinand is considered to be present at an acceptable concentration and no further assessment is required. Additional comment, statistical assessment or further Detailed Quantitative Risk Assessment (DQRA) may be provided where elevated values are revealed.

#### 6.3.2 Selection of Soil Organic Matter (SOM) Content

The SOM content and soil type are used to provide an assessment of the applicability of the screening values adopted (the S4UL values are typically based upon SOM of 1%, 2.5% and 6%, as applicable, with all metals derived utilising 6% SOM as standard).

Where available at Tier 1 level, determinands have in the first instance been compared to screening values adopting a conservative SOM of 1%.

Where the determinand exceeds the relevant screening value at 1% SOM, a site-specific SOM may be adopted as appropriate to derive more site-specific screening values and the dataset reassessed.

## 6.4 Sampling Strategy

The sampling strategy for the site was primarily to retrieve visually representative soil samples from a selection of locations that provide an initial coverage across the entire site area. The sampling strategy was based on a review of the historical, geological and environmental information obtained from the Desk Study enquiries and the current and proposed site setting together with the ground conditions encountered during our Phase II exploratory works.

No specific areas of concern were identified at the site with respect to ground contamination. Therefore, it was considered appropriate to position the exploratory holes to provide general coverage, taking account of the presence of known buried services.

Table 9 summarises the reasoning behind the exploratory hole positions.

| TABLE 9 – REASONING FOR EXPLORATORY HOLE LOCATION             |                                                                                                                        |
|---------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| Exploratory Hole Reference                                    | Reasoning Behind Location                                                                                              |
| WS1                                                           | Targeted towards the off-site historical landfill to the sites northeast. Gas / groundwater monitoring well installed. |
| WS2 to WS5                                                    | General site coverage across the site avoiding known utilities. Gas / groundwater monitoring wells installed.          |
| TP1 to TP14                                                   | General site coverage across the site avoiding known utilities.                                                        |
| <b>Key</b><br>TP – Trial Pit<br>WS – Window Sampling Borehole |                                                                                                                        |

The ground conditions encountered during our Phase II works revealed the presence of two distinct types of material, i) topsoil, and ii) the underlying Natural Strata.

Representative samples of these soil types were obtained during our Phase II works and subjected to chemical analysis for a suite of contaminants deemed appropriate based on the findings of the Desk Study and the ground conditions encountered during the intrusive investigation.

It is noted that the suite of contaminants detailed in Section 3.6.1 and Table 6 were considered to remain applicable as an initial chemical screen of the encountered soils following completion of the site investigation works.

## 6.5 Contamination Analysis

Contamination tests were undertaken on visually representative samples of the topsoil (5No.), and the underlying Natural Strata (5No.) obtained from the site during our works.

In addition, five samples of the topsoil were subjected to pesticide analysis.

For initial assessment purposes, we have collated the results into two datasets, for individual comparison of the reported determinand concentrations against appropriate Tier 1 GACs, namely topsoil and the underlying undisturbed Natural Strata.

Please note that screening values have only been used for determinands where they are present at concentrations in excess of the LOD on at least one occasion.

## 6.6 Contamination Soil Test Results

### 6.6.1 Topsoil

The contamination assessment for the topsoil at the site is summarised in Table 10.

| TABLE 10 – SUMMARY OF TIER 1 GAC ASSESSMENT<br>(TOPSOIL – RESIDENTIAL WITH PLANT UPTAKE END-USE)                                                                                                                                                                                                               |                       |                             |                    |                              |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-----------------------------|--------------------|------------------------------|
| Contaminants – Potentially Harmful to Human Health                                                                                                                                                                                                                                                             | No. of Samples Tested | Concentration Range (mg/kg) | Tier 1 GAC (mg/kg) | Tier 1 GAC Exceeded (Yes/No) |
| <b>Metals</b>                                                                                                                                                                                                                                                                                                  |                       |                             |                    |                              |
| Arsenic                                                                                                                                                                                                                                                                                                        | 5                     | 2 – 6                       | 37 S4UL            | No                           |
| Cadmium                                                                                                                                                                                                                                                                                                        | 5                     | <0.5 & 0.8                  | 11 S4UL            | No                           |
| Chromium III                                                                                                                                                                                                                                                                                                   | 5                     | 22 – 30                     | 910 S4UL           | No                           |
| Copper                                                                                                                                                                                                                                                                                                         | 5                     | 10 – 19                     | 2400 S4UL          | No                           |
| Lead                                                                                                                                                                                                                                                                                                           | 5                     | 13 – 50                     | 200 C4SL           | No                           |
| Nickel                                                                                                                                                                                                                                                                                                         | 5                     | 14 – 21                     | 130 S4UL           | No                           |
| Zinc                                                                                                                                                                                                                                                                                                           | 5                     | 37 – 55                     | 3700 S4UL          | No                           |
| <b>Key</b><br>S4UL – CIEH/LQM Suitable 4 Use Levels (2015). Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3026. All rights reserved.<br>C4SL – value for Lead taken from DEFRA publication SP1010 and based on a residential (with home-grown produce) end-use. |                       |                             |                    |                              |

All determinands for the topsoil assessed (including speciated PAHs) were present at individual concentrations below the Limit of Detection of the method of analysis adopted by the laboratory and / or below the appropriate Tier 1 GAC based on a residential with plant uptake end-use.

### 6.6.2 Natural Strata

The contamination assessment for the Natural Strata at the site is summarised in Table 11.

| TABLE 11 – SUMMARY OF TIER 1 GAC ASSESSMENT<br>(NATURAL STRATA - RESIDENTIAL WITH PLANT UPTAKE END-USE)                                                                                                                                                                                                        |                       |                             |                    |                              |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-----------------------------|--------------------|------------------------------|
| Contaminants – Potentially Harmful to Human Health                                                                                                                                                                                                                                                             | No. of Samples Tested | Concentration Range (mg/kg) | Tier 1 GAC (mg/kg) | Tier 1 GAC Exceeded (Yes/No) |
| <b>Metals</b>                                                                                                                                                                                                                                                                                                  |                       |                             |                    |                              |
| Arsenic                                                                                                                                                                                                                                                                                                        | 5                     | 3 – 16                      | 37 S4UL            | No                           |
| Cadmium                                                                                                                                                                                                                                                                                                        | 5                     | 0.7 – 1.1                   | 11 S4UL            | No                           |
| Chromium III                                                                                                                                                                                                                                                                                                   | 5                     | 26 – 55                     | 910 S4UL           | No                           |
| Copper                                                                                                                                                                                                                                                                                                         | 5                     | 21 – 25                     | 2400 S4UL          | No                           |
| Lead                                                                                                                                                                                                                                                                                                           | 5                     | 10 – 17                     | 200 C4SL           | No                           |
| Nickel                                                                                                                                                                                                                                                                                                         | 5                     | 24 – 43                     | 130 S4UL           | No                           |
| Mercury                                                                                                                                                                                                                                                                                                        | 5                     | <0.17 – 0.87                | 40 S4UL            | No                           |
| Zinc                                                                                                                                                                                                                                                                                                           | 5                     | 49 – 64                     | 3700 S4UL          | No                           |
| <b>Key</b><br>S4UL – CIEH/LQM Suitable 4 Use Levels (2015). Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3026. All rights reserved.<br>C4SL – value for Lead taken from DEFRA publication SP1010 and based on a residential (with home-grown produce) end-use. |                       |                             |                    |                              |

All determinands for the Natural Strata assessed (including speciated PAHs) were present at individual concentrations below the Limit of Detection of the method of analysis adopted by the laboratory and / or below the appropriate Tier 1 GAC based on a residential with plant uptake end-use.

## **6.7 Pesticide Screening**

Pesticide testing was undertaken on 5No. samples of the topsoil recovered from across the site as part of the contamination assessment. The pesticide determinands assessed were present at individual concentrations below the limits of detection of the method of analysis adopted by the laboratory.

## **6.8 Contamination Assessment Summary**

### Human Health

Contamination testing was carried out on selected samples of the topsoil and the underlying Natural Strata.

On the basis of the chemical contamination assessment undertaken, the topsoil and Natural Strata may be considered to be uncontaminated in the context of the proposed end-use (i.e. in relation to human health).

### Controlled Waters

Given the low contaminant concentrations revealed by the testing undertaken, there are considered to be no specific risks posed to Controlled Waters by the findings of the laboratory analysis undertaken.

## 7.0 GROUND GAS & WATER LEVEL MONITORING RESULTS

### 7.1 Introduction

Based on the potential presence of an off-site source of potentially harmful ground gas, monitoring points were installed in each of the window sample boreholes to facilitate an initial programme of monitoring (i.e. for methane and carbon dioxide).

### 7.2 Monitoring Installations

Upon completion, WS1 to WS5 were installed with combined ground gas and water monitoring standpipes to facilitate a programme of monitoring. Installations were positioned to provide general site coverage and to target the off-site historical landfill (as detailed in Table 9). The monitoring wells were sealed near surface with bentonite, with the stop-taps left proud of site levels and enclosed in metal top-hat covers, in an attempt to prevent excessive volumes of surface water (from the waterlogged ground) entering the installations.

During the investigation works, no significant organic soils (such as peat deposits) were encountered within the exploratory holes advanced at the site.

The ground gas and water monitoring data obtained from the site is presented in Appendix XI of this report.

### 7.3 Results of the Ground Gas Monitoring

A total of four ground gas and water monitoring visits have been undertaken at the site over a four week period. The ground gas monitoring results are summarised in Table 12.

| TABLE 12- SUMMARY OF GROUND GAS MONITORING DATA      |         |         |
|------------------------------------------------------|---------|---------|
| Parameter                                            | Minimum | Maximum |
| Methane (v/v)                                        | 0.0     | 0.0     |
| Carbon Dioxide (v/v)                                 | 0.0     | 1.4     |
| Oxygen (v/v)                                         | 19.8    | 21.1    |
| Peak Flow (L/h)                                      | 0.0     | 0.0     |
| Steady Flow (L/h)                                    | 0.0     | 0.0     |
| <b>KEY</b><br>v/v - % by volume<br>L/h - litres/hour |         |         |

A maximum carbon dioxide concentration of 1.4% by volume was recorded during the monitoring programme. Measurable methane concentrations were not recorded during the monitoring programme.

No discernible flow rates (positive or negative) in excess of +/-0.1 litres per hour were recorded during the monitoring programme.

Periods of falling atmospheric pressure are considered to be the optimum barometric conditions for gas emissions from the ground. Two of the gas monitoring visits were carried out following a period of falling atmospheric pressure.

The atmospheric pressure trends over the 24hrs prior to monitoring are summarised below:

- 28<sup>th</sup> November 2022 – Fall of 6mb
- 7<sup>th</sup> December 2022 – Fall of 2mb
- 13<sup>th</sup> December 2022 – Steady
- 19<sup>th</sup> December 2022 – Rise of 6mb

The atmospheric pressure trends noted during the monitoring period do not appear to have affected the ground gas concentrations recorded or more pertinently the flow rates. No variations in flow rates were noted during the monitoring carried out during the differing atmospheric conditions, as no flow rates were recorded on any of the monitoring visits.

The highest recorded carbon dioxide concentration was encountered in WS3, with a concentration of 1.4% by volume, following a fall in atmospheric pressure of 2mb prior to monitoring.

Water was recorded at depths of between 0.15m and 0.82m begl during the monitoring programme. Based on the general absence of water seepages within the exploratory holes during their advancement, it is considered likely that the water recorded within the installations during the monitoring visits represents water that has seeped into the wells from surface. We would reiterate that standing water was encountered at surface across much of the site, both during the site works and during the return monitoring visits.

## 7.4 Appropriate Guidance

### 7.4.1 British Standard & CIRIA

The results of the gas monitoring have been reviewed with reference to the following documentation:

- British Standard BS 8485 '*Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings*' (2015+A1:2019).
- CIRIA Report C665 '*Assessing risks posed by hazardous ground gases to buildings*' (2007).
- CIRIA Report C735 '*Good practice on the testing and verification of protection systems for buildings against hazardous ground gases*' (2014).

### 7.4.2 Gas Screening Value Calculation

BS 8485 and CIRIA Report C665 recommend a risk-based methodology to ground gas assessment, the first step of which includes the calculation of a site-specific Gas Screening Value (GSV). The GSV of a particular ground gas regime equates to:

- $GSV (l/h) = \text{maximum borehole flow rate (l/h)} \times (\text{maximum gas concentration}/100).$

The GSV should be calculated for both Methane and Carbon Dioxide (where appropriate) to determine a site-specific Characteristic Situation for each gas. The higher the calculated GSV, the greater the risk posed by the presence of ground gas. The CIRIA guidance document notes that '*...the GSV is a guideline value and not an absolute threshold*'.

### 7.4.3 Site Classification

The next step in the assessment process is determining the sites classification. Table 2 of BS 8485 (reproduced below) presents six Characteristic Situations (CS) to assist in the classification of the site, based on the calculated GSV for Methane and Carbon Dioxide.

**Table 2** — CS by site characteristic GSV

| CS  | Hazard potential | Site characteristic GSV <sup>A)</sup><br>L/h | Additional factors                                                                                               |
|-----|------------------|----------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| CS1 | Very low         | <0.07                                        | Typically <1% methane concentration and <5% carbon dioxide concentration (otherwise consider an increase to CS2) |
| CS2 | Low              | 0.07 to <0.7                                 | Typical measured flow rate <70 L/h (otherwise consider an increase to CS3)                                       |
| CS3 | Moderate         | 0.7 to <3.5                                  | –                                                                                                                |
| CS4 | Moderate to high | 3.5 to <15                                   | –                                                                                                                |
| CS5 | High             | 15 to <70                                    | –                                                                                                                |
| CS6 | Very high        | >70                                          | –                                                                                                                |

<sup>A)</sup> The figures used in this column are empirical.

*NOTE* The CS is equivalent to the characteristic GSV in CIRIA C665 [6].

#### 7.4.4 Proposed Building Type

In accordance with BS 8485, the CS classification for the site should be considered in conjunction with the proposed Building Type to determine the appropriate level of ground gas protection measures that should be installed to mitigate the risk posed by ground gases.

BS 8485 notes ‘*The Building Type is determined based the proposed construction and use of the building, together with the control of future structural changes to the building and its maintenance (the building’s management) should be assessed, since potential risks posed by ground gases are strongly influenced by these factors*’.

Subject to the development proposals, each building may be categorised as a whole, or for each different part of the building.

The Building Types presented in Table 3 of BS 8485, are reproduced below.

**Table 3 — Building types**

|                                                                     | Type A  | Type B                                              | Type C                | Type D                                 |
|---------------------------------------------------------------------|---------|-----------------------------------------------------|-----------------------|----------------------------------------|
| <b>Ownership</b>                                                    | Private | Private or commercial/<br>public, possible multiple | Commercial/<br>public | Commercial/<br>industrial              |
| <b>Control (change of use, structural alterations, ventilation)</b> | None    | Some but not all                                    | Full                  | Full                                   |
| <b>Room sizes</b>                                                   | Small   | Small/<br>medium                                    | Small to large        | Large industrial/<br>retail park style |

- **Type A building:** private ownership with no building management controls on alterations to the internal structure, the use of rooms, the ventilation of rooms or the structural fabric of the building. Some small rooms present. Probably conventional building construction (rather than civil engineering). Examples include private housing and some retail premises.
- **Type B building:** private or commercial property with central building management control of any alterations to the building or its uses but limited or no central building management control of the maintenance of the building, including the gas protection measures. Multiple occupancy. Small to medium size rooms with passive ventilation of rooms and other internal spaces throughout ground floor and basement areas. May be conventional building or civil engineering construction. Examples include managed apartments, multiple occupancy offices, some retail premises and parts of some public buildings (such as schools, hospitals, leisure centres) and parts of hotels.
- **Type C building:** commercial building with central building management control of any alterations to the building or its uses and central building management control of the maintenance of the building, including the gas protection measures. Single occupancy of ground floor and basement areas. Small to large size rooms with active ventilation or good passive ventilation of all rooms and other internal spaces throughout ground floor and basement areas. Probably civil engineering construction. Examples include offices, some retail premises, and parts of some public buildings (such as schools, hospitals, leisure centres and parts of hotels).
- **Type D building:** industrial style building having large volume internal space(s) that are well ventilated. Corporate ownership with building management controls on alterations to the ground floor and basement areas of the building and on maintenance of ground gas protective measures. Probably civil engineering construction. Examples are retail park sales buildings, factory shop floor areas, warehouses. (Small rooms within these style buildings should be separately categorized as Type B or Type C).

*NOTE 2 Type A buildings are those where the risk of failure of the gas protection measures is likely to be most significant to the safety of the occupants and Type D buildings are those where this same risk is likely to be least significant.*

### 7.4.5 Gas Protection Score (Number of Points to be Achieved)

Table 4 of BS 8485, reproduced below, should be used to derive the minimum level of gas protection applicable to the Building Type, based on the CS determined from the calculated GSV. The Gas protection Score in Table 4 below is used to determine the level and type of protection measures used.

**Table 4** — Gas protection score by CS and type of building

| CS | Minimum gas protection score (points) |                                                              |                                                                       |                                               |
|----|---------------------------------------|--------------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------|
|    | High risk                             | Medium risk                                                  |                                                                       | Low risk                                      |
|    | Type A building                       | Type B building                                              | Type C building                                                       | Type D building                               |
| 1  | 0                                     | 0                                                            | 0                                                                     | 0                                             |
| 2  | 3.5                                   | 3.5                                                          | 2.5                                                                   | 1.5                                           |
| 3  | 4.5                                   | 4                                                            | 3                                                                     | 2.5                                           |
| 4  | 6.5 <sup>A)</sup>                     | 5.5 <sup>A)</sup>                                            | 4.5                                                                   | 3.5                                           |
| 5  | — <sup>B)</sup>                       | $\boxed{A_1} \text{ } 6 \text{ } \boxed{A_1} \text{ } ^{A)}$ | 5.5                                                                   | 4.5                                           |
| 6  | — <sup>B)</sup>                       | — <sup>B)</sup>                                              | $\boxed{A_1} \text{ } \text{---} \text{ } ^{B)} \text{ } \boxed{A_1}$ | $\boxed{A_1} \text{ } 6 \text{ } \boxed{A_1}$ |

<sup>A)</sup> Residential buildings should not be built on CS4 or higher sites unless the type of construction or site circumstances allow additional levels of protection to be incorporated, e.g. high-performance ventilation or pathway intervention measures, and an associated sustainable system of management of maintenance of the gas control system, e.g. in institutional and/or fully serviced contractual situations.

<sup>B)</sup> The gas hazard is too high for this empirical method to be used to define the gas protection measures.

### 7.4.6 Methods of Achieving Gas Protection Scores

The appropriate level of precautions, to be designed in accordance with the point scoring system of BS 8485:2019, should therefore be determined for the specific type of developments based on the GSV and CS of the site. These may include a combination of two or more of the following three types of protection measures, which could be used to achieve the required score:

- The structural barrier of the floor slab, or of the basement slab and walls if a basement is present;
- Ventilation measures; and
- Gas resistant membrane which may include an element of verification and potentially integrity testing.

Verification and integrity testing should be undertaken in accordance with CIRIA report C735 'Good practice on the testing and verification of protection systems for buildings against hazardous ground gases' (2014) and would be detailed in a Remediation Method Statement report in advance of construction which should be agreed with the Local Planning Authority.

The points achieved for each element of the ground gas precautions are summarised in Tables 5, 6 and 7 of the British Standard. These tables are reproduced below.

**Table 5** — Gas protection scores for the structural barrier

| Floor and substructure design (see Annex A)                                                                                            | Score <sup>A</sup> <sup>B</sup> |
|----------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| Precast suspended segmental subfloor (i.e. beam and block)                                                                             | 0                               |
| Cast in situ ground-bearing floor slab (with only nominal mesh reinforcement)                                                          | 0.5                             |
| Cast in situ monolithic reinforced ground bearing raft or reinforced cast in situ suspended floor slab with minimal penetrations       | 1 or 1.5 <sup>B</sup>           |
| Basement floor and walls conforming to BS 8102:2009, Grade 2 waterproofing <sup>C</sup> $\overline{A_1}$ <sup>D</sup> $\overline{A_1}$ | 2                               |
| Basement floor and walls conforming to BS 8102:2009, Grade 3 waterproofing <sup>C</sup> $\overline{A_1}$ <sup>D</sup> $\overline{A_1}$ | 2.5                             |

<sup>A</sup>) The scores are conditional on breaches of floor slabs, etc., being effectively sealed.

<sup>B</sup>) To achieve a score of 1.5 the raft or suspended slab should be well reinforced to control cracking and have minimal penetrations cast in (see A.2.2.2).

<sup>C</sup>) The score is conditional on the waterproofing  $\overline{A_1}$  being provided by a suitable structural barrier with the design and detailing of the walls and floor meeting the requirements for Type B protection. The score cannot be assigned for Type A (waterproof membrane) or Type C (drained cavity wall).  $\overline{A_1}$

<sup>D</sup>)  $\overline{A_1}$  If a membrane is installed beneath and around the basement to provide Type A waterproofing (BS 8102:2009), it can be assigned a gas protection score in accordance with Table 7, if it meets all the criteria for a gas resistant membrane in that table.  $\overline{A_1}$

**Table 6** — Gas protection scores for ventilation protection measures

| Protection element/system                                                                                                                                              | Score | Comments                                                                                                                                                                                                                                             |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (a) Pressure relief pathway (usually formed of low fines gravel or with a thin geocomposite blanket or strips terminating in a gravel trench external to the building) | 0.5   | Whenever possible a pressure relief pathway (as a minimum) should be installed in all gas protection measures systems.<br><br>If the layer has a low permeability and/or is not terminated in a venting trench (or similar), then the score is zero. |

Table 6 (continued)

| Protection element/system                                                                                                                                                                                                                                                 | Score      | Comments                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (b) Passive sub floor dispersal layer:                                                                                                                                                                                                                                    | 2.5        | Performance criteria for methane and carbon dioxide are shown in Figure B.6 and Figure B.7, respectively.                                                                                                                                                                                                                                                                                                                 |
| Very good performance:                                                                                                                                                                                                                                                    | 1.5        |                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Good performance:                                                                                                                                                                                                                                                         |            |                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Media used to provide the dispersal layer are:                                                                                                                                                                                                                            |            | The ventilation effectiveness of different media depends on a number of different factors including the transmissivity of the medium, the width of the building, the side ventilation spacing and type and the thickness of the layer. The selected score should be assigned taking into account the recommendations in Annex E. Passive ventilation should be designed to meet at least "good performance", see Annex E. |
| <ul style="list-style-type: none"> <li>• Clear void</li> <li>• Polystyrene void former blanket</li> <li>• Geocomposite void former blanket</li> <li>• No-fines gravel layer with gas drains</li> <li>• No-fines gravel layer</li> </ul>                                   |            |                                                                                                                                                                                                                                                                                                                                                                                                                           |
| (c) Active dispersal layer, usually comprising fans with active abstraction (suction) from a subfloor dilution layer, with roof level vents. The dilution layer may comprise a clear void or be formed of geocomposite or polystyrene void formers                        | 1.5 to 2.5 | <p>This system relies on continued serviceability of the pumps, therefore alarm and response systems should be in place.</p> <p>There should be robust management systems in place to ensure the continued maintenance of the system, including pumps and vents. Active ventilation should always be designed to meet at least "good performance", as described in Annex E.</p>                                           |
| (d) Active positive pressurization by the creation of a blanket of external fresh air beneath the building floor slab by pumps supplying air to points across the central footprint of the building into a permeable layer, usually formed of a thin geocomposite blanket | 1.5 to 2.5 | <p>This system relies on continued operation of the pumps, therefore alarm and response systems should be in place.</p> <p>The score assigned should be based on the efficient "coverage" of the building footprint and the redundancy of the system. Active ventilation should always be designed to meet at least "good performance".</p>                                                                               |
| (e) Ventilated car park (floor slab of occupied part of the building under consideration is underlain by a basement or undercroft car park)                                                                                                                               | 4          | Assumes that the car park is vented to deal with car exhaust fumes, designed to <i>Buildings Regulations 2000, Approved Document F [9]</i> .                                                                                                                                                                                                                                                                              |

**Table 7 — Gas protection score for the gas resistant membrane**

| Protection element/system                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Score | Comments                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Gas resistant membrane meeting all of the following criteria:</p> <ul style="list-style-type: none"> <li>• sufficiently impervious <math>\overline{A_1}</math>, both in the sheet material <sup>A)</sup> and in the sealing of sheets and sealing around sheet penetrations, to prevent any significant passage of methane and/or carbon dioxide through the membrane; <math>\overline{A_1}</math></li> <li>• sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions;</li> <li>• <math>\overline{A_1}</math> Text deleted <math>\overline{A_1}</math></li> <li>• sufficiently strong <math>\overline{A_1}</math> <sup>B)</sup> <math>\overline{A_1}</math> to withstand the installation process and following trades until covered (e.g. penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, dropping tools, etc); <math>\overline{A_1}</math> and to withstand in-service stresses (e.g. settlement if placed below a floor slab); <math>\overline{A_1}</math></li> <li>• capable, after installation, of providing a complete barrier to the entry of the relevant gas; and</li> <li>• verified in accordance with CIRIA C735 [N1].</li> </ul> | 2     | <p>The performance of membranes is heavily dependent on the quality and design of the installation, resistance to damage after installation and integrity of joints.</p> <p><math>\overline{A_1}</math> Text deleted <math>\overline{A_1}</math></p> <p>If a membrane is installed that does not meet all the criteria in column 1 then the score is zero.</p> |

<sup>A)</sup>  $\overline{A_1}$  A membrane with a methane gas transmission rate <40.0 ml/day/m<sup>2</sup>/atm (average) for sheets and joints (tested in accordance with BS ISO 15105-1:2007 manometric method) is regarded as sufficiently impervious.

<sup>B)</sup> For example, reinforced LDPE (virgin polymer) membranes having a minimum mass per unit area of 370 g/m<sup>2</sup> and not significantly less than 0.4 mm thickness between the reinforcement scrim (tested in accordance with Procedure D (2 mm diameter tip) of BS EN ISO 9863-1:2016) installed above floor slabs are considered sufficiently strong to meet the performance criteria (see also C.3). Thicker and more robust membranes or an additional membrane protection layer should be installed directly beneath cast-in-situ floor slabs.  $\overline{A_1}$

## 7.5 Ground Gas Analysis

### 7.5.1 Gas Screening Value & Site Classification

The ground gas monitoring has identified a maximum carbon dioxide concentration of 1.4% v/v and no detectable methane concentrations. Measurable steady flow rates were not recorded during any of the monitoring visits. In the absence of a measurable steady flow rate, the limit of detection of the gas monitoring instrument (0.1 l/h) should be utilised.

The GSV for carbon dioxide at the site may be calculated as follows:

- $0.1 \times (1.4/100) = 0.0014 \text{ l/h}$

Therefore, with a maximum GSV of 0.0014 l/h, a maximum carbon dioxide concentration of 1.4% v/v, and no measurable steady flow rate, this classifies the site as Characteristic Situation **CS1**, in accordance with Table 2 of BS 8485 (2015+A1:2019) and based on the visits undertaken.

### 7.5.2 Building Type

We understand that it is proposed to construct low-rise residential properties at the site. In accordance with Table 3 of BS 8485, **Building Type A** is considered to be the most appropriate classification.

### 7.5.3 Gas Protection Score

On the basis of Characteristic Situation (CS1) and the development proposals with buildings that may be designated as Building Type A and in accordance with Table 4 of BS 8485 (2015+A1:2019), the minimum gas protection score for the site is **0 points**.

### 7.5.4 Comments

The results of the gas monitoring carried out indicate that no ground gas precautions will be required for the site based on the gas protection score of zero in accordance with BS 8485:2015 (2015+A1:2019).

## **8.0 REVISED CONCEPTUAL SITE MODEL**

### **8.1 Introduction**

In accordance with the approach detailed within Section 4.0, the Conceptual Site Model (CSM) for the site should be refined following acquisition and collection of additional data following completion of the site investigation works.

Our revised assessment following the acquisition and collection of information from the site investigation works is provided in Table 13.

**TABLE 13– REVISED RISK ASSESSMENT SUMMARY TABLE  
PHASE II EXPLORATORY INVESTIGATION**

| Potential Contaminant Source [C]              | Potential Pathway(s) [P]                                                                | Potential Receptor [R]                                                            | Probability of CPR Linkage | Consequence of CPR Linkage | Risk Level | Comments / Justification                                                                                                                                                                                                                                         | Residual Risk After Remedial / Mitigation Measures                                  |
|-----------------------------------------------|-----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------|----------------------------|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Near Surface Soils (Topsoil & Natural Strata) | Direct contact, ingestion or inhalation of fugitive dust                                | End users                                                                         | Low Likelihood             | Mild                       | Low        | Phase II Exploratory Investigation works have revealed that the soils may be regarded as uncontaminated.                                                                                                                                                         | Low – as per 'Risk Level'.<br>No remedial / mitigation measures required.           |
|                                               | Plant uptake                                                                            | End users                                                                         | Low Likelihood             | Mild                       | Low        | Phase II Exploratory Investigation works have revealed that the soils may be regarded as uncontaminated.                                                                                                                                                         | Low – as per 'Risk Level'.<br>No remedial / mitigation measures required.           |
|                                               | Vertical and lateral migration                                                          | Neighbouring properties                                                           | Unlikely                   | Mild                       | Negligible | Phase II Exploratory Investigation works have revealed that the soils may be regarded as uncontaminated.<br>There was no obvious visual or olfactory evidence of any significant contamination (i.e. hydrocarbon impacted soils, for example).                   | Negligible – as per 'Risk Level'.<br>No remedial / mitigation measures required.    |
|                                               | Leaching of Contaminants through unsaturated zone and/or vertical and lateral migration | Controlled Waters                                                                 | Unlikely                   | Mild                       | Negligible | The soil test results are considered to be not sufficiently elevated to represent a significant risk to Controlled Waters.<br>There was no obvious visual or olfactory evidence of any significant contamination (i.e. hydrocarbon impacted soils, for example). | Negligible – as per 'Risk Level'.<br>No remedial / mitigation measures required.    |
|                                               | Direct contact or contact with vapours                                                  | Plastic buildings products (i.e. water supply pipes) and buried concrete          | Low Likelihood             | Mild                       | Low        | Contamination testing has not revealed concentrations of contaminants which may pose a risk to buried services.<br>Design Class DS-1/ACEC Class AC-1s (BRE Spec. Digest 1:2005).                                                                                 | Low – as per 'Risk Level'.<br>Adopt appropriate classification for buried concrete. |
| Off-Site Historical Landfill                  | Vertical and lateral migration of ground gases to indoor air                            | End users of new buildings (asphyxiation) or new buildings (damage via explosion) | Unlikely                   | Medium                     | Low        | Based on the monitoring undertaken the site may be classified as CS1 (i.e. no ground gas precautions required).<br>This corresponds to the classification for the previous Hinckley phases of residential development by Bloor Homes.                            | Low – as per 'Risk Level'.<br>No remedial / mitigation measures required.           |

## **9.0 CONCLUSIONS & RECOMMENDATIONS**

### **9.1 Site Summary**

At the time of our walkover (November 2022), the majority of the site comprised the southeastern extent of a larger grass field which was overgrown with weeds. The site was waterlogged with standing water observed across much of its extent. The northern corner of the site was occupied by recently created soft landscape associated with a housing development, currently under construction to the sites northwest.

Historically, with the exception of the former overhead electricity cables which previously crossed the field, the site is indicated to have remained essentially undeveloped and in agricultural use since the earliest reviewed mapping circa the 1880s.

The site is indicated to be underlain by drift deposits comprising the Bosworth Clay Member and more locally Alluvium. The drift deposits are indicated to be underlain at depth by bedrock strata of the Mercia Mudstone Group.

### **9.2 Geotechnical Information**

#### **9.2.1 Ground Conditions**

Very clayey topsoil was encountered in all of the exploratory holes to depths of between 0.25m and 0.35m begl.

Made Ground was not encountered within any of the exploratory holes advanced at the site.

The Natural Strata typically comprised stiff silty CLAY, which became very stiff with increased depth.

The Clay was locally firm near surface and within approximately half of the exploratory holes was slightly gravelly to a depth of 0.60m begl. Within the majority of the exploratory holes the Clay contained various sized pockets of sand which typically became smaller and less prevalent with increased depth. The sand pockets were encountered to depths of up to approximately 1.65m begl.

Silt pockets, also of various sizes, were encountered within the Clay in four of the exploratory holes from depths in excess of 1.70m begl. The silt pockets were generally firm with the exception of some very soft to soft clayey silt pockets between 1.70m and 2.60m begl in one location (TP8).

The drift deposits were underlain by typically very stiff (locally stiff) CLAY with mudstone lithorelicts. These strata were generally encountered from depths in excess of 2.45m begl.

#### **9.2.2 Foundation Design**

Foundations for the proposed residential dwellings are likely to comprise traditional strip or trench fill. The natural near surface (Clay) soils underlying the site appear suitable to support a nett allowable ground bearing pressure of up to 120kN/m<sup>2</sup>.

Foundations should be advanced to a minimum founding depth of 1.00m below existing or proposed ground level (whichever being the deeper) and founded within undisturbed suitably competent natural soils.

Should any Made Ground or soft spots be encountered at founding depth, foundations will require further deepening to encounter underlying undisturbed suitably competent natural soils. We would reiterate the presence of very soft to soft clayey silt pockets, encountered in one location (TP8) between 1.70m and 2.60m begl. Should any dwellings be proposed in the location of TP8, it is recommended that plot-specific trial pits are undertaken to reassess the ground bearing pressure once the final layout has been confirmed. Shallow foundations should avoid bearing immediately above or within these geotechnically less competent soils. Foundations may also require localised deepening due to the influence of trees and hedgerows (see Section 9.2.6).

Where foundations encounter the sand (or the more localised silt) pockets, it is recommended that nominal light mesh reinforcement is included within foundations to minimise the potential for differential settlement. Alternatively, foundations should be deepened in order to achieve a single competent founding stratum in accordance with NHBC requirements.

### **9.2.3 Floor Slab Design**

Ground bearing floor slabs may be adopted provided that there is less than 0.60m of suitably compacted geotechnically competent sub-slab fill beneath proposed slabs and subject to the requirements of NHBC Standards Chapter 4.2 '*Building Near Trees*'. Where in excess of 0.60m of sub-slab fill is present, a suspended slab may be adopted, which may be either cast in-situ or a pre-cast suspended floor with a clear ventilated void (i.e. beam and block).

### **9.2.4 Ground Gas Precautions**

No ground gas precautions relating to methane or carbon dioxide are required at the site.

### **9.2.5 Radon**

No radon precautions are required at the site.

### **9.2.6 Building Near Trees**

Foundation designs may require adjusting in accordance with NHBC Standards Chapter 4.2, when building near trees / hedgerows, based on the presence of shrinkable soils underlying the site. Soils of a high volume change potential should be used for design purposes (as confirmed by laboratory testing).

We would recommend that an arborist survey is undertaken (where not already completed) to identify the species and heights of the existing trees and hedgerows within influencing distance of the site to enable a foundation schedule to be produced, where appropriate.

### **9.2.7 Water**

Water seepages were not encountered within any of the exploratory holes during their advancement. Standing water was encountered at surface across much of the site, both during the site works and during the return monitoring visits.

On this basis, dewatering of excavations during development is considered unlikely to be necessary, assuming that an effective drainage strategy can be implemented to deal with any surface water prior to development.

We would note that groundwater levels, and the presence of standing water, may vary due to seasonal or other effects.

### **9.2.8 Excavations / Stability**

The trial pits generally remained stable during their excavation and for the short period of time they remained open following completion. Localised collapsing of trial pit walls was recorded within the soft silt pockets encountered in one location.

The boreholes generally remained stable during their advancement with the exception of WS1 which was cased to its full depth to prevent the locally firm clays from closing in before the monitoring well had been installed. The remainder of the boreholes were cased to a depth of 2.00m begl as a precautionary measure.

It is considered that the majority of excavations are unlikely to require trench support other than for health and safety reasons. The assessment of excavations and provision of support will be the responsibility of the contractor on site.

The natural soils may be subject to deterioration and softening if excavations are left open and exposed to wet weather. Any softened soils should be removed from excavations prior to the pouring of concrete and foundation construction.

### **9.2.9 Sulphate Classification**

In accordance with BRE Special Digest 1 (2005), the site falls into Design Sulphate Class DS-1 and an Aggressive Chemical Environment for Concrete (ACEC) classification of AC-1s. Therefore, an appropriate concrete mix should be adopted in accordance with BRE Special Digest 1 for all buried concrete in contact with the ground.

### **9.2.10 Coal Mining**

No coal mining precautions or associated investigation works are required at the site.

### **9.2.11 California Bearing Ratios (CBRs)**

A CBR value of between less than 2% and 4% can be anticipated within the shallow Natural Strata, subject to confirmation by in-situ testing. No frost susceptible material should be within 450mm of the ground surface in road construction.

### **9.2.12 Surface Water Drainage**

Due to the presence of relatively impermeable strata underlying the site, it is considered that the use of soakaways is unlikely to be feasible. Therefore, it is recommended that alternative methods of surface water drainage are investigated in the first instance.

## **9.3 Environmental Considerations**

### **9.3.1 Soil Contamination Assessment**

#### Human Health

Contamination testing was carried out on selected samples of the topsoil and the underlying Natural Strata.

On the basis of the chemical contamination assessment undertaken, the topsoil and Natural Strata may be considered to be uncontaminated in the context of the proposed end-use (i.e. in relation to human health).

### Controlled Waters

Given the low contaminant concentrations revealed by the testing undertaken, there are considered to be no specific risks posed to Controlled Waters by the findings of the laboratory analysis undertaken.

## **9.3.2 Remediation Proposals**

### Human Health

Based on the testing undertaken, no specific remediation works will be required other than the provision of topsoil in proposed gardens and areas soft landscape to provide a suitable growing media for plants. It may be necessary to increase the thickness of topsoil around the root balls of trees to suit the proposed planting regime.

Should there be a requirement to import additional quantities of topsoil to the site, it will be necessary to test the topsoil at source to ensure it is suitably clean (prior to importation) in accordance with CLEA / generic guidance. The topsoil should also conform to BS3882: 2015 '*Specification for topsoil*', with respect to the presence of foreign objects, and ideally nutrient levels etc. The results of the chemical analysis on topsoil proposed for importation should be forwarded to the Local Authority (Environmental Health Officer) for approval (prior to importation). The physical suitability of the existing topsoil should be assessed by the developer.

### Controlled Waters

No specific remediation in relation to Controlled Waters is considered to be necessary at the site on the basis of the available information.

## **9.3.3 Re-use of Existing Natural Strata**

The uncontaminated Natural Strata may be regarded as suitable for re-use within proposed gardens or areas of soft landscape as subsoil or to raise levels (as appropriate) or for landscaping / capping on alternative developments (subject to regulatory approval and the production of any necessary plans or permits) where surplus arisings are generated from the site.

## **9.3.4 Off Site Disposal & Waste Acceptance Criteria Testing**

If off-site disposal is required, the chemical testing regime can be different to the chemical testing required to assess the suitability of the soils for retention on site and the risks to human health. Therefore, a separate contamination assessment may be required to include bespoke leachate analysis (i.e. Waste Acceptance Criteria [WAC] testing) to classify the soils for off-site disposal with testing criteria to assess whether the soil is hazardous, non-hazardous or inert waste. However, the existing chemical test data will assist this process.

If disposal is necessary then the environmental laboratory test results (included within Appendix X) should be provided to several landfill operators for consideration and cost provision in the first instance, prior to the material being removed from the site.

## **9.4 General Considerations**

### **9.4.1 Construction Workers**

It is recommended that construction personnel involved with direct contact with the soils at the site use appropriate PPE equipment together with hygiene facilities in accordance with general health and safety guidelines.

The chosen Contractor should undertake the necessary Risk Assessments and Method Statements (RAMS) to determine the most appropriate protection required for safe working practices at the site.

A copy of all reports relating to the site should be included in the site health and safety file, and site workers should be made fully aware of the sites setting.

#### **9.4.2 Utilities**

Prior to development of the site, we would recommend that a copy of this report is supplied to utility companies, and that their recommendations relating to appropriate supply pipes are adhered to.

#### **9.4.3 Unforeseen Circumstances**

Should any areas of potentially contaminated soil be encountered during site construction works we would recommend consultation with GeoDyne to ensure that our recommendations continue to apply. Any potentially contaminated soils should be left in-situ and subjected to further assessment, to potentially include further chemical testing and risk assessment.

The following procedure should be adhered to if any areas of previously unidentified suspected contamination are encountered during the development of the site:

- i. Suspected contaminated material will remain in-situ.
- ii. GeoDyne to be notified. We will then undertake a visual assessment of the possible contamination, followed by appropriate sampling/testing (as necessary).
- iii. If necessary, contamination will then be treated or removed from site. All necessary remediation works should be validated by testing in accordance with an approved strategy, with the relevant Regulators informed accordingly.

#### **9.4.4 Licenses, Permits, Registrations, Plans and Approvals**

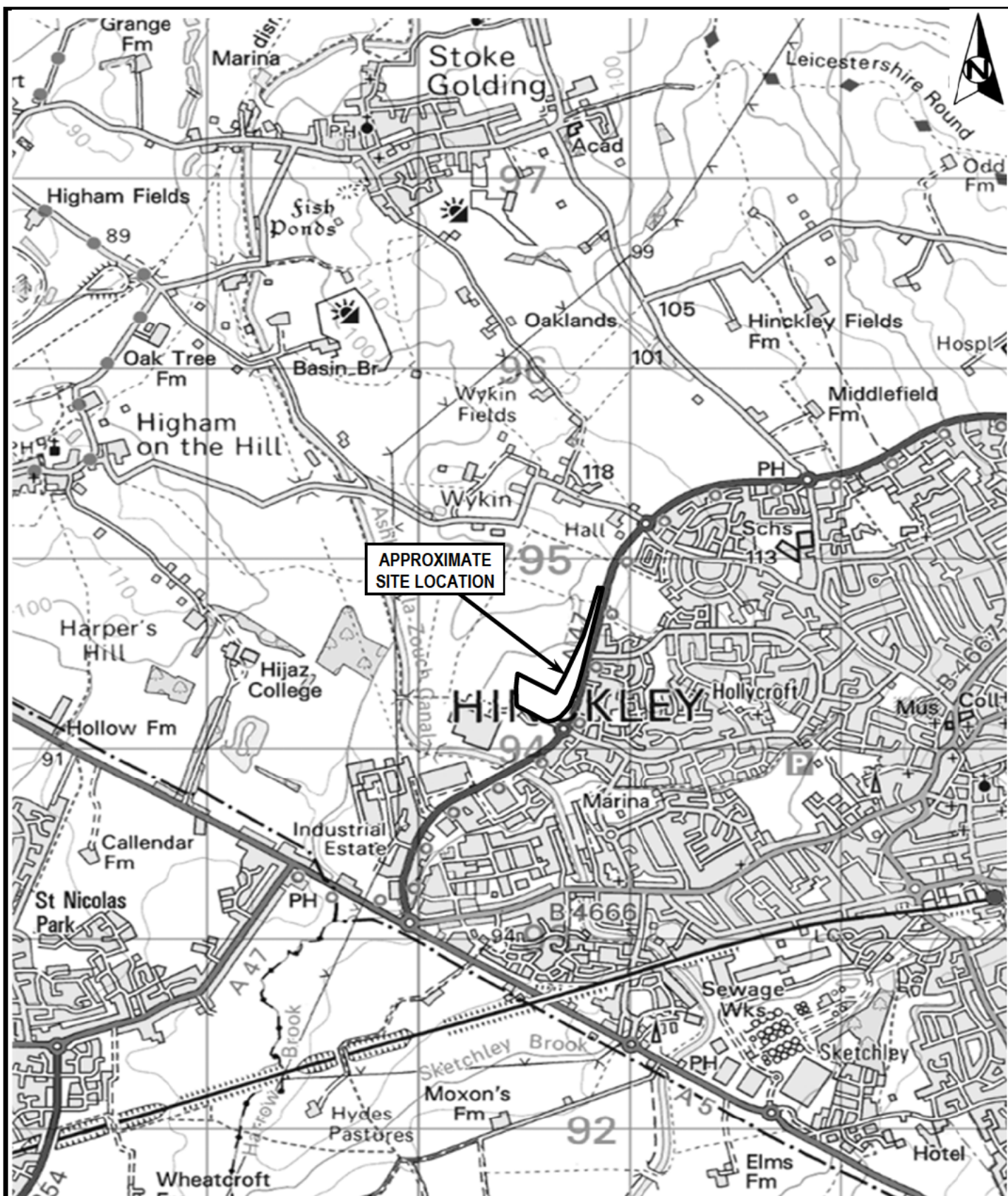
The Contractor / Developer is responsible for, and must ensure that, all necessary licenses, permits, plans, registrations and approvals are in place prior to commencing with the construction works at the site. These may include any Materials Management Plans (MMPs), Site Waste Management Plans (SWMPs) and / or Environmental Permits / Exemptions as necessary to enable the completion of the proposed works. Any MMP should be accompanied by a Qualified Person Declaration (QPD) and will require verification in due course.

#### **9.4.5 Statutory Consultation**

In accordance with normal planning requirements, we would recommend that a copy of our report is issued by the Client to the Local Authority (and NHBC or other Warranty Provider, if necessary) for review / comment and approval prior to commencing with the development of the site.

**APPENDIX I**

**Site Location Plan  
(Figure No. D42153/01)**



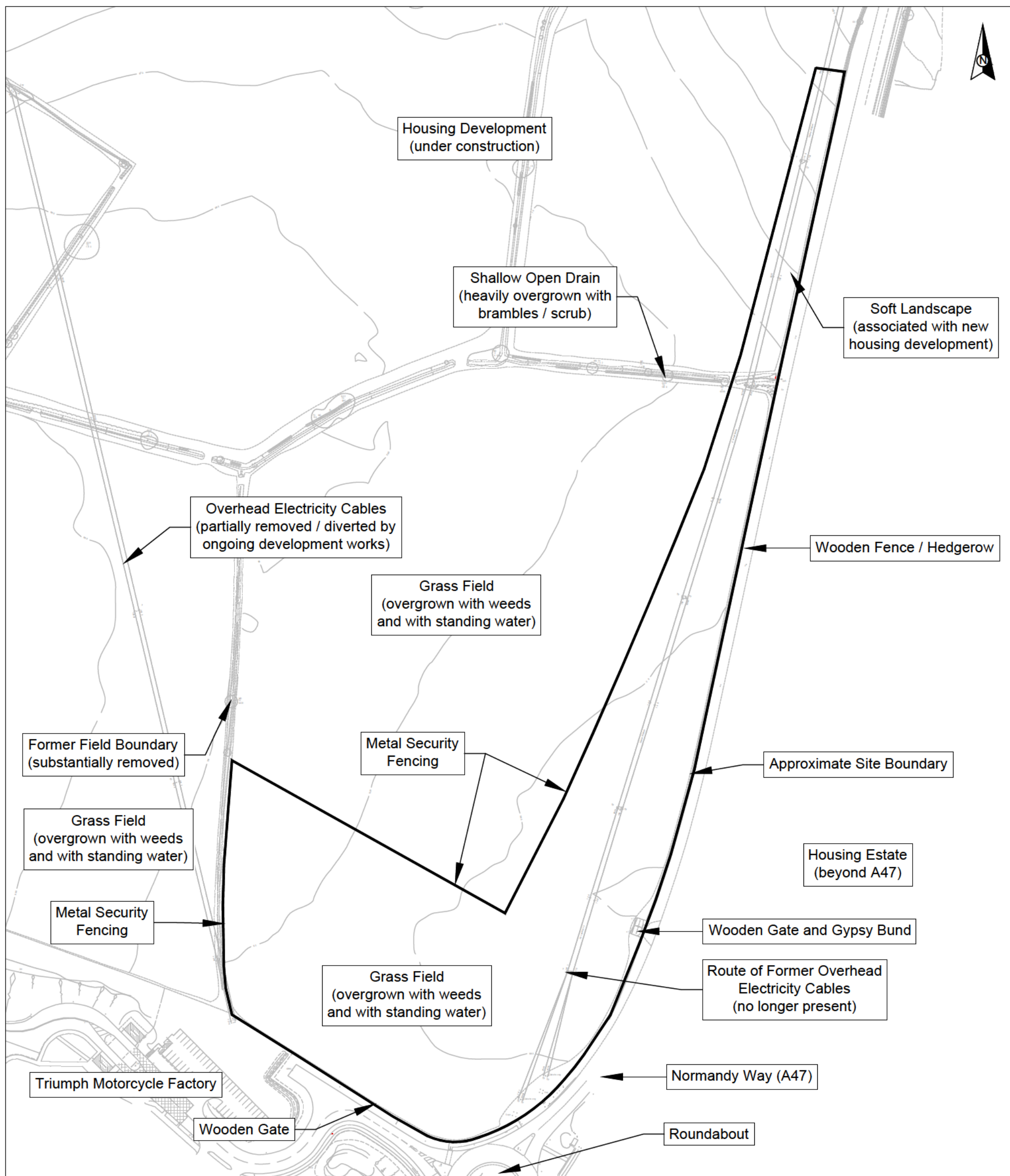
REPRODUCED FROM THE ORDNANCE SURVEY MAP WITH THE PERMISSION OF THE CONTROLLER OF HER MAJESTY'S STATIONERY OFFICE.  
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|             |                           |            |            |
|-------------|---------------------------|------------|------------|
| Project No. | D42153                    | Drawn      | SJ         |
| Client      | Bloor Homes East Midlands | Checked    | SS         |
| Project     | Hinckley Phase 4          | Approved   | PK         |
|             |                           | Scale      | NTS        |
|             |                           | Date Drawn | 29/11/2022 |
| Title       | Site Location Plan        | Rev.       |            |
|             |                           | Figure No. | D42153/01  |



**APPENDIX II**

**Annotated Site Plan  
(Figure No. D42153/02)**



Drawing based on Topographical Survey by Greenhatch Group Drawing No.19969 OGL Rev A Dated: March 2014. Used, edited and reproduced with permission of the Client.

|             |                           |             |            |                                                                                                                                                                                               |
|-------------|---------------------------|-------------|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Project No. | D42153                    | Drawn By    | SJ         |  <p>Nottingham 0115 962 0001<br/>Derby 01332 290 798</p> <p>info@geodyne.co.uk<br/>www.geodyne.co.uk</p> |
| Client      | Bloor Homes East Midlands | Checked By  | SS         |                                                                                                                                                                                               |
|             |                           | Approved By | PK         |                                                                                                                                                                                               |
| Project     | Hinckley Phase 4          | Scale       | NTS        |                                                                                                                                                                                               |
|             |                           | Date Drawn  | 29/11/2022 |                                                                                                                                                                                               |
| Title       | Annotated Site Plan       | Revision    |            |                                                                                                                                                                                               |
|             |                           | Figure No.  | D42153/02  |                                                                                                                                                                                               |

**APPENDIX III**

**Site Plan Showing General Site Views  
(Figure No. D42153/03)**



Approximate Site Boundary



Drawing based on Topographical Survey by Greenhatch Group Drawing No.19969 OGL Rev A Dated: March 2014. Used, edited and reproduced with permission of the Client.

|             |                                      |             |            |
|-------------|--------------------------------------|-------------|------------|
| Project No. | D42153                               | Drawn By    | SJ         |
| Client      | Bloor Homes East Midlands            | Checked By  | SS         |
|             |                                      | Approved By | PK         |
| Project     | Hinckley Phase 4                     | Scale       | NTS        |
|             |                                      | Date Drawn  | 29/11/2022 |
| Title       | Site Plan Showing General Site Views | Revision    |            |
|             |                                      | Figure No.  | D42153/03  |

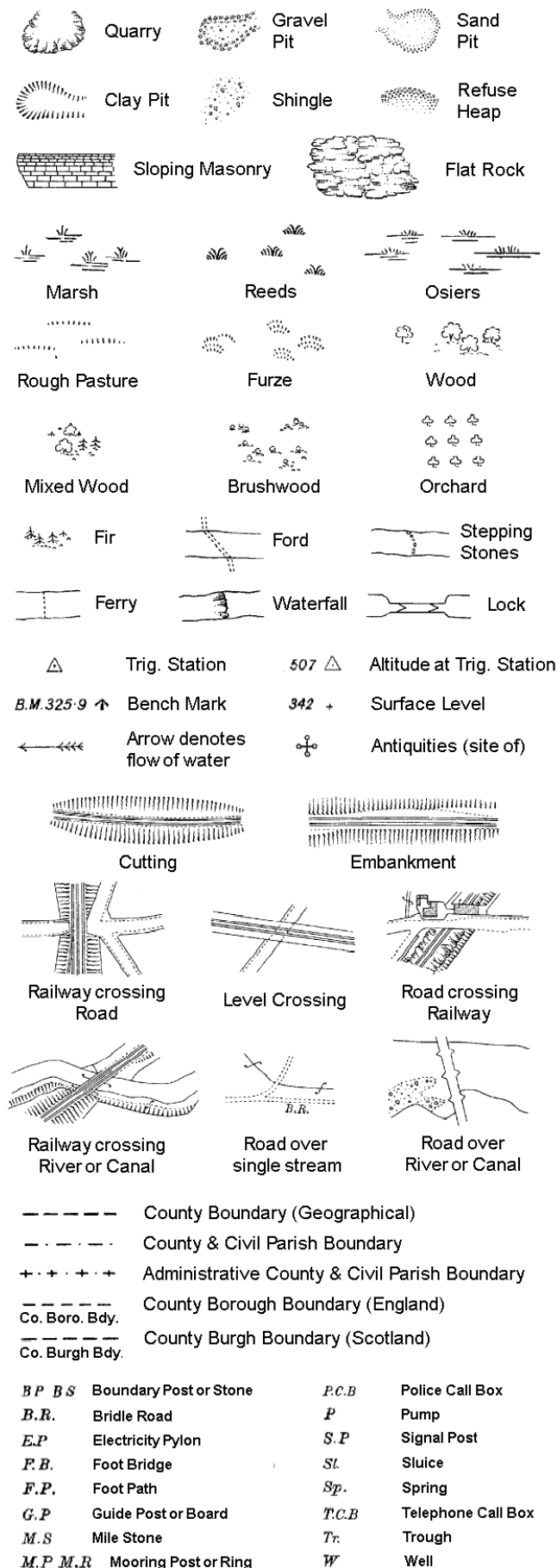


Nottingham 0115 962 0001  
 Derby 01332 290 798  
[info@geodyne.co.uk](mailto:info@geodyne.co.uk)  
[www.geodyne.co.uk](http://www.geodyne.co.uk)

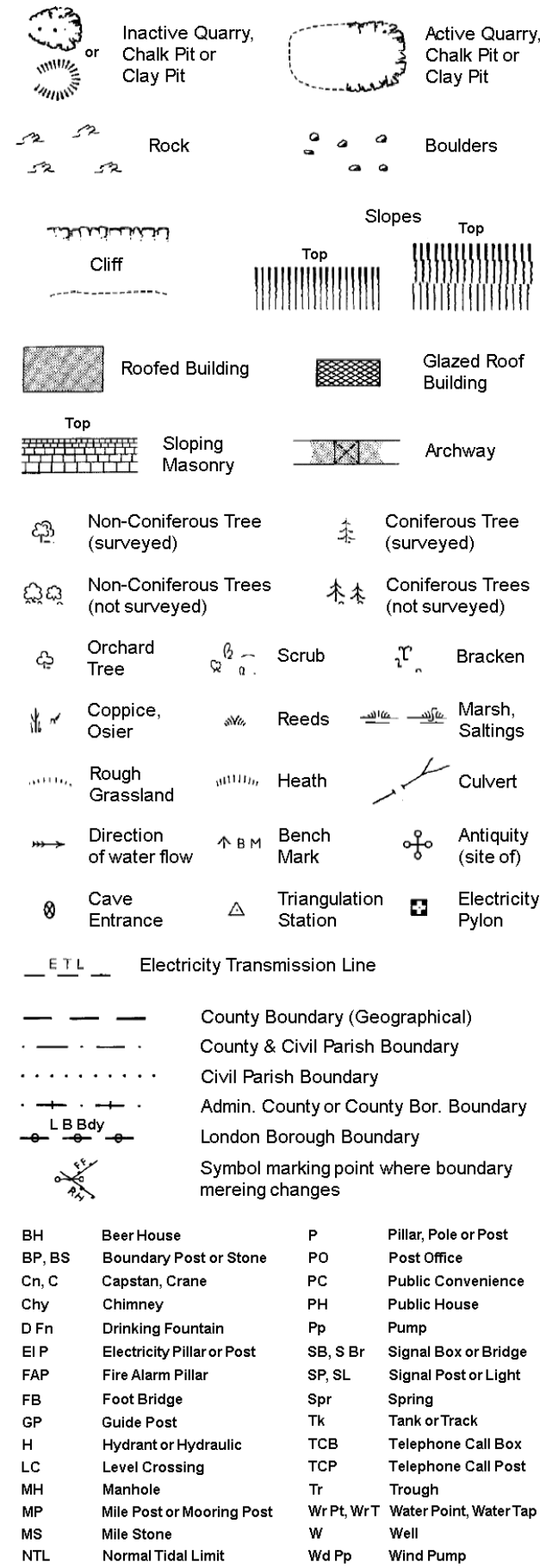
**APPENDIX IV**  
**Historical Plans**

# Historical Mapping Legends

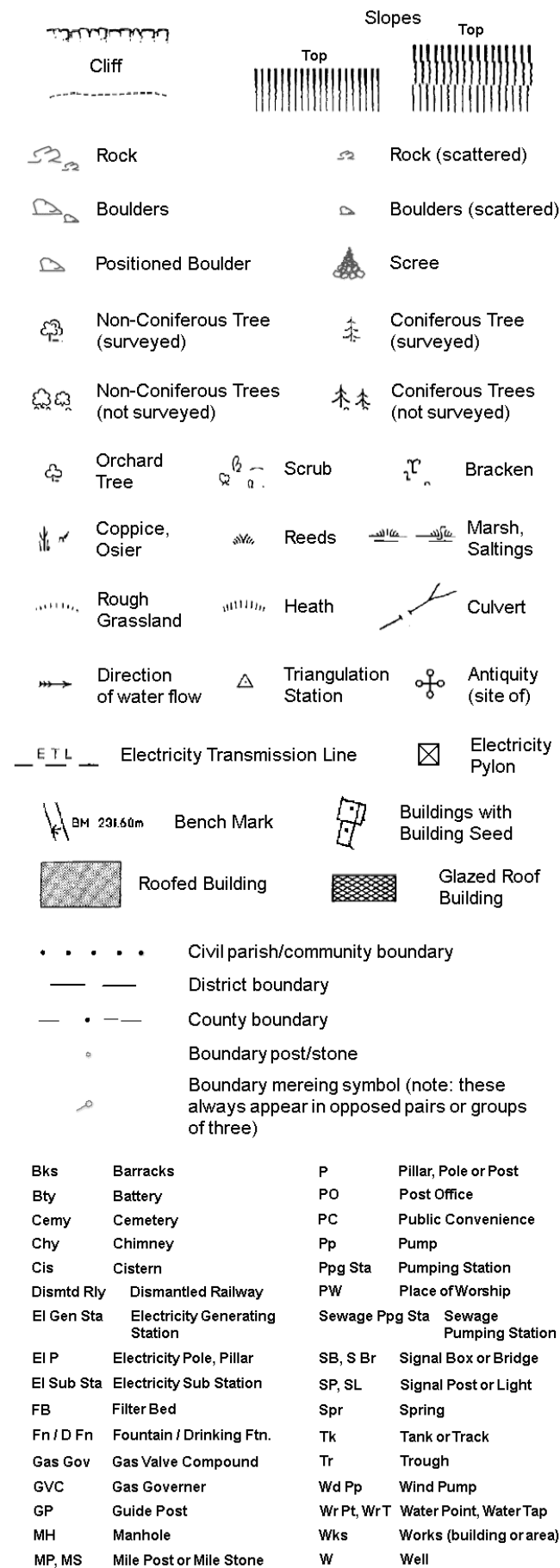
## Ordnance Survey County Series and Ordnance Survey Plan 1:2,500



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



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

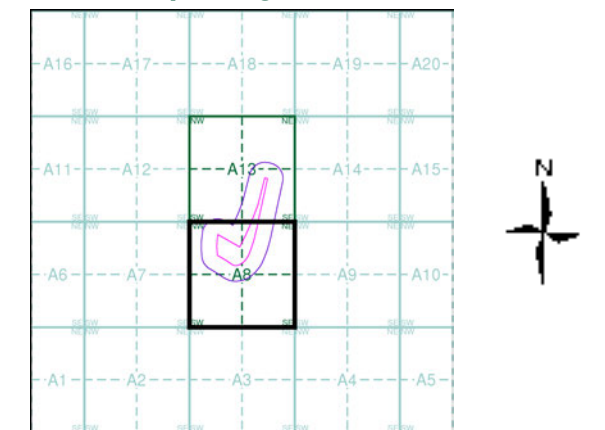


# GeoDyne

## Historical Mapping & Photography included:

| Mapping Type                             | Scale   | Date        | Pg |
|------------------------------------------|---------|-------------|----|
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| Leicestershire                           | 1:2,500 | 1903        | 3  |
| Leicestershire                           | 1:2,500 | 1924        | 4  |
| Ordnance Survey Plan                     | 1:1,250 | 1959 - 1992 | 5  |
| Ordnance Survey Plan                     | 1:2,500 | 1963        | 6  |
| Ordnance Survey Plan                     | 1:1,250 | 1973 - 1983 | 7  |
| Supply of Unpublished Survey Information | 1:1,250 | 1975        | 8  |
| Supply of Unpublished Survey Information | 1:2,500 | 1975        | 9  |
| Additional SIMs                          | 1:1,250 | 1978 - 1992 | 10 |
| Additional SIMs                          | 1:2,500 | 1988        | 11 |
| Additional SIMs                          | 1:1,250 | 1988 - 1991 | 12 |
| Ordnance Survey Plan                     | 1:1,250 | 1990 - 1991 | 13 |
| Large-Scale National Grid Data           | 1:1,250 | 1993        | 14 |
| Additional SIMs                          | 1:1,250 | 1993        | 15 |
| Large-Scale National Grid Data           | 1:1,250 | 1995        | 16 |
| Large-Scale National Grid Data           | 1:1,250 | 1995        | 17 |
| Large-Scale National Grid Data           | 1:1,250 | 1996        | 18 |
| Large-Scale National Grid Data           | 1:1,250 | 1996        | 19 |
| Large-Scale National Grid Data           | 1:1,250 | 1996        | 20 |
| Historical Aerial Photography            | 1:2,500 | 1999        | 21 |

## Historical Map - Segment A8



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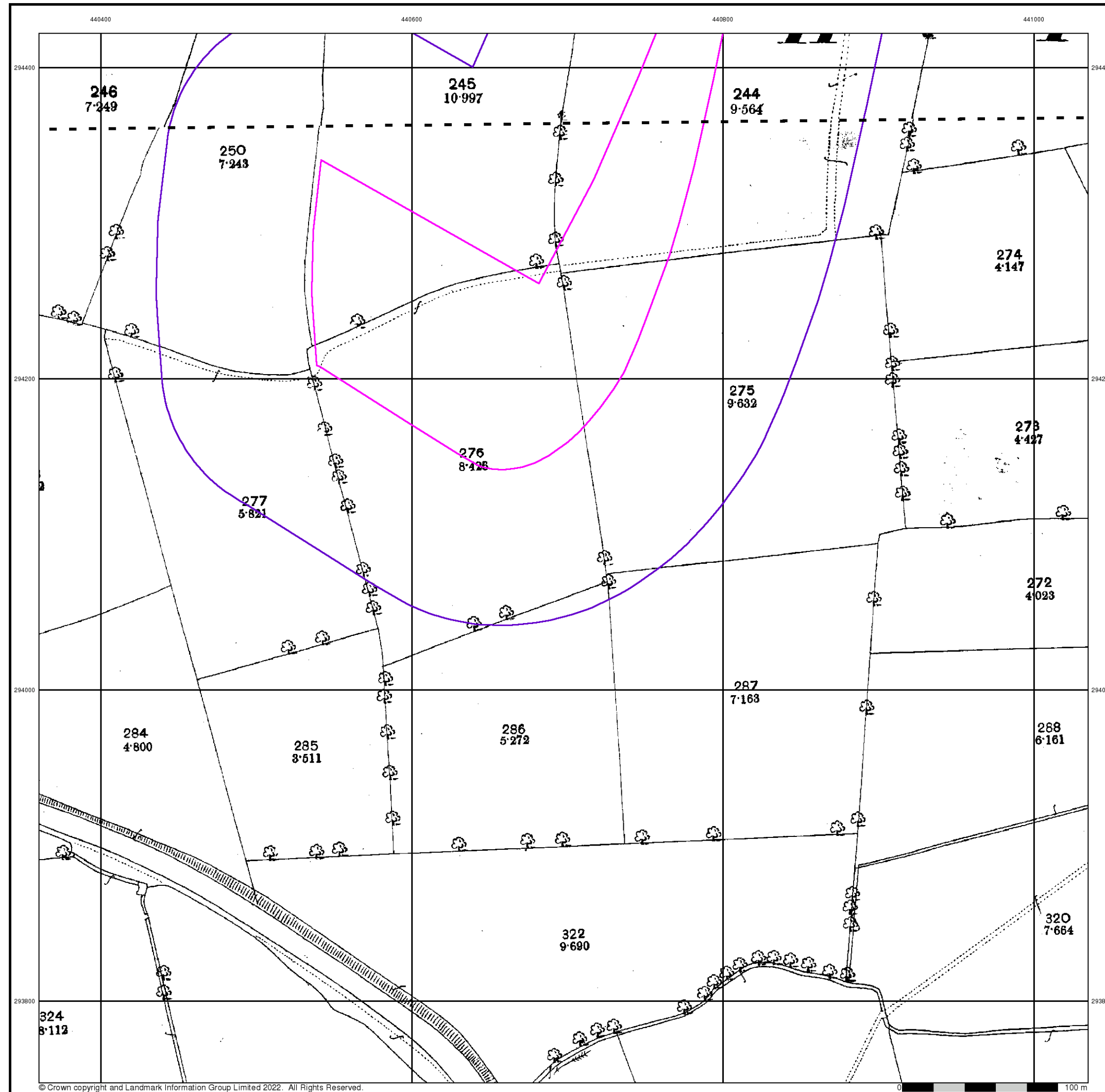
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Search Buffer (m): 100

## Site Details

Hinckley Phase 4

**Landmark**  
INFORMATION GROUP

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



**GeoDyne**

**Leicestershire**

**Published 1888 - 1889**

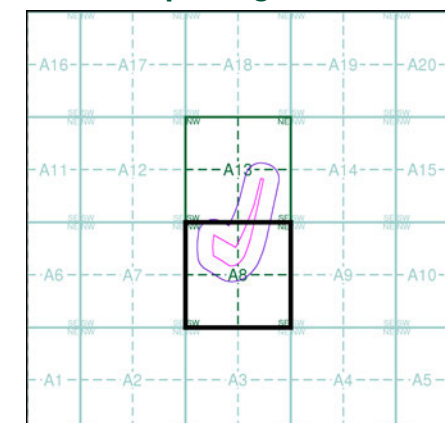
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|                           |
|---------------------------|
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| 042_07<br>1889<br>1:2,500 |

### Historical Map - Segment A8



### Order Details

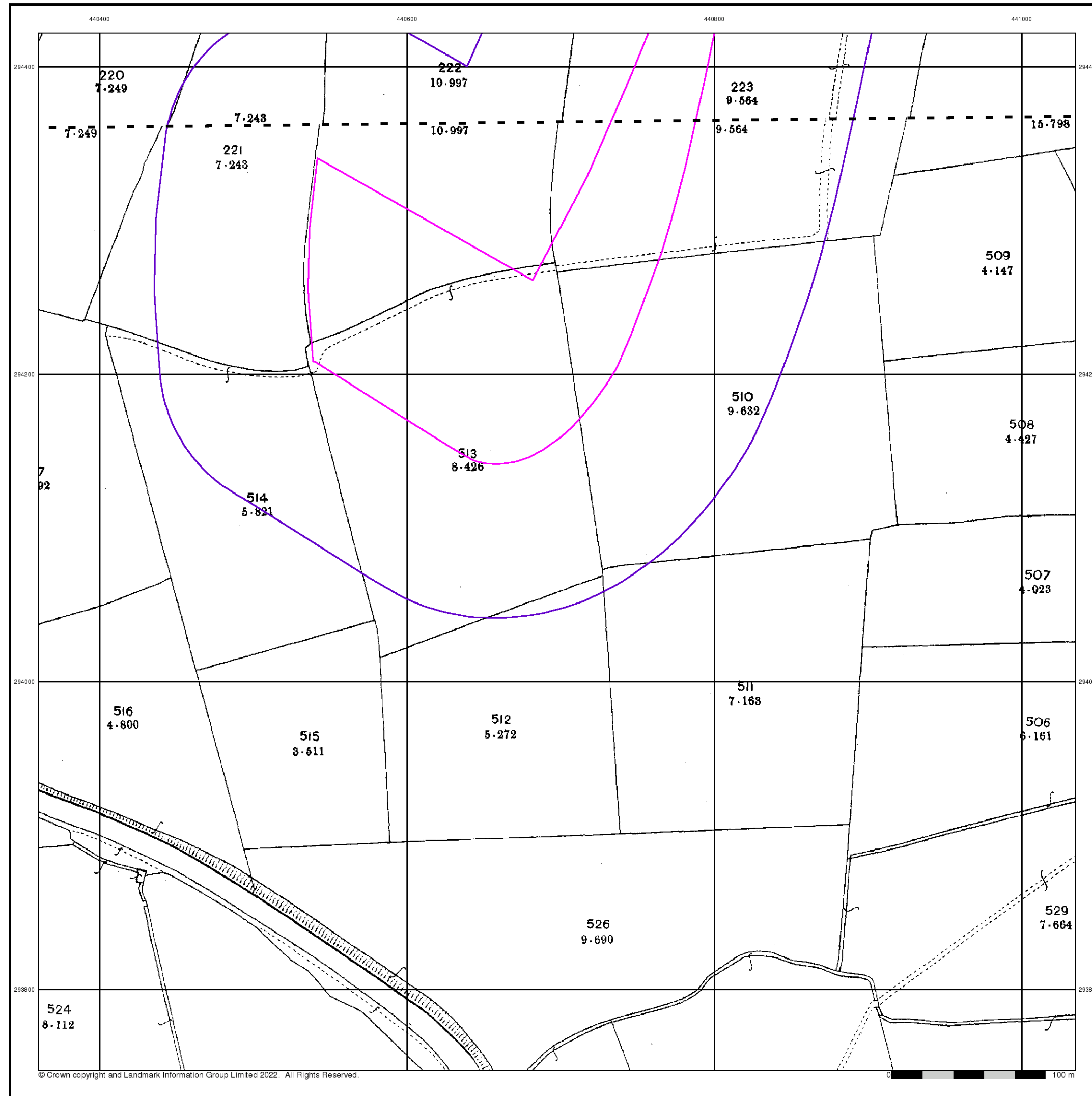
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Search Buffer (m): 100

### Site Details

Hinckley Phase 4

**Landmark**  
INFORMATION GROUP

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Fax: 0844 844 9951  
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Leicestershire

Published 1903

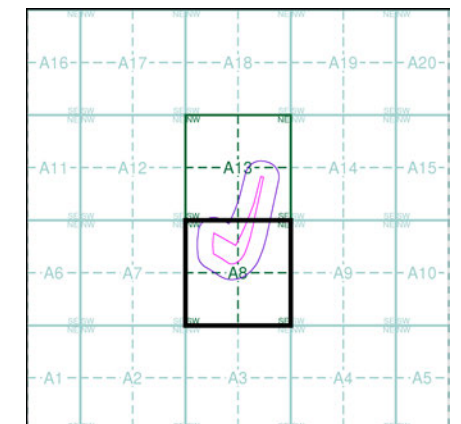
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### Historical Map - Segment A8



### Order Details

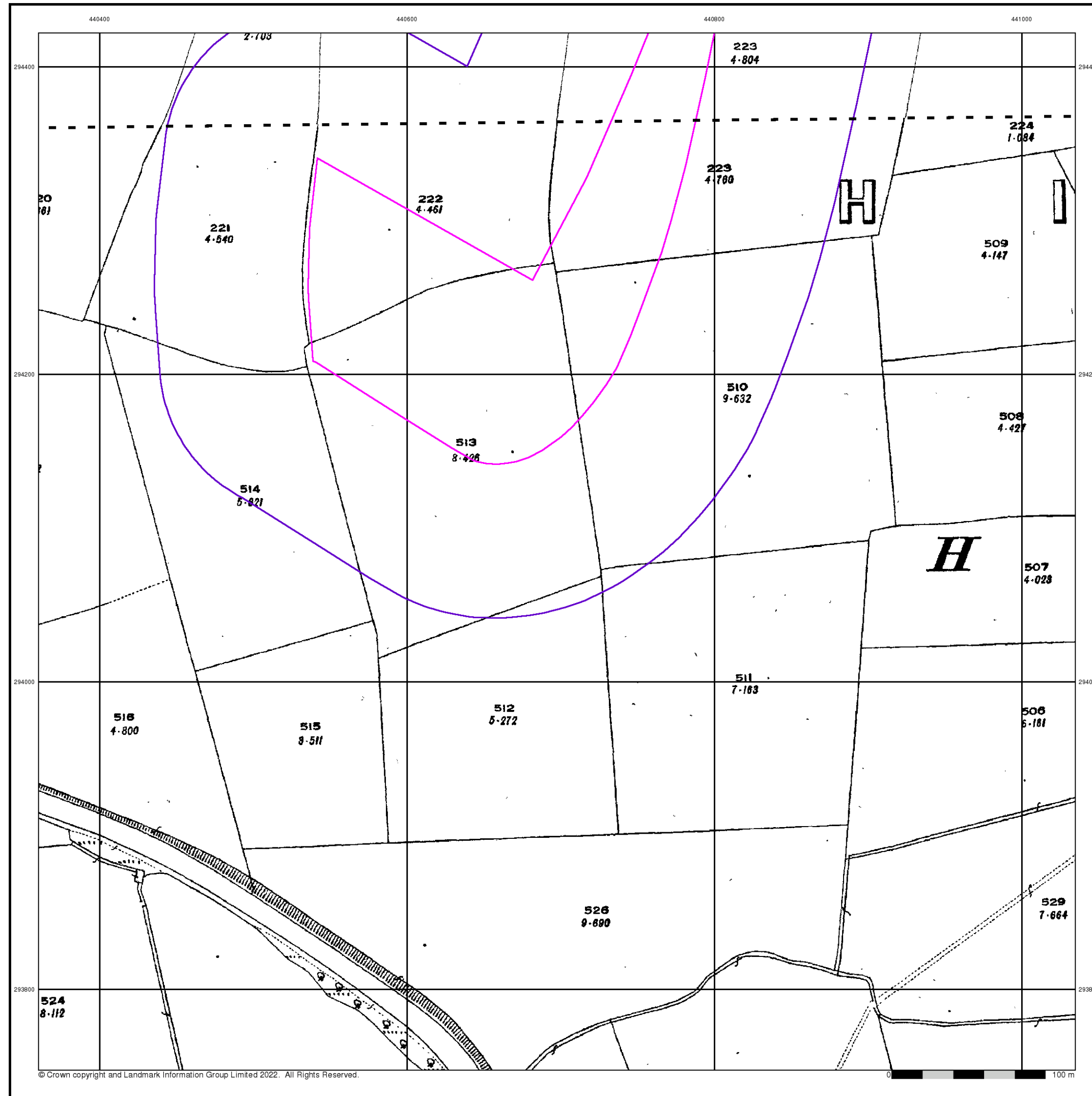
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Search Buffer (m): 100

### Site Details

Hinckley Phase 4



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Leicestershire

Published 1924

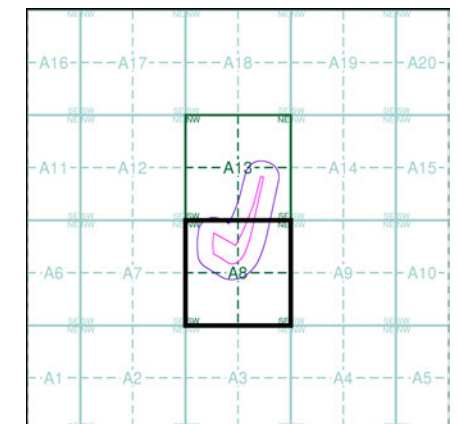
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### Historical Map - Segment A8



### Order Details

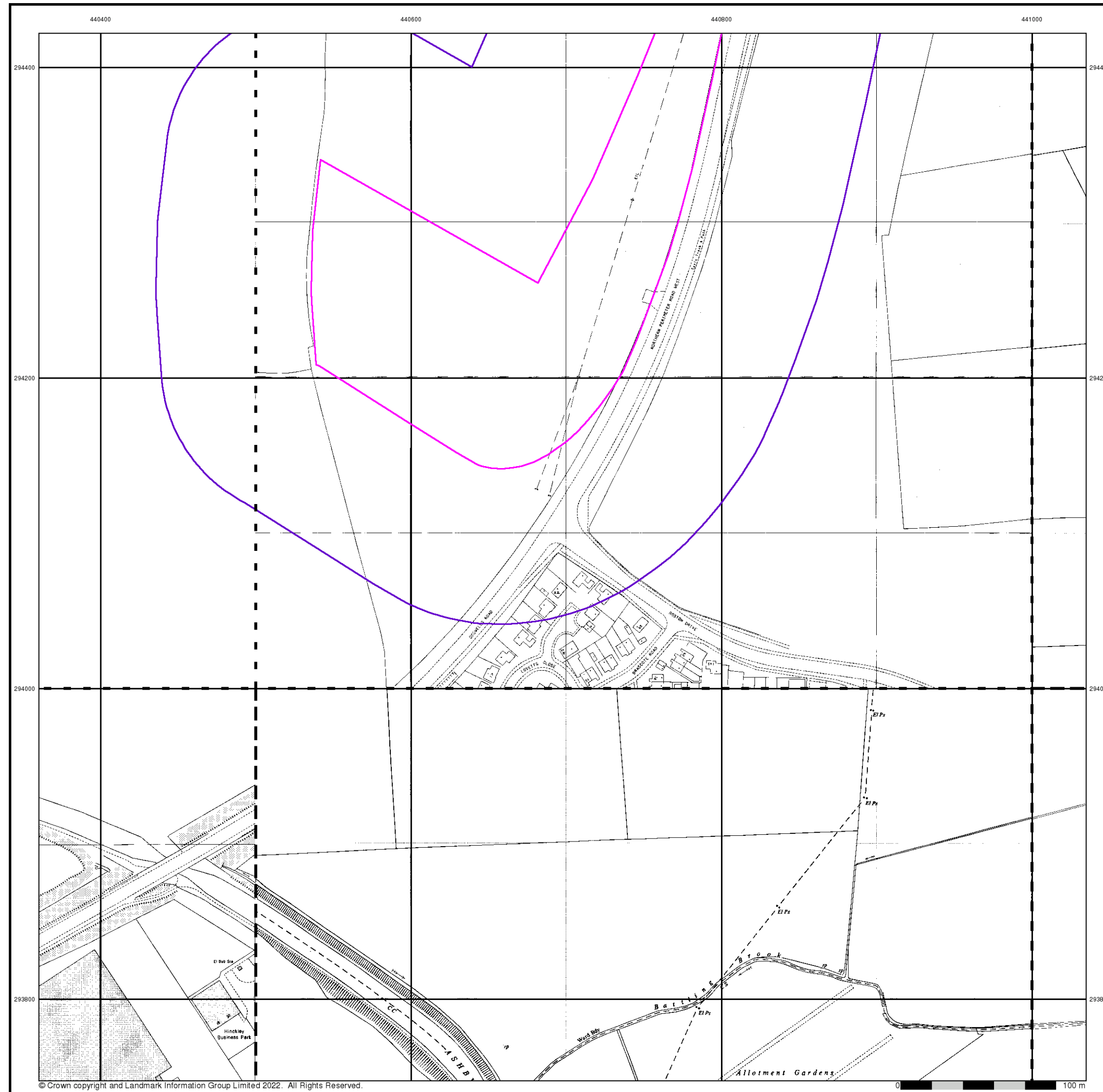
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Search Buffer (m): 100

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## Ordnance Survey Plan

Published 1959 - 1992

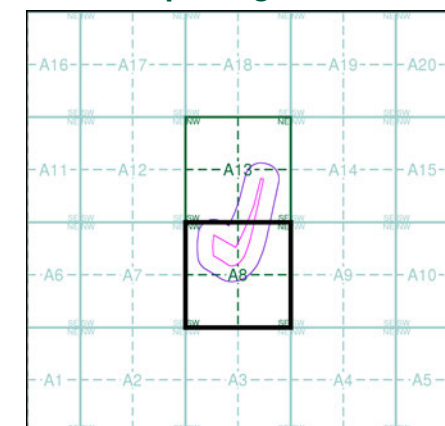
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### Historical Map - Segment A8



### Order Details

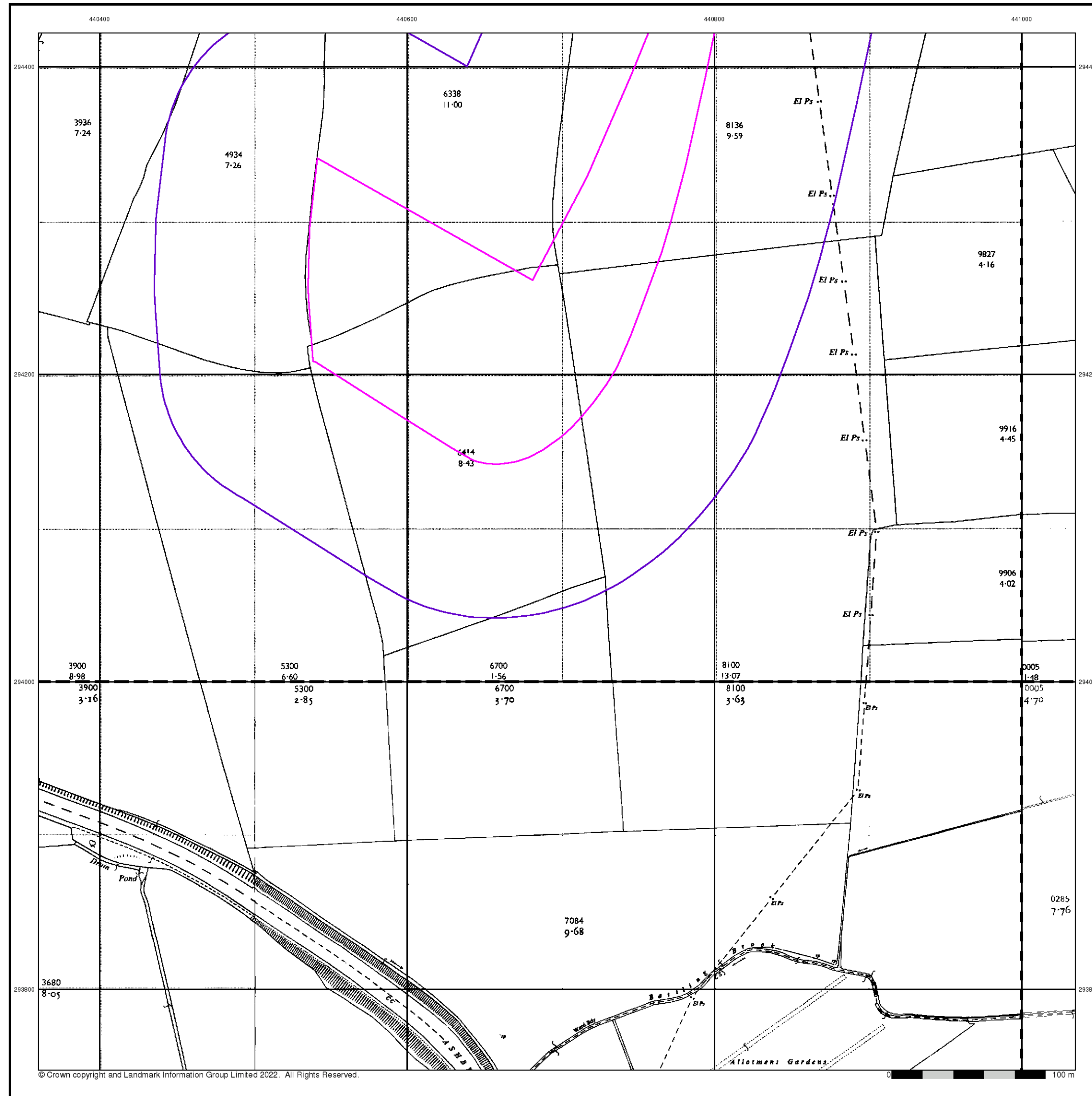
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### Site Details

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GeoDyne

Ordnance Survey Plan

Published 1963

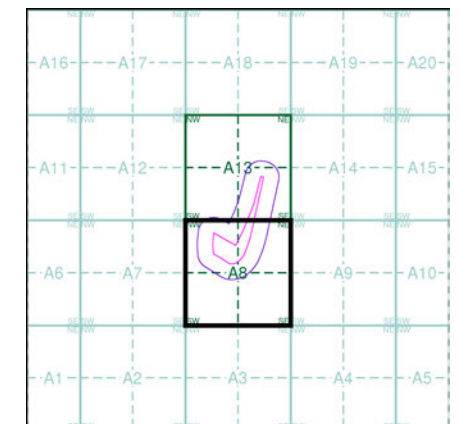
Source map scale - 1:2,500

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)

|                           |                           |
|---------------------------|---------------------------|
| SP4094<br>1963<br>1:2,500 | SP4194<br>1963<br>1:2,500 |
| SP4093<br>1963<br>1:2,500 | SP4193<br>1963<br>1:2,500 |

### Historical Map - Segment A8



### Order Details

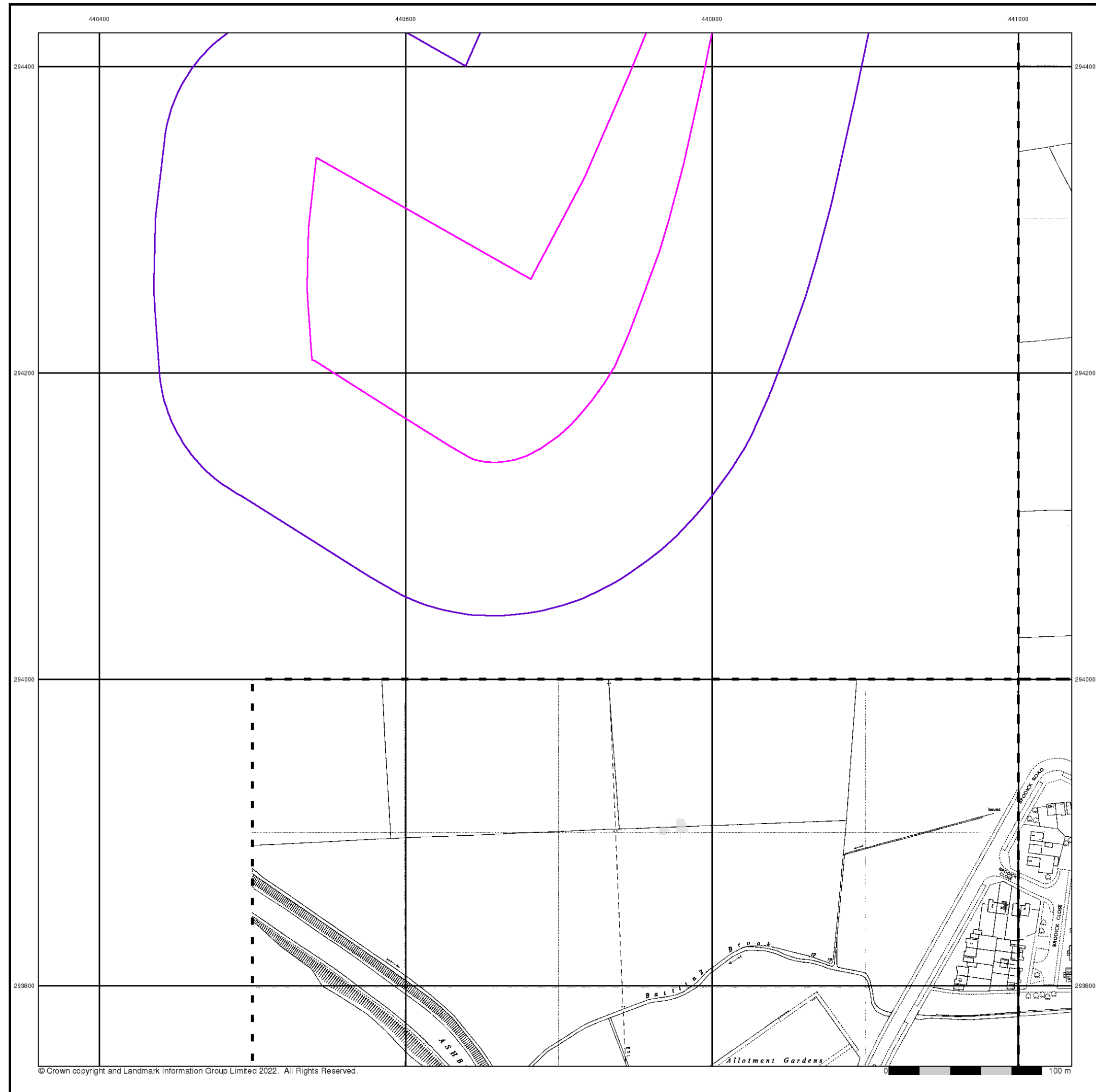
Order Number: 302954152\_1\_1  
Customer Ref: D42153  
National Grid Reference: 440720, 294400  
Slice: A  
Site Area (Ha): 4.18  
Search Buffer (m): 100

### Site Details

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# GeoDyne

## Ordnance Survey Plan

### Published 1973 - 1983

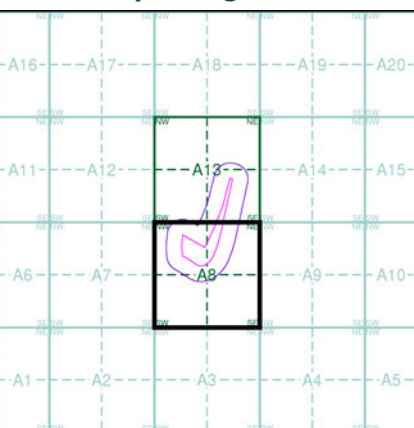
#### Source map scale - 1:1,250

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

#### Map Name(s) and Date(s)

|                             |                             |
|-----------------------------|-----------------------------|
| SP4194SW<br>1983<br>1:1,250 | SP4193NW<br>1973<br>1:1,250 |
| SP4093NE<br>1976<br>1:1,250 |                             |

#### Historical Map - Segment A8



#### Order Details

|                          |                |
|--------------------------|----------------|
| Order Number:            | 302954152_1_1  |
| Customer Ref:            | D42153         |
| National Grid Reference: | 440720, 294400 |
| Slice:                   | A              |
| Site Area (Ha):          | 4.18           |
| Search Buffer (m):       | 100            |

#### Site Details

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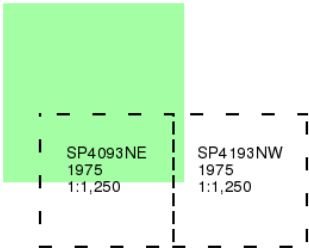
Supply of Unpublished Survey Information

Published 1975

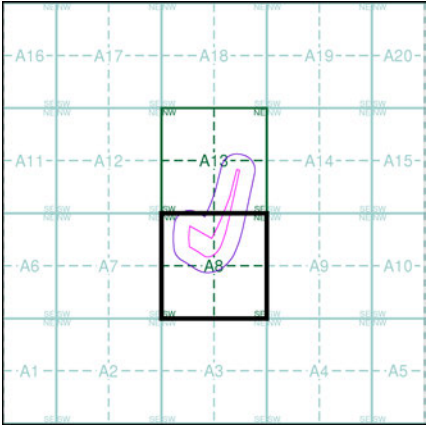
Source map scale - 1:1,250

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

Map Name(s) and Date(s)



Historical Map - Segment A8



Order Details

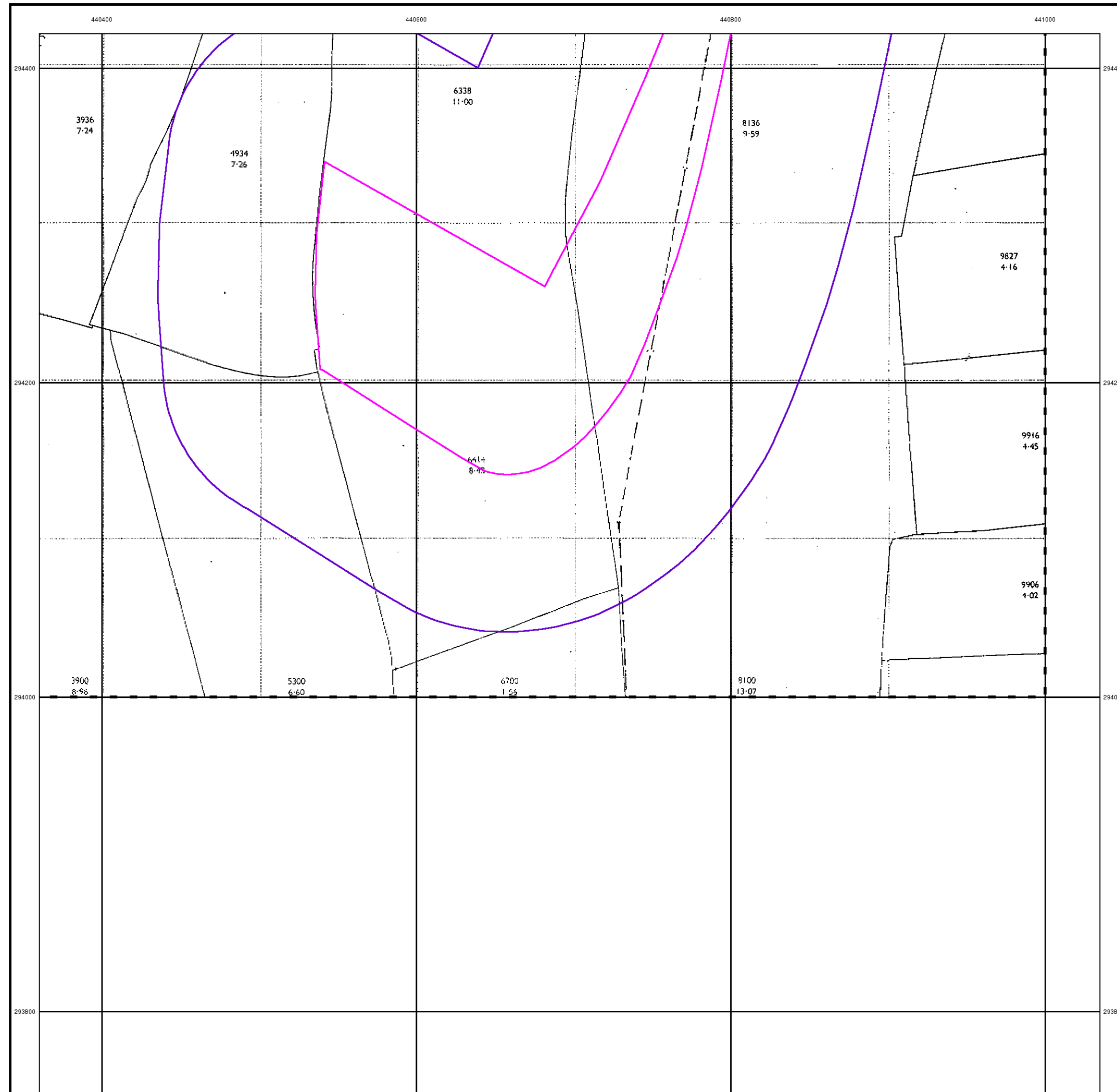
Order Number: 302954152\_1\_1  
Customer Ref: D42153  
National Grid Reference: 440720, 294400  
Slice: A  
Site Area (Ha): 4.18  
Search Buffer (m): 100

Site Details

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# GeoDyne

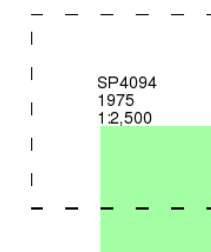
## Supply of Unpublished Survey Information

**Published 1975**

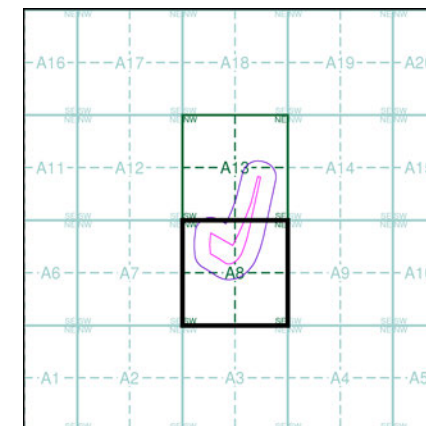
**Source map scale - 1:2,500**

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

### Map Name(s) and Date(s)



### Historical Map - Segment A8



### Order Details

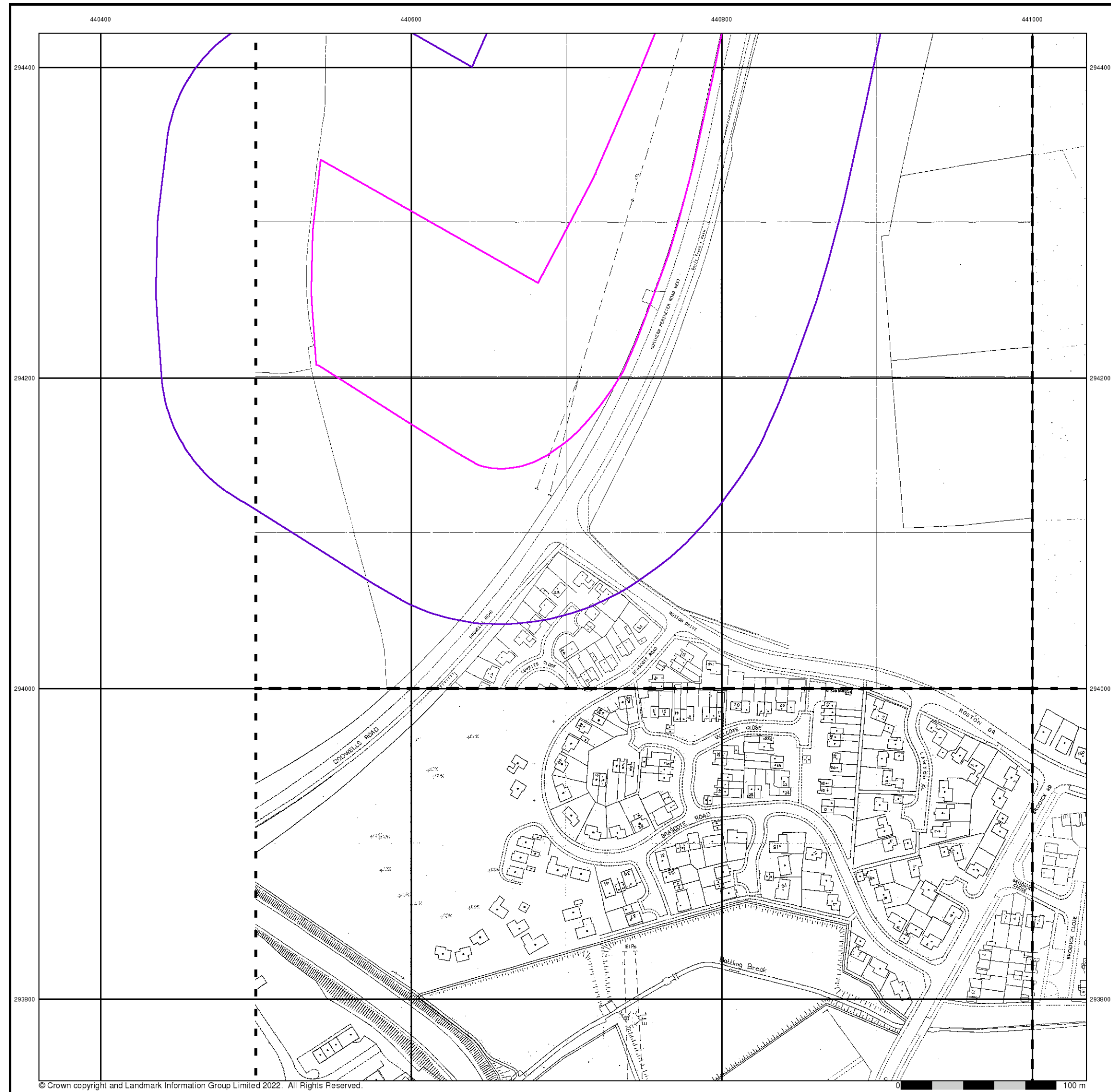
Order Number: 302954152\_1\_1  
Customer Ref: D42153  
National Grid Reference: 440720, 294400  
Slice: A  
Site Area (Ha): 4.18  
Search Buffer (m): 100

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## Additional SIMs

### Published 1978 - 1992

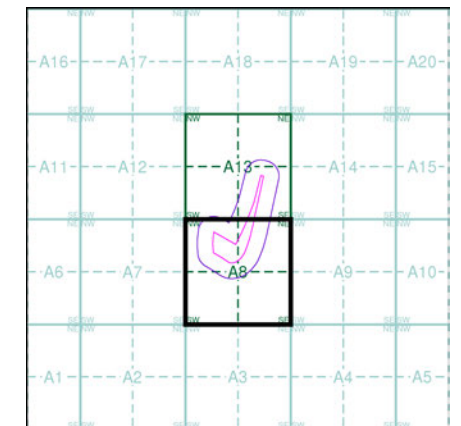
### Source map scale - 1:1,250

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

### Map Name(s) and Date(s)

|                             |                             |
|-----------------------------|-----------------------------|
| SP4094SE<br>1992<br>1:1,250 | SP4194SW<br>1978<br>1:1,250 |
| SP4093NE<br>1987<br>1:1,250 | SP4193NW<br>1987<br>1:1,250 |

### Historical Map - Segment A8



### Order Details

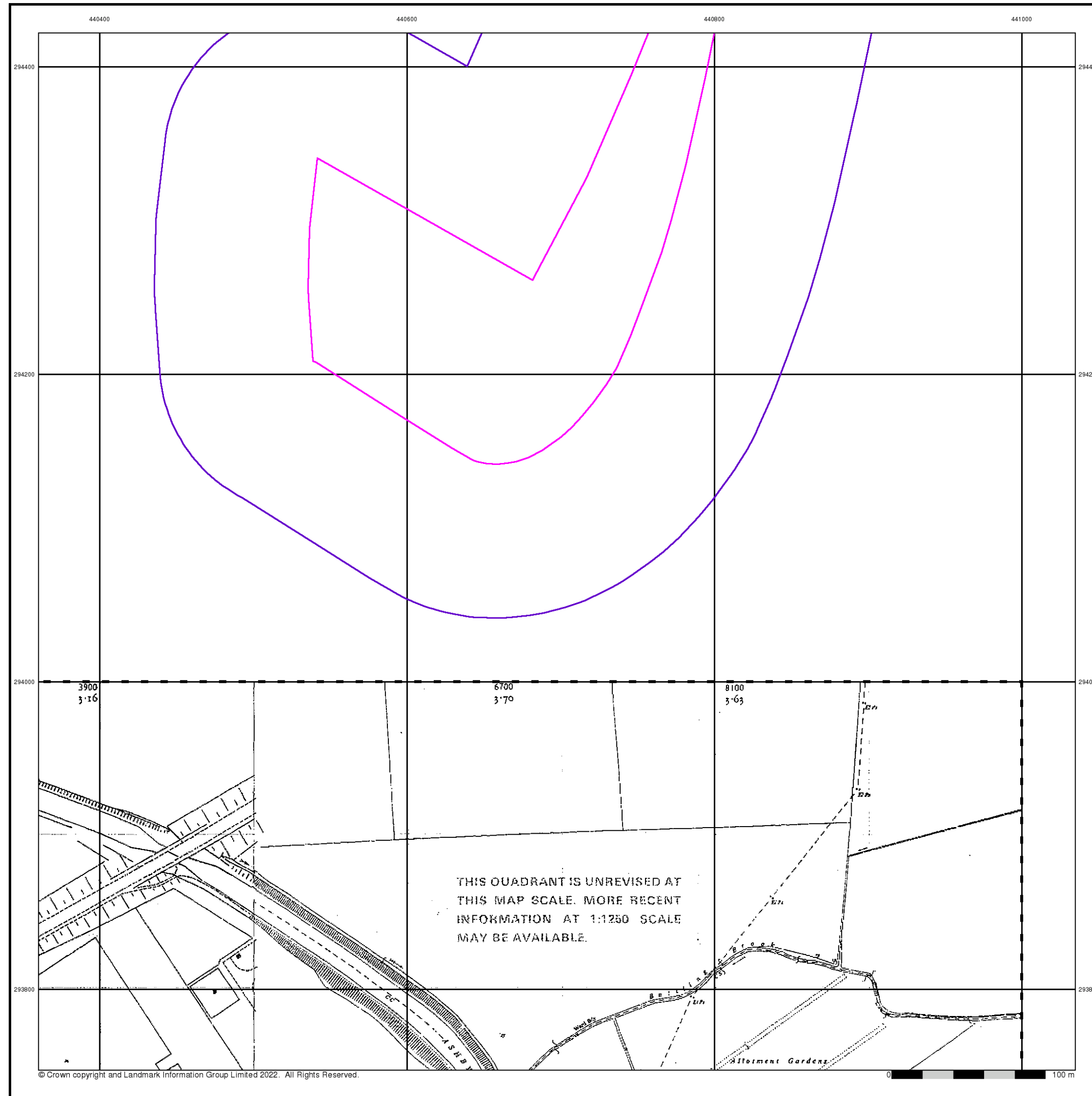
Order Number: 302954152\_1\_1  
Customer Ref: D42153  
National Grid Reference: 440720, 294400  
Slice: A  
Site Area (Ha): 4.18  
Search Buffer (m): 100

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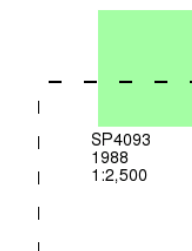
**Additional SIMs**

**Published 1988**

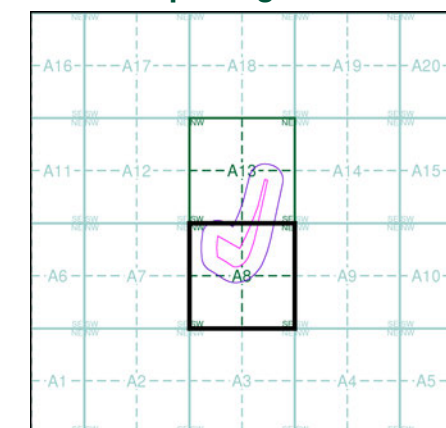
**Source map scale - 1:2,500**

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 A8



### Order Details

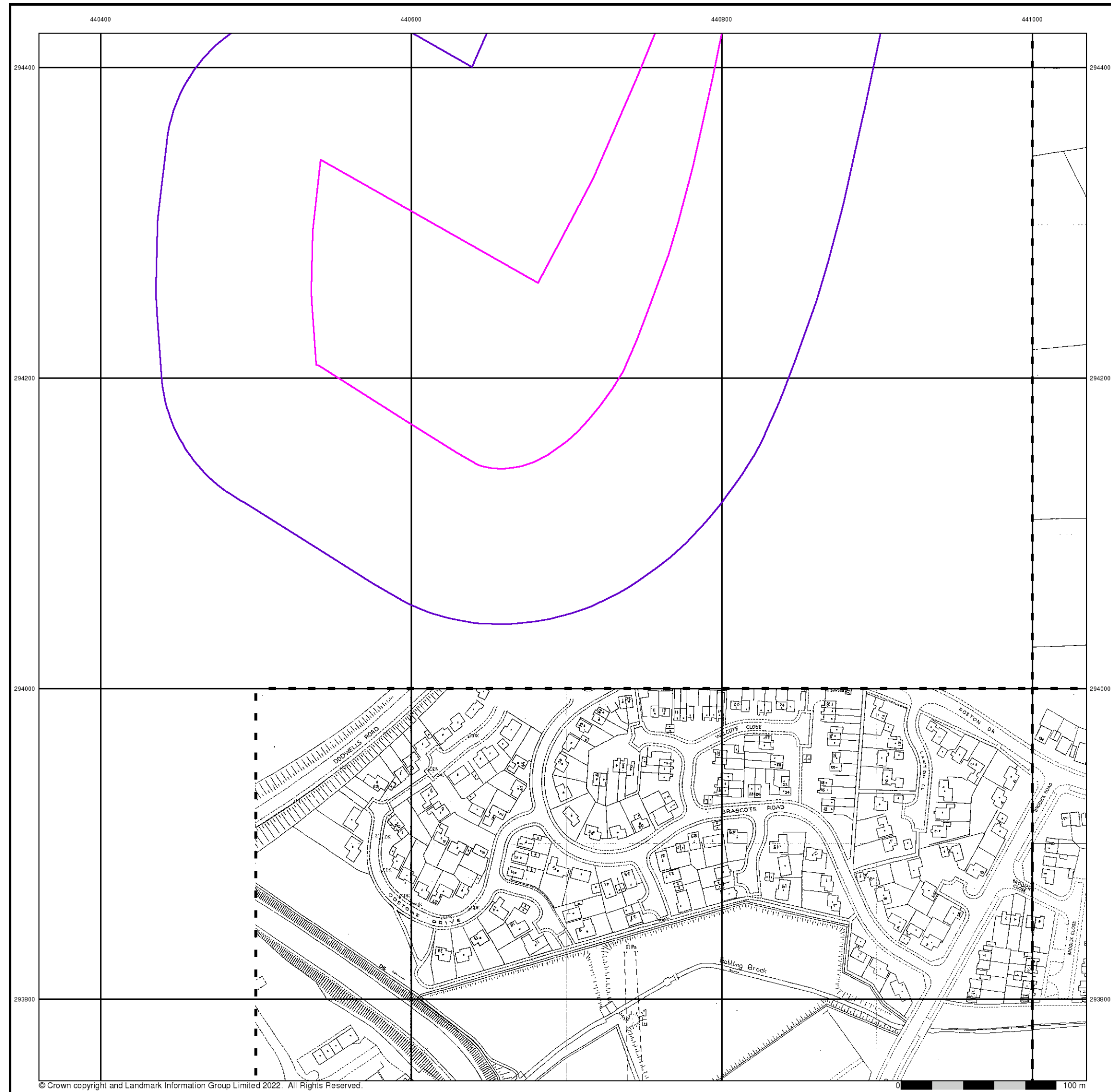
Order Number: 302954152\_1\_1  
Customer Ref: D42153  
National Grid Reference: 440720, 294400  
Slice: A  
Site Area (Ha): 4.18  
Search Buffer (m): 100

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### Additional SIMs

Published 1988 - 1991

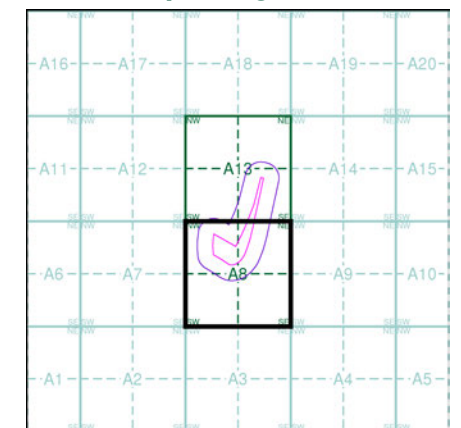
Source map scale - 1:1,250

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

### Map Name(s) and Date(s)

|                             |                             |
|-----------------------------|-----------------------------|
| SP4194SW<br>1990<br>1:1,250 |                             |
| SP4093NE<br>1988<br>1:1,250 | SP4193NW<br>1991<br>1:1,250 |

### Historical Map - Segment A8



### Order Details

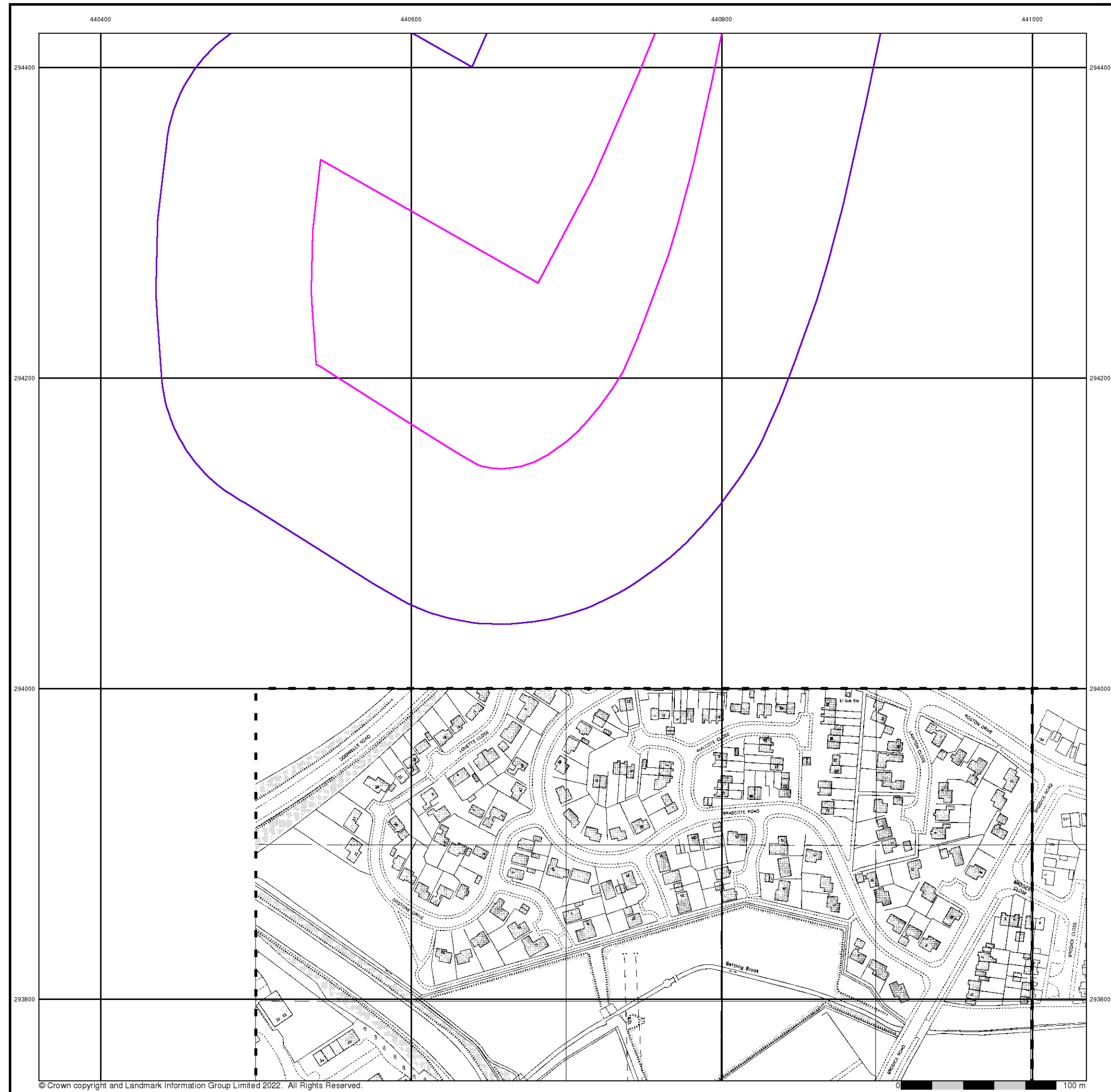
Order Number: 302954152\_1\_1  
Customer Ref: D42153  
National Grid Reference: 440720, 294400  
Slice: A  
Site Area (Ha): 4.18  
Search Buffer (m): 100

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## GeoDyne

### Ordnance Survey Plan

**Published 1990 - 1991**

**Source map scale - 1:1,250**

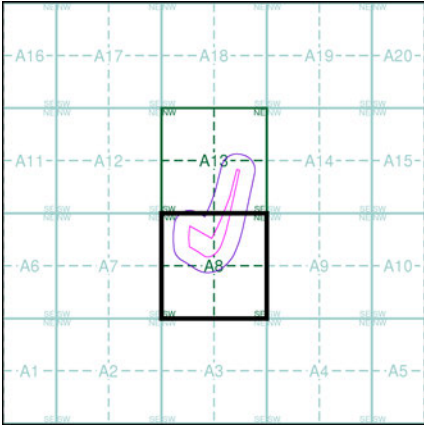
The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain.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

#### Map Name(s) and Date(s)

SP4093NE  
1990  
1:1,250

SP4193NW  
1991  
1:1,250

#### Historical Map - Segment A8



#### Order Details

|                          |                |
|--------------------------|----------------|
| Order Number:            | 302954152_1_1  |
| Customer Ref:            | D42153         |
| National Grid Reference: | 440720, 294400 |
| Slice:                   | A              |
| Site Area (Ha):          | 4.18           |
| Search Buffer (m):       | 100            |

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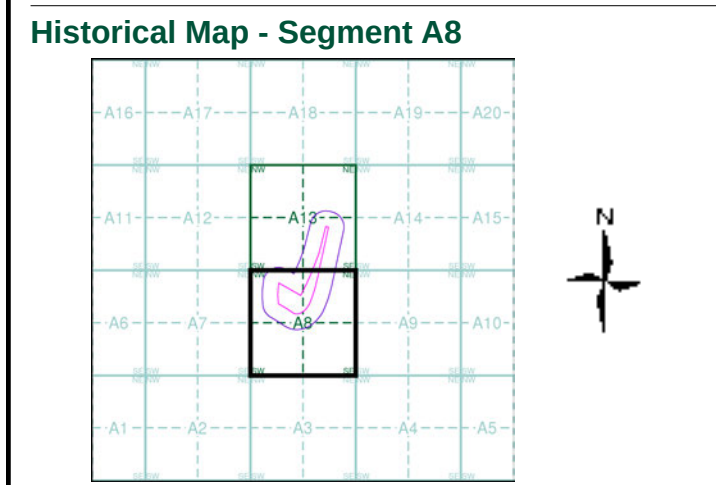
# GeoDyne

**Large-Scale National Grid Data**  
**Published 1993**  
**Source map scale - 1:1,250**

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

**Map Name(s) and Date(s)**

|                             |                             |                             |
|-----------------------------|-----------------------------|-----------------------------|
| SP4094SW<br>1993<br>1:1,250 | SP4094SE<br>1993<br>1:1,250 | SP4194SW<br>1993<br>1:1,250 |
| SP4093NW<br>1993<br>1:1,250 | SP4093NE<br>1993<br>1:1,250 | SP4193NW<br>1993<br>1:1,250 |

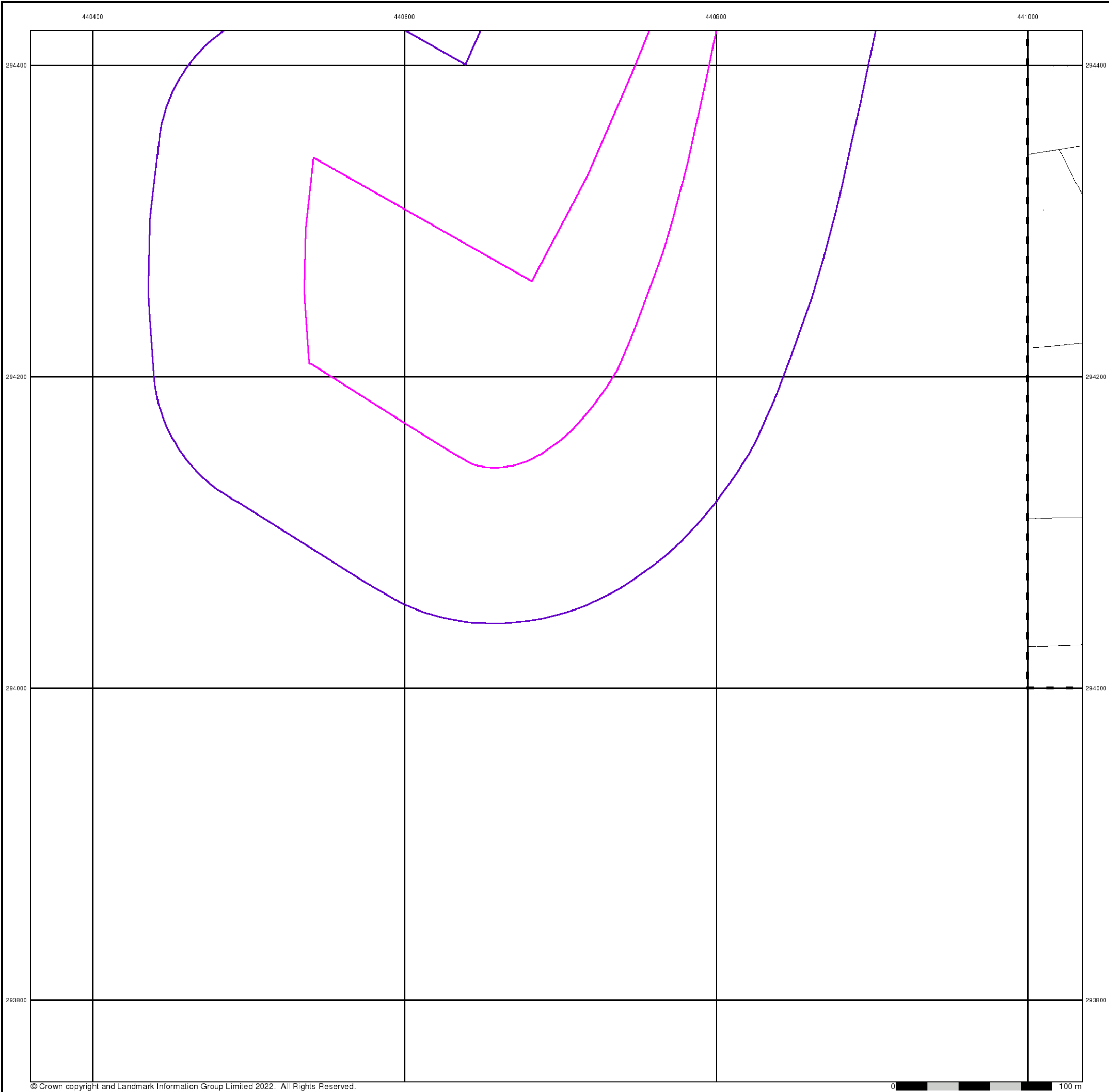


**Order Details**  
Order Number: 302954152\_1\_1  
Customer Ref: D42153  
National Grid Reference: 440720, 294400  
Slice: A  
Site Area (Ha): 4.18  
Search Buffer (m): 100

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0 100 m



GeoDyne

Additional SIMs

Published 1993

Source map scale - 1:1,250

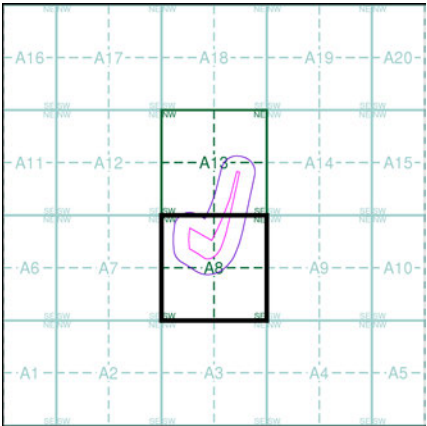
The SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') are further, minor editions of mapping which were produced and published in between the main editions as an area was updated. They date from 1947 to 1994, and contain detailed information on buildings, roads and land-use. These maps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

Map Name(s) and Date(s)



SP4194SW  
1993  
1:1,250

Historical Map - Segment A8



Order Details

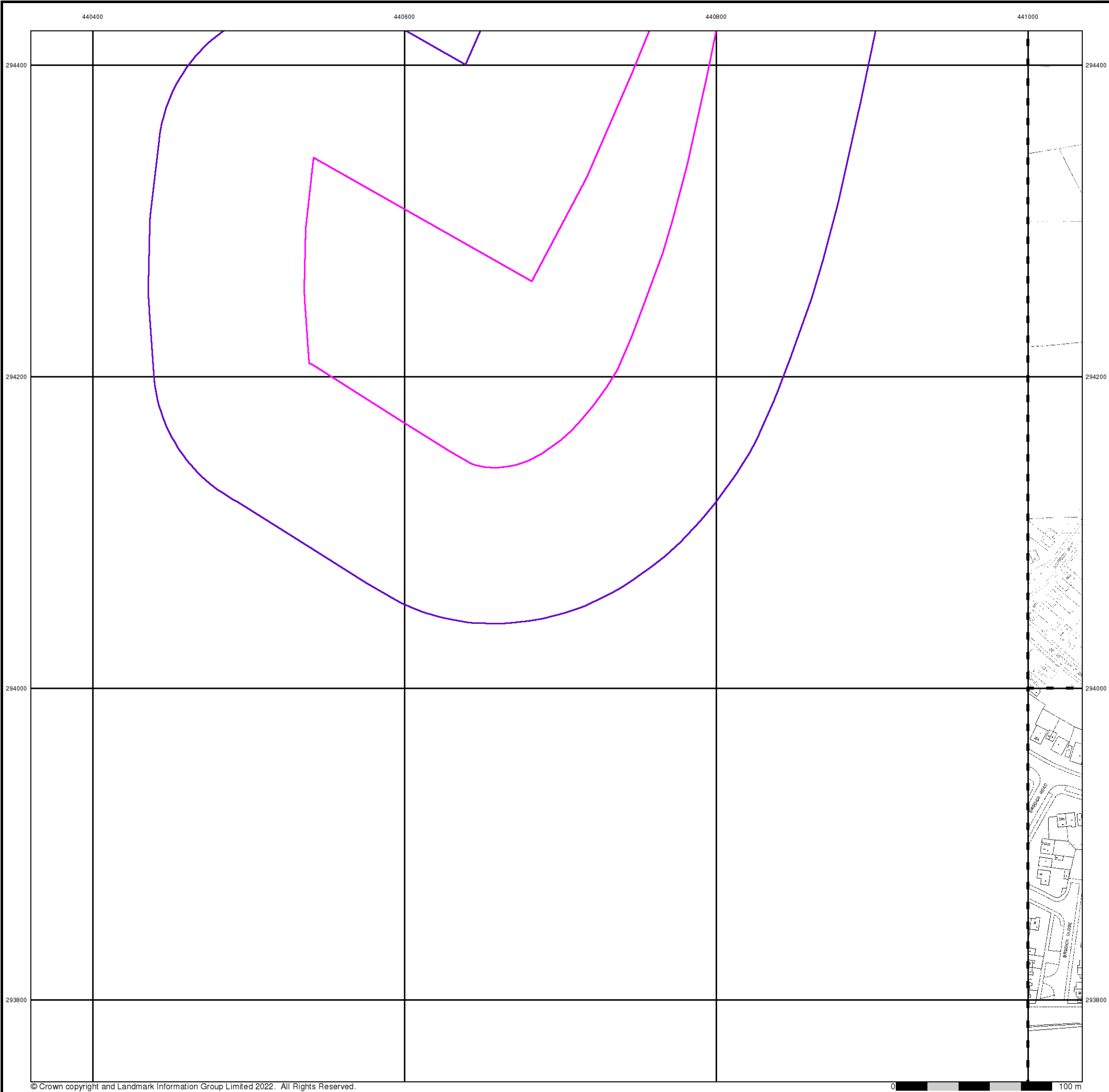
Order Number: 302954152\_1\_1  
Customer Ref: D42153  
National Grid Reference: 440720, 294400  
Slice: A  
Site Area (Ha): 4.18  
Search Buffer (m): 100

Site Details

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**Large-Scale National Grid Data**

**Published 1995**

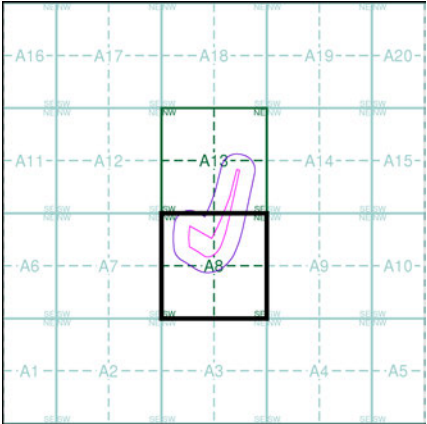
**Source map scale - 1:1,250**

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

**Map Name(s) and Date(s)**

|  |          |
|--|----------|
|  | SP4194SW |
|  | 1995     |
|  | 1:1,250  |
|  | SP4193NW |
|  | 1995     |
|  | 1:1,250  |

**Historical Map - Segment A8**



**Order Details**

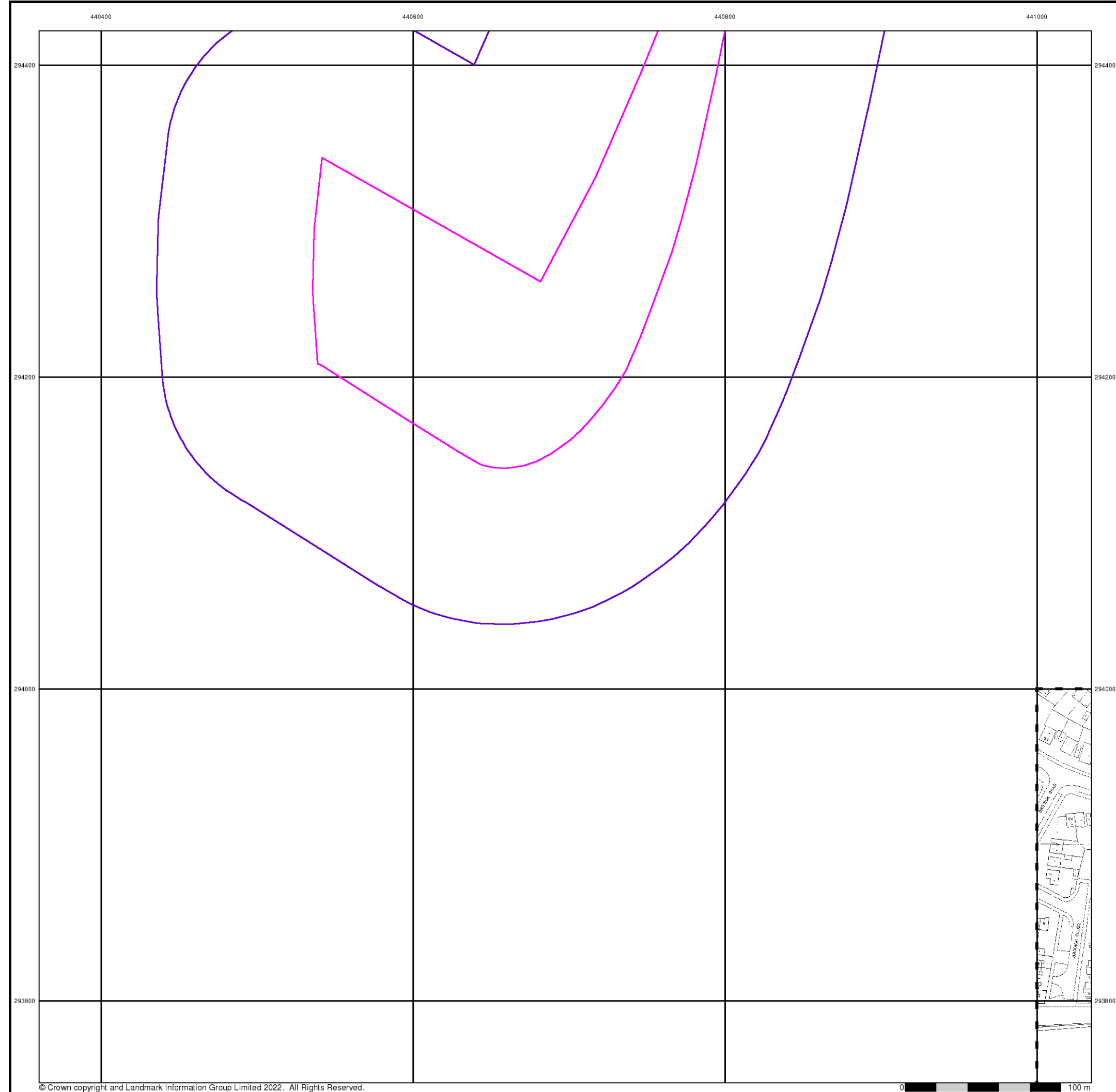
Order Number: 302954152\_1\_1  
Customer Ref: D42153  
National Grid Reference: 440720, 294400  
Slice: A  
Site Area (Ha): 4.18  
Search Buffer (m): 100

**Site Details**

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## Large-Scale National Grid Data

**Published 1995**

**Source map scale - 1:1,250**

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

### Map Name(s) and Date(s)

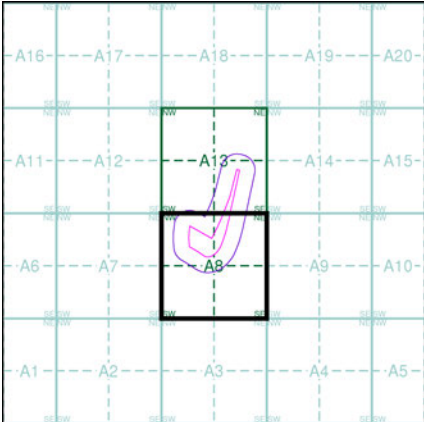


SP4 193NW

1995

1:1,250

### Historical Map - Segment A8



### Order Details

|                          |                |
|--------------------------|----------------|
| Order Number:            | 302954152_1_1  |
| Customer Ref:            | D42153         |
| National Grid Reference: | 440720, 294400 |
| Slice:                   | A              |
| Site Area (Ha):          | 4.18           |
| Search Buffer (m):       | 100            |

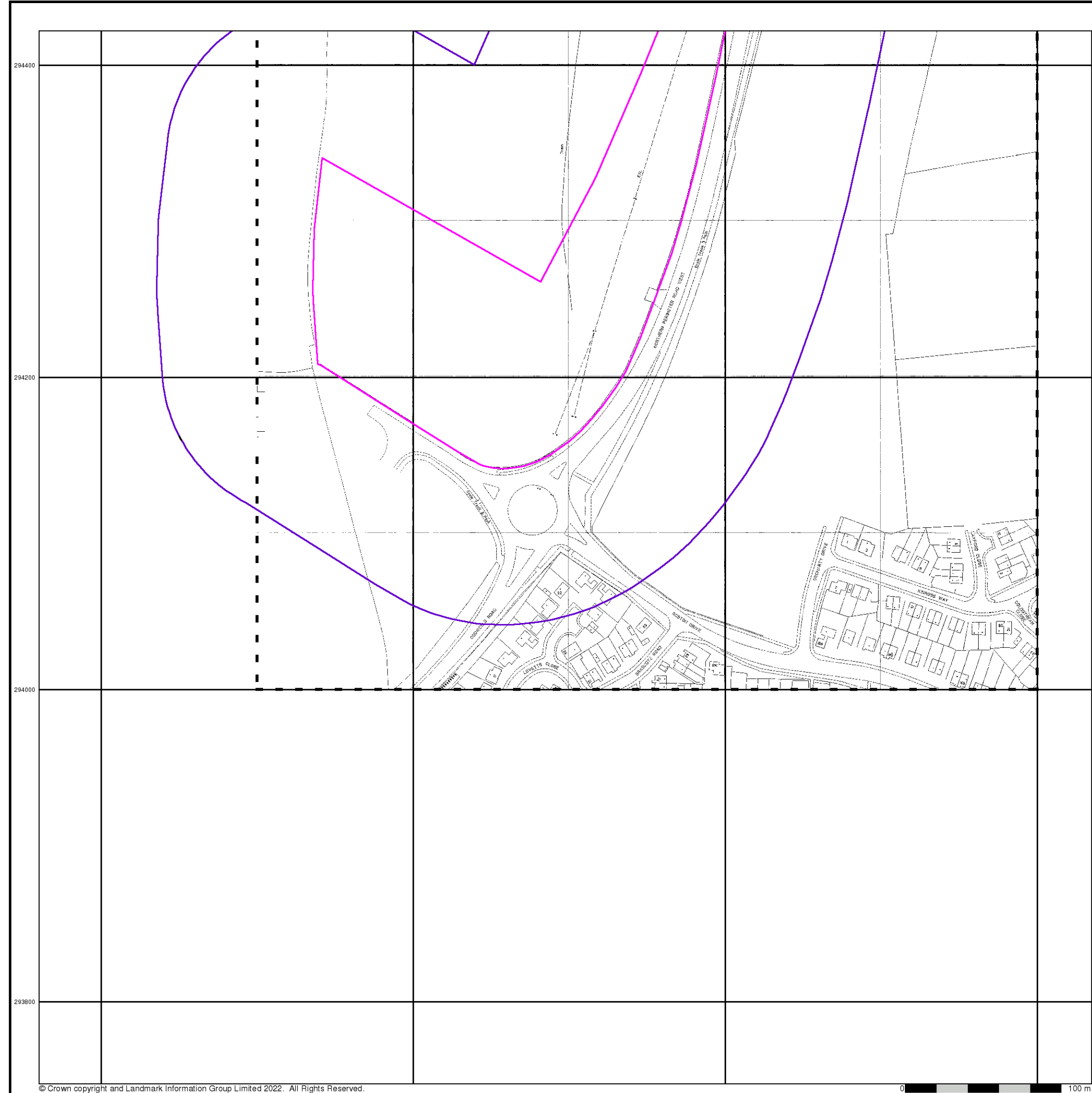
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GeoDyne

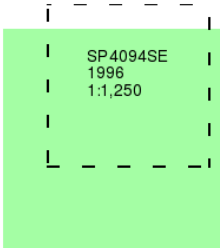
Large-Scale National Grid Data

Published 1996

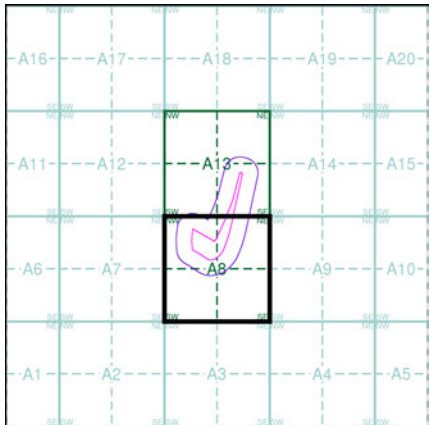
Source map scale - 1:1,250

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

Map Name(s) and Date(s)



Historical Map - Segment A8



Order Details

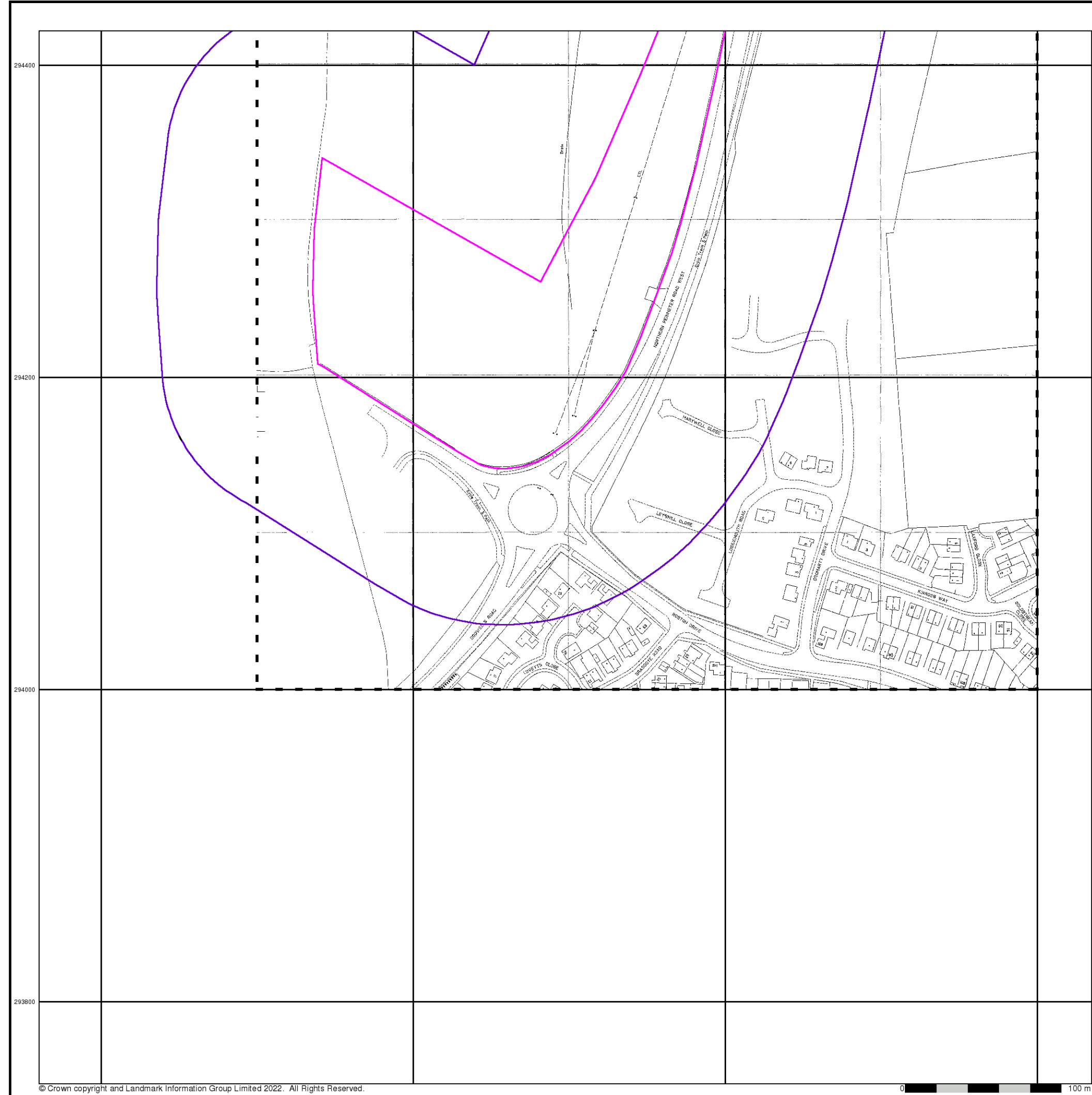
Order Number: 302954152\_1\_1  
Customer Ref: D42153  
National Grid Reference: 440720, 294400  
Slice: A  
Site Area (Ha): 4.18  
Search Buffer (m): 100

Site Details

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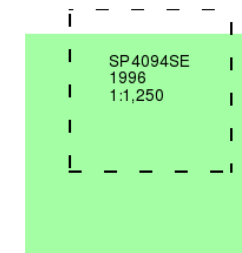
Tel: 0844 844 9952  
Fax: 0844 844 9951  
Web: www.envirocheck.co.uk



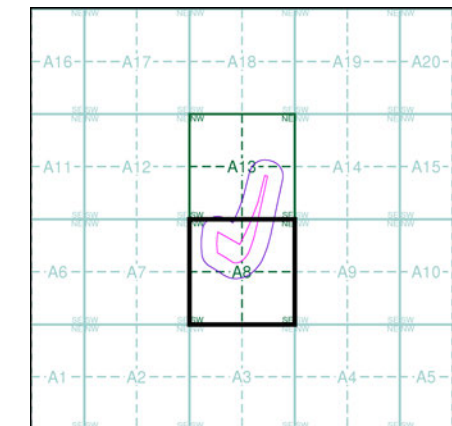
  
**GeoDyne**  
**Large-Scale National Grid Data**  
**Published 1996**  
**Source map scale - 1:1,250**

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

**Map Name(s) and Date(s)**



**Historical Map - Segment A8**

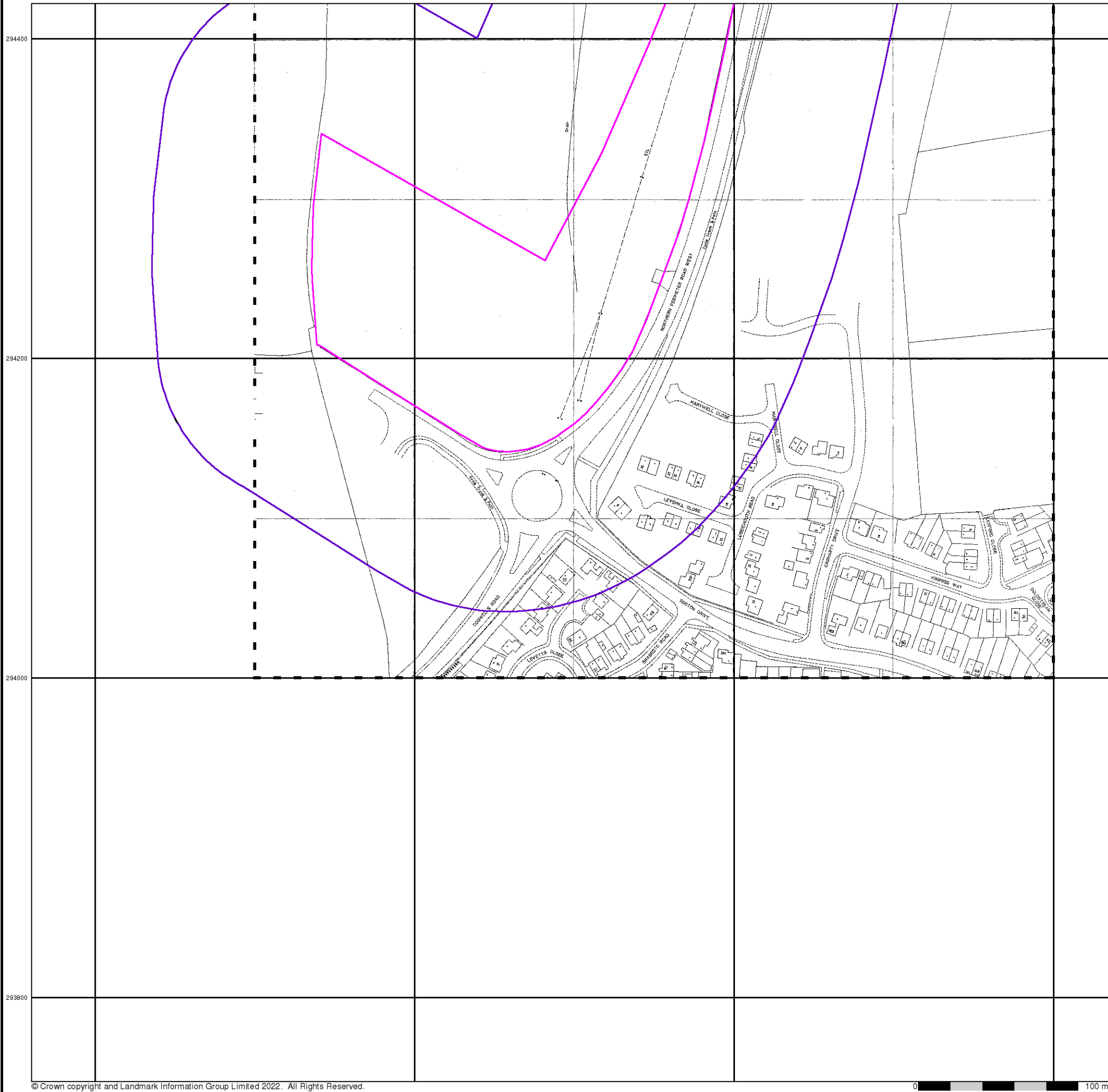


**Order Details**

Order Number: 302954152\_1\_1  
Customer Ref: D42153  
National Grid Reference: 440720, 294400  
Slice: A  
Site Area (Ha): 4.18  
Search Buffer (m): 100

**Site Details**

Hinckley Phase 4



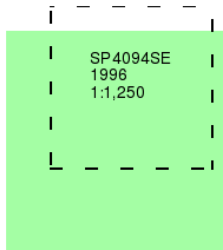
## Large-Scale National Grid Data

Published 1996

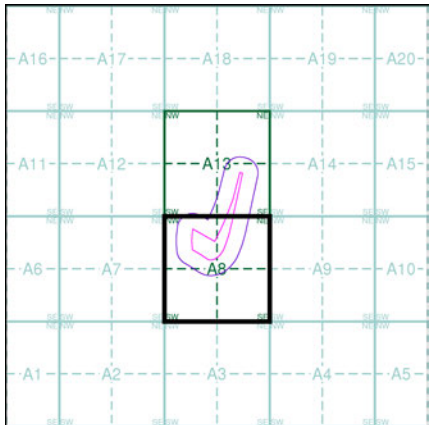
Source map scale - 1:1,250

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

### Map Name(s) and Date(s)



### Historical Map - Segment A8



### Order Details

Order Number: 302954152\_1\_1  
Customer Ref: D42153  
National Grid Reference: 440720, 294400  
Slice: A  
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