

Bellway Homes LTD (Wessex)

TECHNICAL NOTE

Surface & Foul Water Drainage



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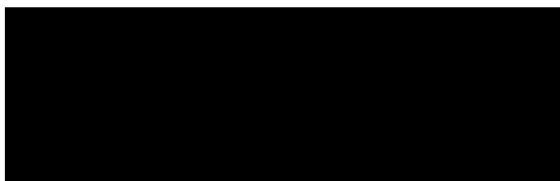
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DRAWINGS

1

SCOPE

11/5/19

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1 SCOPE

WSP has been appointed by Bellway Homes (Wessex) Ltd to provide engineering support and to assist in the discharge of planning conditions and reserved matters for the New Barn Lane development, North Bersted.

This document provides additional information and more detail on the proposed surface and foul water drainage strategies for the Barton Farm development over that presented by Outline Planning Application's Flood Risk Assessment (FRA) prepared by WYG ref: A094107 Flood Risk Assessment dated 15th April 2016.

2

DESIGN CRITERIA

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2 DESIGN CRITERIA

Table 1 provides a brief outline of the drainage design criteria.

Table 1 -Design Criteria

Criteria	Range
Design Document	Sewers for Adoption 7 th Edition BS EN 752 Building Regulations Part H Ciria C697 The SuDS Manual
Max depth of Drainage	6m
Typical Depth	0.9-3m
Gradients	Achieve self-cleansing in pipework where not a storage pipe; in accordance with best practice and standards
Hydraulic Design (surface water)	No surcharge within conveyance pipes for 1 in 1 year storm event (site on average at a gradient in excess of 1%) No flooding for 1 in 40 year storm event No surface water permitted to leave development (capture overland flows) for in 1 in 100 +40 (climate change) storm event.
Design Rainfall Document	FEH

Sustainable Drainage Systems (SuDS) are to be employed at the site including swales and attenuation basins.

Surcharging is permitted in storage structures for the 1 in 1-year rainfall event.

The drainage layout is to be arranged to correspond with phasing of the development.

3

EXISTING CONDITIONS

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3 EXISTING CONDITIONS

3.1 EXISTING SURFACE WATER DRAINAGE

There is no existing below ground surface water drainage located within the development. Existing ordinary watercourses are present, however, at the northern, western and southern boundaries of the site. Where the eastern boundary intersects the ditches, two culverts route the ditches into the existing Southern Water surface water sewer network.

3.2 GEOLOGY AND INFILTRATION

It is understood that infiltration is deemed to be unfeasible due to the "Firm brown Clay" overlying "Firm brown CLAY with chalk" layers below topsoil strip and the high groundwater levels identified and summarised in the Geotechnical Ground Investigation (GGI) report conducted by Pell Frischmann ref: 10148-GI01 rev- dated 11th June 2018.

No infiltration testing was undertaken but given the groundwater level, and to follow the strategy of the Approved FRA, soakage is not deemed viable at this site

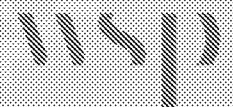
3.3 GROUND WATER

During the geotechnical investigation, undertaken by Land Science and Pell Frischmann and conducted between 23rd and 24th April 2018, groundwater was investigated.

Groundwater was identified within all boreholes as standing at levels between 1.0-1.2m (refer to Appendix A).

4

STRATEGY



4 STRATEGY

4.1 SURFACE WATER STRATEGY

In accordance with details submitted for the Outline Planning Application and the approved FRA, the proposed surface water drainage will comprise of gravity piped system discharging from roofs and driveways to the on-site crate system and open swales, then into the existing ditch system around the perimeter of the development area at greenfield run-off.

To do this, it is proposed that two number drainage networks are utilised at the site to collect and dispose of surface water generated at the site from rainfall.

It is likely that while basins will be used at the site to provide both attenuation storage volume and water quality improvements, further attenuation in the form of oversized pipes will be required. These oversized pipes, and the drainage systems in general, will be designed in consideration of recorded groundwater levels at the site.

The outline surface water drainage strategy can be seen by plan 1643-WSP-XXX-NBL-DR-C-0501, Appendix B.

In accordance with the Approved FRA, flows will be limited to the calculated rate for QBar (estimated at 3.6 l/s/ha). As such Table 1 outlines the required attenuation storage volume for the two networks.

Table 1 – Flow Rates and Attenuation Volumes

Network	Greenfield Rate (l/s) prorated from Approved FRA	Attenuation Storage (m ³)
North	2	195
South	4.8	470

Given the low flow rate from the northern network and the risk of blockage, special maintenance measures will be required to ensure continued operability of the flow control.

To enable the discharge of surface water to the nearby watercourses, ordinary watercourse consent will be required from Lead Local Flood Authority, West Sussex County Council. Such consents will be applied for once the details of the drainage are fully designed.

In times of exceedance, flows will be routed towards the basins in the southern area of the site with ground levels falling gently in the direction of those features. It is proposed that in accordance with the Approved FRA, the roads on the site will act as the means to convey exceedance flows towards soft space located around the site and the aforementioned basins.

4.2 FOUL WATER STRATEGY

Foul water will drain by gravity from the site as per the Approved FRA to a connection point located beneath New Barn Lane.

Given the proximity and level of the existing surface water culvert that lies between the site and the preferred connection manhole (as proposed by the FRA) it is not possible to drain the site without significantly raising levels or utilising pumping.

An alternative connection point into Southern Water's infrastructure and routing to the discharge manhole is therefore proposed. This route avoids the requirement to cross the culvert and permits the site to drain foul water by gravity while complying with best practice.

The outline surface water drainage strategy can be seen by plan 1643-WSP-XXX-NBL-DR-C-0501, Appendix B.

5

CONCLUSION

11/5/19

5 CONCLUSION

WSP has been appointed by Bellway Homes (Wessex) Ltd to provide engineering support and to assist in the discharge of planning conditions and reserved matters for the New Barn Lane development, North Bersted.

This document provides additional information and more detail on the proposed surface and foul water drainage strategies for the Barton Farm development over that presented by Outline Planning Application's Flood Risk Assessment (FRA) prepared by WYG ref: A094107 Flood Risk Assessment rev - dated 15th April 2016.

The strategies outlined in this technical note conform to the philosophy of the Approved Flood Risk Assessment but apply constraints to the proposed drainage systems based on new and updated information.

The surface and foul water strategies demonstrate that the development can be adequately drained; surface water into local watercourses and foul into nearby Southern Water infrastructure.

Surface water will be attenuated to the rates outlined in the FRA and with SuDS to provide water quality improvements.

Appendix A

GEOTECHNICAL INFORMATION

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Church Commissioners for England

**New Barn Lane
North Bersted, Bognor Regis**

Geotechnical Ground Investigation

Date: 11th June 2018
PF Report Ref: 101487- GI01 rev -

REVISION RECORD Report Ref:

Rev	Description	Date	Originator	Checked	Approved
-	Initial Issue	11th June 2018		TMcL	TMcL

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Appendix A – Full Geotechnical Ground Investigation Report

GEOTECHNICAL GROUND INVESTIGATION REPORT

1. INTRODUCTION

1.1 OVERVIEW

- 1.1.1 Pell Frischmann has been retained by the Church Commissioners for England (the Client) to prepare this Geotechnical Ground Investigation Report. This report provides the results of an on-site Ground Investigation for the proposed development area. The site is west of New Barn Lane, North Bersted, Bognor Regis. It is in the administrative boundary of Arun District Council (ADC) and the local highway authority is West Sussex County Council (WSCC)
- 1.1.2 The site has a total area of approximately 1.94Ha with connection to New Barn Lane along its north eastern corner.
- 1.1.3 The development site is identified



Development Site Plan

- 1.1.4 A copy of the full Geotechnical Ground Investigation Report is contained in Appendix A. The following is a synopsis of the key investigation findings.

2. DEVELOPMENT PROPOSALS

- 2.1.1 The area under investigation comprised an undeveloped open field boarded by various trees and hedgerows.
- 2.1.2 The site was located on the edge of a residential area and was surrounded by dwellings to the east and north, with fields to the south and west. The site fronted on to New Barn Lane to the northeast. Two mobile phone masts were immediately on the far southern boundary with a petrol filling station noted 271m to the northeast. No other potentially contaminative land uses were identified within the immediate surrounding area.
- 2.1.3 The topography of the local area was generally flat and level. The site was generally flat and level and was located at an approximate elevation of 4.5mOD.
- 2.1.4 In accordance with the agreed scope, the investigation comprised the following:
- 10 no. dynamic sampler boreholes to a target depth of 5.0m
 - Super heavy dynamic probes to accompany selected boreholes
- 2.1.5 The purpose of the investigation is to provide an interpretation of ground conditions with respect to foundations, pavements, concrete specification and excavations.
- 2.1.6 Geological Hazards – No such features were identified on site or within 250m.
- 2.1.7 Mining and Natural Cavities - no such features were identified on site or within 250m.
- 2.1.8 Radon Potential – Low probability, no protection measures required
- 2.1.9 Surface Water Features - The nearest surface water feature identified on Ordnance Survey mapping was located 380m to the northeast

3. INTRUSIVE INVESTIGATION

- 3.1.1 Generally, the investigation confirmed the anticipated geological succession, comprising the River Terrace Deposits overlying the White Chalk Subgroup.

Base Depth m	Strata	Summary description
0.15 – 0.20	Topsoil	Silty gravelly CLAY
1.30	Made Ground	Reworked silty and gravelly CLAY with brick
2.60 – 5.00	River Terrace Deposits	Silty clays with chalk gravels and gravelly sandy clayey silts
5.00+	White Chalk Subgroup	Structureless chalk comprised of slightly gravelly silt, weak subangular gravels, becoming structured (Grade C) with depth.

- 3.1.2 No evidence of possible soil contamination (such as staining, malodours, or brightly coloured soils) was identified in the field.

4. FOUNDATION DESIGN

4.1 FOUNDATIONS

- 4.1.1 Low volume change potential soils were identified, which may be susceptible to seasonal heave and shrinkage movements caused by changes in moisture content caused by the action of tree roots and rootlets. Trees and hedgerows were noted where noted to surround the perimeter of the site.
- 4.1.2 A shallow water table standing at approximately 1.00mbgl to 1.20mbgl was encountered. Groundwater levels may rise further during prolonged periods of wet climatic conditions.
- 4.1.3 It is considered prudent to confirm groundwater levels and trench stability parameters by means of excavating a series of trial pits across the site immediately prior to construction, or the installation of ground water monitoring sandpipes and undertaken a ground water monitoring program.
- 4.1.4 Based on the ground and groundwater conditions encountered, it is considered that traditional strip foundations are possible but may be tight considering the water table. An alternative foundation solution might be considered, such as the use of rafts, piles or Vibro Concrete Columns (VCC's).
- 4.1.5 Shallow Foundations - All foundations should be taken through any Made Ground, soft or loose zones, disturbed soils, major root zones, or desiccated materials and taken wholly into or onto the Firm Clays and Medium dense Sands of the River Terrace Deposits.
- 4.1.6 Given the variability in engineering characteristics of the River Terrace Deposits at the anticipated formation level, it is recommended that all foundations are lightly reinforced to account for potential differential settlements.
- 4.1.7 The final 50mm of any foundation trench should not be excavated until immediately before concreting, unless blinded or otherwise protected immediately after excavation.

4.2 GROUND FLOOR SLABS

- 4.2.1 Given the presence of soils susceptible to volume change potential (i.e. shrinkable), it is recommended that all ground floor slabs should be fully suspended, with a suitable minimum void space.
- 4.2.2 Ground bearing floor slabs may be considered for other structures such as garages or outbuildings. The formation should be appropriately treated, and the design should allow potential future movements.

4.3 PAVEMENTS

- 4.3.1 The formation level for pavements is expected to comprise firm clays of the River Terrace Deposits. A CBR index of 2% is considered appropriate for firm clays of the River Terrace Deposits.
- 4.3.2 A minimum pavement thickness of up to 450mm should therefore be considered. However due to the low CBR a capping layer may also be required. The extent of the capping will be subject to further testing.

- 4.3.3 Where any roads are to become adopted by the relevant Highways Authority, they should be consulted in order to confirm local specifications and acceptable design parameters.

5. SUMMARY AND CONCLUSIONS

Appointment	Geotechnical ground investigation. The intrusive investigation included ten dynamic sampler boreholes.		
Development	Proposed new low rise residential dwellings.		
Ground Conditions	Strata	Base depth m	Summary
	Topsoil	0.15 – 0.20	Silty gravelly CLAY
	Made Ground	1.30	Reworked silty and gravelly CLAY with brick
	River Terrace Deposits	2.60 – 5.00	Silty clays with chalk gravels and gravelly sandy clayey silts
	White Chalk Subgroup	5.00+	Structureless chalk comprised of slightly gravelly silt, weak subangular gravels, becoming structured (Grade C) with depth.
Groundwater	Groundwater was recorded within all the boreholes standing at levels of between 1.00 – 1.20m.		
Foundations	Traditional foundations designed to a maximum net allowable bearing capacity of 50kN/m ² on the River Terrace Deposits. The formation should be treated as being Low volume change potential. Footings should be lightly reinforced and ground floors fully suspended given the low volume change potential of soils and shallow groundwater table, consideration may be given to rafts, ground improvements or piles.		
Excavations	Excavations below the water table may become highly unstable, a dewatering strategy plan should be undertaken. Risk assessments should be prepared, and appropriate safety measures provided.		
Pavements	CBR value of 2% recommended for the River Terrace Deposits. The formation is classified as being frost susceptible and a minimum pavement thickness of 450mm should be considered.		
Building Materials	DS-1 and AC-1 in accordance with BS8500.		
This Executive Summary is intended to provide a brief summary of the main findings and conclusions of the investigation. For detailed information, the reader is referred to the main report.			

Appendix A – Full Geotechnical Ground Investigation Report

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FIGURES

FIGURE 1:	Site Location Plan
FIGURE 2:	Existing Layout / Investigation Layout
FIGURE 3:	Proposed Layout / Investigation Layout

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1.0 INTRODUCTION

1.1 General

Land Science was instructed by Pell Frischmann to undertake a geotechnical ground investigation at New Barn Lane, Bersted, Bognor Regis, PO21 5DL. The location of the site is shown on Figure 1, which is centred at grid reference SU 917 009

1.2 The Site

The area under investigation comprised an undeveloped open field boarded by various trees and hedgerows.

The layout of the existing site is indicated on Figure 2, and a walkover survey is presented in section 3.0. The area was approximately 1.80 hectares. It was assumed that the Client was in ownership of the site, and that this investigation was not a pre-purchase appraisal.

1.3 Form of Development

The preliminary proposed development was understood to comprise the construction of multiple residential houses and roadways across the entire site. Figure 3 illustrates the layout of the proposed redevelopment.

1.4 Previous Investigations

Land Science was not aware of any previous desk studies or ground investigation(s) undertaken on this site and for this scheme.

1.5 Scope of Works

In accordance with the agreed scope, the investigation comprised the following:

- 10 no. dynamic sampler boreholes to a target depth of 5.0m (WS1 to WS10)
- Super heavy dynamic probes to accompany selected boreholes (DP1 to DP10)

The fieldwork was conducted on 23rd and 24th April 2018 under the supervision of Land Science.

1.6 Geotechnical Objectives

A geotechnical investigation was required to provide an interpretation of ground conditions with respect to foundations, pavements, concrete specification and excavations.

1.7 Standards

Where practicable, the investigation was undertaken in accordance with the following standards and guidance:

- BS 5930:2016 Code of Practice for Site Investigations
- BS 1377:2015 Soils for Civil Engineering Purposes

Unless otherwise explicitly stated, the work has not been undertaken in accordance with Eurocode 7 and this report does not represent a Geotechnical Design Report (GDR) under that standard.

Other technical sources have been cited in respect of specific aspects of the investigation, as referenced throughout the text.

1.8 Confidentiality and Limitations

This report may be relied upon by the Client and their agents and consultants and should be read and used only in full.

The report may not be relied upon or transferred to any other parties without the express written agreement of Land Science. No responsibility will be accepted where this report is used, either in full or in part, by any other party.

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2.0 SITE SETTING

2.1 Geological Mapping

Based on British Geological Survey (BGS) 1:50,000 sheet number 332 entitled "Chichester and Bognor", the geology of the site was anticipated to comprise the following succession:

Strata	Generic description
River Terrace Deposits	Generally found at an elevation close to or higher than that of the existing rivers, and generally comprise sands and gravels of roughly bedded flint or chert gravels varying degrees of coarseness.
White Chalk Subgroup	Chalk with flints. With discrete marl seams, nodular chalk, sponge-rich and flint seams throughout

2.2 Historical Borehole Records

Records of old boreholes are held by the BGS. The following relevant borehole record was identified:

Distance (m):	Direction:	BGS Reference:	Drilled Length (m):	Borehole Name:
382m	Northwest	SU90SW25	34.00	Orchard Caravan Park Sussex

This record has been summarised below:

Strata	Base Depth (m)	Summary Description
Topsoil	0.40	Described as "Topsoil"
River Terrace Deposits	4.30	"Firm brown CLAY" overlying "firm brown CLAY with chalk"
White Chalk Subgroup	34.00	"Grey putty CHALK with large lumps and flints" overlying "stiff/hard chalk with thin putty layers and flints"

2.3 Geological Hazards

The BGS produce hazard assessment maps for a selection of common geotechnical datasets. A search of the classifications referring to the site (and immediate vicinity – if relevant) was carried-out; no such features were identified on site or within 250m.

2.4 Mining and Natural Cavities

A search of various databases for coal mining, mining, brine compensation, and natural cavities was carried-out, no such features were identified on site or within 250m.

2.5 Radon Potential

The requirement for Radon Protection Measures (RPM) has been assessed in accordance with BRE 211:2007¹. Public Health England and the BGS estimate the potential for radon and the requirement for Radon Protection Measures on site as follows:

Probability	Low probability	Between 1% and 3% of homes are estimated by PHE to exceed the threshold for Radon gas in residential dwellings.
Protection Measures	No RPM required	No Radon Protection Measures (RPM) are required for new dwellings or extensions constructed at this location.

2.6 Hydrogeology

The BGS borehole records identified groundwater standing at a depth of 2.80m. Furthermore based on the geology and topography of the local area, a relatively shallow groundwater table was anticipated.

2.7 Aquifer Designations

The Environment Agency classifies geological units across England into different designations as Aquifers. The designations for strata beneath the site are given below, which corresponds to an overall designation as a Principle Aquifer.

Strata	Classification	Details
White Chalk Subgroup	Principle Aquifer	Strata that have high inter-granular and/or fracture permeability, usually providing a high level of water storage. They may support water supply and/or river base flow on a strategic scale.
River Terrace Deposits	Secondary A	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.

2.8 Source Protection Zones

A groundwater Source Protection Zone (SPZ) is an area of protection placed around a well or borehole that supplies groundwater of potable quality. The following data has been identified on and within 250m of the site according to Environment Agency mapping:

Location	Classification	Details
On site	No SPZ	No groundwater Source Protection Zones were identified.
Within 250m		

2.9 Surface Water Features

The nearest surface water feature identified on Ordnance Survey mapping was located 380m to the northeast

2.10 Surface Water Flooding

Land potentially susceptible to flooding from seas, rivers, reservoirs and surface water is identified by the Environment Agency. Current mapping indicated the following:

Source	Details
Areas Benefiting from Flood Defences	The site does not lie within an area classified as being susceptible to significant flooding and does not lie within an area benefiting from flood defences.
Flood Water Storage Areas	
Flood Defences	

Whilst the site was not indicated to be susceptible to flooding, drainage ditches along the site perimeter was identified to be susceptible to surface water flooding (3.3% annual chance).

It is recommended that further more accurate details of potential flooding within the local area be obtained from the Environment Agency, in order to ascertain the level of any risk posed. It may become necessary to undertake a Flood Risk Assessment (FRA).

2.11 Waste Management Facilities

Searches of various databases of current and historical waste management facilities (including mapped areas of possible infilled land) are summarised on the following table:

Database	Results
Historical Landfill Sites	No features found
Licensed Waste Management Facilities	No features found
Registered Landfill Sites	No features found
BGS Recorded Landfill Sites	No features found
Integrated Pollution Control Registered Waste Sites	No features found
Local Authority Recorded Landfill Sites	No features found
Registered Waste Transfer Sites	No features found
Registered Waste Treatment or Disposal Sites	No features found
Potentially Infilled Land	No features found

No waste management facilities were identified within 500m of the site.

2.12 Historical Maps

Large scale (e.g. 1:2,500) historical maps dating between 1876 and 1999 were reviewed to identify the history of the site and local area. The outline of the site shown is geo-referenced to the current grid system; due to inaccuracies in mapping techniques the actual boundary on older maps may vary. Smaller scale (e.g. 1:10,000) maps were reviewed, but did not provide further relevant historical information. Given the size of these files sizes, smaller scale maps are not appended to the report but are available separately.

In summary, from 1876 the site comprised an open field commensurate with present day. From 1876 the local area comprised mainly of open fields with two cottages to the east. By 1964 residential development had been undertaken in the east extending up to the current site boundary by 1967. From 1994 the fields to immediate south was identified as a playing field. From aerial photography in 2001 shows the telephone reception masts to the south west. The site remained unchanged to present day.

3.0 SITE WALKOVER

3.1 General

A site walkover was undertaken in conjunction with the fieldwork on the 23rd and 24th April 2018. Photographs of the site are provided in Appendix A.

3.2 Site Layout

The area under investigation comprised an undeveloped open field boarded by various trees and hedgerows.

3.3 Surrounding Area

The site was located on the edge of a residential area and was surrounded by dwellings to the east and north, with fields to the south and west. The site fronted on to New Barn Lane to the northeast. Two mobile phone masts were immediately on the far southern boundary with a petrol filling station noted 271m to the northeast. No other potentially contaminative land uses were identified within the immediate surrounding area.

3.4 Elevation and Topography

The topography of the local area was generally flat and level. The site was generally flat and level and was located at an approximate elevation of 4.5mOD.

3.5 Ground Conditions

No evidence of existing soil conditions was observed, such as open excavations or the like.

3.6 Surface Water and Groundwater

No surface water features were identified on site or in the immediate vicinity. No evidence of shallow groundwater, such as boggy waterlogged soils or water loving plants etc., were noted.

3.7 Trees and Vegetation

A number of mature deciduous trees and hedgerows were noted around the perimeter of site.

A detailed arboricultural survey was outside the scope of this report. A survey may be required for tree root protection purposes or for assessing the depth of foundations in the vicinity of trees.

4.0 INTRUSIVE INVESTIGATION

A factual record of the conditions encountered during the physical investigation of the site is presented in the following sections.

4.1 Investigation Strategy

Based on the findings of the conceptual site model and the geotechnical objectives, the intrusive investigation was based on the following strategy:

Aspect	Position	Target depth	Existing Location	Testing etc
Dynamic Sampler boreholes	WS1	5m	Northeast area	SHDP
	WS2		Eastern area	
	WS3		Northern area	
	WS4		Central area	
	WS5		Central area	
	WS6		Southeast area	
	WS7		Western area	
	WS8		Western area	
	WS9		Southwestern area	
	WS10		Southern area	

NOTES:

SHDP = Super Heavy Dynamic Probe

WS7 was terminated at 3.70mbgl due to the borehole repeatedly collapsing upon retrieval of the sampler. All others achieved the target depth.

4.2 Soils Encountered

Generally, the investigation confirmed the anticipated geological succession, comprising the River Terrace Deposits overlying the White Chalk Subgroup.

A summary of the encountered conditions is presented below.

Base Depth m	Strata	Summary description
0.15 – 0.20	Topsoil	Silty gravelly CLAY
1.30	Made Ground (WS7)	Reworked silty and gravelly CLAY with brick
2.60 – 5.00	River Terrace Deposits	Silty clays with chalk gravels and gravelly sandy clayey silts

5.00+	White Chalk Subgroup	Structureless chalk comprised of slightly gravelly silt, weak subangular gravels, becoming structured (Grade C) with depth.
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The identification of materials encountered as specific geological strata is tentative and should be used as a guide and interpolation between or below investigation points should be treated with caution.

4.2.2 Topsoil

A thin cover of topsoil was encountered at surface to depths of between 0.15m and 0.20m and generally described as silty slightly gravelly CLAY with medium subrounded flint. These materials are identified separately from Made Ground, even though they may have been disturbed through human activity and contained recent entrained materials such as fragments of brick and concrete.

4.2.4 Made Ground

Made Ground was only encountered to a depth of 1.30 within WS7 and generally comprised of reworked silty and gravelly CLAY with brick. Abundant brick was noted at 1.30mbgl and was likely to originate from a disused land drain.

4.2.5 River Terrace Deposits

The River Terrace Deposits were encountered to depths of between 2.60m to 5.00m and generally comprised silty clays with chalk gravels and gravelly sandy clayey silts.

4.2.6 White Chalk Subgroup.

Below the River Terrace Deposits, the White Chalk Subgroup was encountered to depths of 5m+. the chalk generally consisted of structureless chalk comprising of a slightly gravelly silt, gravels were weak and subangular. The chalk grade was assessed in accordance with CIRIA C574 (Engineering in Chalk) and corresponded to grade Dm becoming a grade C with depth.

4.2.7 Roots and Rootlets

Rootlets were identified in all positions (to maximum depths of 0.15 to 0.85m) and were noted within all positions. No roots were encountered during the works.

Position	Roots	Rootlets
WS1	None noted	0.0-0.80m
WS2		0.0-0.20m
WS3		0.0-0.75m
WS4		0.0-0.35m
WS5		0.0-0.45m
WS6		0.0-0.15m
WS7		0.0-0.85m
WS8		0.0-0.80m
WS9		0.0-0.35m
WS10		0.0-0.80m

4.2.8 Field Evidence of Contamination

No evidence of possible soil contamination (such as staining, malodours, or brightly coloured soils) was identified in the field.

Made Ground was identified within WS7 to a maximum depth of 1.30m, and such materials may be imported from an unknown source or mixed with hazardous materials, and as such may contain a wide range of potential contaminants. All such materials should be treated as suspect unless proven otherwise.

4.3 Groundwater

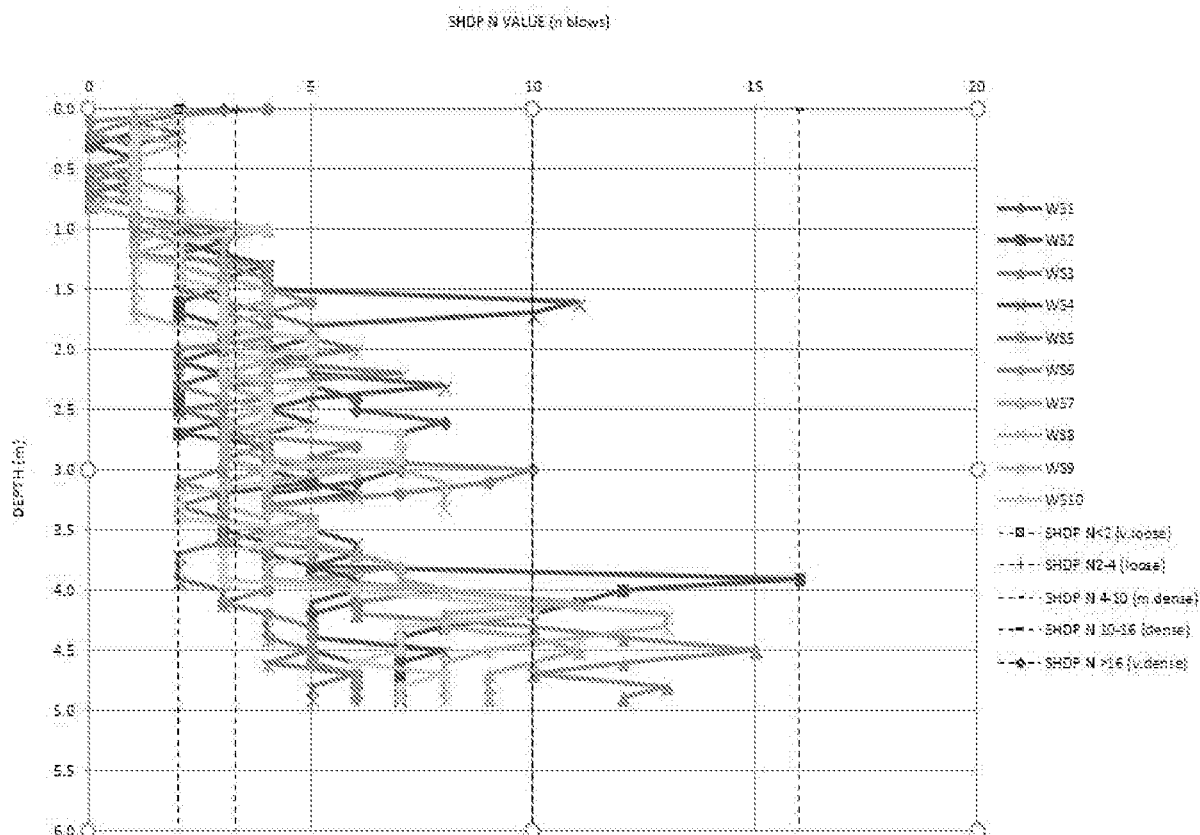
Groundwater was struck during the excavation of all positions. Short-term standing water depths are summarised below.

Position	Depth struck	Level after 20 minutes
WS1	1.35	1.20
WS2	1.40	1.00
WS3	1.45	1.30
WS4	1.70	1.80
WS5	1.75	1.85
WS6	1.45	1.10
WS7	1.30	1.06
WS8	1.55	1.05
WS9	1.25	1.10
WS10	1.30	1.00

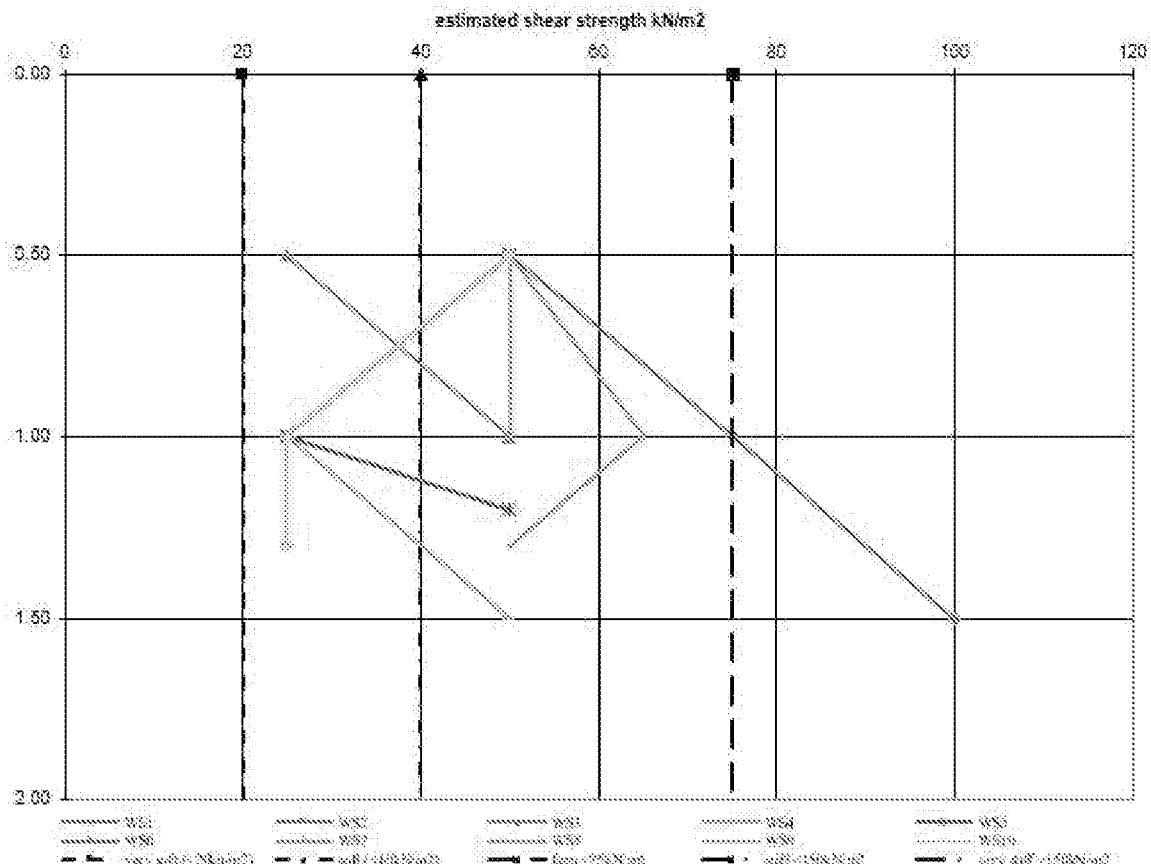
Groundwater levels may vary seasonally and with variations in rainfall. Water may also become perched upon cohesive strata or around features such as foundations, and may also occur from leaking drains and water mains etc.

4.4 Geotechnical Field Testing

A super heavy dynamic probe (SHDP) was undertaken at all positions. The test is used as a measure of the relative density of granular soils (as defined in BS5930:1999). The test provides limited data in cohesive soils but may be used to illustrate changes in consistency with depth. The test may be used in Chalk to assess the density grade. A typical range of results is summarised below.



Hand penetrometer tests were performed on samples of cohesive materials recovered within the boreholes. The test is used to approximate undrained shear strength and in turn has been used to give an indication of consistency as defined in BS5930. The results are summarised below.



No materials appropriate for shear vane tests were identified in the boreholes.

4.5 Geotechnical Laboratory Testing

Samples of soil were sent for laboratory geotechnical testing; copies of the results are appended, and summaries are given in the following tables. The testing was undertaken in accordance with the relevant British Standards in BS1377 following documented quality procedures.

Particle Size Distribution analysis was performed on representative samples of more granular materials as summarised below.

Strata	No. of tests	% Clay/Silt	% Sand	% Gravel
River Terrace Deposits	2	18.8 – 59.9	79.7 – 36.4	1.5 – 4.1

Atterberg Limit tests were undertaken on selected samples of cohesive soils, as summarised below. A modified plasticity index (PI') was calculated following the NHBC methodology, to account for any non-shrinkable percentage not passing the 425µm sieve, and a mean PI' value is shown in brackets.

Strata	No. of tests	Plasticity index (PI) %	% Passing 0.425µm	PI' %
River Terrace Deposits	16	6 - 28	72 - 100	8 – 27.7

Water content determinations (formerly known as *moisture content*) were undertaken in combination with various classification tests, and the results are summarised below.

Strata	No. of tests	Moisture content %
River Terrace Deposits	16	13 - 25

Geochemical testing for water soluble Sulphate and pH were undertaken, and the results are summarised on the following table.

Strata	No. of tests	Water soluble Sulphate (SO ₄ g/l)	pH (value)
River Terrace Deposits	10	0.0046 – 0.021	8.2 – 8.5

Bulk density, dry density and saturated moisture content tests were carried out on samples from the River Terrace Deposits and White Chalk Subgroup as described below.

Strata	No. of tests	Bulk density (Mg/m ³)	Dry density (Mg/m ³)
River Terrace Deposits	4	2.09 – 2.18	1.74 – 1.86
White Chalk Subgroup	3	1.93 – 1.98	1.61 – 1.64

5.0 GEOTECHNICAL ASSESSMENT

The following recommendations have been made with respect to geotechnical design.

5.1 General Foundation Design

The provisional proposed development was understood to comprise the development of multiple residential houses across the entire site.

Low volume change potential soils were identified, which may be susceptible to seasonal heave and shrinkage movements caused by changes in moisture content caused by the action of tree roots and rootlets. Trees and hedgerows were noted where noted to surround the perimeter of the site.

A shallow water table standing at approximately 1.00mbgl to 1.20mbgl was encountered. Groundwater levels may rise further during prolonged periods of wet climatic conditions. The minimum depth for footings for low volume change soils is 0.75m, but due to the low SHDP readings a minimum depth of 1.0m is recommended, close to the water table.

It is considered prudent to confirm groundwater levels and trench stability parameters by means of excavating a series of trial pits across the site immediately prior to construction, or the installation of ground water monitoring sandpipes and undertaken a ground water monitoring program. Care should be taken during any dewatering and construction so as not to loosen the exposed formation level.

Based on the ground and groundwater conditions encountered, it is considered that traditional strip foundations are possible but may be tight considering the water table. A alternative foundation solution might be considered, such as the use of rafts, piles or Vibro Concrete Columns (VCC's).

5.2 Volume Change Potential

Soil shrinkability has been assessed following the NHBC Standards Chapter 4.2 (January 2018 edition). It is recommended that the advice of this publication (or similar guidance) is taken when designing and constructing foundations in the zone of influence of trees and hedgerows that currently exist, are to be planted, or have recently been felled.

Strata	% passing 425µm sieve	Modified Plasticity Index	Shrinkability classification
River Terrace Deposits	-	10-20%	Low volume change potential

Specifications for heave precautions on Low volume change soils are summarised below. In addition to the depths marked *, localised deepening of foundations will be required in the influence of trees;

it will be necessary to evaluate tree species and height in relation to the proposed building footprints. If not already carried out, an arboricultural survey will be required.

Volume Change Potential		Low
Minimum depth for traditional foundations outside zone of influence of trees (m) *		0.75m
No tree planting zone required for minimum depth foundations above (m)		0.2 x mature tree height
Minimum depth for traditional foundations but allowing for restricted new planting (m) *		1.00m
Minimum void dimension	Against side of traditional foundations and ground beams etc.	0mm
	Beneath ground beam and suspended in-situ concrete ground floors etc.	50mm
	Beneath suspended precast concrete or timber floors etc.	200mm
Minimum allowance for potential ground movement for new drains		50mm

All foundations should extend below any major root zones or desiccated soil encountered, and trenches should be carefully inspected accordingly. Void former will be required for foundations deeper than 1.50m and within the influence of trees.

5.3 Traditional Shallow Foundations

All foundations should be taken through any Made Ground, soft or loose zones, disturbed soils, major root zones, or desiccated materials and taken wholly into or onto the Firm Clays and Medium dense Sands of the River Terrace Deposits.

Such foundations symmetrically loaded and up to a width of 1.20m and at a depth of 1.00m, may be designed based on a maximum allowable net bearing pressure of 50 kN/m². This assessment includes an appropriate factor of safety against shear failure, and settlements should remain within appropriate limits. This figure should be sufficient for the type of construction proposed.

Given the variability in engineering characteristics of the River Terrace Deposits at the anticipated formation level, it is recommended that all foundations are lightly reinforced to account for potential differential settlements.

The River Terrace Deposits will soften rapidly when exposed to free water. The final 50mm of any foundation trench should not be excavated until immediately before concreting, unless blinded or otherwise protected immediately after excavation.

5.4 Ground Floor Slabs

Given the presence of soils susceptible to volume change potential (i.e. shrinkable), it is recommended that all ground floor slabs should be fully suspended, with a suitable minimum void space.

Ground bearing floor slabs may be considered for other structures such as garages or outbuildings. The formation should be appropriately treated, and the design should allow potential future movements.

5.5 Excavations

The risks arising from excavation works should be properly assessed and appropriate safety precautions should be adopted. Reference may be made to various guidance including BS8000-1:1989, BS6031:2009 and CIRIA C97.

The likelihood of excavation instability through different strata has been assessed as summarised below. It should be noted that all open unsupported excavations have the potential to collapse.

Strata	Stability
River Terrace Deposits	Marginally stable in the short term. Spalling and collapse should be expected, particularly in long or deep excavations which are left open for prolonged periods, or those taken below the water table.

Excavations which are to remain open for prolonged periods will require trench support.

All excavations taken beneath the water table are likely to become highly unstable. Significant collapse and over-dig expected. Consideration should be given to the use of dewatering and full-trench support.

It is considered that normal-rated plant and machinery will be sufficient for undertaking excavations.

Adjacent excavations should generally be tackled in order of depth with the deepest first. Vehicles and spoil heaps etc. should not surcharge excavations, and edge protection and fencing should be used as appropriate. Frozen materials should generally not be used as backfill.

5.6 Pavements

The formation level for pavements is expected to comprise firm clays of the River Terrace Deposits.

With reference to Transport Road Research Laboratory Report LR1132 "The Structural Design of Bituminous Roads", a CBR index of 2% is considered appropriate for firm clays of the River Terrace Deposits, assuming average construction conditions and a shallow groundwater table.

Based on the Atterberg Limit test results in conjunction with the field observations, the formation will be frost susceptible. A minimum pavement thickness of up to 450mm should therefore be considered.

The formation level should be carefully inspected, and any soft or loose zones should be removed and replaced with engineering fill, well-compacted in layers to a suitable specification. Consideration might be given to installing geotextiles. Cohesive formations will degrade rapidly if exposed to standing water for even short periods. All engineering fill should be granular and non-frost susceptible (i.e. <10% fine material passing 425µm sieve).

It is assumed that all estate roads will be privately maintained. Where any roads are to become adopted by the relevant Highways Authority, they should be consulted in order to confirm local specifications and acceptable design parameters. Further testing is likely to be required.

5.7 Building Materials

Based on BS8500-1:2015+A1:2016, the results of the Sulphate and pH analyses fell into Class DS-1 and an ACEC class AC-1 is deemed appropriate. The advice of this publication should be taken for the design and specification of all sub surface concrete.

REPORT CONDITIONS

Interpretation of ground conditions inherently depends on the conditions revealed by a limited data set. Land Science takes all reasonable professional care in preparation of this report, using current standards and industry best practice. However, we accept no liability whatsoever expressed or implied in respect of:

- The scope, extent or design of an investigation.
- Any conditions not directly revealed by the investigation.
- Published standards or methodologies used or adopted in this report.
- The opinion or position of any other party including any regulator, authority or stakeholder.
- Any dispute, claim or consequential loss arising from any finding or result in this report.
- Any matter other than ground conditions in the area under investigation.

Information contained in this report is intended for the use of the Client and his agents for the purposes set out, and we accept no liability for its use by other party or for any other purpose.

This report makes no representation on other matters such as ecology, agronomy, arboriculture, structural condition, building materials, boundaries and planning etc.

No aspect of this report should be taken as a guarantee whatsoever that a site is free of pollution, contamination or hazardous materials.

The levels of mobile liquid or gaseous contaminants may vary over time. Further or additional investigation may be necessary.

GLOSSARY OF TERMS

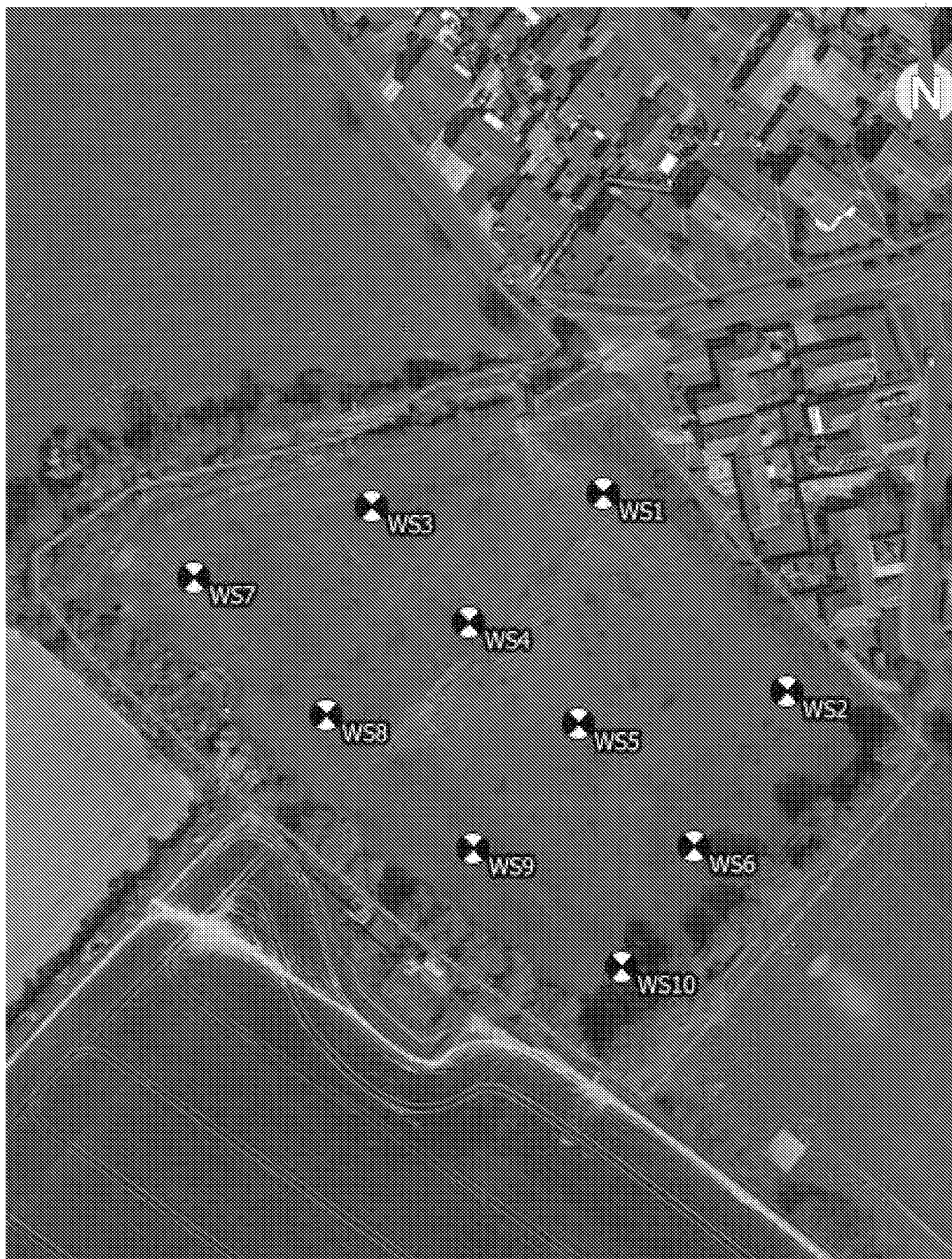
ACM	Asbestos Containing Material
BGS	British Geological Survey
BRE	Building Research Establishment
BSI	British Standards Institute
CBR	California Bearing Ratio
CDM	Construction Design and Management regulations
CIRIA	Construction Industry Research and Information Association
CL:AIRE	Contaminated Land: Applications in Real Environments
CLEA	Contaminated Land Exposure Assessment model
CLR	Contaminated Land Remediation report
CLR11	Model Procedures for the Management of Land Contamination, DEFRA & EA, 2004
COSHH	Control of Substances Hazardous to Human Health regulations
COMAH	Control of Major Accident Hazards regulations
CSM	Conceptual Site Model
DEFRA	Department for Environment, Food and Rural Affairs
DETR	Department for Environment, Transport and the Regions
DQRA	Detailed Quantitative Risk Assessment
DP	Dynamic Probe
EA	Environment Agency
EQS	Environmental Quality Standards
F.O.C	Fraction of Organic Carbon
GAC	Generic Assessment Criterion
GQRA	Generic Quantitative Risk Assessment
HSE	Health and Safety Executive
ICRCL	Inter-departmental Committee for the Redevelopment of Contaminated Land
IPC	Integrated Pollution Control
IPPC	Integrated Pollution Prevention and Control
MBGL	Meters Below Ground Level
NHBC	National House Building Council
NIHHS	Notification of Installations Handling Hazardous Substances
OD	Ordnance Datum
PAH's	Polycyclic Aromatic Hydrocarbons
PBET	Physiological Based Extraction Testing
PHE	Public Health England
PID	Photo-Ionisation Detector
PQRA	Preliminary Quantitative Risk Assessment
PSD	Particle Size Distribution Test
RMS	Remediation Method Statement
SGV	Soil Guideline Value
SOM	Soil Organic Matter
SPZ	Source Protection Zone
SPT	Standard Penetration Test
SSSI	Sites of Special Scientific Interest
ST-WEL	Short Term Workplace Exposure Limit
SVOC's	Semi-Volatile Organic Compounds
TPH	Total Petroleum Hydrocarbons
TRRL	Transport Road Research Laboratory
TWA-WEL	Time Weighted Average Workplace Exposure Limit
UK HBF	United Kingdom House Building Federation
VOC's	Volatile Organic Compound



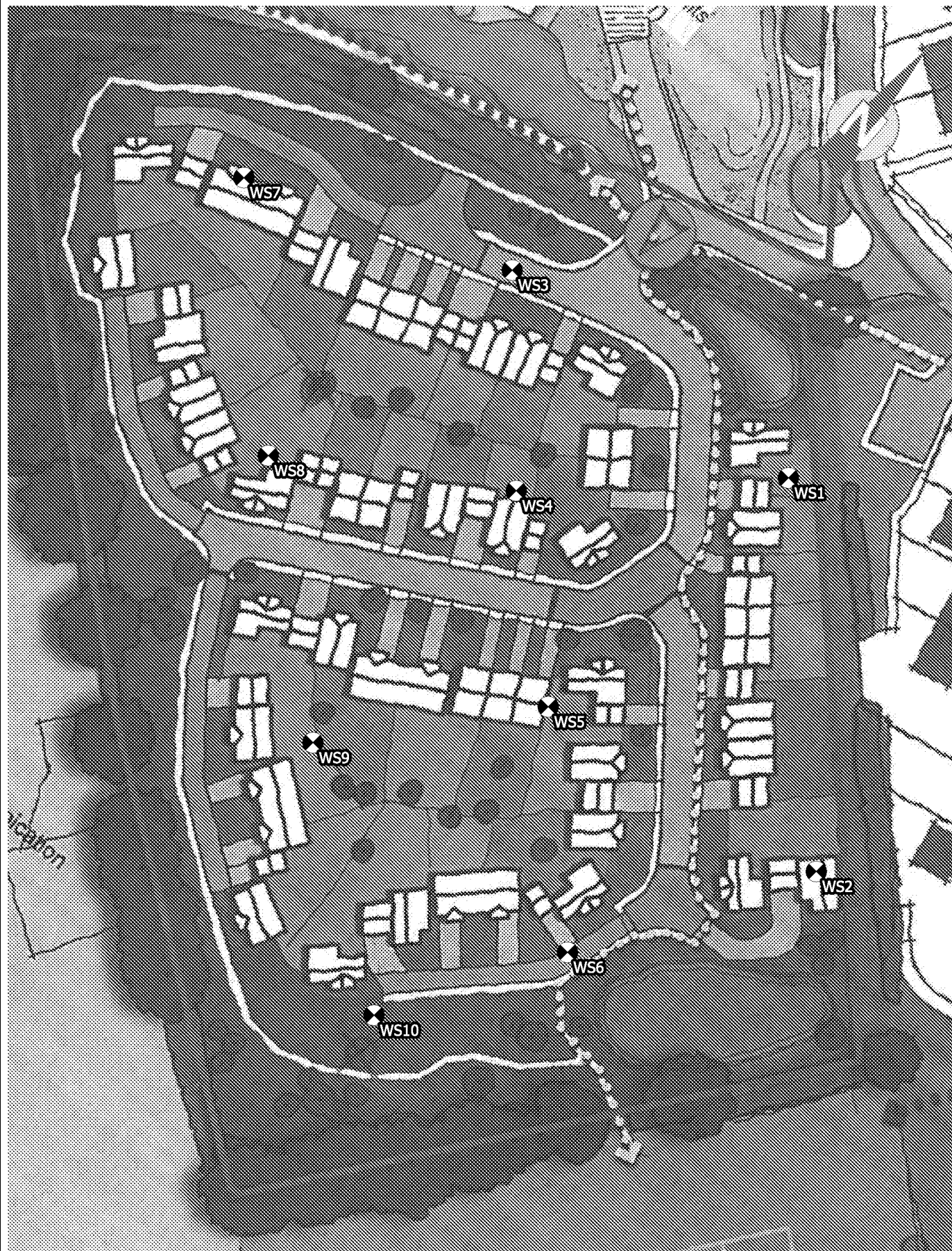
Legend

 Site Boundary

	Title: Site Location			Reference: LS3463
	Project: New Barn Lane, Bersted, Bognor Regis, PO21 5DL			Figure: 1
	Client: Pell Frischmann			Date: 23/04/2018
	Prepared by: JG	Checked by :ET	Version: 1	Sheet: 1 of 1



			Title: Exploratory Hole Location Plan	Reference: LS3463
			Project: New Barn Lane, Bersted, Bognor Regis, PO21 5DL	Figure: 2
			Client: Pell Frischmann	Date: 23/04/2018
			Prepared by: JG	Checked by: ET
			Version: 1	Sheet: 1 of 1



Title: Proposed Development Layout			Reference: LS3463
Project: New Barn Lane, Bersted, Bognor Regis, PO21 5DL			Figure: 3
Client: Pell Frischmann			Date: 23/04/2018
Prepared by: JG	Checked by: ET	Version: 1	Sheet: 1 of 1

APPENDIX A

Photo 1: Access gate



Photo 2: Facing east from the centre of the site



Photo 3: Facing north from the centre of the site



Photo 4: Facing south from the centre of the site



Title: Photographs

Reference: LS3463

Project: New Barn Lane, Bersted, Bognor Regis, PO21 5DL

Figure: 1

Client: Pell Frischmann

Date: 23/05/2018

Prepared by: RL

Checked by : ET

Version: 1

Sheet: 1 of 1

Photo 5: Facing south-east from the site gate



Photo 6: Facing west from the site centre



Photo 7: Facing west from the site centre with BT Tower



Photo 8: Site Access



Title: Photographs

Reference: LS3463

Project: New Barn Lane, Bersted, Bognor Regis, PO21 5DL

Figure: 1

Client: Pell Frischmann

Date: 23/05/2018

Prepared by: RL

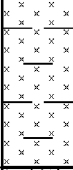
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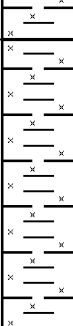
Sheet: 1 of 1

APPENDIX B

				Site New Barn Lane, Bersted, Bognor Regis, PO21 5DL		Number WS1		
Machine : Archway Dart Method : Drive-in Windowless Sampler		Dimensions Location (Handheld GPS) 491728.9 E 100938.5 N		Ground Level (mOD) Dates 23/04/2018- 24/04/2018		Client Pell Frischmann		Job Number LS3463
				Engineer		Sheet 1/1		
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.50	HP 50kPa				(0.15)	Grass over brown silty slightly gravelly CLAY with rootlets. Gravel comprises medium subrounded flint (TOPSOIL)		
0.50	D				0.15			
					(0.25)	Firm brown silty CLAY with frequent fine to medium chalk flints and rare medium subrounded flints with rootlets (RIVER TERRACE DEPOSITS)		
					0.40			
						Firm brownish grey mottled very sandy CLAY with occasional fine subrounded flints and rootlets. (RIVER TERRACE DEPOSITS)		
						Rootlets to 0.80m		
1.00	HP 75kPa				(1.20)			
1.00	D							
			Water strike(1) at 1.35m, rose to 1.20m in 20 mins.					
1.50	HP 100kPa				1.60	Firm brownish grey gravelly sandy SILT. Gravel comprises fine rounded flints. (RIVER TERRACE DEPOSITS)		
1.50	D				(0.50)			
					2.10	Firm pale brown slightly sandy, very gravelly CLAY. Gravel comprise medium to coarse subrounded flints and rare coarse chalk. (RIVER TERRACE DEPOSITS)		
2.00	D				(1.00)			
					3.10	Off-white, weak, low density structured CHALK (Grade C or better) with rare light brown clay fracture inclusions.		
2.50	D				(0.90)			
3.00	D				4.00	Off-white, weak, low density, structureless CHALK (Grade Dm). Composed of a slightly gravelly SILT. Gravels are off-white black speckled with rare brown clay fracture inclusions		
3.50	D				(1.00)			
4.00	D							
4.50	D							
5.00	D				5.00			
Remarks NOTES: Hand excavated inspection pit to 1.20mbgl. Borehole terminated at target depth BACKFILL: Backfilled with arisings INSTALLATION: None CASING: No casing used. GROUNDWATER: Struck at 1.35m, standing at 1.20m after 20mins.							Scale (approx) 1:25	Logged By LS
							Figure No. LS3463.WS1	

				Brighton London Bristol		Site New Barn Lane, Bersted, Bognor Regis, PO21 5DL		Number WS2	
Machine : Archway Dart Method : Drive-in Windowless Sampler		Dimensions		Ground Level (mOD)		Client Pell Frischmann		Job Number LS3463	
		Location 491772 E 100897.3 N		Dates 23/04/2018- 24/04/2018		Engineer		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	
0.50 0.50	HP 50kPa D				(0.20) 0.20 (0.20) 0.40	Grass over brown silty slightly gravelly CLAY with rootlets. Gravel comprises medium subrounded flint. (TOPSOIL) Firm brown silty CLAY with frequent fine to medium chalk gravels and rare medium subrounded flint. (RIVER TERRACE DEPOSITS) Firm brown and grey mottled silty CLAY with occasional fine subrounded flints. (RIVER TERRACE DEPOSITS)	  		
1.00 1.00	HP 25kPa D				(0.70) 1.10 (0.30)	Loose brown and grey gravelly silty SAND. Gravel comprises fine, rounded flint. (RIVER TERRACE DEPOSITS)		▼1	
1.50	D		Water strike(1) at 1.40m, rose to 1.00m in 20 mins.		1.40 (0.20) 1.60	Firm pale brown very gravelly slightly silty sandy CLAY. Gravel comprises fine rounded flint. (RIVER TERRACE DEPOSITS) Loose pale brown and grey gravelly very clayey SAND. Gravel comprises fine rounded flint. (RIVER TERRACE DEPOSITS)	 	▼1	
2.00	D				(0.80)				
2.50	D				2.40	Brown and grey sandy, very gravelly SILT with abundant fine to medium subangular chalk gravels. (RIVER TERRACE DEPOSITS)			
3.00	D								
3.50	D				(2.60)				
4.00	D					Very sandy between 3.90m and 4.20m			
4.50	D								
5.00	D				5.00				
Remarks GROUNDWATER: Struck at 1.40m, standing at 1.00m after 20mins. CASING: No casing used. INSTALLATION: None BACKFILL: Backfilled with arisings NOTES: Hand excavated inspection pit to 1.20mbgl. Borehole terminated at target depth							Scale (approx) 1:25	Logged By LS	
							Figure No. LS3463.WS2		

Brighton London Bristol					Site		New Barn Lane, Bersted, Bognor Regis, PO21 5DL		Number WS3	
Machine : Archway Dart		Dimensions		Ground Level (mOD)		Client		Job Number		
Method : Drive-in Windowless Sampler						Pell Frischmann		LS3463		
		Location		Dates		Engineer		Sheet		
		491676.6 E 100943.1 N		23/04/2018-24/04/2018				1/1		
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water		
0.50	HP 25kPa		Water strike(1) at 1.45m, rose to 1.30m in 20 mins.		(0.15)	Grass over dark greyish brown silty CLAY. Occasional gravel comprising fine to medium subrounded flints. (TOPSOIL)				
0.50	D				(0.20)	Soft brown silty CLAY with occasional fine to medium subrounded flints and rootlets (RIVER TERRACE DEPOSITS)				
					0.35	Firm orangish brown silty sandy CLAY with occasional fine to medium subrounded flints and rootlets (RIVER TERRACE DEPOSITS)				
					(0.85)	Rootlets to 0.75m				
1.00	HP 50kPa				1.20	Loose brownish grey gravelly silty SAND. Gravel comprises fine to medium rounded flints. (RIVER TERRACE DEPOSITS)			▼1	
1.00	D				(0.70)				▼1	
					1.90	Pale brown very gravelly slightly sandy silty CLAY. Gravel comprises medium to coarse subrounded flints and rare coarse chalk. (RIVER TERRACE DEPOSITS)				
					(0.80)					
2.50	D				2.70	Firm bluish grey mottled gravelly SILT. Gravel comprises fine rounded chalk. (RIVER TERRACE DEPOSITS)				
					(1.40)					
3.50	D				4.10	Off-white, weak, low density, structureless CHALK (Grade Dm). Composed of a slightly gravelly SILT. Gravels are off-white black speckled with rare brown clay fracture inclusions. (LEWES NODULAR CHALK FORMATION)				
4.00	D				(0.90)					
4.50	D									
5.00	D				5.00					
Remarks							Scale (approx)	Logged By		
GROUNDWATER: Struck at 1.45m, standing at 1.30m after 20mins.							1:25	LS		
CASING: No casing used.										
INSTALLATION: None										
BACKFILL: Backfilled with arisings										
NOTES: Hand excavated inspection pit to 1.20mbgl. Borehole terminated at target depth										
							Figure No.			
							LS3463.WS3			

				Brighton London Bristol 		Site New Barn Lane, Bersted, Bognor Regis, PO21 5DL		Number WS4	
Machine : Archway Dart Method : Drive-in Windowless Sampler		Dimensions		Ground Level (mOD)		Client Pell Frischmann		Job Number LS3463	
		Location 491709.3 E 100920.1 N		Dates 23/04/2018- 24/04/2018		Engineer		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	
0.50 0.50	HP 50kPa D				(0.15) 0.15 (0.20) 0.35	Grass over dark brown silty slightly gravelly CLAY with rootlets. Gravel comprises medium subrounded flint. (TOPSOIL) Dark brown slightly silty CLAY with rootlets and occasional fine, rounded flints. (RIVER TERRACE DEPOSITS) Firm orange and brown mottled very silty sandy CLAY with occasional fine, subrounded flints. (RIVER TERRACE DEPOSITS)	 		
1.00 1.00	HP 50kPa D				(0.95)				
1.50	D		Water strike(1) at 1.70m, fell to 1.80m in 20 mins.		1.30	Loose to dense, fine pale brown very gravelly slightly silty clayey SAND. Gravel comprises medium to coarse subrounded flint and rare coarse chalk. (RIVER TERRACE DEPOSITS)		∇ ₁ 	
2.00	D				(1.30)				
2.50	D				2.60	Off-white, weak, low density, structured CHALK (Grade C or better) with rare light brown clay fracture inclusions (LEWES NODULAR CHALK FORMATION)			
3.00	D				(1.40)	No sample recovery from 3m.			
					4.00	Off-white, weak, low density, structureless CHALK (Grade Dm). Composed of a slightly gravelly SILT. Gravels are off-white, black speckled with rare brown clay fracture inclusions. (LEWES NODULAR CHALK FORMATION)			
					(1.00)				
					5.00				
Remarks GROUNDWATER: Struck at 1.70m, standing at 1.80m after 20mins. CASING: No casing used. INSTALLATION: None BACKFILL: Backfilled with arisings NOTES: Hand excavated inspection pit to 1.20mbgl. Borehole terminated at target depth. No sample recovery from 3m.								Scale (approx) 1:25	
								Logged By LS	
								Figure No. LS3463.WS4	

		Brixton, London, Bristol		Site: [REDACTED] Barn Lane, Bersted, Bognor Regis, PO21 5DL		Number WS5	
Machine : Archway Dart Method : Drive-in Windowless Sampler		Dimensions		Ground Level (mOD)		Client Pell Frischmann	
		Location (Handheld GPS) 491739.3 E 100892.1 N		Dates 23/04/2018- 24/04/2018		Engineer 	
						Job Number LS3463	
						Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend
0.50	HP 50kPa				(0.20)	Grass over dark brown silty CLAY with occasional fine rounded flint and rootlets (TOPSOIL)	
0.50	D				0.20	Firm brown slightly silty sandy CLAY with frequent fine rounded flints and rootlets (RIVER TERRACE DEPOSITS)	
					(0.20)		
					0.40	Soft brown and grey mottled very silty CLAY. (RIVER TERRACE DEPOSITS)	
						Rootlets to 0.45m	
					(0.70)		
							
					1.10	Firm brownish grey very clayey gravelly sandy SILT. Gravel comprises fine rounded flints. (RIVER TERRACE DEPOSITS)	
1.00	HP 25kPa				(0.20)		
1.00	D				1.30		
1.20	HP 50kPa						
							
1.50	D					Loose to medium dense, fine pale brown clayey, slightly silty, very gravelly SAND. Gravel comprises medium to coarse subrounded flint and rare coarse chalk. (RIVER TERRACE DEPOSITS)	
			Water strike(1) at 1.75m, fell to 1.85m in 20 mins.		(1.10)		
2.00	D						
					2.40	Off-white, weak, low density, structureless CHALK (Grade Dm). Composed of a slightly gravelly SILT. Gravels are off-white black speckled with rare brown clay fracture inclusions. (LEWES NODULAR CHALK FORMATION)	
2.50	D						
							
3.00	D					No sample recovery from 3.00m	
					(2.60)		
							
							
							
							
							
							
							
							
							
							
							
							
							
							
							
							
							
							
							
							
							
Remarks NOTES: Hand excavated inspection pit to 1.20mbgl. Borehole terminated at target depth. No sample recovery from 3m. BACKFILL: Backfilled with arisings INSTALLATION: None CASING: No casing used. GROUNDWATER: Struck at 1.75m, standing at 1.85m after 20mins.						Scale (approx) 1:25	Logged By LS
						Figure No. LS3463.WS5	

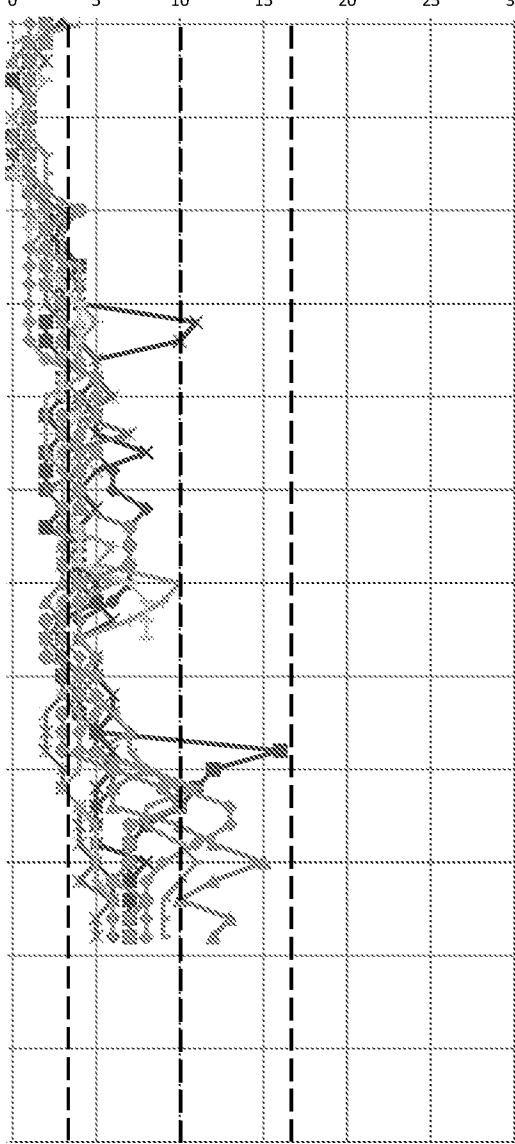
				Brighton London Bristol 		Site New Barn Lane, Bersted, Bognor Regis, PO21 5DL		Number WS6	
Machine : Archway Dart Method : Drive-in Windowless Sampler		Dimensions		Ground Level (mOD)		Client Pell Frischmann		Job Number LS3463	
		Location (Handheld GPS) 491762.2 E 100874.5 N		Dates 23/04/2018- 24/04/2018		Engineer		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	
0.50 0.50	HP 50kPa D				(0.15) 0.15 (0.20) 0.35	Grass over dark brown silty slightly gravelly CLAY with rootlets. Gravel comprises fine rounded flint. (TOPSOIL) Firm brown slightly silty gravelly CLAY. Gravel comprises fine subrounded flint. (RIVER TERRACE DEPOSITS) Very soft to firm brown and orange mottled silty CLAY with rootlets (RIVER TERRACE DEPOSITS)	  		
1.00 1.00	HP 25kPa D				(0.95)		  		
1.30	HP 25kPa				1.30 (0.10) 1.40	Firm pale brown very gravelly slightly silty sandy CLAY. Gravel comprises medium to coarse subrounded flints and occasional coarse chalk. (RIVER TERRACE DEPOSITS)	 		
1.50	D		Water strike(1) at 1.45m, rose to 1.10m in 20 mins.			Loose to dense, brown and grey very clayey SAND with occasional fine to medium flints. (RIVER TERRACE DEPOSITS)			
2.00	D						  		
2.50	D				(2.20)	Black specks noted between 2.30m and 2.70m	  		
3.00	D						  		
3.50	D						  		
4.00	D				3.60 (0.10) 3.70 (0.80)	Loose, medium brown very clayey gravelly SAND. Gravel comprises medium chalk. (RIVER TERRACE DEPOSITS) Off-white, weak, low density, structured CHALK (Grade C or better) with rare light brown clay fracture inclusions. (LEWES NODULAR CHALK FORMATION)	 		
4.50	D				4.50 (0.50)	Off-white, weak, low density, structureless CHALK (Grade Dm). Composed of a slightly gravelly SILT. Gravels are off-white black speckled with rare brown clay fracture inclusions. (LEWES NODULAR CHALK FORMATION)	  		
5.00	D				5.00		 		
Remarks GROUNDWATER: Struck at 1.45m, standing at 1.10m after 20mins. CASING: No casing used. INSTALLATION: None BACKFILL: Backfilled with arisings NOTES: Hand excavated inspection pit to 1.20mbgl. Borehole terminated at target depth							Scale (approx) 1:25	Logged By LS	
							Figure No. LS3463.WS6		

				Brighton London Bristol 		Site New Barn Lane, Bersted, Bognor Regis, PO21 5DL		Number WS7	
Machine : Archway Dart Method : Drive-in Windowless Sampler		Dimensions		Ground Level (mOD)		Client Pell Frischmann		Job Number LS3463	
		Location (Handheld GPS) 491630.2 E 100929.4 N		Dates 23/04/2018- 24/04/2018		Engineer		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	
0.50	D				(0.17) Grass over dark brown silty CLAY with occasional fine brick and rootlets (MADE GROUND) 0.17 (0.13) Firm, reworked, dark brown and grey reworked silty slightly gravelly CLAY with rootlets. Gravel comprises fine rounded flints. Rare brick encountered at 0.30m (MADE GROUND) 0.30 Firm, reworked brown, orange and grey mottled silty sandy CLAY with frequent rounded flints. (MADE GROUND)	   			
1.00	D				(1.00)		   	▼1	
1.50	D		Water strike(1) at 1.30m, rose to 1.06m in 20 mins.		1.30	Loose brownish grey gravelly silty clayey SAND Gravel comprises fine rounded flint. (RIVER TERRACE DEPOSITS) Abundant brick at 1.30m, possible land drain.		▽1	
2.00	D				(0.90)				
3.00	D				2.20	Firm pale brown very gravelly slightly sandy silty CLAY. Gravel comprises medium to coarse subrounded flints and rare coarse chalk. (RIVER TERRACE DEPOSITS)			
3.70	D				(1.50)				
					3.70	Terminated due to collapse No sample recovery from 3.7m Terminated at 3.70m			
Remarks GROUNDWATER: Struck at 1.30m, standing at 1.06m after 20mins. CASING: No casing used. INSTALLATION: None BACKFILL: Backfilled with arisings NOTES: Hand excavated inspection pit to 1.20mbgl. Borehole terminated at target depth. No sample recovery from 3.70m.								Scale (approx) 1:25	Logged By LS
								Figure No. LS3463.WS7	

				Brighton London Bristol		Site New Barn Lane, Bersted, Bognor Regis, PO21 5DL		Number WS8	
Machine : Archway Dart Method : Drive-in Windowless Sampler		Dimensions		Ground Level (mOD)		Client Pell Frischmann		Job Number LS3463	
		Location (Handheld GPS) 491664.8 E 100905.8 N		Dates 23/04/2018- 24/04/2018		Engineer		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	
0.50	HP 50kPa				(0.20)	Grass over dark brown silty CLAY with rootlets (TOPSOIL)			
0.50	D				0.20 (0.15) 0.35	Firm brown silty slightly gravelly CLAY. Gravel comprises fine, subrounded flint. (RIVER TERRACE DEPOSITS)			
					(0.95)	Firm orangish brown and grey mottled slightly gravelly silty CLAY. Gravel comprises very fine to fine chalk and fine rounded flint.		▼1	
1.00	HP 65kPa					Rootlets to 0.80m			
1.00	D								
1.30	HP 50kPa				1.30	Loose pale brown very gravelly slightly silty clayey SAND. Gravel comprises medium to coarse subrounded flints and rare coarse chalk. (RIVER TERRACE DEPOSITS)		▼1	
1.50	D		Water strike(1) at 1.55m, rose to 1.05m in 20 mins.		(0.60)				
					1.90	Loose to medium dense, brown and orange clayey SAND with occasional fine chalk and fine rounded flints. (RIVER TERRACE DEPOSITS)			
2.00	D				(1.20)				
2.50	D								
3.00	D				3.10	Loose to medium dense, brown clayey medium SAND with occasional fine chalk. (RIVER TERRACE DEPOSITS)			
3.50	D				(0.70)				
4.00	D				3.80	Medium dense to very dense, grey very gravelly slightly clayey silty SAND. Gravel comprises fine to coarse chalk. (RIVER TERRACE DEPOSITS)			
4.50	D				(1.20)				
5.00	D				5.00				
Remarks GROUNDWATER: Struck at 1.55m, standing at 1.05m after 20mins. CASING: No casing used. INSTALLATION: None BACKFILL: Backfilled with arisings NOTES: Hand excavated inspection pit to 1.20mbgl. Borehole terminated at target depth							Scale (approx) 1:25	Logged By LS	
							Figure No. LS3463.WS8		

				Brighton London Bristol		Site New Barn Lane, Bersted, Bognor Regis, PO21 5DL		Number WS9	
Machine : Archway Dart Method : Drive-in Windowless Sampler		Dimensions		Ground Level (mOD)		Client Pell Frischmann		Job Number LS3463	
		Location (Handheld GPS) 491712.5 E 100868.6 N		Dates 23/04/2018- 24/04/2018		Engineer		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	
0.50 0.50	HP 50kPa D				(0.20) 0.20 (0.15) 0.35	Grass over brown silty slightly gravelly CLAY with rootlets. Gravel comprises medium subrounded flint (TOPSOIL) Firm brown silty CLAY with frequent fine to medium chalk flints and rare medium, subrounded flints with rootlets (RIVER TERRACE DEPOSITS) Loose, brown silty clayey SAND with occasional fine subrounded flints. (RIVER TERRACE DEPOSITS) Rootlets to 0.35m			
1.00 1.00	HP 25kPa D				(1.05)				
1.50	D		Water strike(1) at 1.25m, rose to 1.10m in 20 mins.		1.40 (0.40) 1.80	Loose, medium brown and grey clayey slightly gravelly SAND. Gravel comprises fine to medium subrounded flint (RIVER TERRACE DEPOSITS)			
2.00	D								
2.50	D								
3.00	D								
3.50	D								
4.00	D				3.70 (1.00)	Brown and grey very gravelly sandy SILT with abundant fine to medium subangular chalk. (RIVER TERRACE DEPOSITS)			
4.50	D				4.70 (0.30)	Off-white, weak, low density, structureless CHALK (Grade Dm). Composed of a slightly gravelly SILT. Gravels are off-white black speckled with rare brown clay fracture inclusions. (LEWES NODULAR CHALK FORMATION)			
5.00	D				5.00				
Remarks NOTES: Hand excavated inspection pit to 1.20mbgl. Borehole terminated at target depth BACKFILL: Backfilled with arisings INSTALLATION: None CASING: No casing used. GROUNDWATER: Struck at 1.25m, standing at 1.1m after 20mins.								Scale (approx) 1:25	Logged By LS
								Figure No. LS3463.WS9	

				Brighton London Bristol 		Site New Barn Lane, Bersted, Bognor Regis, PO21 5DL		Number WS10	
Machine : Archway Dart Method : Drive-in Windowless Sampler		Dimensions		Ground Level (mOD)		Client Pell Frischmann		Job Number LS3463	
		Location 491734.1 E 100844.4 N		Dates 23/04/2018- 24/04/2018		Engineer		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	
0.50 0.50	HP 50kPa D				(0.15) 0.15 (0.15) 0.30	Grass over brown silty slightly gravelly CLAY with rootlets. Gravel comprises medium subrounded flint (TOPSOIL) Firm brown silty CLAY with frequent fine to medium chalk fragments and rare medium subrounded flints with rootlets (RIVER TERRACE DEPOSITS) Firm brownish grey mottled silty CLAY with occasional fine subrounded flint gravel and rootlets. (RIVER TERRACE DEPOSITS)	  		
1.00 1.00	HP 25kPa D				(1.00)				
1.30	HP 25kPa		Water strike(1) at 1.30m, fell to 2.00m in 20 mins.		1.30	Loose to medium dense, pale brown very gravelly slightly silty very clayey SAND Gravel comprises medium to coarse, subrounded flints and rare coarse chalk. (RIVER TERRACE DEPOSITS)		▽1	
1.50	D								
2.00	D					No sample recovery from 2.0m		▽1	
					(2.70)				
					4.00	Complete at 5.00m			
Remarks GROUNDWATER: Struck at 1.30m, standing at 1.00m after 20mins. NOTES: Hand excavated inspection pit to 1.20mbgl. Borehole terminated at 4.0m due to poor retrieval. No sample recovery from 2m. BACKFILL: Backfilled with arisings INSTALLATION: None CASING: No casing used.								Scale (approx) 1:25	Logged By LS
Figure No. LS3463.WS10									

SUPER HEAVY DYNAMIC PROBE RESULTS											Drilled 23/04/2018 - 24/04/2018						
Project: New Barn Lane, Bersted, Bognor Regis, PO21 5DL											Ref LS 3463						
Probe Depth	Borehole reference										0	5	10	15	20	25	30
	WS1	WS2	WS3	WS4	WS5	WS6	WS7	WS8	WS9	WS10							
0.0	3	2	2	2	2	4	2	2	1	2		loose	m.dense	dense	v.dense		
0.1	1	1	1	2	1	0	1	1	1	1							
0.2	1	1	0	1	2	0	1	1	1	1							
0.3	0	0	1	1	1	1	1	2	1	1							
0.4	1	1	1	1	1	1	1	1	1	1							
0.5	1	1	1	1	0	0	1	1	1	1							
0.6	1	0	0	1	1	1	1	1	1	1							
0.7	0	1	1	1	0	1	2	1	1	1							
0.8	0	0	0	1	1	1	2	0	1	1							
0.9	1	1	1	1	1	1	2	1	1	2							
1.0	2	2	1	2	3	1	4	2	2	4							
1.1	3	2	2	2	2	1	3	1	2	2							
1.2	2	3	2	3	2	1	3	1	1	2							
1.3	2	4	3	4	2	4	3	2	1	2							
1.4	3	3	4	4	2	4	3	3	1	2							
1.5	3	3	4	4	2	4	4	4	1	3							
1.6	3	2	4	4	11	3	5	4	4	1						3	
1.7	3	2	3	10	4	4	3	4	1	3							
1.8	3	3	4	5	5	4	3	3	2	3							
1.9	3	3	3	5	5	4	3	3	5	5							
2.0	4	3	4	4	6	2	4	3	5	5							
2.1	4	2	4	5	4	2	4	4	5	3							
2.2	3	3	4	5	7	2	3	3	4	3							
2.3	5	2	4	8	3	2	4	3	3	5							
2.4	6	2	4	5	4	3	4	4	3	4							
2.5	6	2	4	4	2	3	4	4	4	4							
2.6	8	3	4	5	3	3	4	3	3	4							
2.7	7	2	3	4	3	3	3	4	3	7							
2.8	7	4	4	4	4	3	6	3	4	3						7	
2.9	7	4	3	4	3	5	4	4	3	7							
3.0	7	4	3	5	4	10	6	7	4	4							
3.1	6	5	2	5	3	9	4	8	3	4							
3.2	4	3	3	6	3	7	4	8	3	2							
3.3	4	3	3	4	2	4	4	8	3	2							
3.4	5	3	3	5	3	5	5		4	2							
3.5	4	3	4	5	3	4	4		4	5							
3.6	5	4	4	6	3	3	5		5	4							
3.7	5	4	6	6	2	4	6		5	3							
3.8	5	5	7	5	2	4	7		4	3							
3.9	5	16	5	6	2	4	7		4	3							
4.0	6	12	8	6	3	4	8		8	6							
4.1	6	11	6	5	3	3	11		10	9							
4.2	5	10	6	5	4	4	8		13	10							
4.3	5	8	10	5	4	5	8		13	7							
4.4	5	7	12	5	4	5	10		11	7							
4.5	5	7	15	8	5	5	11		9	7							
4.6	6	7	12	7	4	5	10		8	6							
4.7	6	7	10	7	6	6	9		8	8							
4.8	6	7	13	7	5	6	9		8	7							
4.9	6	7	12	7	5	6	9		8	7							
5.0																	

APPENDIX C

SUMMARY OF MOISTURE CONTENT AND ATTERBERG LIMIT DETERMINATIONS

Site Name: New Barn Lane

Samples Received: 02/05/2018

Reference: LS3463

Reported: 15/05/2018

Position	Depth m	Sample Description	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index %	Passing 425µm %
WS1	1.00	Light brown, slightly silty, sandy CLAY	19	34	20	14	95%
WS2	1.50	Light brown/grey mottled orange/grey very clayey SAND. Rare gravels.	15	25	16	9	92%
WS2	2.00	Light brown/grey mottled orange/grey very clayey SAND.	18	27	18	9	100%
WS3	1.50	Light brown/grey mottled orange/grey very clayey , gravelly/chalky SAND with flint	16	27	19	8	95%
WS4	1.50	Light brown/grey mottled orange/grey very clayey , gravelly/chalky SAND with flint	13	23	14	10	80%
WS4	2.00	Light brown/grey mottled orange/grey very clayey , gravelly/chalky SAND with flint	15	25	15	10	82%
WS5	1.50	Light brown/grey mottled orange/grey very clayey , gravelly/chalky SAND with flint and black speckling	16	27	15	11	90%
WS6	1.00	Light brown/orange sandy CLAY	25	47	18	28	99%
WS6	1.50	Light brown/grey mottled orange/grey very clayey , gravelly/chalky SAND with flint	18	25	17	7	81%
WS7	1.50	Light brown/grey mottled orange/grey clayey , gravelly/chalky SAND with flint	16	27	20	6	94%
WS7	2.00	Light brown/orange mottled orange/grey very clayey , gravelly/chalky SAND	20	28	18	10	99%
WS8	1.50	Light brown slightly mottled very gravelly/chalky, clayey SAND with rare flint	17	24	16	7	79%
WS8	2.00	Orange/ brown mottled clayey , slightly gravelly/chalky SAND with black speckling	17	24	16	8	99%
WS9	1.00	Brown/grey very clayey, slightly gravelly/chalky SAND with black speckling	21	30	18	12	94%
WS10	1.50	Brown/grey/orange mottled very chalky/gravelly, clayey SAND with flint.	18	20	NP	NP	68%
WS10	2.00	Brown/grey/orange mottled very chalky/gravelly, clayey SAND with flint.	16	47	NP	NP	72%

BS 1377 : Part 2 : Clause 4.4 : 1990 Determination of the liquid limit by the cone penetrometer method

BS 1377 : Part 2 : Clause 5 : 1990 Determination of the plastic limit and plasticity index

BS 1377 : Part 2 : Clause 3.2 : 1990 Determination of the moisture content by the oven-drying method.

Test Results relate only to the sample numbers shown above.

Prepared:

T Curtis

Checked:

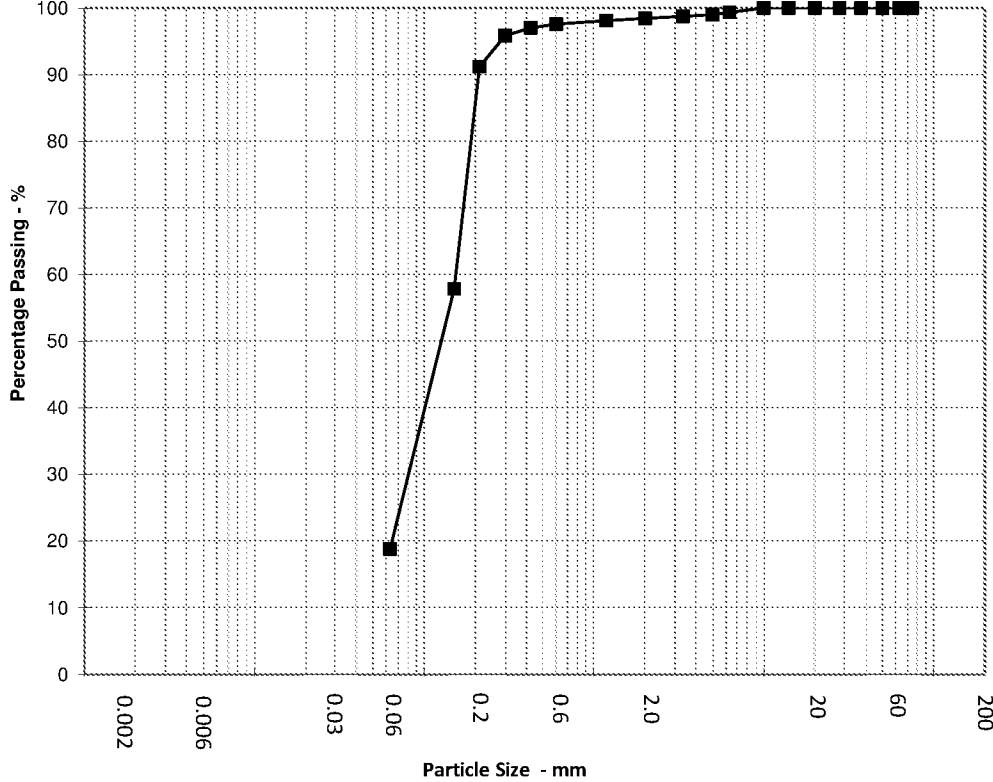
E Toms

THE OLD POLICE STATION, JOBS LANE, SAYERS COMMON, WEST SUSSEX, BN6 9HE

SUMMARY OF PARTICLE SIZE DISTRIBUTION

ANALYSIS

Site Name:	New Barn Lane	Samples Received:	02/05/2018
Reference:	LS3463	Reported:	10/05/2018

Sample Data				Sample Description																																	
Position		WS8		Light brown/grey mottled slightly clayey , slightly gravelly/chalky SAND with rare flint																																	
Sample Ref		-																																			
Depth		3.80																																			
Sieve Analysis				CLAY Fine Medium Coarse SILT Fine Medium Coarse SAND Fine Medium Coarse GRAVEL Coarse COBBLES  <table><thead><tr><th colspan="2">Sample Proportions</th><th colspan="2">Grading Analysis</th></tr></thead><tbody><tr><td>Cobbles</td><td>0.0</td><td>D100</td><td>10</td></tr><tr><td>Gravel</td><td>1.5</td><td>D60</td><td>0.15</td></tr><tr><td>Sand</td><td>79.7</td><td>D10</td><td>-</td></tr><tr><td>Silt & Clay</td><td>18.8</td><td>Uniformity Coeff.</td><td>-</td></tr><tr><td>-</td><td></td><td>-</td><td></td></tr></tbody></table>										Sample Proportions		Grading Analysis		Cobbles	0.0	D100	10	Gravel	1.5	D60	0.15	Sand	79.7	D10	-	Silt & Clay	18.8	Uniformity Coeff.	-	-		-	
Sample Proportions		Grading Analysis																																			
Cobbles	0.0	D100	10																																		
Gravel	1.5	D60	0.15																																		
Sand	79.7	D10	-																																		
Silt & Clay	18.8	Uniformity Coeff.	-																																		
-		-																																			
mm	%																																				
125																																					
90																																					
75	100.0																																				
63	100.0																																				
50	100.0																																				
37.5	100.0																																				
28	100.0																																				
20	100.0																																				
14	100.0																																				
10	100.0																																				
6.3	99.4																																				
5.0	99.0																																				
3.35	98.7																																				
2.0	98.5																																				
1.18	98.1																																				
0.60	97.6																																				
0.425	97.1																																				
0.30	95.9																																				
0.212	91.2																																				
0.150	57.9																																				
0.063	18.8																																				
0.020																																					
0.006																																					
0.002																																					

BS 1377 : Part 2 : 1990 : Clause 9

Test Results relate only to the sample numbers shown above.

Prepared:

T Curtis

Checked:

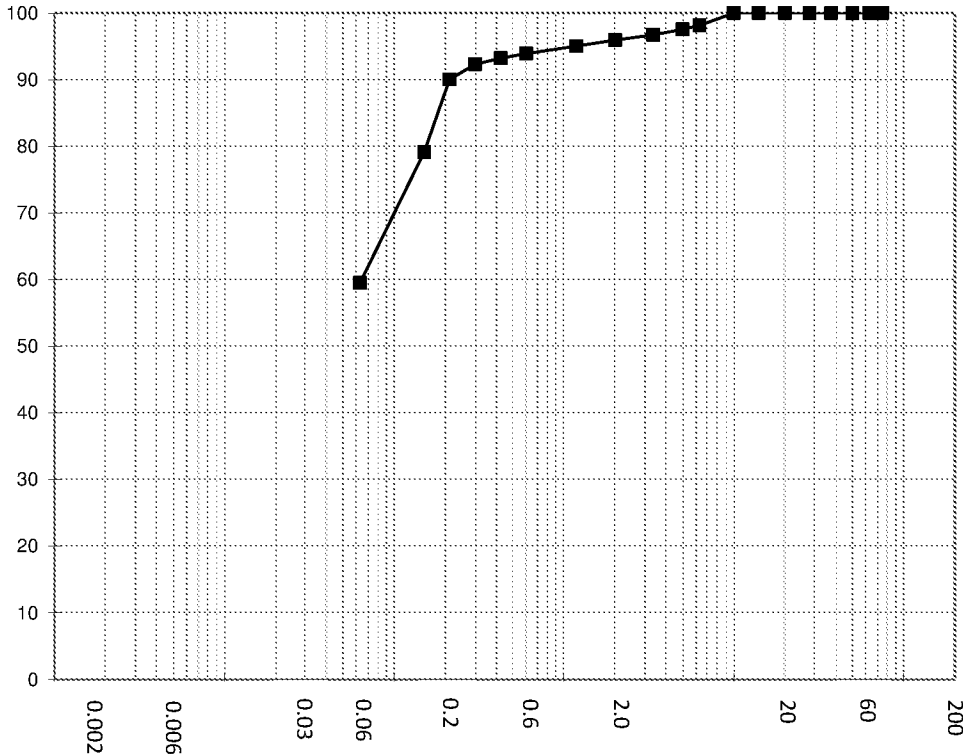
E Toms

THE OLD POLICE STATION, JOBS LANE, SAYERS COMMON, WEST SUSSEX, BN6 9HF

SUMMARY OF PARTICLE SIZE DISTRIBUTION

ANALYSIS

Site Name:	New Barn Lane	Samples Received:	02/05/2018
Reference:	LS3463	Reported:	10/05/2018

Sample Data				Sample Description																																																							
Position		WS9		Light brown/orange, very clayey, rare chalky gravelly SAND																																																							
Sample Ref		-																																																									
Depth		1.50																																																									
Sieve Analysis				CLAY Fine Medium Coarse SILT Fine Medium Coarse SAND Fine Medium Coarse GRAVEL COBBLES  <table><thead><tr><th>Particle Size - mm</th><th>Percentage Passing - %</th></tr></thead><tbody><tr><td>0.06</td><td>59.5</td></tr><tr><td>0.075</td><td>79.1</td></tr><tr><td>0.106</td><td>90.0</td></tr><tr><td>0.15</td><td>92.3</td></tr><tr><td>0.25</td><td>93.2</td></tr><tr><td>0.425</td><td>93.9</td></tr><tr><td>0.75</td><td>95.1</td></tr><tr><td>1.18</td><td>95.9</td></tr><tr><td>2.0</td><td>96.7</td></tr><tr><td>3.35</td><td>97.5</td></tr><tr><td>5.0</td><td>98.2</td></tr><tr><td>6.3</td><td>100.0</td></tr><tr><td>10</td><td>100.0</td></tr><tr><td>14</td><td>100.0</td></tr><tr><td>20</td><td>100.0</td></tr><tr><td>28</td><td>100.0</td></tr><tr><td>37.5</td><td>100.0</td></tr><tr><td>50</td><td>100.0</td></tr><tr><td>63</td><td>100.0</td></tr><tr><td>75</td><td>100.0</td></tr><tr><td>90</td><td>100.0</td></tr><tr><td>125</td><td>100.0</td></tr></tbody></table>										Particle Size - mm	Percentage Passing - %	0.06	59.5	0.075	79.1	0.106	90.0	0.15	92.3	0.25	93.2	0.425	93.9	0.75	95.1	1.18	95.9	2.0	96.7	3.35	97.5	5.0	98.2	6.3	100.0	10	100.0	14	100.0	20	100.0	28	100.0	37.5	100.0	50	100.0	63	100.0	75	100.0	90	100.0	125	100.0
Particle Size - mm	Percentage Passing - %																																																										
0.06	59.5																																																										
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0.063	59.5																																																										
0.020																																																											
0.006																																																											
0.002																																																											

Sample Proportions				Grading Analysis			
Cobbles		0.0		D100		10	
Gravel		4.1		D60		0.065	
Sand		36.4		D10		-	
Silt & Clay		59.5		Uniformity Coeff.		-	
-				-			

BS 1377 : Part 2 : 1990 : Clause 9

Test Results relate only to the sample numbers shown above.

Prepared:

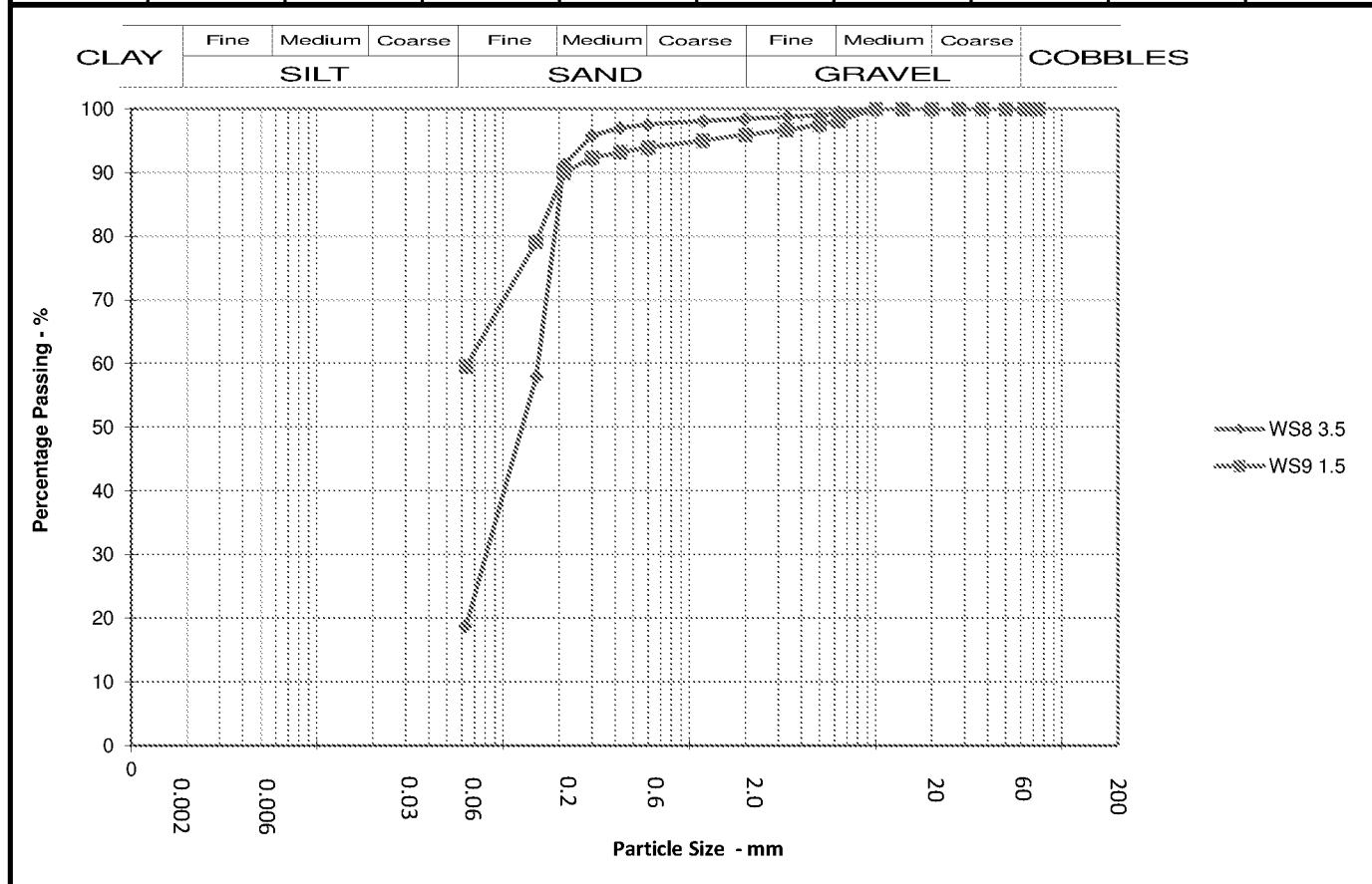
T Curtis

Checked:

E Toms

THE OLD POLICE STATION, JOBS LANE, SAYERS COMMON, WEST SUSSEX, BN6 9HE

COMPOSITE PSD GRAPH									
Site Name:	New Barn Lane			Date:	10/05/2018				
Reference:	LS3463			Client:					
Position	WS8	WS9							
Depth	3.5	1.5							
mm	%	%	%	%	%	%	%	%	%
125									
90									
75	100	100							
63	100	100							
50	100	100							
37.5	100	100							
28	100	100							
20	100	100							
14	100	100							
10	100	100							
6.3	99	98							
5.0	99	98							
3.35	99	97							
2.0	98	96							
1.18	98	95							
0.60	98	94							
0.425	97	93							
0.30	96	92							
0.212	91	90							
0.150	58	79							
0.063	19	60							
0.020									
0.006									
0.002									



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0345 604 6494

Unit 10, 19 Albert Drive, Burgess Hill, West Sussex, RH15 9TN



SUMMARY OF DETERMINATION OF DENSITY - IMMERSION IN WATER METHOD

Site name:	New Barn Lane	Samples received:	02/05/2018
Reference:	LS3463	Reported:	15/05/2018

Sample	Tin weight (g)	Wet weight with tin(g)	Dry weight with tin (g)	Weight of water (g)	Dry weight (g)	Initial Wet Weight, Ms (g)	Filled outer voids weight, Mf (g)	Waxed sample Weight, Mw (g)	Weight in water, Mg (g)	Moisture content, w (%)	Test specimen volume, Vs (cm3)
WS1 3.50	19.72	162.11	137.67	24.44	117.95	966	1001	1018	511	20.7206443	487.19
WS3 5.00	19.74	175.27	149.35	25.92	129.61	690	712	726	358	19.9984569	351.69
WS6 4.50	19.75	139.87	119.98	19.89	100.23	531	550	558	274	19.844358	274.68

Sample	Sample Description	Specific gravity, Gs	Bulk Density, pb (Mg/m3)	Dry Density, pd (Mg/m3)	Void ratio
WS1 3.50	CHALK with flint	4.83	1.98	1.64	1.94
WS3 5.00	CHALK	5.00	1.96	1.63	2.06
WS6 4.50	CHALK	5.04	1.93	1.61	2.12

Density of water (kg/m3)	1000	Density of the parrafin wax (g/cm3)	0.8583
--------------------------	------	-------------------------------------	--------

Test Method:	BS 1377-2:1990:7.3	Prepared:	
Comments:		Checked:	
Test Results relate only to the sample numbers shown above.			



Site name:	New Barn Lane	Samples received:	02/05/2018
Reference:	LS3463	Reported:	15/05/2018

[illegible]

Density of water (kg/m ³)	1000	Density of the parrafin wax (g/cm ³)	0.8583
---------------------------------------	------	--	--------

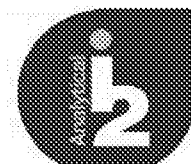
[REDACTED]



4841



CERTS



Environmental Science

Michael Rose

Land Science
The Old Police Station
Jobs Lane
Sayers Common
West Sussex
BN6 9HE

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 0845 604 6494

e: mike.rose@landscience.co.uk

Analytical Report Number : 18-83994

Project / Site name:	New Barn Lane	Samples received on:	01/05/2018
Your job number:	LS3463	Samples instructed on:	01/05/2018
Your order number:		Analysis completed by:	08/05/2018
Report Issue Number:	1	Report issued on:	09/05/2018
Samples Analysed:	10 soil samples		

Signed: 

Jordan Hill
Reporting Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :	soils	- 4 weeks from reporting
	leachates	- 2 weeks from reporting
	waters	- 2 weeks from reporting
	asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Analytical Report Number: 18-83994

Project / Site name: New Barn Lane

Lab Sample Number				953184	953185	953186	953187	953188
Sample Reference				WS1	WS2	WS3	WS4	WS5
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				2.00	1.00	2.00	2.50	2.00
Date Sampled				26/04/2018	26/04/2018	26/04/2018	26/04/2018	26/04/2018
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	11	14	12	11	14
Total mass of sample received	kg	0.001	NONE	1.5	1.3	1.6	1.0	1.3

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.4	8.2	8.4	8.5	8.5
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.0046	0.0080	0.010	0.011	0.015

Analytical Report Number: 18-83994

Project / Site name: New Barn Lane

Lab Sample Number				953189	953190	953191	953192	953193
Sample Reference				WS6	WS7	WS8	WS9	WS10
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				2.00	3.00	1.00	3.00	1.00
Date Sampled				26/04/2018	26/04/2018	26/04/2018	26/04/2018	26/04/2018
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	11	13	14	11	11
Total mass of sample received	kg	0.001	NONE	1.3	1.0	1.9	0.94	1.2

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.4	8.5	8.4	8.5	8.4
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.015	0.018	0.013	0.021	0.021

Analytical Report Number : 18-83994

Project / Site name: New Barn Lane

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
953184	WS1	None Supplied	2.00	Light brown clay and sand.
953185	WS2	None Supplied	1.00	Light brown clay and sand.
953186	WS3	None Supplied	2.00	Light brown clay and sand with chalk.
953187	WS4	None Supplied	2.50	Light brown clay and sand with chalk.
953188	WS5	None Supplied	2.00	Light brown clay and sand with chalk.
953189	WS6	None Supplied	2.00	Light grey clay.
953190	WS7	None Supplied	3.00	Light brown clay and sand with gravel.
953191	WS8	None Supplied	1.00	Light brown clay with gravel.
953192	WS9	None Supplied	3.00	Light brown clay and sand with chalk.
953193	WS10	None Supplied	1.00	Light brown clay and sand.

Analytical Report Number : 18-83994

Project / Site name: New Barn Lane

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP-OES.	L038-PL	D	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

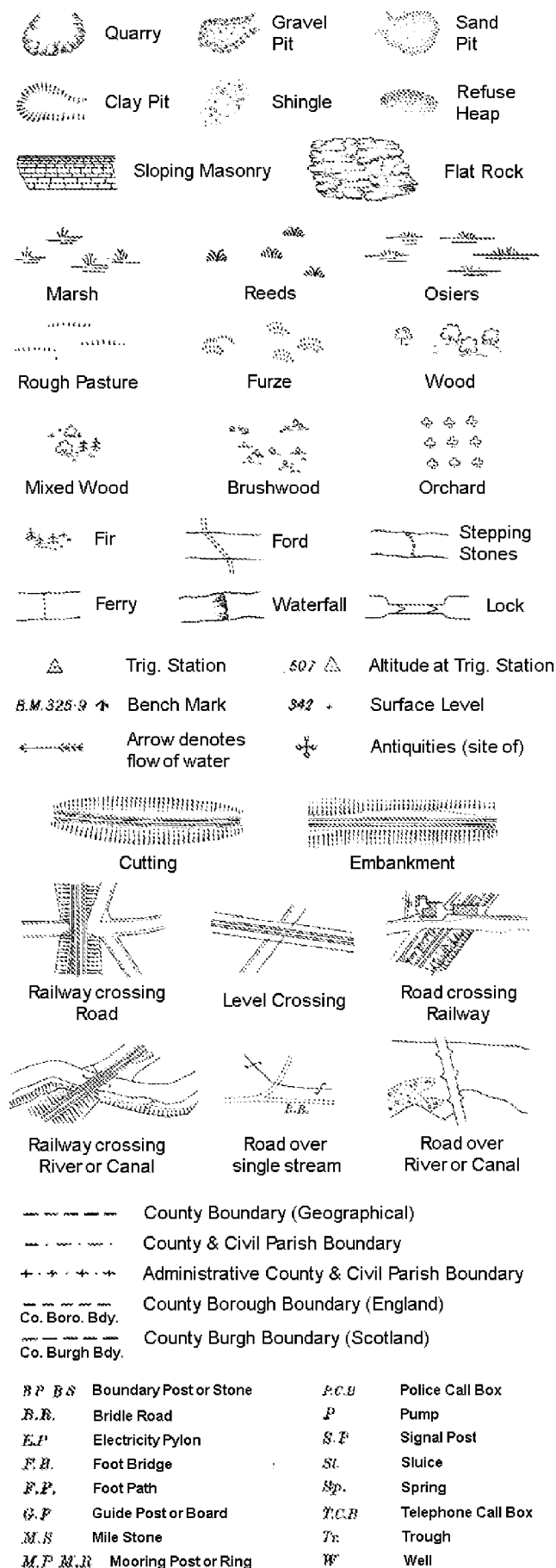
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

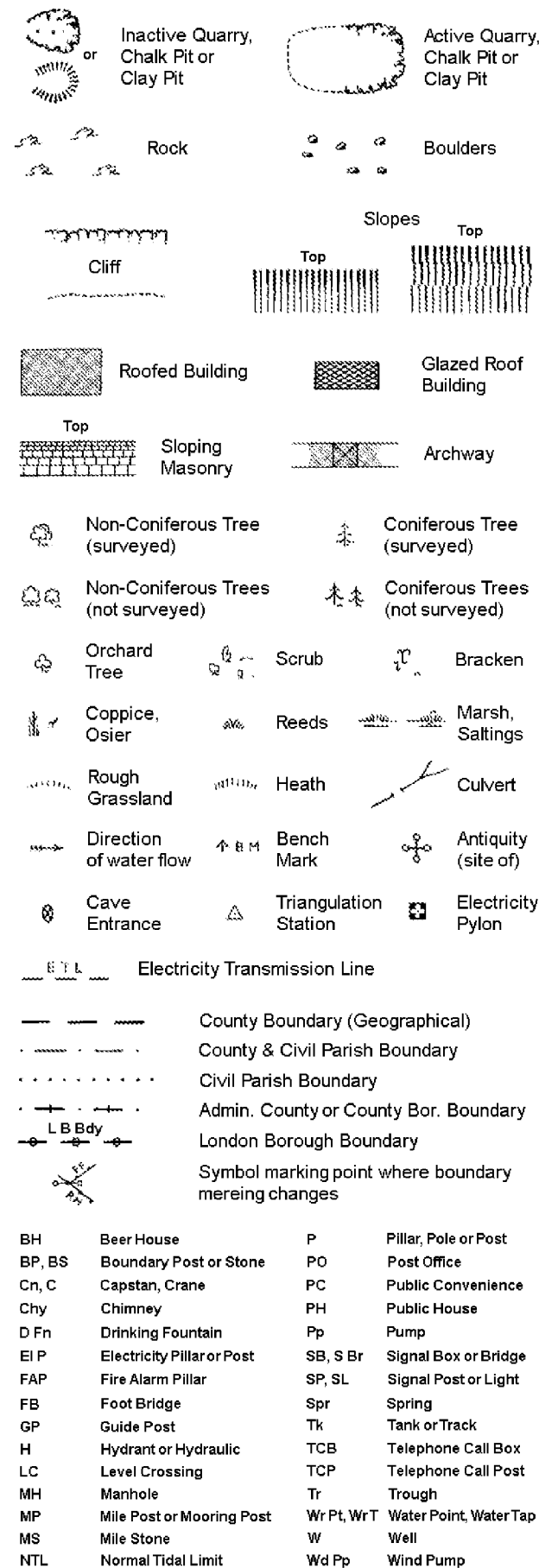
APPENDIX D

Historical Mapping Legends

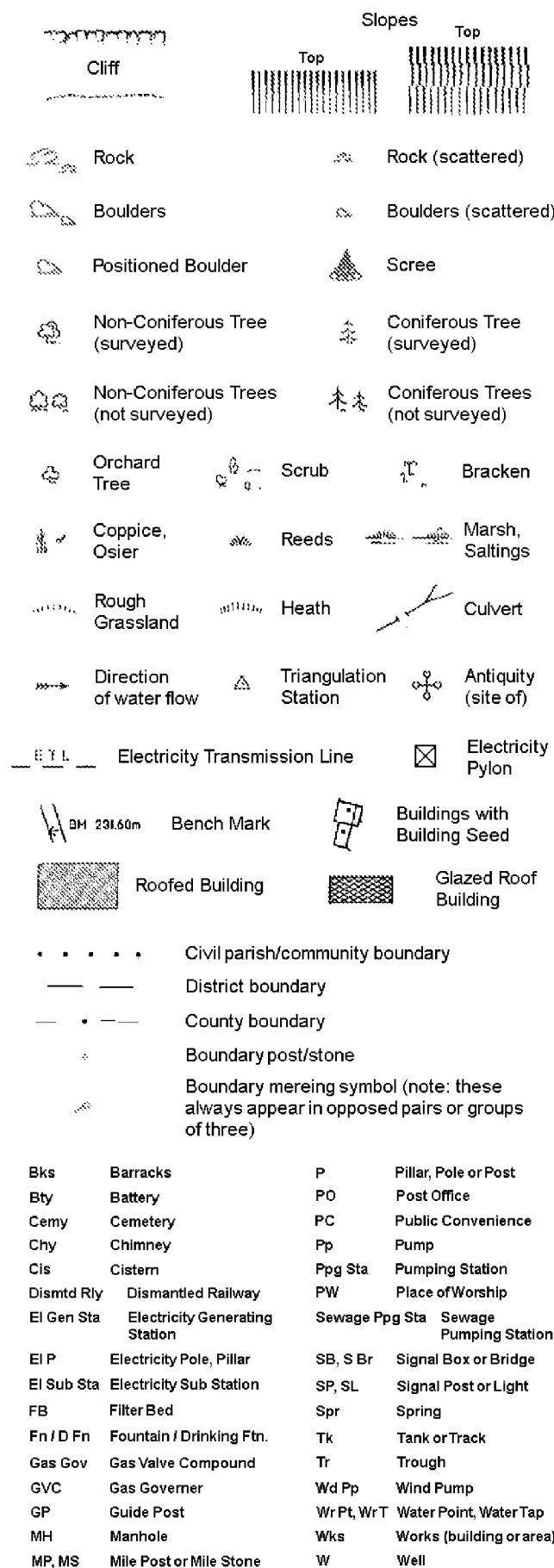
Ordnance Survey County Series and Ordnance Survey Plan 1:2,500



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

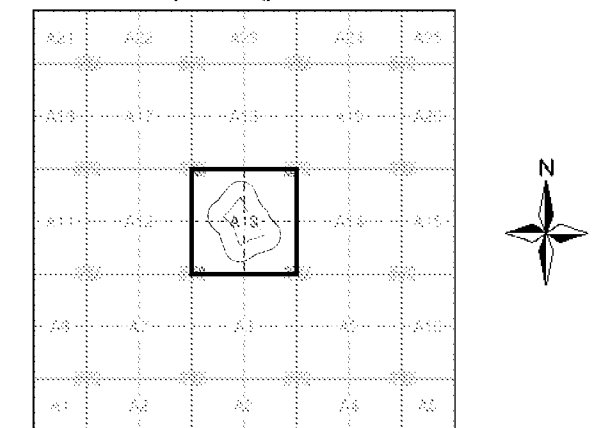


Land Science

Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Sussex	1:2,500	1876 - 1877	2
Sussex	1:2,500	1898	3
Sussex	1:2,500	1912	4
Sussex	1:2,500	1933 - 1940	5
Ordnance Survey Plan	1:1,250	1964	6
Ordnance Survey Plan	1:1,250	1967 - 1968	7
Ordnance Survey Plan	1:1,250	1971	8
Supply of Unpublished Survey Information	1:2,500	1973	9
Ordnance Survey Plan	1:2,500	1976	10
Additional SIMs	1:1,250	1979 - 1991	11
Large-Scale National Grid Data	1:1,250	1994	12
Historical Aerial Photography	1:2,500	1999	13

Historical Map - Segment A13



Order Details

Order Number: 163211272_1_1
Customer Ref: LS3463
National Grid Reference: 491570, 101060
Slice: A
Site Area (Ha): 3.57
Search Buffer (m): 100

Site Details

66a, New Barn Lane, North Bersted, BOGNOR REGIS, PO21 5DL

Landmark
INFORMATION GROUP

Tel: 0844 844 9852
Fax: 0844 844 9951
Web: www.envisirocheck.co.uk

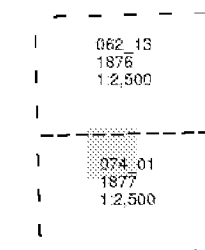
Sussex

Published 1876 - 1877

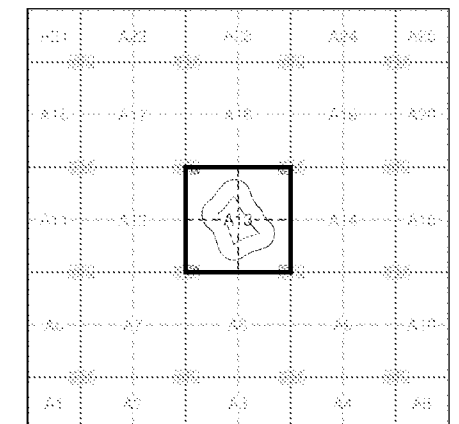
Source map scale - 1:2,500

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

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

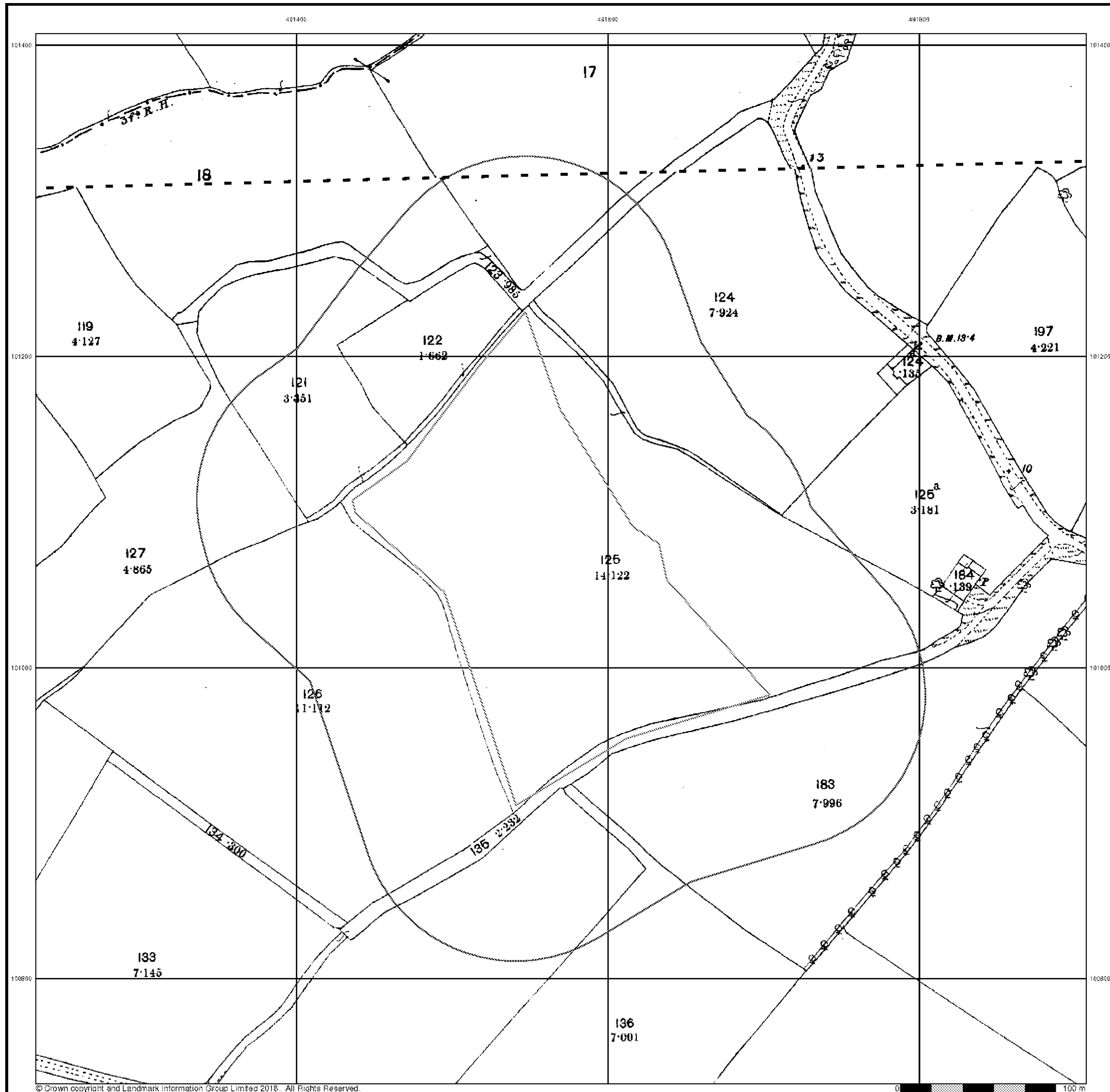
Order Number: 163211272_1_1
Customer Ref: LS3463
National Grid Reference: 491570, 101060
Slice: A
Site Area (Ha): 3.57
Search Buffer (m): 100

Site Details

66a, New Barn Lane, North Bersted, BOGNOR REGIS, PO21
5DL

Landmark
INFORMATION GROUP

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





1	062.13
1	1898
1	12,500
1	
1	074.01
1	1898
1	12,500
1	

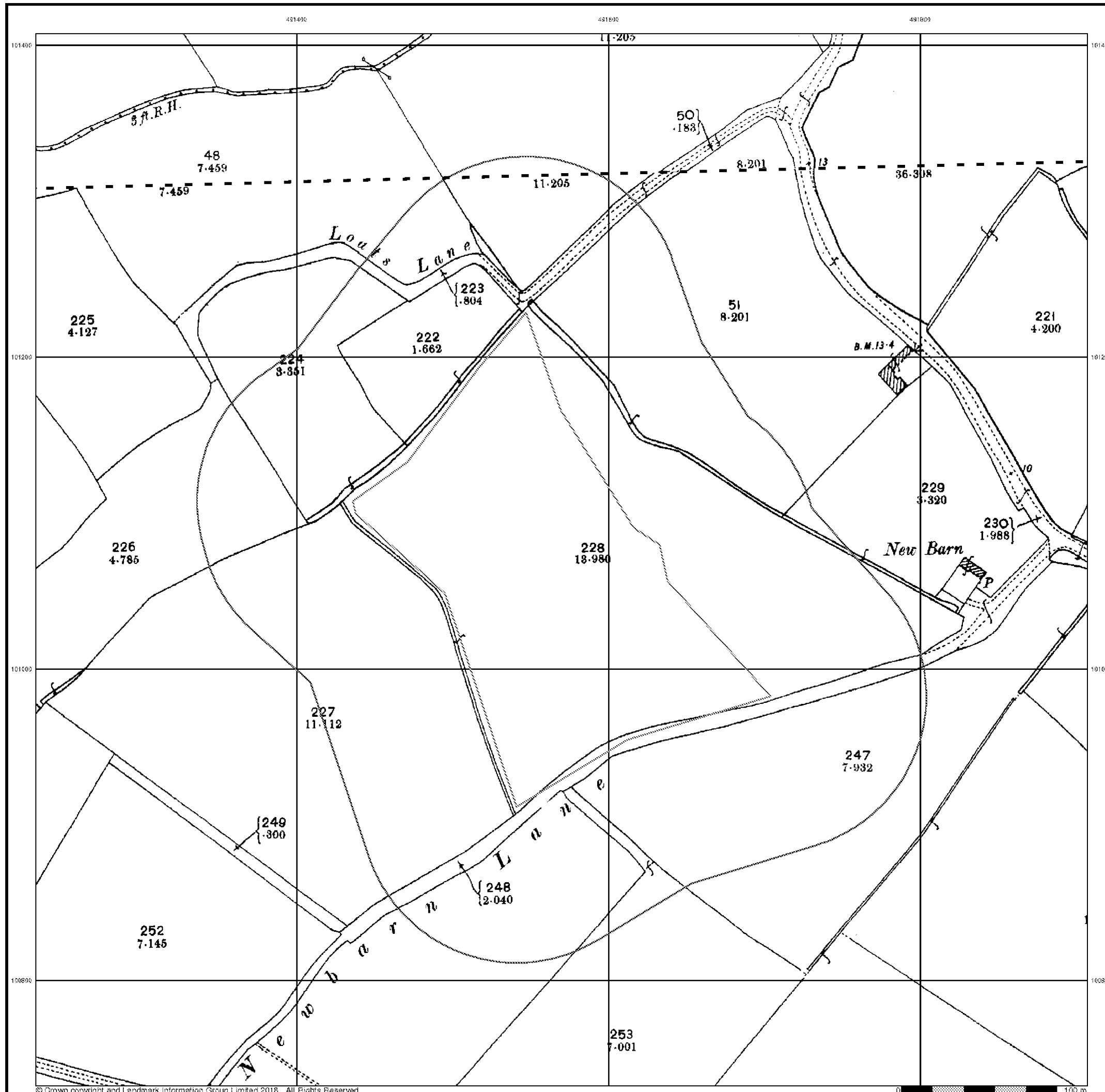
The figure shows a 10x10 grid of points labeled A01 to A100. A 4x4 square region is highlighted in the center, containing points A33 to A44. Within this square, a complex, irregular shape is outlined, representing the 'true' boundary of the object. The points A33 to A44 are the 'estimated' boundary points.



Order Number: 163211272_1_1
Customer Ref: LS3463
National Grid Reference: 491570, 101060
Slice: A
Site Area (Ha): 3.57
Search Buffer (m): 100

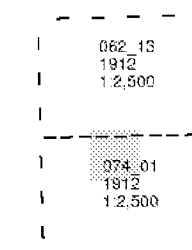
66a, New Barn Lane, North Bersted, BOGNOR REGIS, PO21
5DL

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

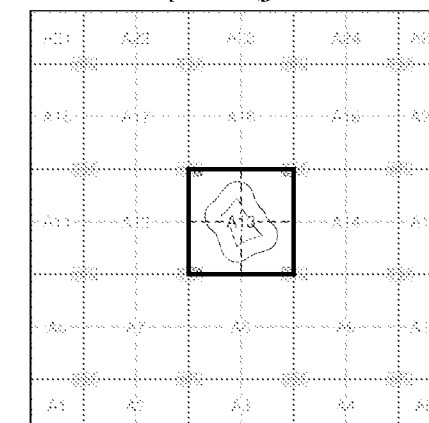


The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain.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

Map Name(s) and Date(s)



Historical Map - Segment A13

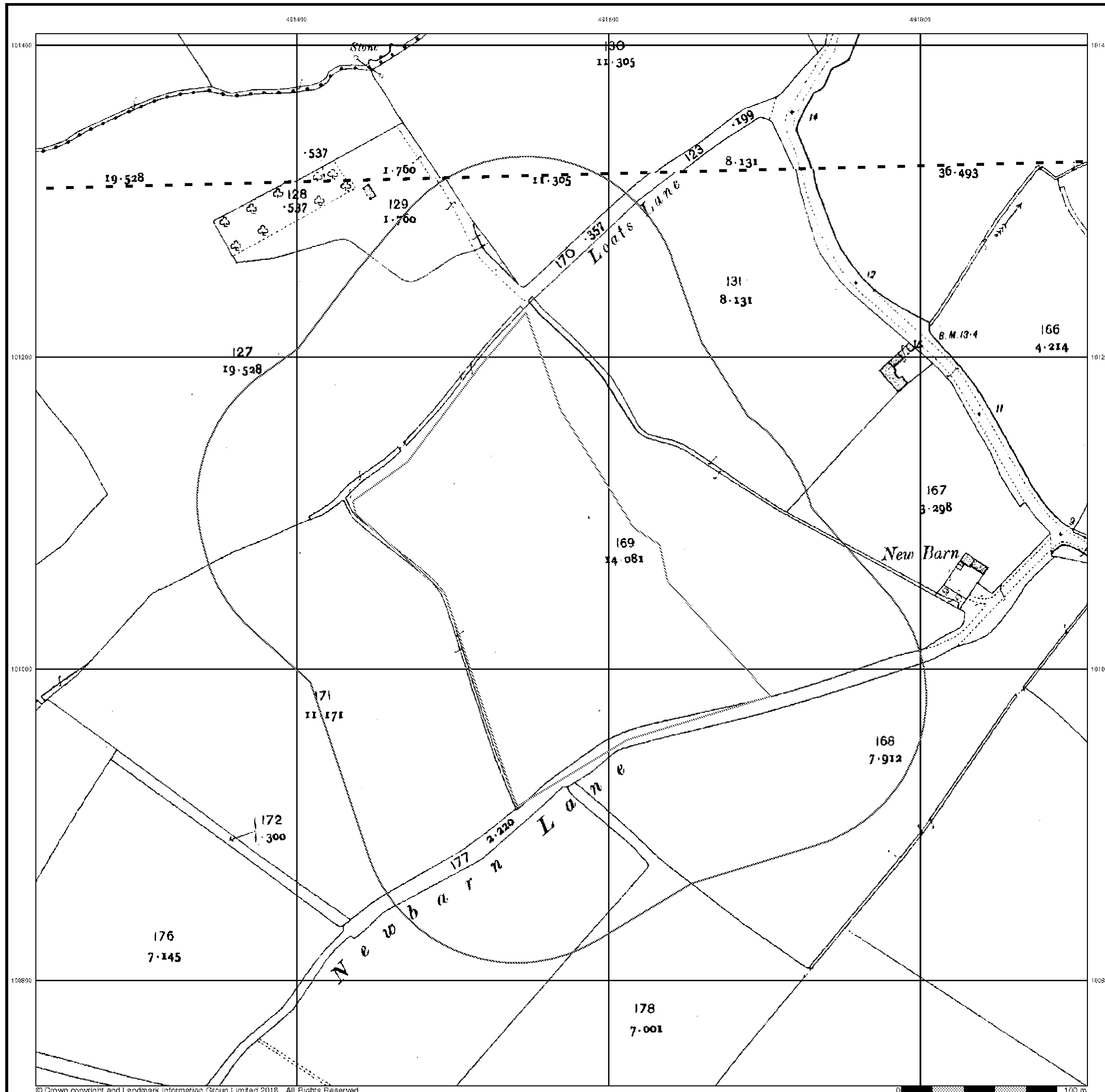


Order Details

Order Number: 163211272_1_1
 Customer Ref: LS3463
 National Grid Reference: 491570, 101060
 Slice: A
 Site Area (Ha): 3.57
 Search Buffer (m): 100

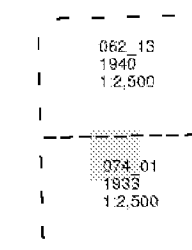
Site Details

66a, New Barn Lane, North Bersted, BOGNOR REGIS, PO21 5DL

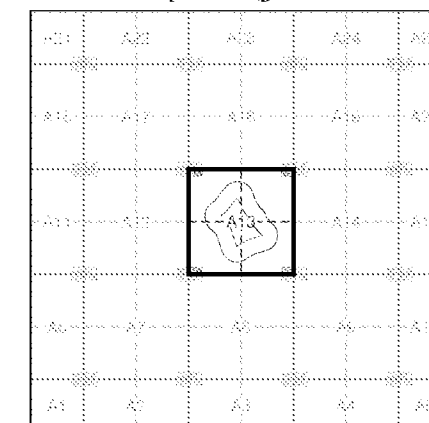


The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain.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

Map Name(s) and Date(s)



Historical Map - Segment A13

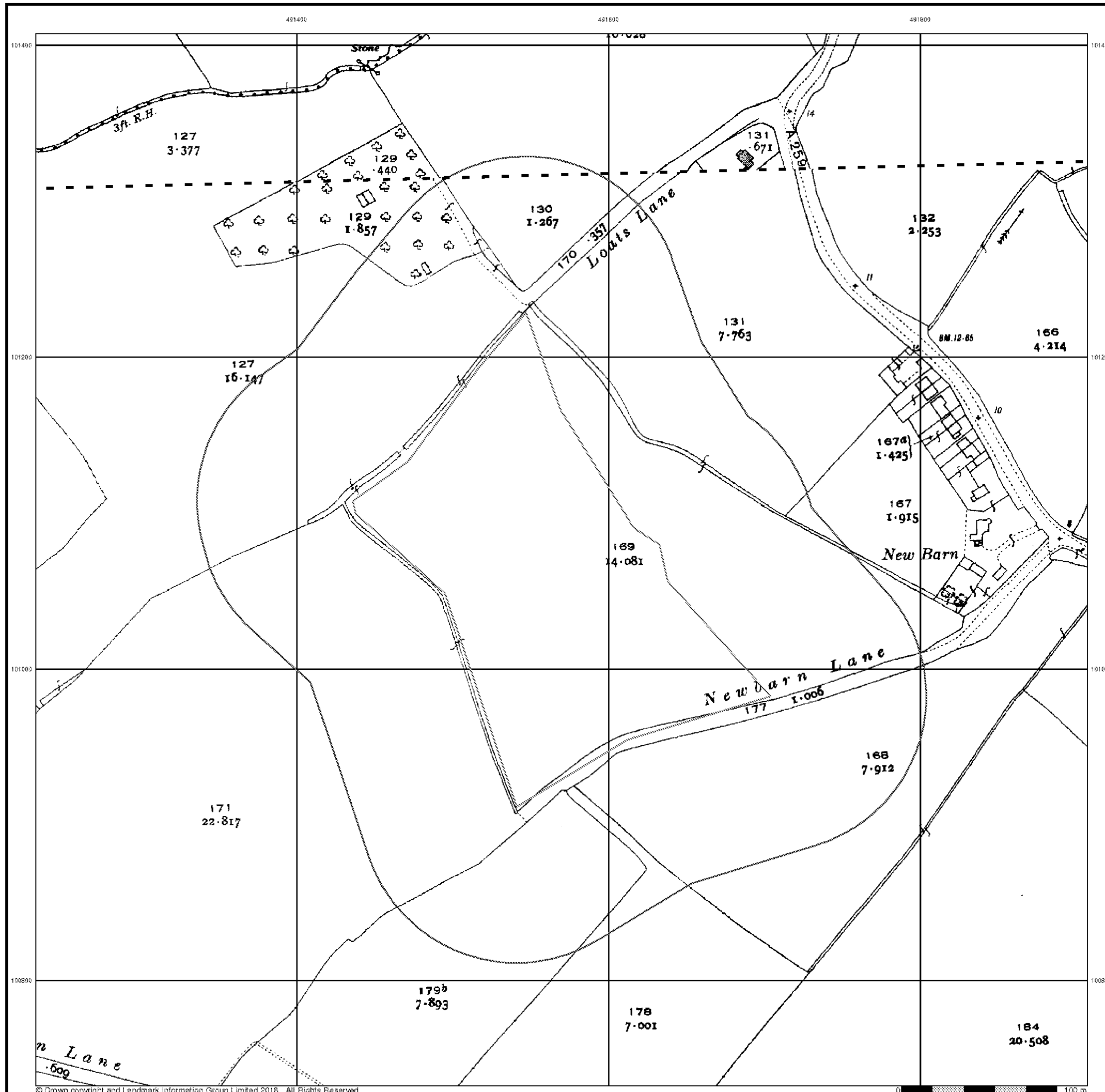


Order Details

Order Number: 163211272_1_1
 Customer Ref: LS3463
 National Grid Reference: 491570, 101060
 Slice: A
 Site Area (Ha): 3.57
 Search Buffer (m): 100

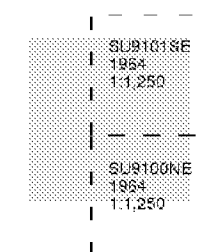
Site Details

66a, New Barn Lane, North Bersted, BOGNOR REGIS, PO21 5DL

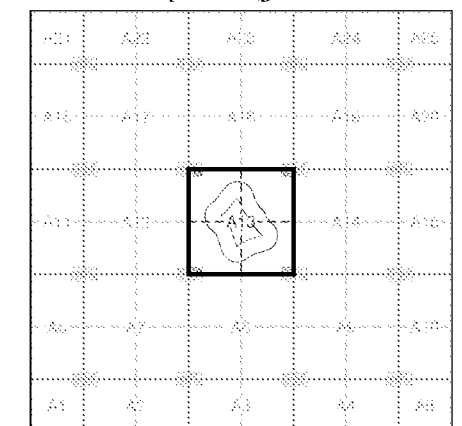


The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain.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

Map Name(s) and Date(s)



Historical Map - Segment A13

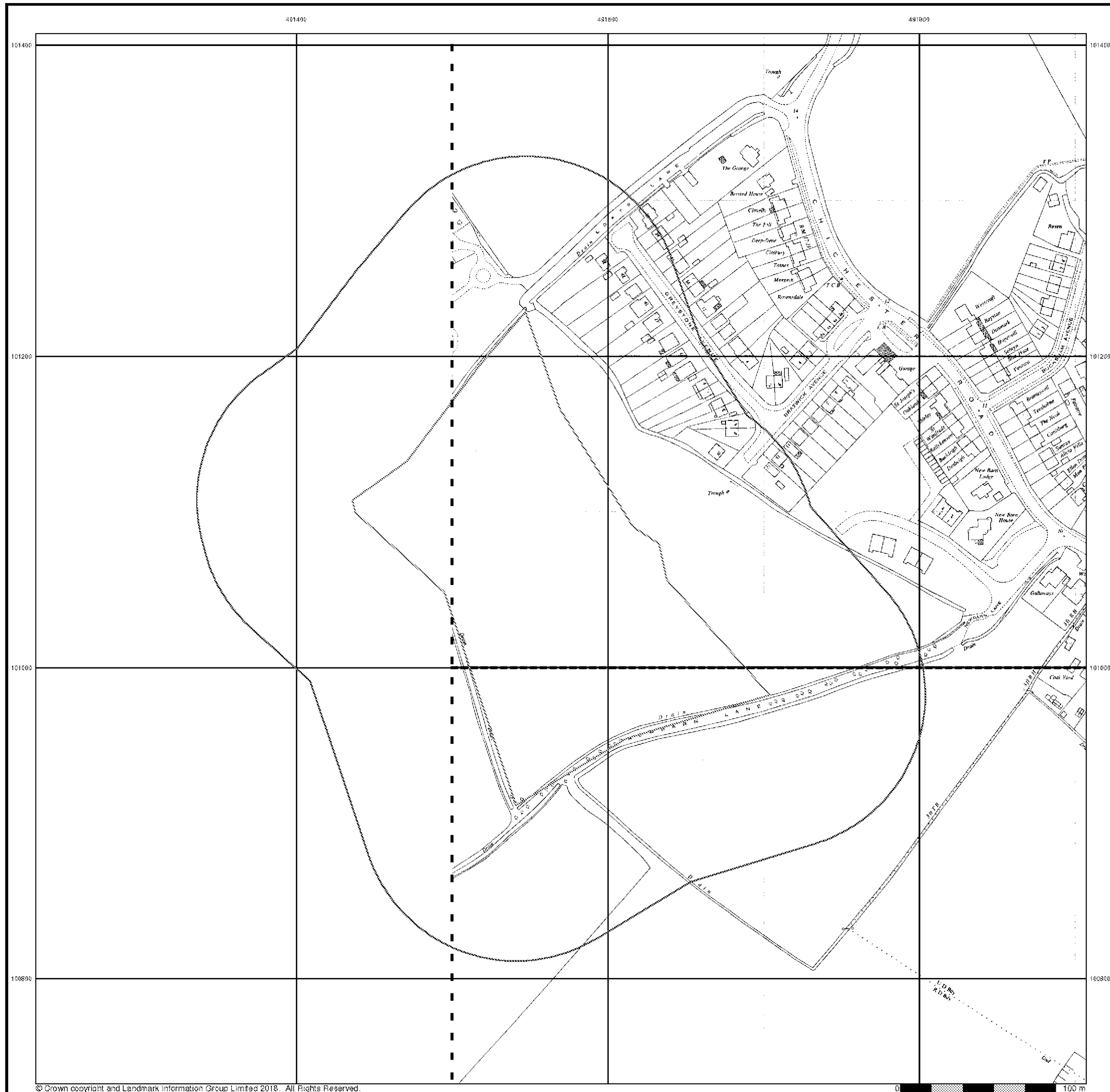


Order Details

Order Number: 163211272_1_1
 Customer Ref: LS3463
 National Grid Reference: 491570, 101060
 Slice: A
 Site Area (Ha): 3.57
 Search Buffer (m): 100

Site Details

66a, New Barn Lane, North Bersted, BOGNOR REGIS, PO21 5DL

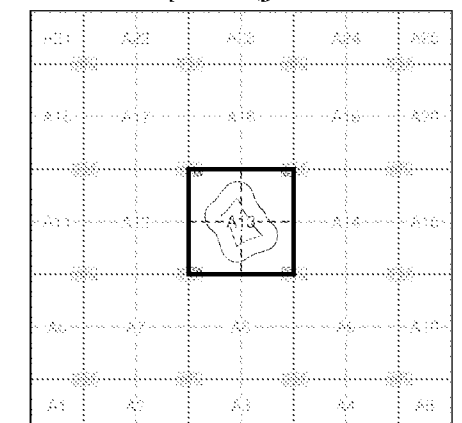


The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain.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

SL9101SE
1958
1:1,250
SL9100NE
1957
1:1,250

Historical Map - Segment A13

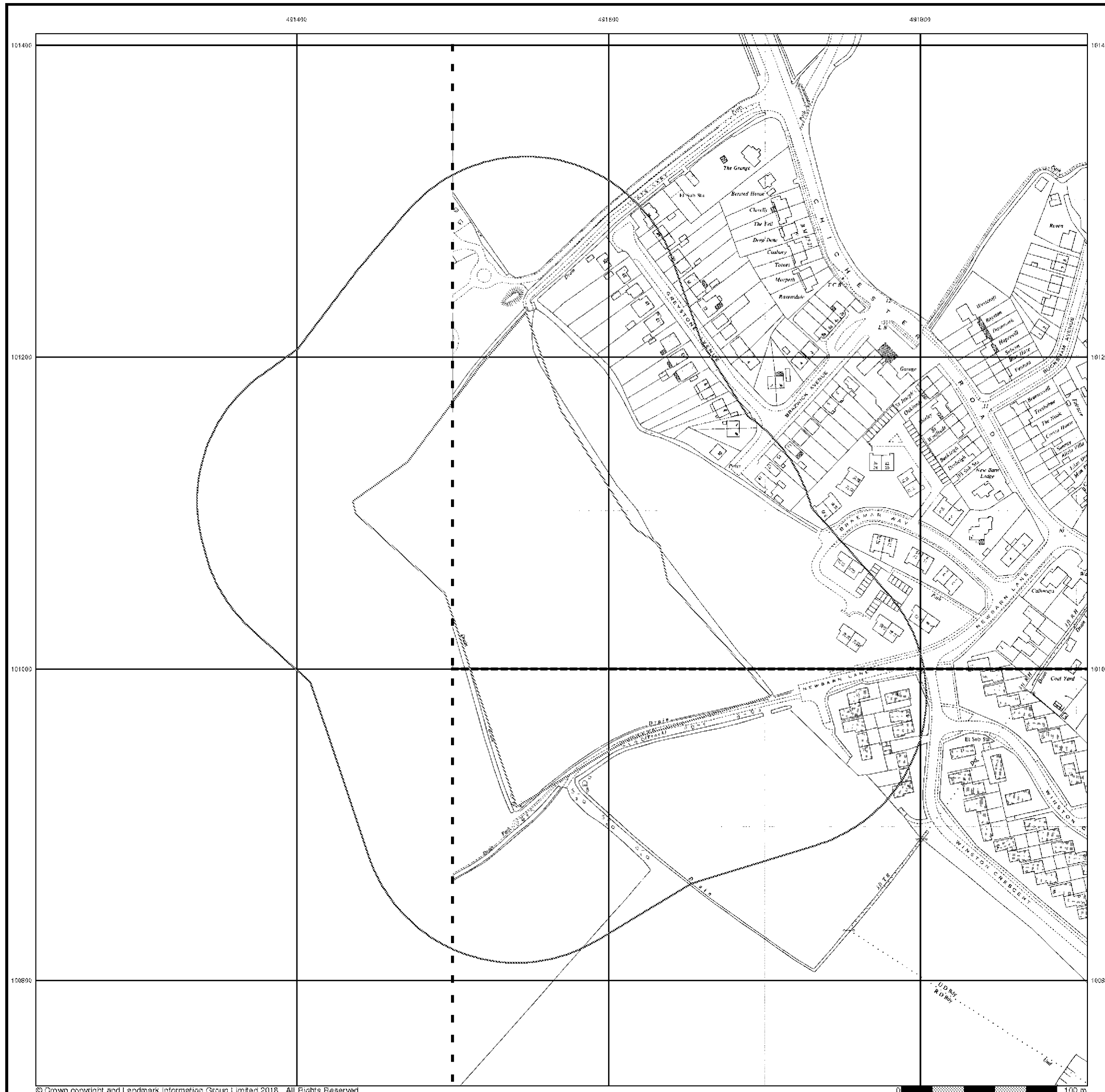


Order Details

Order Number: 163211272_1_1
 Customer Ref: LS3463
 National Grid Reference: 491570, 101060
 Slice: A
 Site Area (Ha): 3.57
 Search Buffer (m): 100

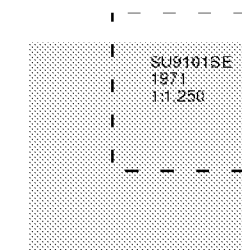
Site Details

66a, New Barn Lane, North Bersted, BOGNOR REGIS, PO21 5DL

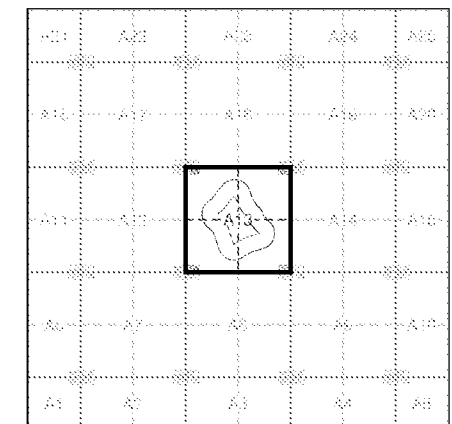


The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain.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

Map Name(s) and Date(s)



Historical Map - Segment A13

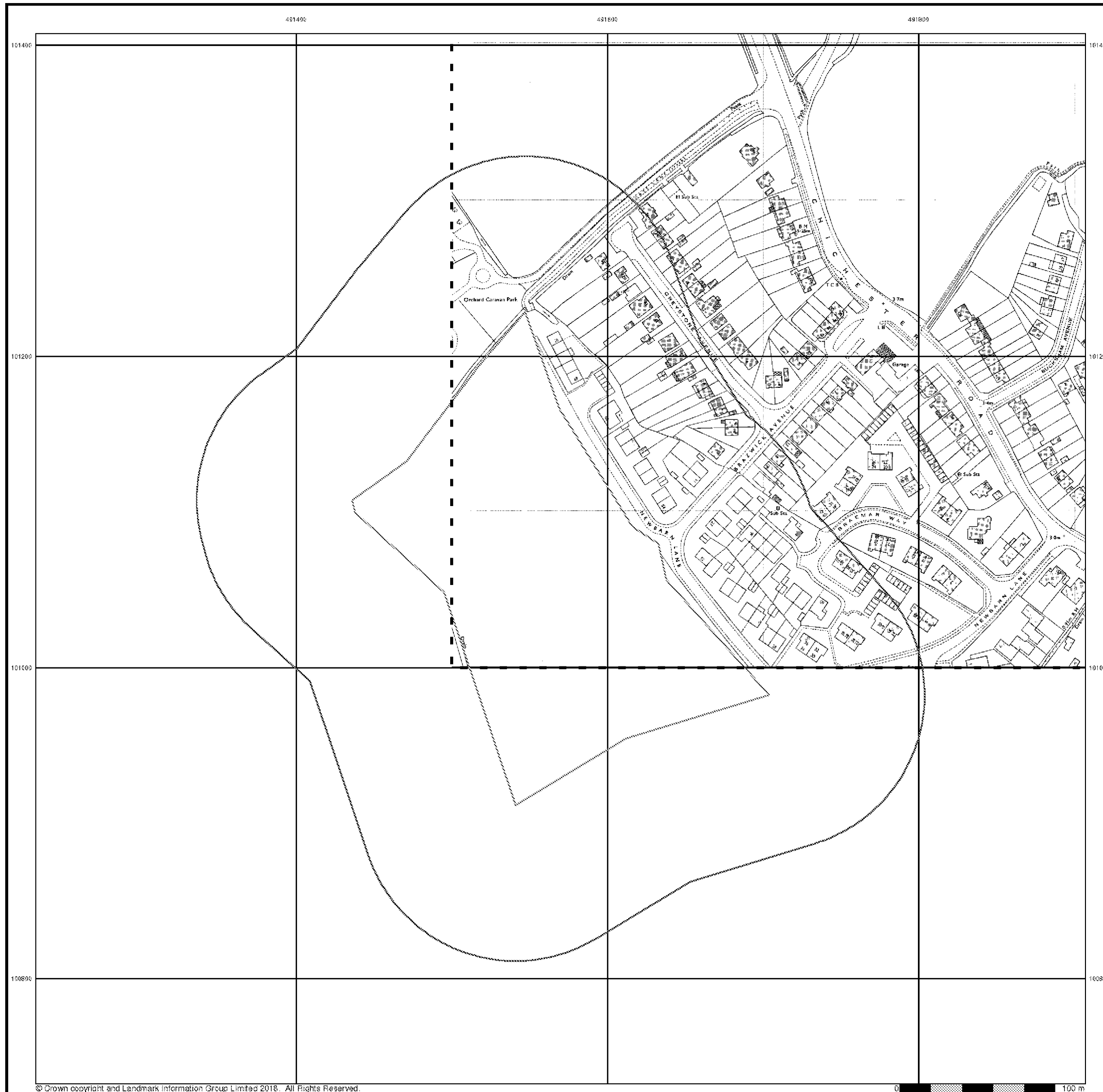


Order Details

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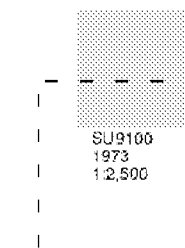
Site Details

66a, New Barn Lane, North Bersted, BOGNOR REGIS, PO21 5DL

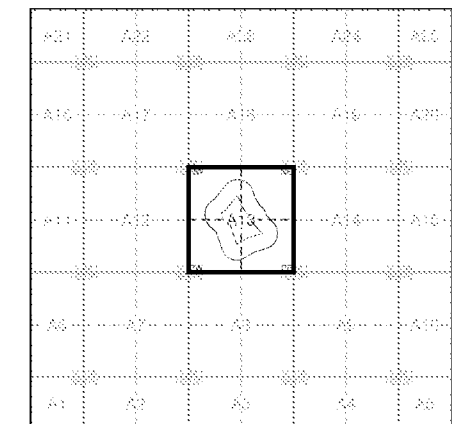


SUSI maps (Supply of Unpublished Survey Information) were produced between 1972 and 1977, mainly for internal use at Ordnance Survey. These were more of a 'work-in-progress' plan as they showed updates of individual areas on a map. These maps were unpublished, and they do not represent a single moment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

Map Name(s) and Date(s)



Historical Map - Segment A13

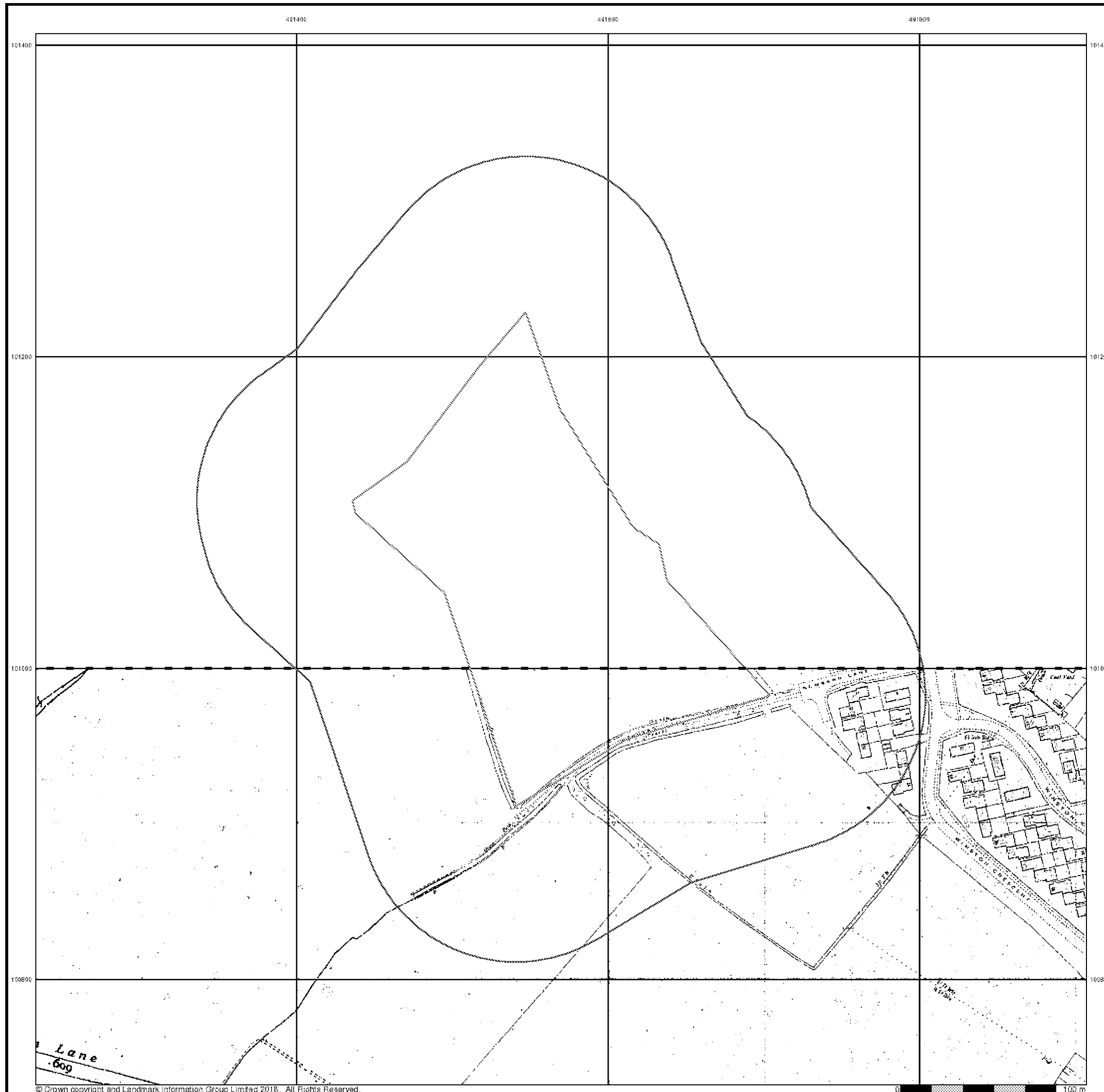


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Site Details

66a, New Barn Lane, North Bersted, BOGNOR REGIS, PO21 5DL

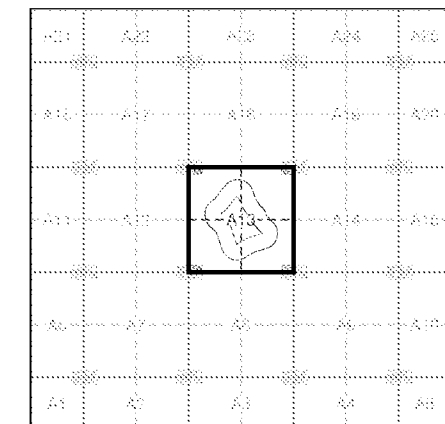


The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain.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

SU9101
1976
1:2,500
SU9100
1976
1:2,500

Historical Map - Segment A13

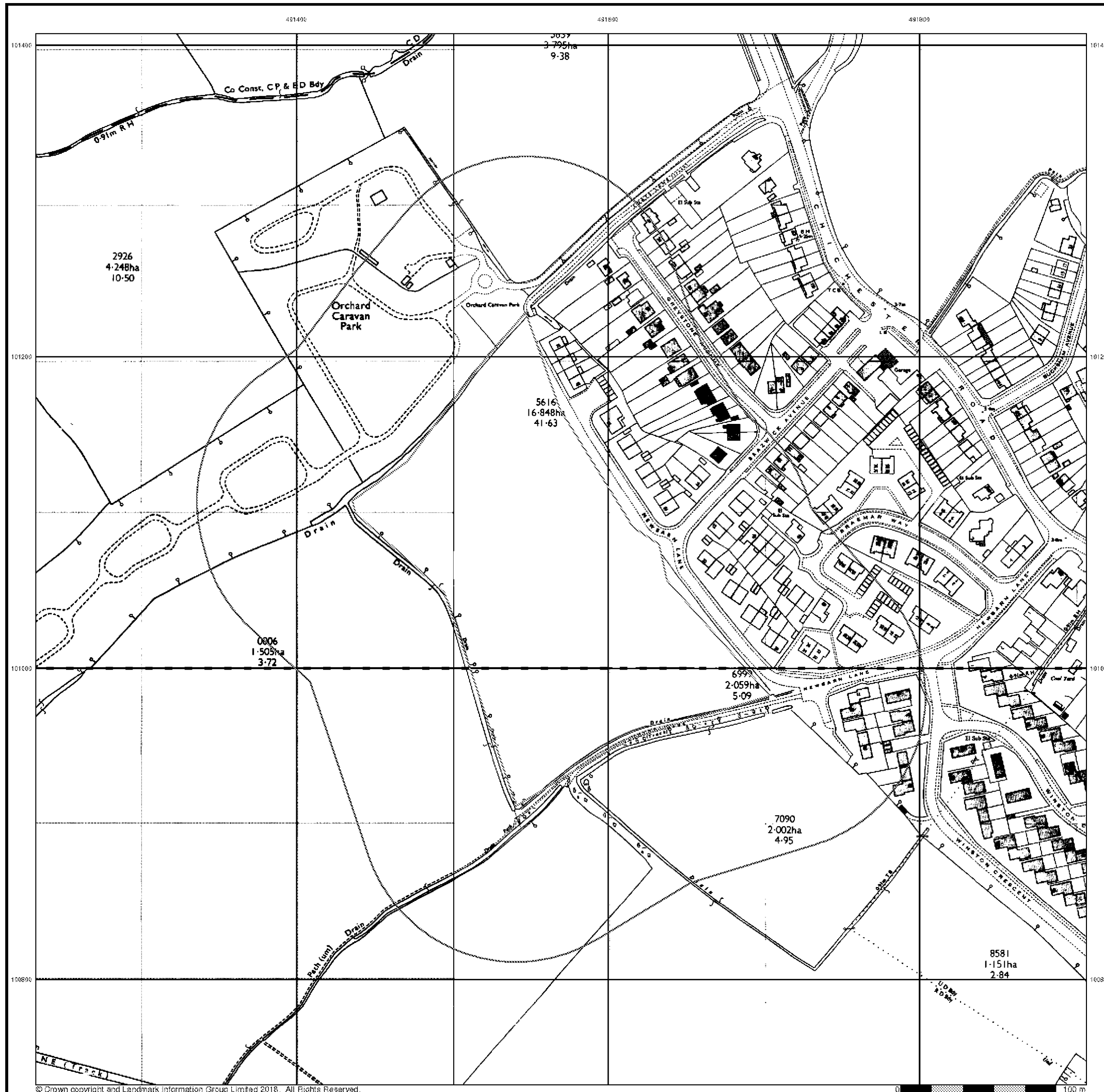


Order Details

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 National Grid Reference: 491570, 101060
 Slice: A
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Site Details

66a, New Barn Lane, North Bersted, BOGNOR REGIS, PO21 5DL

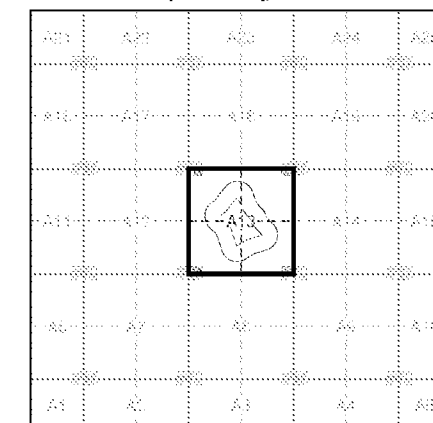


The SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') are further, minor editions of mapping which were produced and published in between the main editions as an area was updated. They date from 1947 to 1994, and contain detailed information on buildings, roads and land-use. These maps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

Map Name(s) and Date(s)

SL9101SE
1991
1:1,250
SL9100NE
1979
1:1,250

Historical Map - Segment A13

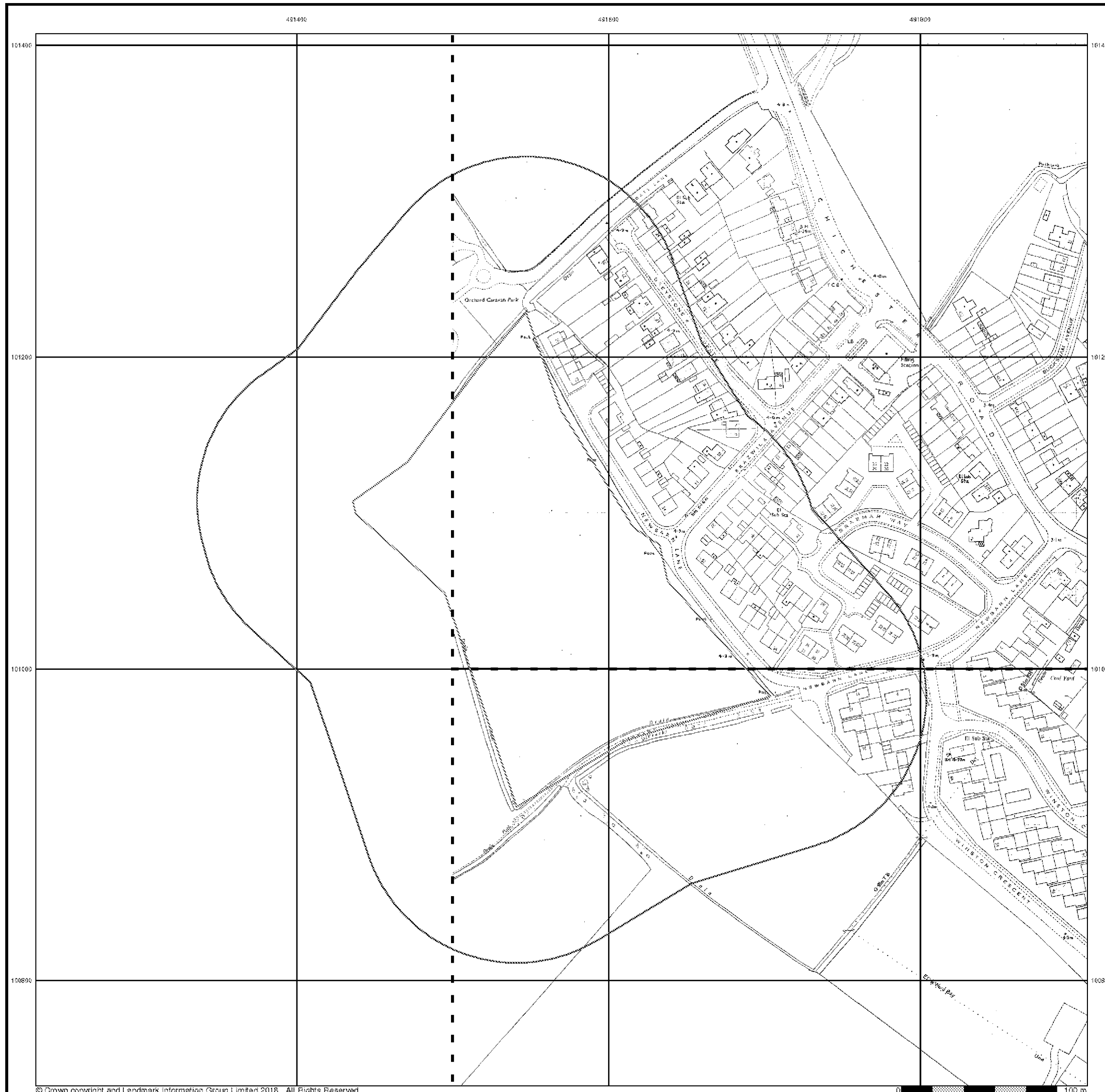


Order Details

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Site Details

66a, New Barn Lane, North Bersted, BOGNOR REGIS, PO21 5DL

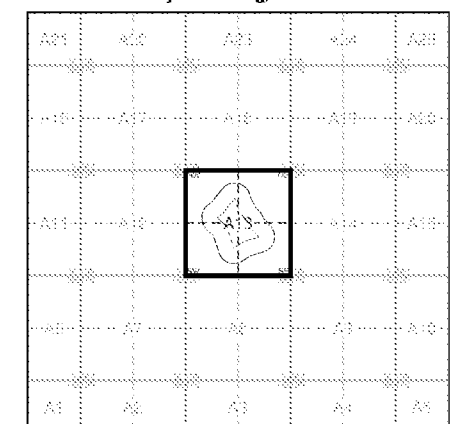


'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic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

Map Name(s) and Date(s)

SU9101SW	SU9101SE
1994	1994
1:1,250	1:1,250
SU9100NW	SU9100NE
1994	1994
1:1,250	1:1,250

Historical Map - Segment A13

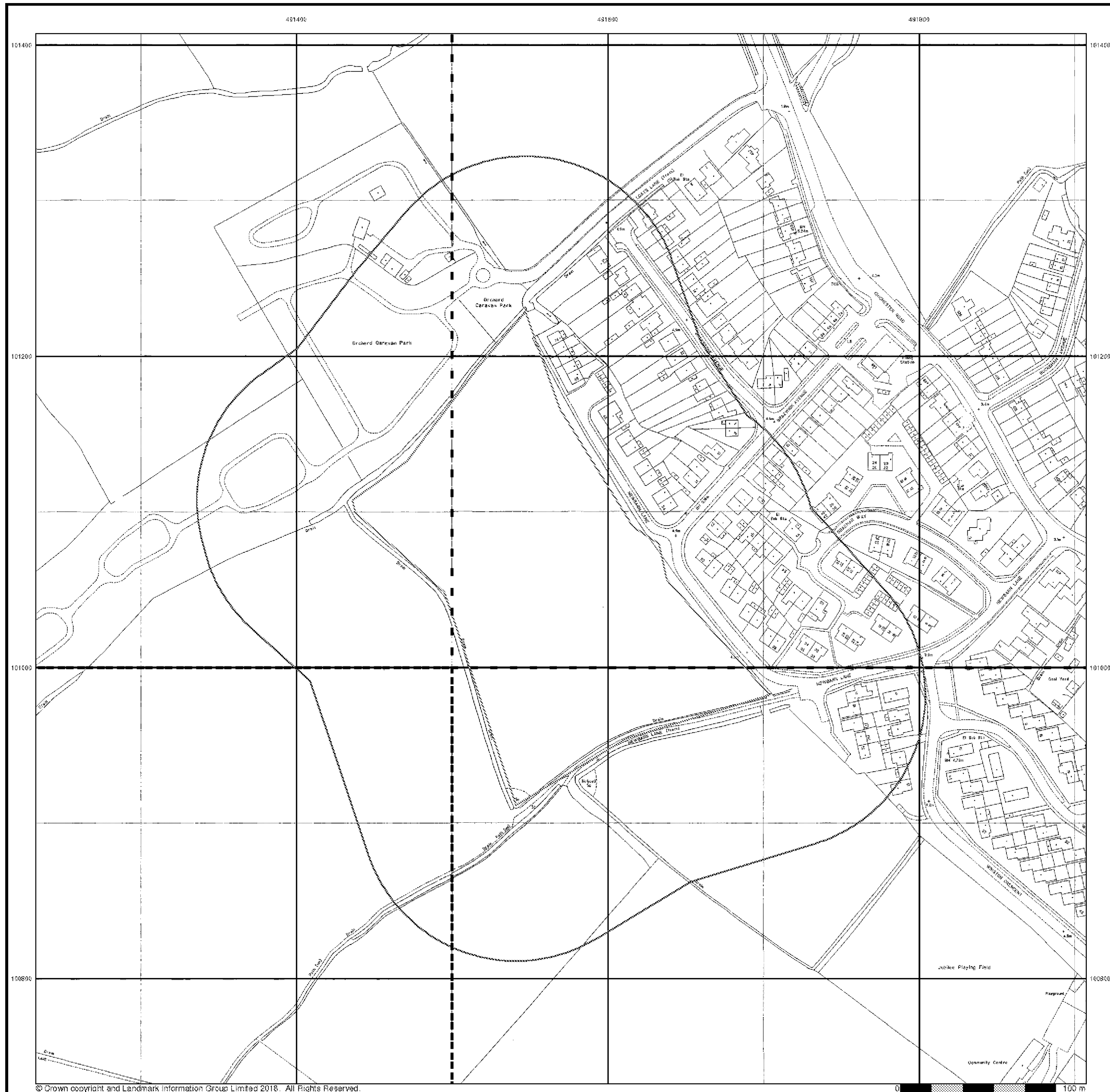


Order Details

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 Search Buffer (m): 100

Site Details

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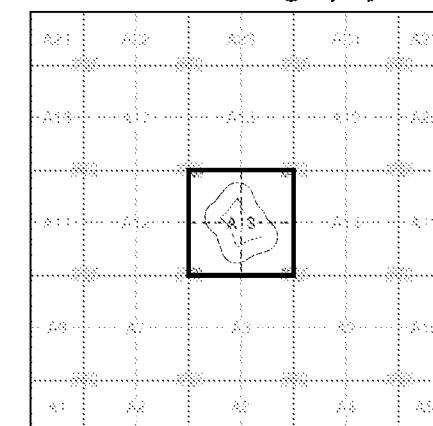
Land
Science

Historical Aerial Photography

Published 1999

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

Historical Aerial Photography - Segment A13



Order Details

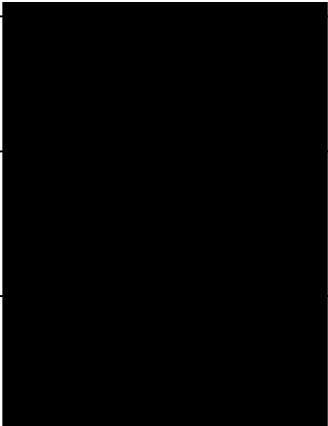
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National Grid Reference: 491570, 101060
Slice: A
Site Area (Ha): 3.57
Search Buffer (m): 100

Site Details

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Landmark
INFORMATION GROUP

Tel: 0844 844 9852
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

Title:	GEOTECHNICAL GROUND INVESTIGATION	
Site:	NEW BARN LANE, NORTH BERSTED, BOGNOR REGIS, PO21 5DJ	
Development:	PROPOSED NEW RESIDENTIAL DEVELOPMENT	
Client:	PELL FRISCHMANN	
Date:	29th MAY 2018	
Reference:	LS 3463	
Version:	V1.0	
Prepared by:		LUKE STOCK M.Sc., B.Sc. (Hons), FGS, AMIEnvSci <u>Geo-Environmental Consultant</u>
Prepared by:		DANIEL CANNEAUX B.Sc. (Hons.), FGS <u>Senior Geotechnical Engineer</u>
Authorised by:		ELLIOT TOMS CEnv M.Sc., B.Sc. (Hons.), FGS, MIEnvSci <u>Managing Director</u>

Land Science are Geotechnical Engineering and Contaminated Land specialists for construction, regulation, property ownership, and due diligence. By understanding our client's needs and appreciating the role that ground issues play within a wider context, we provide a reliable service and first class expertise tailored to their specific requirements. For more information on how we can benefit your project, please visit 



Appendix B

DRAWINGS



115/1

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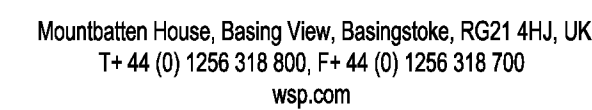
DO NOT SCALE



- | | | | | | |
|-----|----------|----|-------------|-----|-----|
| P01 | 19/09/19 | TI | FIRST ISSUE | CS | CS |
| REV | DATE | BY | DESCRIPTION | CHK | APP |

DRAWING STATUS:

S2 - FOR INFORMATION



CLIENT:

BELLWAY HOMES LTD

ARCHITECT:

OSP ARCHITECTURE

SITE/PROJECT:

NEW BARN LANE, NORTH BERSTED

TITLE:

PRELIMINARY DRAINAGE STRATEGY

DRAWING No:	REV:
1643-WSP-XXX-NBL-DR-C-0501	P01

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RG21 4HJ

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