Mr and Mrs Munford
London

The Waterhouse,
Fitzroy Park, Highgate,
North West London

Geotechnical, Hydrogeological and Geoenvironmental Site Investigation Report

Project no. 241830-01 (00)

February 2011

Safeguarding your business environment

CONTENTS

FIGURES

APPENDICES

Appendix A Desk Study Information

Envirocheck Report and Historical Maps [on CD]
BGS Borehole Log

Appendix B Fieldwork Records

Borehole Records
Water Monitoring Record Sheets

Appendix C Geotechnical Laboratory Test Records

Moisture Content and Plasticity Index of Soil
Triaxial Test Results
Particle Size Distribution Results

Appendix D Chemical Laboratory Test Records

Chemical Analysis of Soils
Chemical Analysis of Waters
PAH Double Ratio Plot
Piper Diagram

Appendix E CLEA Software Output Reports

Appendix F HASWASTE Assessment

RSK STATS Geoconsult Ltd
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT
UK

Telephone: +44 (0)1442 437500
Fax: +44 (0)1442 437550
www.rsk.co.uk

DOCUMENT CONTROL

Document Title: Geotechnical, Hydrogeological and Geoenvironmental Site Investigation Report

The Waterhouse, Fitzroy Park, Highgate, North West London

The Client: Mr and Mrs Munford
13 Albermarle Street
Mayfair
London
W1S 4HJ

RSK STATS Geoconsult Ltd (RSK) has prepared this report in accordance with the instructions of Engineers Haskins Robinson Waters, acting on behalf of Mr and Mrs Munford ("the Client"), by email dated 29th October 2010, and under the terms of appointment for RSK. This report is confidential and non-assignable by the Client and RSK shall not be responsible for any use of the report or its contents for any purpose other than that for which it was prepared and provided. Should the Client require to pass copies of the report to other parties for information, the whole of the report should be so copied, but no professional liability or warranty shall be extended to other parties by RSK in this connection without the explicit written agreement thereto by RSK.

Report Number	Status	Date of issue
241830-01 (00)	FINAL	February 2011

Author/Project Manager: Clive Gerring
Senior Geoenvironmental Engineer

Technical Reviewer: Jon Bailey
Associate Director

RSK STATS Geoconsult Ltd
Registered office
Spring Lodge • 172 Chester Road • Helsby • Cheshire • WA6 0AR • UK
Registered in England No. 2611785
www.rsk.co.uk

EXECUTIVE SUMMARY

On the instructions of Engineers Haskins Robinson Waters, on behalf of Mr and Mrs Munford, RSK STATS Geoconsult (RSK) has carried out a Phase 1 and Phase 2 geotechnical, hydrogeological, and geoenvironmental site investigation of 'The Waterhouse' Fitzroy Park, located close to Highgate, North West London. The project was commissioned in connection with the proposed redevelopment of the site with a detached property with localised basements to replace the existing house on site.

Project Findings

Site History	From mid-Victorian times, the site lay within the wider area of Fitzroypark Farm and to have been covered by mixed woodland and open farmland with several paths or tracks crossing the site and several small, possible farm, buildings located in the central area of the site. The site remained unchanged until the early-1930s, by which time it was developed with a large detached residential property (Fitzroy Farm Cottage) set in extensive gardens. The site remained apparently unchanged until the early-1990s, when Fitzroy Farm Cottage was demolished and the current 'Waterhouse' was constructed. A pool-house was added to the 'Waterhouse' in the mid-1990s, the site attaining its current configuration at that time.
Geology, Hydrogeology and Hydrology	The published geological information indicates that the site is underlain by Unit D of the London Clay Formation. The London Clay is a non-aquifer (non-productive strata) and the site does not lie within a groundwater Source Protection Zone (SPZ). Springs/ seepages / issues are indicated in the wider vicinity, associated with geological boundaries between units of contrasting permeability. Information provided by the Resident's Association suggests that a continuously flowing spring is present within the subject site, located beneath the current house, and that this feature may be related to the presence of the Claygate Member within the site area. The subject site lies within the catchment of a stream formerly known as the Highgate Brook, forming one of the tributaries of the River Fleet, which rises on Hampstead Heath. A series of historical artificial ponds (Highgate Ponds) lie within this stream and serve a variety of leisure and recreational purposes, and are the subject of a number of conservation and management measures under the Corporation of London's Hampstead Heath Management Plan. These ponds lie down-gradient from the site. The subject site lies within a northeast to southwest orientated valley, within which no surface watercourse currently flows. Information provided by the Resident's Association suggests that drainage in this area is diverted through a culvert / buried channel beneath the residential properties in this area.
Contaminative Uses	The historical research has revealed no evidence of contaminative activities having occurred on the site.
Review of Previous Report	An intrusive site investigation was formerly undertaken at the site by GEA, details of which were provided within their report no. J07385, dated February 2008. Five boreholes were advanced to depths of between 4m and 15m below ground level (bgl) across the site. The encountered ground conditions were described as 0.5m to 1.8m thickness of Made Ground overlying the London Clay Formation. The London Clay was described as firm brown fissured silty clay becoming a firm to stiff grey silty clay.
RSK Site Investigation Findings	Eight further boreholes were undertaken across the site, to depths between 4m and 20m bgl, with samples taken to determine the geotechnical and material properties of the London Clay and with groundwater monitoring equipment installed.

	The site investigation confirmed the ground conditions as encountered by GEA and confirmed that the site is underlain by the London Clay Formation. No evidence was encountered to support that the Claygate Member is present beneath the site. Any water 'issuing' from the ground surface is, therefore, more likely to be associated with shallow perched water and surface run-off (particularly after heavy rain) due to the low permeability of the underlying soils. Water-bearing reworked ground was encountered locally in the southeast of the site. Minor seepages were encountered within the London Clay and rising head tests were undertaken to allow an assessment of recharge and permeability. Values of permeability within the range 2.4 to 4.1 x 10^{-8} m/s were obtained for the weathered London Clay, and a value of 8.1 x 10^{-9} m/s was obtained from deeper unweathered clay, indicating that the natural soils beneath the site are practically impermeable. Any groundwater movement within the London Clay is likely to be through the secondary effect of fissuring. Chemical testing of groundwater and pond water within the immediate site vicinity indicate that groundwater is unlikely to make any significant contribution to the adjacent pond, which is more likely to be fed by surface water. No significant ground or groundwater contamination was encountered at the site.

Project Conclusions

Geoenvironmental Conclusions	The findings of the site investigation, conceptual site model and the assessment of potential health and environmental risks from contamination for the proposed development has identified no evidence of significant ground contamination on the site and hence pollutant linkages are deemed not to exist. The only exception is some localised marginal benzo(a)pyrene contamination within Made Ground. However, under the proposed development plan this area of the site will either be excavated to form the new development or be encapsulated beneath the development, breaking any pollutant linkages towards human health. Groundwater testing indicates no evidence of contamination with the above-mentioned contaminants, and therefore it is considered that there is no risk to nearby water resources.
Geotechnical Conclusions	The soils encountered during the investigation comprised very high plasticity clays of high volume change potential underlying variable Made Ground at shallow depths. Soils in the vicinity of the proposed development also show evidence of desiccation within the upper few metres. A piled foundation solution has been proposed for the redevelopment. It is understood that the permanent basement structure will be constructed in reinforced concrete with a piled raft to support the vertical load and deal with any tensile forces that might develop as a result of any heave or hydrostatic pressures. Construction of the proposed basement will be facilitated by a king post retaining wall. Perched water has been encountered in the Made Ground and slow seepages are recorded within the London Clay Formation. Temporary groundwater control will be necessary for construction of the basement. Provision should also be made for the build up of hydrostatic pressures behind retaining walls and beneath the basement slab, and waterproofing of the basement structure.
Hydrogeological Conclusions	Perched water appears to be locally present in the Made Ground, overlying the weathered London Clay. In the vicinity of the proposed development, seepages at the Made Ground/London Clay boundary were encountered at a depth of approximately 1m bgl, and at this level the proposed foundations and basement

	are likely to have no more effect on the perched water regime than the foundations to the existing property on site. Disturbance of the shallow water regime during construction is likely to be limited to the effects of severing existing drainage networks. Therefore, all efforts should be made to identify current surface drainage arrangements and any possible land drains so that mitigation arrangements can be put in place before decommissioning the existing system and to avoid unexpected severance of drainage lines. Groundwater monitoring indicates slow rates of water seepage within the London Clay, compatible with the anticipated low permeability of the encountered materials. In view of the proposal to facilitate basement construction with king post retaining walls, it is considered that temporary groundwater control will be necessary in the form of gravity drainage and pumping from sumps. The short-term disadvantage of temporary groundwater control is outweighed by the long-term advantage of the proposed king post retaining wall system which will negate the use for deeper cut-off systems and allow the free passage of groundwater, ensuring long-term drainage An area of water-bearing Made Ground was encountered in the southeast of the site close to the small pond. Water was encountered at a depth of 1.7m bgl (rising to 1.0m bgl), whilst the depth of the pond is believed to be constrained to approximately 0.4m. No redevelopment works are planned for this area of the site that would intrude into the groundwater environment, although it is proposed to alter site levels in this area of the site and possibly infill the existing pond. It is, therefore, recommended that this area of the site is further investigated to ensure that no unforeseen ground conditions or drainage lines are encountered during construction. It is recommended that a ground penetrating radar (GPR) survey be undertaken to establish whether any drainage lines enter or exit the pond and it is recommended that the encountered area of water-bearing Made Ground is excavated to elucidate the nature of the encountered water strike. It is considered that the impact of the proposed development on the local hydrological/hydrogeological regime will be minimal and is considered unlikely to have any significant effect on the water supply to the Highgate Ponds. Any potential disturbances to drainage from the site may be effectively mitigated by the measures outlined above.

1. INTRODUCTION

1.1 Instructions

On the instructions of Engineers Haskins Robinson Waters, on behalf of Mr and Mrs Munford (the 'Client'), RSK STATS Geoconsult (RSK) has carried out a Phase 1 and Phase 2 geotechnical, hydrogeological, and geoenvironmental site investigation of 'The Waterhouse' Fitzroy Park, located close to Highgate, North West London.

The project was commissioned in connection with the proposed redevelopment of The Waterhouse site with a new detached property with a basement to replace the existing house on site. The site is located on the edge of Hampstead Heath, within an area of drainage which supports a chain of ponds (the Highgate Ponds), which lie topographically down-gradient of the subject site. An assessment of the hydrogeology of the site and the potential for the redevelopment to impact upon the groundwater regime is required to support the planning application. The project was also commissioned in order to identify the potential for hazardous substances or conditions to exist on, at or near the site and therefore, via the development of a Conceptual Site Model (CSM), identify the necessity for and extent of mitigation measures to be employed in relation to the proposed development of a residential property on the site.

By way of background to the project, a site investigation was previously undertaken at the site by Geotechnical & Environmental Associates (GEA), as presented in their report dated February 2008 (report no. J07385). Based on this report, Engineers Haskins Robinson Waters developed an 'Initial Feasibility Comments' document (Report no. 901/rl/Oct2010), dated October 2010. The scope of work reported upon herein is based upon the above mentioned documents and subsequent discussions with Engineers Haskins Robinson Waters.

These reports and documents have been made available to RSK for review as part of this study.

1.2 Project Brief

The project was carried out to an agreed brief as set out in RSK's proposal letter of 7th September 2010.

The work undertaken included the following tasks:

(i) Desk Study

- A site walk-over reconnaissance survey;
- A study of the history of development and industry on the site, including reference to archival Ordnance Survey mapping and pre-OS maps of London;
- A search of Statutory Registers for potentially contaminative land uses and licences in the vicinity of the site, in the form of an environmental database report, and a search of the Environment Agency website;
- A review of existing reports/documents for the site;
- A study of the local geology, hydrology and hydrogeology of the site, including the identification of geological hazards and historic mining activities, and a search of the British Geological Survey database for relevant borehole logs; and
- A preliminary Conceptual Site Model (CSM) of contamination, identifying possible pollutant linkages.

(ii) Site Investigation

By means of:

- Light cable-percussive boreholes;
- Drive-in window sampler boreholes;
- On-going monitoring of groundwater wells;
- Off-site analysis for geotechnical and geoenvironmental purposes; and
- Interpretative reporting (including development of the CSM).

1.3 Standards

The project was designed generally to meet the objectives of a Preliminary (Phase 1) Investigation and an Exploratory Investigation, as defined by BS 10175:2001 “Code of Practice for the Investigation of Potentially Contaminated Sites”. Exploratory Investigations usually involve only limited intrusive/analytical work in which relatively few samples are collected for contamination identification/confirmation purposes. They play a role in establishing the potential for short-term exposure or other immediate risks to health and the environment, and they are used to generate initial gas, vapour and water quality data.

The intrusive aspects of the investigation were generally carried out following guidance given in BS 5930:1999 - Code of Practice for Site Investigations.

This report adopts the technical approach presented in Contaminated Land Report 11 “Model Procedures for the Management of Land Contamination” (Environment Agency 2004) for applying a risk management process when dealing with land affected by contamination.

The project and this report have been designed to fulfil the information requirements set out in the Environment Agency Guidance on Requirements for Land Contamination Reports (Environment Agency 2005).

1.4 Limitations

This report should be considered in the light of any changes in legislation, statutory requirement or industry practices that may have occurred subsequent to the date of issue.

The "vicinity" of the site for the purposes of this report, is defined as locations situated within an approximate 250m radius of the site, although certain sources of contamination and / or sensitive targets further than 250m may also have been considered.

The opinions and recommendations expressed in this report are based on the ground conditions encountered during the site work, the results of field and laboratory testing and interpretation between exploratory holes. The material encountered and samples obtained represent only a small proportion of the materials present on-site, therefore other conditions may prevail at the site which have not been revealed by this investigation.

The environmental reconnaissance survey consisted of a general external inspection of the site aimed at identifying any obvious signs of potential sources of ground contamination. A detailed internal inspection of the buildings was outside the brief for the study.

As an Exploratory Investigation, the results may not provide sufficient data to make detailed estimates of the quantities involved in any remediation work, if required.

The results of RSK laboratory tests are covered by UKAS accreditation, but opinions and interpretations expressed in the report and on the site work records are outside the scope of this accreditation. Where laboratory testing has been carried out at a sub-contractor laboratory, this laboratory is an approved sub-contractor in accordance with the requirements of the RSK quality management system and is UKAS accredited for the relevant range of tests undertaken.

2. SITE DETAILS

2.1 Description and Geographic Setting

The site is located at National Grid reference TQ 277 869, as shown on **Figure 1**. The site lies to the southwest of Fitzroy Park and is accessed via Millfield Lane to the southwest. The site is bordered to the north, east and west by the gardens of neighbouring detached properties and a pond within the neighbouring garden of No.55 Fitzroy Park to the southeast.

The site currently comprises a large detached residential property set within mature, landscaped gardens (**Figure 2**).

2.2 Reconnaissance Survey

The characteristics of the site observed during a site reconnaissance visit and obtained from current Ordnance Survey maps are summarised in **Table 2.1**.

Table 2.1 – Site description

Feature	Description
Physical characteristics	
Area of site	Approximately 0.23 hectare.
Ground levels	The site lies on a general southerly/southeasterly facing slope. Ground levels at the site range from an elevation of approximately 82mAOD in the site's northern part to approximately 79mAOD to 80mAOD in the site's southern part.
Depressions in the ground surface	None observed.
Waterlogged or marshy ground	None observed.
Surface water	There is a small ornamental pond in the southeast of the site. There are no streams or drainage ditches on the site.
Trees	Numerous mature trees and shrubs are present on site.
Existing buildings on site	The current building on site comprises a two-storey detached property in the centre of the site, cut into the sloping ground. A single-storey former pool house extends from the southwestern corner of the property and appears to be currently utilised as a playroom. There is also a small, detached single-storey building in the northwest corner of the site, which appears to be utilised for recreational purposes.
Basements on site	It is understood that a swimming pool is, or was formerly, present within the pool house. No evidence of other existing or infilled basements was observed.
External hardstanding	There is a gravelled drive along the northwestern boundary of the site and a small gravelled area to the east of the house.
Retaining walls and adjacent buildings on or close to site boundary	None observed.
Made ground and earthworks	The site appears to have been historically cut or levelled to allow development of the building currently occupying the site. Some garden areas of the site appear to have been locally landscaped.
Potentially unstable slopes on or close to	None observed. However, see **Section 4.1.2**.

Feature	Description
site	
Environmental characteristics	
Tank storage and dispensing facilities	None observed.
Potentially hazardous materials storage and use	None observed.
Asbestos-containing materials	No obvious asbestos construction materials were observed but a detailed survey of the buildings would be required to confirm the presence or otherwise of asbestos-containing materials.
Waste storage	None observed.
Evidence of possible land contamination on site	None observed.
Potential off-site sources of ground contamination	None observed.

No potentially significant ground contamination issues were identified during the site reconnaissance survey.

2.3 Information from Environmental Searches

2.3.1 Environmental Database Report and Environment Agency (EA) information

Details on the presence of industries with pollution-related licences, landfill sites and pollution incidents have been obtained via an environmental database report and from a search of information publicly available on the EA website. A copy of the environmental database report is included in **Appendix A**. Salient information from these sources is as follows:

- There are no records of landfill sites (former or current) within 250m of the site (i.e. within the Planning Consultation Zone). Furthermore, there are no records of landfills within a 1km radius of the site.
- There are no records of facilities currently operating under an Integrated Pollution Prevention and Control (IPPC) or a Local Authority Pollution Prevention and Control (LAPPC) authorisation within 500m of the site.
- There are no records of pollution incidents attributable to the site itself, and no records of prosecution or enforcement action against the site with respect to environmental issues.
- There are no Contemporary Trade Directory Entries or Fuel Station Entries within 250m of the site.

3. DEVELOPMENT HISTORY

3.1 Sources of Information

The history of the site's land-use and development from Victorian times onwards has been researched from:

- Early Ordnance Survey (OS) maps; and
- Pre-Ordnance Survey (County Series) maps.

Copies of OS and County Series maps are included in the environmental database report in **Appendix A**. Reference to historical maps provides invaluable information regarding the land use history of the site, but historical evidence may be incomplete for the period pre-dating the first edition and between successive maps.

The development history of the site and surrounding area from the above sources is summarised below.

3.2 Summary of Development History

3.2.1 The Site

From mid-Victorian times, the site lay within the wider area of Fitzroypark Farm to the west and the highways of Fitzroypark Road and Millfield Lane to the northeast and southwest, respectively. The site appears to have been covered by mixed woodland and open farmland at this time, with several paths or tracks crossing the site and several small, possible farm, buildings located in the central area of the site. The site remained unchanged until the early-1930s, by which time it was developed with a large detached residential property (Fitzroy Farm Cottage) set in extensive gardens. The site remained apparently unchanged until the early-1990s, when Fitzroy Farm Cottage was demolished and the current 'Waterhouse' was constructed. A pool-house was added to the 'Waterhouse' in the mid-1990s, the site attaining its current configuration at that time.

3.2.2 The Surrounding Area

From mid-Victorian times, the site lay within the wider area of Fitzroypark Farm, and was surrounded by open woodland, farmland and heathland to the east and south, with large detached residential properties ('Lodges') to the north and the west, set in large gardens and surrounded by fields / open land. Urban development was present 750m northeast (Highgate), 1km southwest (Hampstead), and 1km southeast (Dartmouth Park) of the site. The Highgate Ponds were present to the southwest of the site, the ponds being shown as the property of the 'New River Company's Water Works'. A large pond (No.55 Fitzroy Park) was also present to the immediate east of the site boundary. Two smaller ponds, evidently lying along the same northeast-southwest axis through the topographic valley in this area were also present to the northeast of the site (see **Figure 3**).

No significant changes occurred in the site's vicinity, until the early-1910s, when the ponds to the northeast were no longer evident and a 'miniature rifle range' was present, located south of the site, adjacent to the Wildfowl Reserve Pond. By the early-1930s, new residential developments were constructed across Fitzroy Park road, including Fitzroy Farm to the northwest of the site. The 'miniature rifle range' was no longer present by this time. By the early-1990s, some redevelopment of private residences including Fitzroy Close appears to have taken place to the immediate northeast of the site and the southeast of the site. No further significant changes appear to have occurred in the site vicinity to the present day.

4. GEOLOGY, HYDROGEOLOGY AND HYDROLOGY

4.1 Geology

4.1.1 General Characteristics

The published 1:50,000 scale geological map (Sheet No. 256 'North London') and 1:10,560 scale geological map (TQ28NE) of the area indicate that the immediate site area is underlain by the London Clay Formation (**Figure 3**).

The London Clay Formation is divided by the British Geological Survey (BGS) into five informal units. The lowest four, denoted A to D, are not mapped, whereas the top part of the formation is mapped as the Claygate Member. The site lies on the flank of, and topographically below, a dissected outlier comprising the Claygate Member and the overlying Bagshot Formation. These latter strata form the high ground on which Hampstead and Highgate are located, and comprise sandier lithologies, which give rise to the sandy soils of the heathlands. The geological boundary between the Claygate Member and the underlying Unit D of the London Clay Formation is mapped as lying close to the site's northeastern boundary along Fitzroy Park. (**Figure 3**). It is therefore considered that the site area lies within Unit D of the London Clay Formation.

The BGS define the Claygate Member as "all the deposits above the base of the lowest fine-grained sandy bed that are thick enough to be distinguished from the underlying relatively homogenous clays". However, it notes in this regard that the criteria are "difficult to maintain in the mapping of outliers of Claygate Member in central London and westwards from there because of the increasing number of sand beds in the underlying Unit D of the London Clay".

In the west of the (London) district, the Claygate Member is described as a finely interbedded and thinly laminated sequence of clay, silt and fine-grained sand with numerous interbeds of planar and lenticular bedded fine-grained, finely laminated sand. The Hampstead Heath borehole (TQ28NE/198, **Appendix A**), reported by the BGS, indicates that the Claygate Member is dominated by mainly very fine-grained sand and silt in this area, whilst the underlying London Clay comprises silt, clay and silty clay. According to the BGS Memoir for London, beds of clayey silt grading to silty fine-grained sand increase in number and thickness within the London Clay across the London district from east to west. However, the Hampstead Heath borehole (TQ28NE/198) indicates that Unit D is dominated by silt, clay and silty clay in this area. Indeed, it should be noted that this BGS borehole records the base of the Claygate Member at an elevation of approximately 93mAOD, which is at a considerably higher elevation than the drawn boundary on the current published map of approximately 85mAOD in the site area. The 1:50,000 scale geological map indicates that the strata in this area are essentially horizontal, with the outcrop pattern parallel to the local topographic contours (see also Section **4.2.1**).

An intrusive site investigation was formerly undertaken at The Waterhouse by GEA, details of which were provided within their report no. J07385, dated February 2008. Four drive-in sampler boreholes were advanced to depths of 4m to 5m below ground level (bgl) across the site and a single cable-percussive borehole was advanced to a depth of 15m bgl. The encountered ground conditions were described as 0.5m to 1.8m thickness of Topsoil/Made Ground, generally comprising brown sandy silty clay with occasional fragments of flint, brick and ash overlying the London Clay Formation. The London Clay was described as locally soft and slightly gravelly in its uppermost part, becoming firm brown fissured clay with occasional 'claystone' and selenite crystals, typical of weathered London Clay, locally becoming a firm to stiff grey silty clay below 6.5m bgl, more typical of 'fresh', unweathered London Clay. This material is described as locally containing partings of silt and pockets of sand.

No superficial deposits are shown in the site area, but the 1:50,000 scale geological map indicates that the site lies within an area of 'Head propensity', which is based on the geotechnical properties of the London Clay. These areas are most likely to be covered by Quaternary Head deposits as interpreted from digital slope analysis and confirmed by borehole data. These are not mapped deposits and not verified by fieldwork. However, the presence of Head deposits within this area may also contribute to placement of the Claygate Member/ London Clay boundary at too low an elevation on the geological map due to the effects of solifluction translating material to lower elevations and blurring geological boundaries.

4.1.2 Slope Stability Issues

The 1:50,000 scale geological map for the area indicates that the site lies within an 'Area of Significant Landslide Potential'.

The BGS' assessment of the potential for slope stability is given as follows:

"Due to a long history of intensive land use and urban development it has only been possible to recognise and map, with confidence, a few areas of past landslide activity. However, beyond the North London District, areas of similar bedrock geology and topography contain significant areas of mapped landslides. Therefore, a slope instability assessment has been made to act as a guide to where areas of significant landslide potential are present, but obscured, and where further information regarding their stability are needed before development or major changes in land use are made.

The assessment used a deterministic approach that looks at the presence at a site of landslide causative factors, such as slope angle, lithology and groundwater conditions that increase the susceptibility of a site to landslide activity. The causative factors were weighted according to their relative importance in promoting landslides and combined in a Geographical Information System to produce a computer generated map of the relative susceptibility to landslide activity across the area. It does not necessarily mean that landslides have happened in the past or will do so in the future, but if conditions change through natural or artificial means and a causative factor increases, then slope instability may be triggered."

The site reconnaissance survey did not reveal any obvious significant issues associated with the stability of slopes on the site or immediate surrounding area. Under the proposed development plan (see **Section 10.3**), slope stability issues are unlikely to affect the proposed residential structure, although it may need to be taken into consideration with regard to any landscaping proposals.

4.1.3 Radon

The environmental database report indicates that the site is not located within an 'Affected Area' as defined by the Documents of the National Radiological Protection Board (Radon Atlas of England and Wales, NRPB-W26-2002). Therefore the risk of significant ingress of radon into structures on-site is considered to be low and no radon protective measures are required within new dwellings at the site.

4.2 Hydrogeology

4.2.1 General Characteristics

The London Clay Formation (excluding the Claygate Member) is classified by the Environment Agency as a Non-aquifer (non-productive strata) (**Section 4.2.2**), reflecting its inability to store and transmit significant quantities of groundwater. Values for the coefficient of

permeability for the London Clay Formation range from 3 x 10^{-9} m/s for clay with sand partings and silty clay to 3 x 10^{-11} m/s for intact clay, indicating the very low permeability of these materials.

In contrast, a perched water table may be present within the sandier lithologies of the overlying Claygate Member and Bagshot Formation, both of which are classified by the Environment Agency as Secondary Aquifers of variable permeability. Springs/ seepages / issues are indicated in the wider vicinity. Springs are associated with geological boundaries between units of contrasting permeability; within the general site area such conditions would be expected to be encountered at the junction between the Bagshot Formation and Claygate Member, and the Claygate Member and underlying argillaceous London Clay.

Information provided by the Resident's Association suggests that a continuously flowing spring is present within the subject site, located beneath the current house, and that this feature may be related to the presence of the Claygate Member within the site area. It is indicated that this spring continuously feeds a large pond within the grounds of an adjacent property (No.55 Fitzroy Park), which in turn feeds into the Wildfowl Reserve pond within the Highgate Chain of ponds, via a surface watercourse (**Figure 3**).

A spring-fed fountain, the Goodison Fountain, is located approximately 400m northwest of the site and is believed to be associated with the Claygate Member/argillaceous London Clay boundary. (It should be noted that this fountain appears to be at a higher elevation (approximately 91mAOD) than the traditionally mapped boundary between the Claygate Member and London Clay in this area, see **Figure 3**). The subject site is located topographically below (i.e. at a lower elevation), and hence down-gradient from, these spring lines, and is underlain by low permeability London Clay. It is therefore considered likely that any subsurface groundwater flow will be restricted to perched water within any Made Ground / reworked London Clay or weathered material at shallow depth.

During the previous site investigation undertaken by GEA, no groundwater was encountered during the site works, with the exception of one borehole to the north of the small pond in the southeast of the site, in which water was encountered at 3.8m bgl (76.2mAOD). Subsequent monitoring visits after completion of the site works recorded a water level at 1.0m bgl (79mAOD) within this borehole, whilst all other boreholes remained dry. However, it should be noted that equilibrium conditions may not have been achieved within the timescale of the monitoring undertaken.

4.2.2 Vulnerability of Groundwater Resources

The London Clay Formation is classified by the Environment Agency (EA) as a Non-aquifer (non-productive strata) (as indicated on the Environment Agency Groundwater Vulnerability Map of the area, Sheet No.39 '*West London'*).

The London Clay acts as an aquiclude, restricting the downwards migration of shallow groundwater (and mobile contaminants, if present) to deeper groundwater resources in the Thanet Sands / Lambeth Group (Minor Aquifers) and the Chalk Group (a Major Aquifer).

However, the presence of low permeability clay at relatively shallow depths beneath the site, whilst restricting downwards migration, may increase the potential for lateral migration of shallow groundwater (and therefore mobile contamination, if present).

4.2.3 Licensed Groundwater Abstraction

The environmental database report indicates that there are no current licensed groundwater abstractions and no public water supply boreholes within a 1km radius of the site.

Information provided by the Environmental Health Department of the London Borough of Camden indicates that there are a number of groundwater abstraction boreholes (recorded by the BGS) within 2km of the site. These appear to be historical (1833 – 1900), with the exception of one record for the Royal Free Hospital, Hampstead, dated 1999. The depths given relate to the abstraction of groundwater from the Chalk aquifer and overlying Thanet Sand Formation / Lambeth Group aquifers, which underlie the London Clay Formation.

In terms of aquifer protection, the EA generally adopts a three-fold classification of Source Protection Zones for public supply abstraction wells.

- *Zone I* - or 'Inner Protection Zone' is located immediately adjacent to the groundwater source and is based on a 50-day travel time. It is designed to protect against the effects of human activity and biological/chemical contaminants that may have an immediate effect on the source.

- *Zone II* - or 'Outer Protection Zone' is defined by a 400-day travel time to the source. The travel time is designed to provide delay and attenuation of slowly degrading pollutants.

- *Zone III* - or 'Total Catchment' is the total area needed to support removal of water from the borehole, and to support any discharge from the borehole.

Information available on the EA website indicates that the site does not lie within a currently designated groundwater Source Protection Zone.

4.3 Hydrology

The subject site lies within the catchment of the stream formerly known as the Highgate Brook, forming one of the tributaries of the River Fleet, which drains to the River Thames near Blackfriars. The Fleet rises on Hampstead Heath by two heads, separated by Parliament Hill. The eastern, or Highgate, source lies near to the subject site, and is fed via a series of springs in the grounds of Kenwood House, whence the stream flows southwards, via the Highgate Ponds (**Figure 3**). It is understood that this series of ponds was excavated in the 17th and 18th centuries for water supply purposes. The ponds currently serve a variety of leisure and recreational purposes, and are the subject of a number of conservation and management measures under the Corporation of London's Hampstead Heath Management Plan.

The ponds are formed in the channel of the Highgate Brook, which flows over impermeable London Clay. Flow in the stream is likely to be derived from direct surface runoff, and by drainage of groundwater from springs.

The topography and geological outcrop pattern shown on the 1:10,560 geological map (**Figure 3**) indicate that the subject site lies within a northeast to southwest orientated valley. There is no surface watercourse currently flowing within this valley and historical maps dating from the 1870s indicate that there was no overland flow (e.g. stream or drain) within the valley by at least that time. The map of 1896 shows two small ponds within the valley, up-gradient from the site, which were evidently dug to capture water, as it would also appear for the larger pond within the grounds of No.55 Fitzroy Park. These ponds lie on a northeast-southwest trend along the central axis of this small valley system. A drain is evident at the extreme southwestern end of this system where it enters the Wildfowl Reserve Pond within the chain of Highgate Ponds.

Information provided by the Resident's Association suggests that drainage in this valley is diverted through a culvert / buried channel beneath the residential properties in this area. Whilst it is possible that any watercourse occupying this valley is buried or culverted, given the scale of drainage in this area it is likely that any surface flow would be redirected through

shallow pipework systems and it is possible that a system of land drains may have developed with time across this area.

A second northeast to southwest orientated topographic valley is located approximately 220m to the northwest of the site, adjacent to Fitzroy Farm and the North London Bowls Club (**Figure 3**). A small surface watercourse flows within this valley, entering the Highgate chain of ponds at the northern end of the Ladies Bathing Pond.

It should be noted that the origins of these valleys lie at an elevation above the currently drawn Claygate Member/London Clay boundary and, therefore, are unlikely to be related to spring lines associated with this geological boundary, at its currently drawn level (**Figure 3**).

4.3.1 Preliminary Flood Risk Assessment

The indicative floodplain map for the area, published by the EA, shows that the site does not lie within any designated fluvial floodplains.

4.4 Mining, Quarrying and Landfilling

Evidence has been sought to identify any mining, quarrying and landfilling operations, past and present which have taken place in the vicinity of the site. The sources of information referenced in this element of the desk study include:

- Environmental database report;
- Records held by Local Authority / Environment Agency;
- Old Ordnance Survey maps and plans (see **Section 3**); and
- Geological maps (see **Section 4.1**).

With reference to the above data there are no recorded mines, quarries or landfills within a 1km radius of the site, although ‘brick fields’ are known from the wider area. However, with regard to fill, and with reference to the historical data, there appears to have been some limited phases of construction and demolition on the site and therefore the presence of Made Ground should not be overlooked. Made Ground was also recorded on site as part of the previous GEA site investigation.

5. PRELIMINARY CONCEPTUAL SITE MODEL

5.1 Introduction

A CSM is a simplified written and/or visual/schematic description of the environmental conditions on a site and the surrounding area. It is developed from the individual components of the investigation at each stage to provide a depiction of likely contaminants, pathways and receptors, and highlights key areas of uncertainty.

Fundamental to the CSM is the principle of pollutant linkages, i.e. a source of contamination, a migration pathway and a receptor at risk from that contamination must all be present for a pollutant linkage to be complete. This approach is now accepted best practice in the industry but it does not take into account less scientific factors such as perceived risk, which frequently has a significant influence on land values.

The site is considered for the proposed future end use, which is understood to be a residential development with private gardens.

The preliminary CSM presented below is based on the findings of the Preliminary (Phase 1) investigation and information from previous intrusive investigations and therefore contains elements of conjecture and hypothesis. The exploratory investigation reported upon herein was designed to test those hypotheses and acquire data on the actual ground conditions beneath the site, enabling the CSM to be further refined.

In the following sections, the individual components of all identified possible pollutant linkages are assessed using the information identified during the course of the Preliminary (Phase 1) investigation described above.

5.2 Sources of Contamination

The study has identified no direct evidence of potentially contaminative land uses on or in the vicinity of the site. However, at least one limited phase of demolition and construction appears to have taken place locally on the site, which could have resulted in unknown Made Ground being present, with potential contaminants as identified in **Table 5.1**.

Table 5.1 – Potential Sources and Types of Contamination

Potential Sources	Contaminants of Concern
On-site	
Made Ground (i.e. fill material).	Unknown fill material (but potentially including heavy metals, ash, clinker, sulfates, polycyclic aromatic hydrocarbons (PAHs), asbestos etc.).

5.3 Receptors at Risk

The risk assessment identifies potential receptors within the following four categories:

i. end users of the site who may have acute exposure to sources of contamination on a regular and predictable basis;

ii. controlled waters, being defined as all surface water, groundwater or perched water;

iii. building structures and services placed in or on the ground;

iv. other targets such as the “environment”, including any flora and fauna on or near the site and construction and maintenance workers who will have chronic but potentially higher levels of exposure than end users.

Table 5.2 below lists the main sensitive targets within these categories as follows:

Table 5.2 – Receptors at Risk

Category	Details of receptor
Current/End users	As detailed within the CLEA Model, this comprises a 0-6 year old female child with respect to the proposed residential end use.
Controlled waters	From the desk study/walkover information these comprise the water features of Highgate Ponds and associated surface drainage lines.
Buildings/services	Buried concrete and other material within the ground, including water supply pipes etc.
Other targets	Short term occupation by construction workers and long term but intermittent visits by maintenance workers. Vegetation may be present in the form of planting within private gardens.

5.4 Pathways for Migration

Based on the proposed end use of the site and the anticipated ground conditions at and in the vicinity of the site, the contaminant pathways identified within **Table 5.3** are considered potentially to be present.

Table 5.3 – Pathways for Migration

Category	Details of pathway
End users	Pathways relevant to the end user are identified in the CLEA Model as ingestion, inhalation of soil / dust particulates or contaminant vapours, dermal contact (absorption through skin), and consumption of garden vegetables and fruit.
Controlled waters	The presence of low permeability clay beneath the site, whilst restricting downwards migration, may increase the potential for migration of surface / perched water, and therefore mobile contamination, if present.
Buildings/services	Buried concrete and services will be susceptible to attack via contact with aggressive/contaminated ground, especially if mobile groundwater is present.
Other targets	Pathways towards construction and maintenance workers will relate to acute exposure and as such are outside the scope of chronic risk assessment methodologies. Vegetation and other ecological targets may be affected by contact with contaminated soils via plant uptake routes.

5.5 Preliminary CSM

Based on the assumptions above, a preliminary CSM of pollutant linkages on the site has been developed from the above information and is presented as **Table 5.4**, which combines and summarises the information contained within **Table 5.1** to **5.3**. The CSM includes a qualitative estimation of risk for each pollutant linkage, based on a comparison of the

consequence of the event against the probability of its occurrence, in line with the risk classification methodology presented in CIRIA Report C552 (2001).

Table 5.4 – Preliminary Conceptual Model of Pollutant Linkages

Sources Potentially Present	Pathways	Receptors	Qualitative Assessment of Risk
Made Ground across site (may include heavy metals, PAH, sulphate, asbestos, etc.)	Ingestion of contaminated soil, dust, liquid Inhalation of contaminated dust and vapours/gases Contact with contaminated ground/liquid Migration via surface runoff / perched water flow	Human health (current and future site users) Human health (construction workers) Building materials Controlled waters Third Party land	**LOW** - Made Ground encountered by previous site investigation, although no direct evidence of contamination identified. No history of potentially contaminative land use.

To summarise, although the preliminary CSM has identified no direct evidence of ground contamination on the site, unknown Made Ground may be present and possible pathways for contamination to migrate and sensitive receptors potentially at risk have been identified. Possible pollutant linkages are therefore deemed to exist, albeit that this qualitative assessment indicates a low risk.

6. GROUND INVESTIGATION

6.1 Site Work

6.1.1 Rationale

The purpose of the intrusive investigation was to aid the confirmation of the ground conditions at the site with regard to the hydrogeological assessment, and to obtain geotechnical parameters for design purposes. With regard to contamination and environmental issues, the investigation was also designed to test the potential pollutant linkages identified within the Preliminary CSM. The techniques adopted for the investigation have been chosen considering the anticipated ground conditions and the proposed development.

6.1.2 Scope of Works

The intrusive site work was carried out by RSK in November 2010, and comprised the activities summarised in **Table 6.1**, below. The investigation and the soil descriptions were carried out in general accordance with BS5930:1999 - Code of Practice for Site Investigations. The exploratory hole logs are presented in **Appendix B**.

Table 6.1 – Summary of Ground Investigation Activities

Investigation Type	Number	Designation	Rationale
Boreholes - by light cable percussive methods	2	BH1 & BH2	To prove the geological succession beneath the site, obtain geotechnical data and install standpipes and piezometers.
Boreholes – by drive-in-sampler	6	WS1 to WS6	To prove the geological succession beneath the site and install standpipes.
Standpipe/Piezometer installations	5	BH1, BH2, WS1, WS5 & WS6	Groundwater monitoring installations
Water level monitoring in piezometer/monitoring well installations	-	BH1, BH2, WS1, WS5 & WS6	Measurement of depth to groundwater and establish groundwater conditions
Rising Head Permeability Testing	3	BH1, BH2 & WS1	Determine the coefficient of permeability for encountered ground conditions

The investigation points were located approximately by reference to physical features present on the site at the time of investigation. An exploratory hole location plan is shown in **Figure 2**. The ground levels at the borehole locations have been determined by rigorous surveying techniques.

6.2 Laboratory Testing

6.2.1 Introduction

A programme of geotechnical and chemical laboratory testing, scheduled by RSK and as detailed below, was carried out on selected samples taken from various strata. The laboratory results are presented in **Appendices C** and **D**, respectively.

6.2.2 Geotechnical Testing

The programme of geotechnical tests undertaken on samples obtained from the intrusive investigation is presented in **Table 6.2**. Where appropriate, testing was undertaken in accordance with BS 1377:1990 Method of Tests for Soils for Civil Engineering Purposes within RSK's UKAS accredited laboratory.

Tests carried out in order to classify the concrete class required on site have been undertaken following the procedures within BRE SD1:2005 by a UKAS accredited laboratory (Envirolab).

Table 6.2 – Summary of Geotechnical Testing Programme

Strata	Tests undertaken	No of Tests
Made Ground	pH and sulfate	2
London Clay Formation	pH and sulfate	6
	Plasticity Index	14
	Natural Moisture Content	14
	Triaxial Compression	10
	Particle Size Distribution and Hydrometer Analysis	2

6.2.3 Chemical Testing

The programme of chemical tests was undertaken on samples obtained from the intrusive investigation as presented in **Table 6.3**. The scope of the testing undertaken is based on the findings of the Phase 1 study discussed above and includes the Contaminants of Concern listed within the Preliminary CSM in **Section 5.2**.

The testing was carried out to assess the levels of contamination within the Made Ground encountered on the site with regard to identified receptors as detailed within the Conceptual Model. Testing was undertaken by a UKAS accredited laboratory (Envirolab). MCERTS accredited test methods were specified where applicable.

Table 6.3 Summary of Chemical Testing Programme

Strata	Tests undertaken	No of Tests	Rationale
Made Ground	Metals Suite: As, Cd, tCr, Pb, Hg, Se, wsB, Cu, Ni, Zn, pH	4	**Non-Targeted** (representative Made Ground)
	Total Petroleum Hydrocarbons	2	**Non-Targeted** (representative Made Ground)
	Speciated Polycyclic Aromatic Hydrocarbons	4	**Non-Targeted** (representative Made Ground)
	Asbestos Screen	4	**Non-Targeted** (representative Made Ground)
	Soil Organic Matter	2	**Non-Targeted** (representative Made Ground)
Groundwater	pH and sulfate	2	**Non-Targeted** (representative groundwater)
	Major Ion Analysis	1	**Non-Targeted** (representative groundwater)

Strata	Tests undertaken	No of Tests	Rationale
	Speciated Polycyclic Aromatic Hydrocarbons	1	**Targeted** (groundwater in BH1)
Pond Water	Major Ion Analysis	1	**Non-Targeted** (representative pond water)

7. PHYSICAL GROUND CONDITIONS

7.1 Findings of Ground Investigation

7.1.1 General Succession of Strata

The exploratory holes revealed that the site is underlain by a variable thickness of Made Ground over weathered London Clay Formation, which becomes 'fresh' (unweathered) with depth. This confirms the stratigraphical succession described within the Preliminary CSM and confirms the ground conditions encountered by GEA during the previous phase of site investigation. For the purpose of discussion, the ground conditions are summarised in **Table 7.1** below.

Table 7.1 – General Succession of Strata Encountered

Strata	Exploratory Holes Encountered	Depth to top of stratum m.bgl (mAOD)	Thickness (m)
Made Ground	All WS2	GL (79.67 – 82.28) GL (79.85)	0.2 – 1.7 2.0m+?
Weathered London Clay Formation	All	0.2 – 1.7 (77.85 – 81.82)	3.3+ - 5.8
London Clay Formation	BH1 & BH2	5.5 – 5.8 (74.66 – 76.72)	4.5+ - 14.2+

+ Thickness penetrated without proving full thickness of stratum

7.1.2 Made Ground

The exploratory holes encountered a variable thickness of Made Ground across the site, ranging from 0.2m to 1.7m thick. The thickest areas of Made Ground were located in WS3 and WS5 (1.2m to 1.7m thick), located in the garden area in southwest of the site, and in WS4 (1.4m thick) beneath the gravel driveway in the northwest of the site.

In general, the Made Ground comprised soft brown slightly sandy to very sandy slightly gravelly clay and silty clay with roots, locally comprising reworked London Clay. The gravel fraction generally comprised flint, with fragments of brick and concrete and occasional fragments of clay tile, slate and glass and occasional coal/charcoal and ash-type fragments. Locally in WS4, the Made Ground between 0.4m and 1.1m bgl comprised black sandy slightly gravelly organic clay with abundant plant fragments and fragments of glass, pottery, wood and coal.

In WS2, Made Ground was encountered to 1.2m bgl, overlying orangey-brown and grey silty clay with occasional fine to medium flint gravel and fragments of organic material, which appeared to be distinct from the weathered London Clay encountered beneath the Made Ground across the rest of the site. Large fragments of brick were encountered at 1.7m bgl, with water also being struck at this depth, rising to 1.0m bgl. Due to the uncertainty of the nature of this water strike, the borehole was terminated at 2.0m (77.85mAOD).

No visual or olfactory evidence of contamination was encountered within the Made Ground.

7.1.3 Weathered London Clay Formation

The London Clay Formation was encountered across the site beneath the Made Ground. The upper part of the London Clay, which was encountered at depths ranging between 0.2m and

1.7m beneath Made Ground, was deeply weathered, this horizon extending to depths of 5.5m to 5.8m bgl.

In general, the weathered London Clay comprised firm, locally soft in its uppermost part, fissured brown mottled grey-green silty clay. The clay was also locally slightly sandy (fine sand) with occasional partings of fine sand/coarse silt. Roots and rootlets were common. Selenite crystals were abundant, occurring throughout, predominantly as fine to coarse sand-sized aggregates. Powdery iron oxide and carbonate precipitate and discrete carbonate nodules were also locally present. Particle size distribution analyses between 1.0m and 3.0m bgl confirm that this material is a slightly sandy (fine) (1 – 2%) silty (40 – 47%) clay (51 – 58%) of very high plasticity (**Appendix C**).

Despite lying in an area of 'Head propensity', no deposits were encountered that could unambiguously be described as 'Head' although elements of the Made Ground (e.g. reworked sandy slightly gravelly clay) could represent reworked or disturbed Head deposits.

No visual or olfactory evidence of contamination was encountered within the weathered London Clay.

The measured and inferred soil parameters for the weathered London Clay Formation are listed in **Table 7.2** below.

Table 7.2 – Summary of Soil Parameters for Weathered London Clay Formation

Soil Parameters	Range	Results
Liquid Limit (%)	73 – 84	Appendix C
Plastic Limit (%)	27 – 30	Appendix C
Plastic Index (%)	43 – 55	Appendix C
Modified Plasticity Index (%)	43 – 55	Figure 4
Plasticity Term	Very High	Figure 4
Volume Change Potential (NHBC)	High	
Moisture Content (%)	30 – 37	Figure 7
SPT 'N' Values	8 - 19	Figure 5
Undrained Shear Strength (kN/m2) measured by Triaxial Testing	48 - 77	Figure 6
Undrained Shear Strength (kN/m2) inferred from SPT 'N' values	34 - 80	Figure 6
Strength Term	Low to High	
Consistency Index	0.82 – 1.0	
Consistency Term	Stiff*	

*Field tests indicate a general firm to stiff consistency

7.1.4 London Clay Formation

Beneath the weathered London Clay, 'fresh' unweathered London Clay was encountered within the boreholes at depths of between 5.5m to 5.8m bgl (74.66mAOD to 76.72mAOD), and extending to the base of the boreholes, to a maximum depth of 20m bgl (60.46mAOD). The 'fresh' London Clay generally comprised stiff, locally firm, becoming very stiff, fissured dark-brownish grey silty clay, locally slightly sandy (fine sand), with occasional thin partings of

fine sand/coarse silt. Bands of 'claystone' (carbonate concretion) were encountered at depths of 11.3m bgl (69.16mAOD) and 8m bgl (74.22mAOD) in BH1 and BH2, respectively.

The measured and inferred soil parameters for the stratum are listed in **Table 7.3** below.

Table 7.3 – Summary of Soil Parameters for 'fresh' London Clay Formation

Soil Parameters	Range	Results
Liquid Limit (%)	71 - 86	Appendix C
Plastic Limit (%)	26 - 32	Appendix C
Plastic Index (%)	45 – 54	Appendix C
Modified Plasticity Index (%)	45 - 54	
Plasticity Term	Very High	Figure 4
Volume Change Potential (NHBC)	High	
Moisture Content (%)	26 - 31	Figure 7
SPT 'N' Values	16 - 41	Figure 5
Undrained Shear Strength (kN/m2) measured by Triaxial Testing	64 – 150	Figure 6
Undrained Shear Strength (kN/m2) inferred from SPT 'N' values	67 - 172	Figure 6
Strength Term	Medium to Very High	
Consistency Index	0.92 – 1.04	
Consistency Term	Stiff	

In general, no material distinction was discernible between the weathered London Clay and underlying 'fresh' London Clay, all analyses falling within the very high plasticity clay classification. No significant sand or silt dominated beds were encountered, and the principal lithologies encountered were clay dominated (i.e. the primary soil type was a clay). On the basis of this, it is considered that the encountered stratum is within Unit D of the London Clay Formation, and that there is no evidence to suggest that the Claygate Member is present on site.

The SPT 'N' Values versus elevation (**Figure 5**) and undrained shear strength versus elevation (**Figure 6)** plots both show consistent increases in values with decreasing elevation (i.e. with increasing depth below ground level), indicating a normal transition from lower strength materials at shallower levels to higher strength materials at depth, with no dramatic change in strength across the boundary of the weathered/unweathered London Clay.

7.2 Moisture Content and Desiccation Assessment

There are a number of mature trees present in the vicinity of the proposed new property. In order to assess whether the London Clay in these areas is currently desiccated, a comparison of the soil moisture profiles and soil index properties have been considered.

The following assessment is based on Driscoll criteria. This criteria indicates that onset of desiccation can be defined if the natural moisture content of the soil is less than 50% of its Liquid Limit and that significant desiccation can be defined if the natural moisture content is less than 40% of its Liquid Limit. The results of the assessment for samples showing desiccation are shown in **Table 7.4** below.

Table 7.4 Desiccation Assessment

BH Depth (m bgl)	Moisture Content (%)	Atterberg Limits			Driscoll Criteria[1]		Desiccation
		LL (%)	PL (%)	PI (%)	0.5 x LL (%)	0.4 x LL (%)	
Weathered London Clay							
BH1(0.8m)	35	80	28	52	40	32	Onset
BH1(1.2m)	35	79	27	52	39.5	31.6	Onset
BH1(5.0m)	30	73	30	43	36.5	29.2	Onset
BH2 (0.7m)	37	82	27	55	41	32.8	Onset
BH2 (2.0m)	36	84	30	54	42	33.6	Onset
WS1 (1.0m)	33	74	28	46	37	29.6	Onset
WS4 (1.5m)	34	78	28	50	39	31.2	Onset

The assessment indicates the general widespread onset of desiccation within the upper few metres of the weathered London Clay. It should also be noted that field evidence indicates that the upper 2m of WS5 are significantly desiccated, as the encountered clay soils were dry and friable. It should be noted that this latter borehole is located within an area of mature deciduous trees in the southwest of the garden area.

7.3 Groundwater

Observations made during the initial site works and subsequent groundwater monitoring suggest that water is present on the site in several distinct settings:

- Perched water was locally encountered during the site works as very minor seepages within Made Ground (WS2, 1.0m bgl) and at the Made Ground/weathered London Clay interface (WS3, 1.1m bgl).

- No seepages were encountered within the London Clay during the site works, with the exception of a very minor seepage above a 'claystone' band in BH1 at 11.5m bgl. Approximately 4 litres of water entered the borehole before the seepage dried up. Piezometers were sealed at various depths within the London Clay in BH1 (response zone between 4.8m and 5.8m bgl), BH2 (response zone between 8.8m and 10m bgl) and WS1 (response zone between 2.5m and 4.0m bgl). Datalogging transducers were installed within these piezometers to provide a continuous record of water inflow into the boreholes and to allow values of the coefficient of permeability to be determined for the London Clay. Values for the coefficient of permeability within the range 2.4 to 4.1 x 10^{-8} m/s were obtained from the weathered London Clay (BH1 and WS1), and a value of 8.1 x 10^{-9} m/s was obtained at deeper level with the 'fresh' London Clay (BH2). The former values are entirely consistent with those from clay modified by the effects of weathering, desiccation and fissuring, and the latter is entirely consistent with that from clay with sand partings and silty clay, which reflects the materials encountered on-site. In both cases, values of permeability of 10^{-8} and lower are considered practically impermeable. Any groundwater movement within the London Clay is likely to be through the secondary effect of fissuring.

- A groundwater strike was encountered at 1.7m bgl (rising to 1.0m bgl) in WS2. Within this hole, Made Ground was encountered to 1.2m bgl, overlying orangey-brown and grey silty clay with occasional fine to medium flint gravel and fragments of organic material, which appeared to be distinct from the weathered London Clay and interpreted to be

disturbed/reworked material. Large fragments of brick were encountered at 1.7m bgl in association with the water strike. Due to the uncertainty of the encountered conditions the borehole was terminated.

Groundwater monitoring and testing sheets are presented in **Appendix B**.

A record of the groundwater monitoring programme and observations for each of the exploratory holes is summarised in **Table 7.5**.

Table 7.5 – Groundwater Results

BH	Strike / Seepage m.bgl (mAOD)	Standpipe/ piezometer Response Zone	Monitoring Results Date m.bgl (mAOD)	Interpretation
BH1	Very minor perched water seepage on 'claystone' at 11.5m (68.69)	Piezometer response zone between 4.8m and 5.8m	23/11/10 – Dry (datalogger installed to allow permeability assessment)	Borehole completed and installed on 16/11/10; borehole dry on completion. Slow seepages within weathered London Clay. *K* value of 4.14 x 10^{-8} m/s.
BH2	None	Piezometer response zone between 8.8m and 10.0m	23/11/10 – Dry (datalogger installed to allow permeability assessment)	Borehole completed and installed on 23/11/10; borehole dry on completion. Very slow seepage within 'fresh' London Clay. *K* value of 8.1 x 10^{-9} m/s.
WS1	None	Piezometer response zone between 2.5m and 4.0m	23/11/10 – Dry (datalogger installed to allow permeability assessment)	Borehole completed and installed on 18/11/10; borehole dry on completion. Slow seepages within weathered London Clay. *K* value of 2.43 x 10^{-8} m/s.
WS2	1.7 (78.80) (rose to 1.0 (79.12))	None	None; hole backfilled	Completed on 18/11/10. Possible strike within localised water-bearing reworked ground.
WS3	Very minor perched water seepage at 1.1m	None	Dry on completion; hole backfilled	Borehole completed and backfilled on 17/11/10. Minor perched water seepage at Made Ground/weathered London Clay interface
WS4	None	None	Dry on completion; hole backfilled	No perched water/groundwater encountered.
WS5	None	Standpipe in general WLCF	23/11/10 – Dry 30/11/10 – 3.67 (79.0) 10/01/11 – 2.71 (76.96)	Borehole completed and installed on 17/11/10. Very low permeability clay.
WS6	None	Standpipe in general WLCF	23/11/10 – Dry 30/11/10 – 4.77 (77.51) 10/01/11 – 3.53 (78.75)	Borehole completed and installed on 18/11/10. Very low permeability clay.

7.4 Water Chemistry

In addition to the groundwater monitoring, a sample of groundwater was collected from BH1 and a sample of surface water was collected from the pond in the southeast of the site to allow a direct comparison of 'water types' within each setting. The results of chemical testing for dissolved major ions have been plotted as a Piper Diagram, which is shown in **Appendix B**.

The results of the chemical testing indicate two distinct water types; the groundwater has significantly higher concentrations of dissolved ions (e.g. sulfate values of 4520mg/l and 325mg/l for the groundwater and pond water, respectively), and the samples plot into distinct fields on the Piper Diagram. The higher dissolved ion load of the groundwater is consistent with the slow percolation of water through the weathered London Clay.

It is therefore considered that groundwater beneath the site is unlikely to make any significant contribution to the pond in the southeast of the site, which is more likely to be fed by surface water.

8. GROUND CONTAMINATION CONDITIONS

8.1 Chemical Analysis of Soil Samples

8.1.1 Introduction

The findings of the investigation have been assessed in relation both to a combination of specific site characteristics, as identified within the Preliminary Conceptual Model, and the future site use proposals.

Chemical analyses have been performed on a total of four representative samples of Made Ground from across the site. In addition to the chemical analyses, the samples of the Made Ground were screened in the laboratory for the presence of asbestos fibres.

All soil samples scheduled for laboratory testing are also inspected visually on receipt at the laboratory for the presence of materials potentially containing asbestos, e.g. fragments of asbestos-cement products.

The full chemical results are presented within **Appendix D**. The results have been assessed with respect to human health, plant phytotoxicity, the performance of construction materials and water resources in the following sections.

8.1.2 Summary of Soil Results with Respect to Human Health

Assessment of risk is considered as a tiered approach. Assessment based on non-intrusive means is considered a Tier 1 assessment, comparison against Generic Assessment Criteria (GACs) is a Tier 2 assessment, and the generation of and comparison with Site Specific Assessment Criteria (SSACs) is a Tier 3 assessment and is conducted when deemed appropriate from the Tier 2 assessment.

The Tier 1 assessment is summarised in the CSM provided in **Chapter 5**. The following represents the Tier 2 assessment and an overview of the methodology applied is provided below. The Tier 2 Human Health Risk Assessment conducted on the results of the laboratory tests on soils sampled from the site were evaluated using Generic Assessment Criteria (GACs) calculated using the final updated CLEA framework, comprising the new CLEA Software (version 1.06), and supporting documents.

It should be noted that the new CLEA Software has not yet incorporated lead and therefore the former CLEA Soil Guideline Value (SGV) for lead, for a residential with plant uptake end use, has been used in this assessment.

It is proposed to redevelop the site with a large detached residential property. Initially the soil chemical results have been compared directly against the residential with plant uptake GACs calculated using the new CLEA software, as these are considered to be the most suitable guidelines to protect the most critical targets from contaminants via all possible exposure routes.

The CLEA software output reports for the site are presented in **Appendix E**.

For non-volatile contaminants the human health risk assessment has been conducted to a depth of 1m. At depths greater than 1m it is considered that no relevant pathway for human exposure to occur will be present. For volatile contaminants, the human health risk assessment may be conducted on samples collected at depths in excess of 1m as it is assumed that an inhalation pathway (i.e. from vapours) could potentially be present regardless of the depth of the contamination.

Non-volatile contaminants are considered to be those that have a Henry's Law Constant of less than 0.001 whilst volatile contaminants are considered to be those that have Henry's Law Constants greater than 0.001.

The samples were tested for a range of common contaminants including heavy metals, polycyclic aromatic hydrocarbons (PAHs) and petroleum hydrocarbons.

None of the samples returned values in excess of the adopted assessment criteria with the exception of the PAH compound benzo(a)pyrene, as detailed in **Table 8.1**, below.

Table 8.1 – Data Summary Table

Material	Determinant	Total No c samples tested	Number o Non Detect	Adoptec screenin value	No of exceed-ances	Maximum concentration (mg/kg) Value (Location and Depth in parentheses)
Made Ground	Benzo(a)-pyrene	4	0	1.0	3	4.41 (BH1, 0.2m) 1.45 (BH2, 0.2m 2.18 (WS1, 0.1m)

The encountered exceedances of benzo(a)pyrene are considered to be associated with the localised presence of small dispersed fragments of coal and charcoal-type material within the shallow Made Ground; this interpretation is confirmed by the results of a PAH double ratio plot (**Appendix D)**, which identifies the source of PAHs as coal- and plant-derived. The encountered materials are therefore considered likely to be inert and immobile and therefore of very low risk. Notwithstanding the above, under the proposed development scheme, boreholes BH1, BH2 and WS1 are within the area of proposed redevelopment. Shallow soils in these areas will therefore be stripped during construction thus removing the Made Ground and breaking any *potential* pollutant linkages towards human health.

With regards to petroleum hydrocarbons, no elevated concentrations were recorded in excess of the relevant assessment criteria.

With regards to asbestos, the visual inspection at the laboratory identified no materials suspected of potentially containing asbestos and the scheduled laboratory screening for asbestos found no detectable asbestos fibres within the samples of Made Ground.

No other potential risks associated with soil contamination have been identified at the site and it is considered that the majority of the site may be regarded as free from contamination with respect to the end use.

8.1.3 Summary of Soil Results with Respect to Plant Phytotoxicity Effects

With respect to future planting at the site, concentrations of phytotoxic elements have been compared against the relevant assessment values adopted from The Soil Code (1998). Local marginal exceedances for boron and zinc were encountered within shallow Made Ground in BH1, BH2 and WS1. However, as noted above, under the proposed development scheme

boreholes BH1, BH2 and WS1 are within the area of proposed redevelopment and shallow soils in these areas will therefore be stripped during construction.

8.1.4 Summary of Soil Results with Respect to Performance of Building Materials

Table 8.2 – Summary of Soil Results with Respect to Performance of Building Materials

Category of substance	Receptor at risk	Assessment value adopted	Maximum concentration where in excess of assessment value
Sulfates (W Sol SO_4)	Concrete	500mg/l	2180 mg/l
TPH*	Fresh concrete	1000mg/kg	None
TPH*	Plastics	50mg/kg	None

*Note: TPH assessment values are based on the presence of potentially mobile petroleum hydrocarbons

An assessment of the risks to concrete and concrete classification is given in **Section 10.6**.

With respect to concrete and plastic water supply pipes, no determinants were present at concentrations in excess of the adopted assessment criteria. However, the pH of the soils locally marginally exceeds the upper threshold value of 8 for materials selection for water supply pipes. It is therefore recommended that service providers be consulted to discuss their requirements.

8.1.5 Summary of Soil Results with Respect to Water Resources

With respect to the chemical analyses conducted on soils, only the PAH compound benzo(a)pyrene has been identified at marginally elevated concentrations, associated with the localised presence of small, dispersed fragments of coal and charcoal-type material within the shallow Made Ground. PAHs in general are immobile and almost insoluble in water and as such, it is considered that the encountered materials are likely to be inert and of very low risk to water resources.

Notwithstanding the above, a sample of groundwater was collected from BH1 (from which the highest soil concentration was recorded) and tested for PAHs to establish whether the encountered material presents a risk to nearby water resources.

The sample recorded a total PAH concentration of 0.04 µg/l, which is well below the UK Drinking Water Standard of 0.1 µg/l. Chemical test certificates are presented in **Appendix D**. It is therefore considered that the exceedances, encountered locally in the soils, do not pose a risk to nearby water resources.

8.2 Ground Gas Monitoring

An assessment of ground gas was outside the scope of works for this investigation. However, the encountered ground conditions (Made Ground with very low degradable organic content overlying low permeability London Clay Formation) indicate very low ground gas generation potential and a negligible level of risk for on-site development.

8.3 Waste Classification of Soils

It is understood that the proposed development will include the excavation of Made Ground and natural soils to facilitate the formation of basements and foundations.

All excavated material and excess spoil must be classified for waste disposal purposes prior to disposal at landfill. Under the Landfill (England and Wales) Regulations 2002 (as amended) all wastes must be classified as inert, non-hazardous, stable non-reactive hazardous or hazardous wastes prior to disposal. The Environment Agency guidance document WM2 (interpretation of the definition and classification of hazardous waste) outlines the methodology for classifying wastes.

HASWASTE is a waste soils characterisation assessment tool, developed by Envirolab, which follows the guidance within WM2. The analytical results have been run the through this assessment tool for potential off-site disposal of materials. The results are presented in **Appendix F**.

The results indicate that the Made Ground across the site would not be classified as hazardous waste. Waste Acceptance Criteria testing will be required prior to off-site disposal to classify the soils into inert and non-hazardous categories. Consideration may need to be given to further sampling in the areas of proposed excavation to determine accurately the likely waste classification of the soils.

It is important to note that the assessment given in this report is for guidance only and it is always necessary to confirm the actual classification with prospective landfill operators prior to disposal.

Further, all non-hazardous soils will require pre-treatment prior to disposal at landfill. Pre--treatment is defined as a physical, chemical or biological process that changes the characteristics of the waste in order to reduce its volume / reduce its hazardous nature / facilitate its handling or enhance its recovery. It should also be noted that as an alternative to landfill disposal, inert soils may potentially be suitable for re-use or disposal at an appropriate site, which is exempt from waste management licensing.

8.4 Site Waste Management Plans

It should be noted that the Site Waste Management Plans Regulations 2008 came into force in April 2008. The Regulations require the preparation of a Site Waste Management Plan (SWMP) for all construction projects in England with a value of more than £300,000 and a more detailed plan for projects with a value of more than £500,000. The purpose of the SWMPs is to encourage better resource utilisation and waste management practices in construction, improve environmental performance, minimise the landfilling of wastes, and reduce instances of fly-tipping. A SWMP will therefore be required for the development and will need to consider all potential construction waste streams, including soils.

Some of the materials tested during this investigation appear to be suitable for re-use on site, primarily the inert London Clay from the basement excavations, which is considered to be geotechnically and chemically suitable for re-use as either engineering or general fill without treatment. As noted in **Section 8.3**, the Made Ground across the site would not be classified as hazardous waste. Waste Acceptance Criteria testing will be required prior to off-site disposal to classify the soils into inert and non-hazardous categories.

In line with the principles of sustainable development and to reduce costs, it is recommended that the strategy for the site should attempt to minimise the volume of contaminated and uncontaminated soils removed off-site for disposal. Prior to commencing any excavation works on site, a Materials Management Plan (MMP) will need to be prepared to establish whether specific materials are classified as waste or not and how excavated materials will be treated and / or re-used, in line with *The Definition of Waste: Development Industry Code of Practice* (CL:AIRE, 2008). The MMP is likely to form part of the Site Waste Management Plan for the site.

9. CONCEPTUAL SITE MODEL AND CONTAMINATION ALLEVIATION MEASURES

9.1 Conceptual Site Model (CSM)

The findings of the site investigation and the above assessment of potential health and environmental risks from contamination has been used to refine a CSM of pollutant linkages. The findings of the investigations and the conceptual site model for the proposed type of development has identified no evidence of significant ground contamination on the site and hence pollutant linkages are deemed not to exist.

The only exception is some localised marginal benzo(a)pyrene contamination within the Made Ground in BH1, BH2 and WS1, associated with dispersed fragments of coal and charcoal-type material. The encountered materials are therefore considered likely to be inert and immobile and therefore of very low risk. Notwithstanding the above, under the proposed development scheme, boreholes BH1, BH2 and WS1 are within the area of proposed redevelopment. Shallow soils in these areas will therefore be stripped during construction thus removing the Made Ground and breaking any *potential* pollutant linkages towards human health.

Groundwater from BH1 indicated no evidence of significant contamination with the above-mentioned contaminant, and therefore it is considered that there is no risk to nearby water resources.

9.2 Alleviation Measures in Respect of Ground Contamination

It is understood that the proposed development will comprise a large detached residential property over localised basement areas, set within private gardens.

The CSM indicates that there is no evidence of significant ground contamination nor pollutant linkages on site in relation to the proposed end-use. Hence, no contamination alleviation measures are required, subject to ensuring that suitable topsoil/subsoil is present in garden and landscaped areas. Only validated sources of imported material should be used, and the imported materials from each source should be validated with appropriate chemical test certificates.

It should be noted that the above assessment is based on the ground conditions encountered during the investigation, the results of field and laboratory testing and interpretation between exploratory holes. The material encountered and samples obtained represent only a small proportion of the materials present on-site. Therefore other conditions may be encountered during ground works, which have not been revealed by this investigation. It is therefore recommended that the groundworks be monitored for previously undetected suspect materials and, if found, appropriate additional testing and advice is sought.

It is recommended that the Local Authority be contacted at an early stage to seek their views on the assessment of contamination at the site.

10. ENGINEERING CONSIDERATIONS

10.1 Details of the Proposed Development

The proposed development involves demolition of the existing property and construction of a new, larger, residential property over the existing footprint. The development will comprise several smaller basement areas. The basement areas will be located below ground level at an anticipated level of 78mAOD.

A proposed development plan and section are shown as **Figure 8** and **Figure 9**, respectively.

10.2 Geotechnical Hazards

A summary of commonly occurring geotechnical hazards is given in **Table 10.1** together with an assessment of whether the site may be affected by each of the stated hazards.

Table 10.1 – Summary of Main Potential Geotechnical Hazards that May Affect Site

Hazard category (excluding contamination issues)	**Hazard status** based on investigation findings and proposed development			**Engineering considerations** if hazard affects site
	Found to be present on site	Could be present but not found	Unlikely to be present and/or affect site	
Sudden lateral changes in ground conditions		✓		Likely to affect ground engineering and foundation design and construction
Shrinkable clay soils	✓	High volume change potential London Clay		Design to NHBC Standards Chapter 4 or similar
Highly compressible and low bearing capacity soils, (including peat and soft clay)	✓	Locally soft weathered London Clay and Made Ground		Likely to affect ground engineering and foundation design and construction
Silt-rich soils susceptible to rapid loss of strength in wet conditions		✓		Likely to affect ground engineering and foundation design and construction
Running sand at and below water table			✓	Likely to affect ground engineering and foundation design and construction
Karstic dissolution features (including ‘swallow holes’ in Chalk terrain)			✓	May affect ground engineering and foundation design and construction – refer to **Section 4.1.2**
Evaporite dissolution features and/or subsidence			✓	May affect ground engineering and foundation design and construction
Ground subject to or at risk from landslides	✓	See **Section 4.1.2**		Likely to require special stabilisation measures
Ground subject to peri-glacial valley cambering with gulls possibly present			✓	Likely to affect ground engineering and foundation design and construction
Ground subject to or at risk from coastal or river erosion			✓	Likely to require special protection/stabilisation measures

Hazard category (excluding contamination issues)	**Hazard status** based on investigation findings and proposed development			**Engineering considerations** if hazard affects site
	Found to be present on site	Could be present but not found	Unlikely to be present and/or affect site	
High groundwater table (including waterlogged ground)	✓	Shallow perched water present and seepage in London Clay		May affect temporary and permanent works
Rising groundwater table due to diminishing abstraction in urban area			✓	May affect deep foundations, basements and tunnels
Underground mining			✓	Likely to require special stabilisation measures
Existing sub-structures (e.g. tunnels, foundations, basements, and adjacent sub-structures)	✓	Foundations to existing structures on site		Likely to affect ground engineering and foundation design and construction
Filled and made ground (including embankments, infilled ponds and quarries)	✓	0.4m to 1.7m thickness of Made Ground encountered (possible up to 2.0m in southwest of site)		Likely to affect ground engineering and foundation design and construction
Adverse ground chemistry (including expansive slags and weathering of sulphides to sulphates)	✓	See **Section 10.6**		May affect ground engineering and foundation design and construction

Note: Seismicity is not included in the above Table as this is not normally a design consideration in the UK.

10.3 Foundations

10.3.1 General Suitability

In general, the ground conditions in the vicinity of the proposed new development comprised up to 1.7m of variable Made Ground, generally consisting of soft brown slightly sandy to very sandy slightly gravelly clay and silty clay with roots, locally comprising reworked London Clay. The latter may have comprised an element of reworked 'Head' deposits. Weathered London Clay was encountered underlying the Made Ground and generally comprised firm, locally soft, fissured brown mottled, locally slightly sandy, silty clay. This material has a very high plasticity and high volume change potential and is locally desiccated within the upper few metres close to existing trees and vegetation. The weathered horizon of London Clay extended to depths between 5.5m and 5.8m bgl and was underlain by 'fresh' London Clay, consisting of stiff fissured dark-brownish grey, locally slightly sandy, silty clay.

Minor perched water seepages were encountered only locally within the Made Ground / at the junction between the Made Ground and low permeability weathered London Clay. No seepages were encountered within the London Clay during the site works, with the exception of a minor perched water seepage above a 'claystone' band in BH1 at 11.5m bgl. Subsequent groundwater monitoring has recorded water levels between 1.6m and 2.8m bgl, although it should be noted that equilibrium groundwater levels may not have been achieved within the timescales involved in this investigation.

In view of the encountered shallow ground conditions, relatively shallow spread footings will not be suitable as foundations for the proposed development. Whilst deep spread foundations

appear technically feasible, the depth to which such foundations will need to extend, and the amount of excavation that would be required is incompatible with the proposal to reduce the amount of materials movement on site. A piled foundation solution has, therefore, been proposed for the redevelopment. It is understood that two options have been proposed for the piled foundations to support the ground floor and basement slabs:

- An *in situ* concrete bored pile solution; or
- A steel screw pile solution.

It is understood that the permanent basement structure will be constructed in reinforced concrete with a piled raft to support the vertical load and deal with any tensile forces that might develop as a result of any heave or hydrostatic pressures.

10.3.2 Piled Foundations

With regard to a traditional bored concrete pile solution, the recommendations for the design and construction of piled foundations in relation to the ground conditions are set out in **Table 10.2**.

Table 10.2 – Design and Construction of Piled Foundations

Design/construction considerations	Design/construction recommendations	
Pile type	The construction of conventional bored and CFA piles is considered technically feasible at this site.	
Possible constraints on choice of pile type	Given the close proximity of the site to other properties and the proposed method of construction, the use of driven piles will not be acceptable due to ground heave, vibration and noise related problems.	
Temporary casing where groundwater is present	Bored piles are likely to require temporary casing throughout their depth due to the presence of groundwater. Alternatively, the use of continuous-flight-auger (CFA) injected bored piles usually overcomes this issue.	
Hard strata	An allowance should be made for the presence of thin 'rock' bands (claystone) within the London Clay.	
Made Ground and Desiccated soils	Due to the presence of Made Ground and the localised occurrence of desiccation within the weathered London Clay, the upper 3m of soils have been omitted from the calculations of shaft friction (i.e. only soils beneath 77mAOD considered - proposed basement level at 78mAOD).	
Soil and pile design parameters for London Clay (cohesive soils)	Adhesion Factor (α)	0.6
	Bearing Capacity Factor (N_c)	9
	Undrained Shear Strength (c_u) (from 77mAOD)	55 + 6z kN/m^2 where z = depth into clay
	Global Safety Factor	3.0
	Limiting Shaft Friction	140 kN/m^2
	Limiting Concrete Stress	7.5N/mm^2
Bored pile shafts and bases	Bored pile concrete should be cast as soon after the completion of boring as possible and in any event the same day as boring. Prior to casting the base of the pile bore should be clean otherwise a reduced safe working load will be required. Similarly, if the pile bore is left open the shaft walls may relax/soften, leading to a reduced safe working load.	

The design procedure for piles varies considerably, depending on the proposed type of pile. However, for illustrative purposes **Table 10.3** gives likely working pile loads for traditional bored, cast-in-situ concrete piles of various diameters and lengths, based on the design parameters given in **Table 10.2**.

Table 10.3 – Illustration of Typical Pile Working Loads for Bored Cast-in-situ Piles

Typical Pile Working Loads (kN)				
Depth of pile below 77mAOD	**Pile Diameter**			
	300mm	**350mm**	**400mm**	**450mm**
10	185	220	257	295
12.5	246	292	340	389
15	313	372	432	493

A specialist piling contractor should be contacted at an early stage in the design to seek their advice on the most suitable pile type, depth and capacity for the ground and groundwater conditions encountered on site.

If steel screw piles are proposed, a specialist steel screw piling contractors should be consulted to determine the appropriate pile design. However, it should be noted that, in stiff clays, predrilling may be required to install screw piers to design depth and the effect of any predrilling needs to be taken into account in any design. In addition, special considerations of the design life are required when installing in chemically aggressive ground conditions.

10.4 Retaining Wall Design Parameters

In order to facilitate basement construction, it will be necessary to construct a retaining wall around the perimeter. With regard to temporary works, it is proposed to employ a king post retaining wall system, or similar, within which will be constructed permanent reinforced concrete basement box structures.

The construction of the basement is anticipated to involve excavations up to 3.2m below existing ground level i.e. to approximately 78mAOD. The ground conditions likely to be encountered include a variable thickness of Made Ground, up to 1.7m thick, overlying the weathered London Clay Formation and 'fresh' London Clay at depth.

10.4.1 Open Cut Excavation

It is understood that open cut excavations are not proposed for the development at this stage. However, information on open cut excavations is provided in this section, should they be considered.

The angle to which the sides of an excavation can be cut and remain stable depends on several factors, including:

- Type and condition of soil;
- Presence of surface or groundwater;
- Surcharge loading (e.g. spoil heaps or construction traffic);
- Depth of excavation;

- Angle of slope; and
- The time the excavation is left open.

The use of open cut excavations may be constrained by the available space on site / proximity of proposed excavations to adjacent site boundaries and structures and the angle of cut which is required to achieve stable temporary slopes. Additionally, as well as the local stability of the excavation slopes, their impact on the overall slope stability should be checked via detailed slope stability analysis prior to adopting an open cut excavation.

Based on recommendations given in CIRIA 113 'Control of groundwater for temporary works', battered excavation sides should generally be temporarily stable at the slope angles given in Table **10.4**.

Table 10.4 Temporary Slopes

Soil type	Depth of Cut[2]	Safe Temporary Slopes[1] (degrees from horizontal)	
		'Dry' site[3]	'Wet' Site[4]
Weathered London Clay (Firm Clay)	1.2 to 3m	35/45	20/25
	3 to 6m	30/40	

1) Guide figures based on temporary conditions, experience on site and no water seepage that could cause instability
2) Fissuring will cause unstable face and failure can occur due to underlying soft clay
3) Minor or no seepage from excavated faces. Minor or no surface run-off
4) Submerged or widespread seepage from excavated faces

Other precautions to protect the slopes should include drainage ditches at the surface to divert surface water and perched water within the Made Ground away from the excavation and prevent water discharging down slope. The slope may also be covered with polythene to protect them from rain and excessive loss of moisture.

10.4.2 Retaining Wall

On the basis of the ground investigation information, the soil parameters in **Table 10.5** are recommended for retaining wall design purposes.

Table 10.5 Retaining wall design parameters

Soil type	C_U (kN/m^3)	SPT 'N' value	Unit weight (kN/m^3)	Short Term Characteristics		Long Term Characteristics	
				C_U (kN/m^2)	ϕ (°)	c' (kN/m^3)	ϕ' (°)
Made Ground	N/A	-	17[1)]	0[2)]	28[3)]	0	28[3)]
Weathered London Clay Formation	34 - 80	8 to 19	19.5	37 + 6z	0	0[3)]	21[3)]
London Clay Formation	64 - 172	16 to 41	19.5	69 + 6z	0	3[3)]	25[3)]

1) Estimated values
2) Assumed from field observation that the material is variable
3) Estimated values – no drained analysis undertaken

Perched water seepages have locally been encountered at shallow levels at the site and very slow rates of seepage have been recorded within the weathered London Clay. For the proposed temporary works, it is, therefore, considered that temporary groundwater control may be necessary, and could be achieved by a combination of gravity drainage and pumping from sumps to allow construction of the basement structure in relatively dry conditions.

Provision should be made for the build up of hydrostatic pressures behind the walls, and waterproofing of the basement structure.

10.5 Ground Floor and Basement Slabs

The soils encountered during the investigation comprised very high plasticity clays of high volume change potential underlying variable Made ground at shallow depths. Soils in the vicinity of the proposed development also show signs of being desiccated. Therefore it is recommended that ground floor slabs should be suspended with a void former beneath.

The basement formation level is up to approximately 3.2m bgl within the weathered London Clay Formation. The proposed basement excavation and unloading caused by the removal of the overburden pressure will result in heave of the London Clay soils below formation level. The subsequent reloading from the building will reduce this heave, the final amount depending on the maximal total loads applied at the formation level. The ground movements resulting from heave of clay soils and the settlements from the building will depend on many factors including the stiffness of the underlying soils, the depth of excavation and the rate of construction. The basement slab will therefore have to be designed to withstand potential heave of the underlying clay soils resulting from unloading due to excavation. Alternatively, suspending the slab with a void former beneath will overcome this issue.

It is understood that a suspended slab is to be considered, with a 65mm thick composite void former beneath, comprising 50mm of polystyrene and 15mm of cellcore, which can accommodate up to 8mm of movement. No elastic analysis has been undertaken to assess the likely magnitude of heave for the proposed basement structures at the Waterhouse. However, in view of the limited size of the structures and from experience of analyses carried out in similar ground conditions, long-term movements are estimated to be less than 10mm.

Given the presence of groundwater seepages within the London Clay, the basement slab design should allow for hydrostatic pressures in both the temporary and permanent cases.

All formation levels should be proof-rolled and all topsoil and any other loose, soft, organic or otherwise unsuitable materials should be removed and replaced with well compacted, suitable granular fill.

10.6 Chemical Attack on Buried Concrete

The results of chemical tests carried out on soil samples indicate 2:1 water soil extract sulfate contents of up to 2180 mg/l, and with near neutral to slightly alkaline pH values. The results of chemical tests carried out on groundwater samples indicate soluble sulfate contents of up to 4520 mg/l, with near neutral pH values.

These results indicate that, in accordance with BRE Special Digest 1: 2005 *Concrete in aggressive ground*, the Aggressive Chemical Environment for Concrete (ACEC) Classification is ***AC-4*** with a Design Sulphate Class for the site of ***DS-4***. This assumes nominally mobile groundwater conditions and that no significantly disturbed clay comes into contact with concrete foundations or structures. However, BRE SD1 indicates that static water conditions may be assumed where the value for the coefficient of permeability is less than 10^{-7} m/s. The AC-4 and DS-4 classifications are therefore considered onerous and, based on the soil results, an ACEC Classification of ***AC-3*** and Design Sulphate Class of ***DS-3*** are recommended.

If significantly disturbed clay is likely to come into contact with concrete foundations or structures it will be necessary to carry out additional tests on the soil to investigate its total potential sulphate content. This will facilitate a re-evaluation of the ACEC Classification and

Design Sulphate Class for the material, to take into consideration potential oxidation of available sulphides (e.g. pyrite), as defined in Table C1 (natural ground sites) or C2 (brownfield sites) BRE Special Digest 1: 2005.

This will be required if excavated London Clay is to be re-used as fill in contact with retaining walls or other concrete structures.

10.7 Soakaways

The use of pit soakaways will not be appropriate given the encountered ground conditions and sensitive nature of the site area with regard to hydrology and hydrogeology.

10.8 Earthworks Assessment

It is understood that, where possible, excavated soil from the basement and other areas of the scheme are to be re-used across the site.

For guidance on the re-use of materials as backfill, reference has been made to The Department of Transport (DOT), Manual of Contract Documents for Highway Works, Volume 1, Specification for Highway Works, 1998 incorporating November 2009 amendments.

On the basis of the investigation data, the soil type available for re-use from the basement excavation will consist of slightly sandy (1 – 2%) silty (40 – 47%) clay (51 – 58%).

The ground investigation indicates that in accordance with Table 6/1 and 6/2 of the Specification for Highway Works (SHW), Volume 1, the excavated material will predominantly be classed as Class 2A (wet cohesive material) for the purpose of general fill.

11. HYDROGEOLOGICAL IMPACTS OF THE PROPOSED DEVELOPMENT

On the basis of the information presented herein, it is considered that the proposed development is unlikely to impact significantly upon the local hydrological / hydrogeological environment, for the following reasons:

- Perched water appears to be locally present in the Made Ground, overlying the weathered London Clay. In the vicinity of the proposed development, seepages at the Made Ground/London Clay boundary were encountered at a depth of approximately 1m bgl, and at this level the proposed foundations and basement are likely to have no more effect on the perched water regime than the foundations to the existing property on site. Disturbance of the shallow water regime during construction is likely to be limited to the effects of severing existing drainage networks. Therefore, all efforts should be made to identify current surface drainage arrangements and any possible land drains so that mitigation arrangements can be put in place before decommissioning the existing system and to avoid unexpected severance of drainage lines.

- The proposed basement level is up 3.2m below ground level (approximately 78mAOD), within the weathered London Clay. No seepages were encountered within the weathered London Clay during the site works, but the results of a groundwater monitoring programme indicate slow rates of seepage (approximately 2 to 4 x 10^{-8} m/s) within this material. Although the soils are unlikely to hold significant quantities of groundwater, it is anticipated that groundwater seepages may be encountered during excavation for the construction of the basement and during the use of the king post retaining wall system. Temporary groundwater control is therefore likely to be necessary in the form of gravity drainage and pumping from sumps. The short-term disadvantage of temporary groundwater control is outweighed by the long-term advantage of the proposed king post retaining wall system which will negate the use for deeper cut-off systems and allow the free passage of groundwater, ensuring long-term drainage. Information provided by the Resident's Association indicates that water entered excavations previously undertaken at the Waterhouse in the mid-1990s, to facilitate construction of the current pool house. However, from discussions with the consulting engineers at that time, it is understood that this was due to surface run-off associated with heavy rainfall.

- The subject site lies within a northeast to southwest orientated valley, associated with the catchment of the former Highgate Brook. There is no surface watercourse currently flowing within this valley. Information provided by the Resident's Association suggests that drainage is diverted through a culvert / buried channel beneath the residential properties in the site area. Whilst it is possible that any watercourse occupying this valley is buried or culverted, given the scale of drainage in this area it is likely that any surface flow would be redirected through shallow pipework systems and it is possible that a system of land drains may have developed with time across this area. No direct evidence of a culvert or buried channel was encountered during the site investigation. In WS2, in the east of the site, a water strike was encountered at 1.7m depth, associated with bricks. Although it is considered unlikely that this is associated with a culvert/buried channel it is recommended that this water strike is further investigated to ensure that no unforeseen ground conditions are encountered during construction.

- Information provided by the Resident's Association suggests that a continuously flowing spring is present within the subject site, located beneath the current house, and that this feature may be related to the presence of the Claygate Member within the site area. However, the ground conditions encountered in this investigation (and during the previous GEA investigation) indicate that the site is underlain by Unit D of the London Clay Formation, as no significant sand dominated beds have been encountered. Springs are

generally associated with geological boundaries between units of contrasting permeability; within the site area such conditions have not been encountered. Any water 'issuing' from the ground surface is, therefore, more likely to be associated with shallow perched water and surface run-off (particularly after heavy rain) due to the low permeability of the underlying soils. It has also been suggested that the 'spring' from the subject site continuously feeds a large pond within the grounds of an adjacent property (No.55 Fitzroy Park). However, a recent survey undertaken by RSK within the grounds of No.55 Fitzroy Park included lifting of a surface water inspection cover adjacent to the large pond. This inspection confirmed that two pipes exited the shallow inspection chamber, one heading directly to the pond, the second heading towards the southwest. The inspection also revealed a shallow pipe entering the inspection chamber from the Waterhouse site. However, this pipe was sealed with a pipe bung, which appeared to have been *in situ* for a considerable time. No water was flowing in the pipework at the time of this inspection.

- The results of chemical testing of groundwater from the site and pond water from the small pond in the southeast of the site indicates distinct 'water-types' with significantly different concentrations of major ions. It is therefore considered that groundwater beneath the site is unlikely to make any significant contribution to the pond, which is more likely to be fed by surface water. Although the construction of the pond is not currently known, the pond was investigated during the site works and found to be only approximately 400mm deep.

- Surface run-off from the site may potentially be disturbed during construction by the removal of vegetation and run-off from stockpiles of excavated soils. However, any potential impacts may be effectively mitigated by on-site bunding of stockpiled materials and/or creation of retention basins to attenuate surface run-off.

In summary, it is considered that the impact of the proposed development on the local hydrogeological regime will be minimal and is considered unlikely to have any effect on the water supply to the Highgate Ponds. Any potential disturbances to existing drainage from the site may be effectively mitigated by the measures outlined above.

12. CONCLUSIONS

12.1 Geoenvironmental Conclusions

The findings of the site investigation, conceptual sites model and the assessment of potential health and environmental risks from contamination for the proposed development has identified no evidence of significant ground contamination on the site and hence pollutant linkages are deemed not to exist.

The only exception is some localised marginal benzo(a)pyrene contamination within Made Ground. However, under the proposed development plan this area of the site will either be excavated to form the new development or be encapsulated beneath the development, breaking any pollutant linkages towards human health. Groundwater from BH1 indicated no evidence of contamination with the above-mentioned contaminants, and therefore it is considered that there is no risk to nearby water resources.

12.2 Geotechnical Conclusions

The soils encountered during the investigation comprised very high plasticity clays of high volume change potential underlying variable Made Ground at shallow depths. Soils in the vicinity of the proposed development also show evidence of desiccation within the upper few metres.

A piled foundation solution has been proposed for the redevelopment. It is understood that the permanent basement structure will be constructed in reinforced concrete with a piled raft to support the vertical load and deal with any tensile forces that might develop as a result of any heave or hydrostatic pressures.

Construction of the proposed basement will be facilitated by a king post retaining wall. Perched water has been encountered in the Made Ground and slow seepages are recorded within the London Clay Formation. Temporary groundwater control will be necessary for construction of the basement. Provision should also be made for the build up of hydrostatic pressures behind retaining walls and beneath the basement slab, and waterproofing of the basement structure.

The soils encountered during the investigation comprised very high plasticity clays of high volume change potential underlying variable Made Ground at shallow depths. Soils in the vicinity of the proposed development also show signs of being desiccated. Therefore, it is recommended that ground floor slabs should be suspended with a void former beneath.

The basement formation level is up to 3.2m bgl (78mAOD) within the weathered London Clay Formation. The proposed basement excavation and unloading caused by the removal of the overburden pressure will result in heave of the London Clay soils below formation level. The basement slab should therefore be designed to resist this or be suspended with a void former beneath.

Concrete (ACEC) Classification is AC-3 with a Design Sulphate Class for the site of DS-3.

The use of pit soakaways will not be appropriate given the encountered ground conditions and sensitive nature of the site area with regard to hydrology and hydrogeology

12.3 Hydrogeological Conclusions

Perched water appears to be locally present in the Made Ground, overlying the weathered London Clay. In the vicinity of the proposed development, seepages at the Made Ground/London Clay boundary were encountered at a depth of approximately 1m bgl, and at

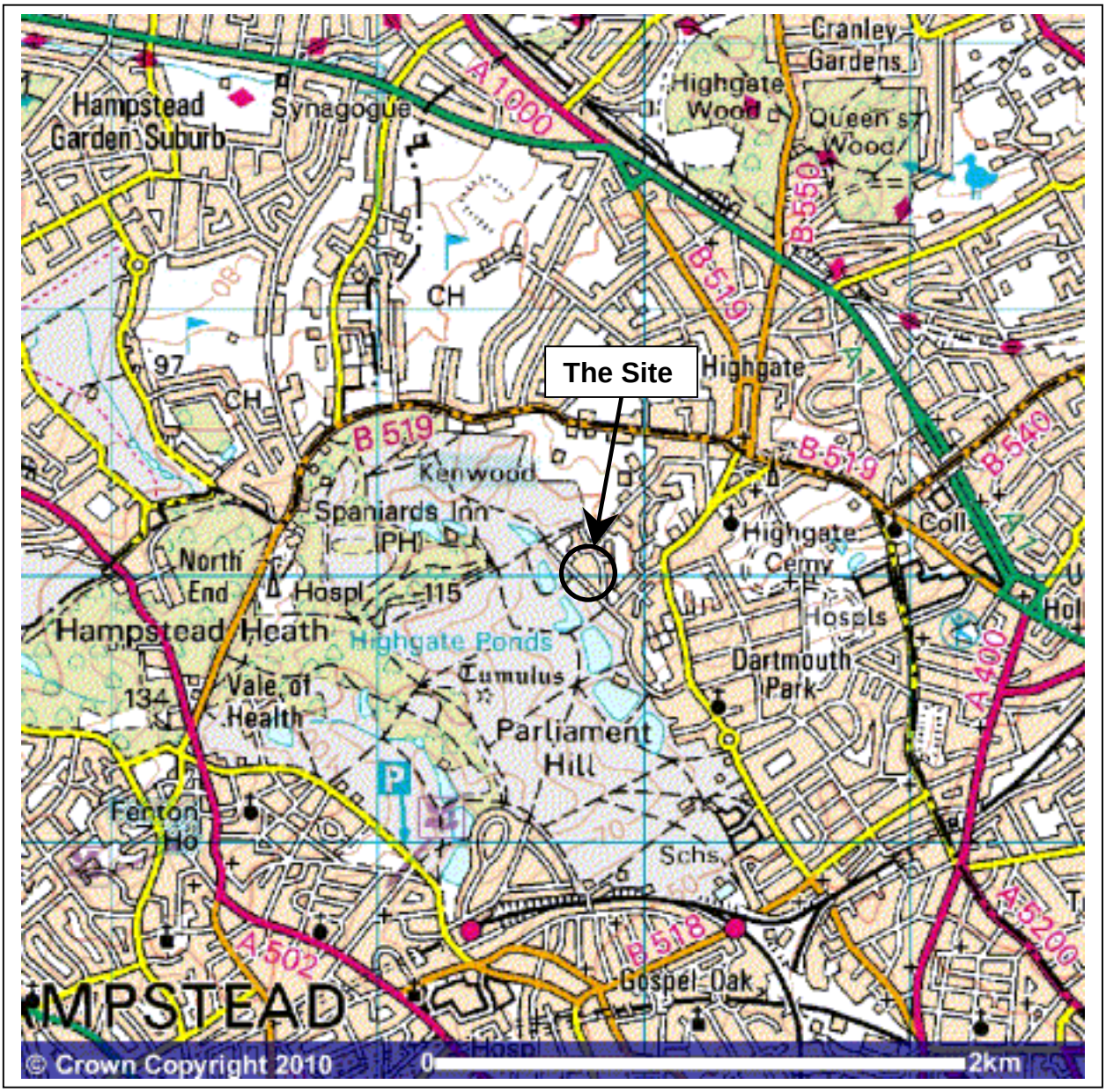
this level the proposed foundations and basement are likely to have no more effect on the perched water regime than the foundations to the existing property on site. Disturbance of the shallow water regime during construction is likely to be limited to the effects of severing existing drainage networks. Therefore, all efforts should be made to identify current surface drainage arrangements and any possible land drains so that mitigation arrangements can be put in place before decommissioning the existing system and to avoid unexpected severance of drainage lines.

Groundwater monitoring indicates slow rates of water seepage within the London Clay, compatible with the anticipated low permeability of the encountered materials. In view of the proposal to facilitate basement construction with king post retaining walls, it is considered that temporary groundwater control will be necessary in the form of gravity drainage and pumping from sumps. The short-term disadvantage of temporary groundwater control is outweighed by the long-term advantage of the proposed king post retaining wall system which will negate the use for deeper cut-off systems and allow the free passage of groundwater, ensuring long-term drainage

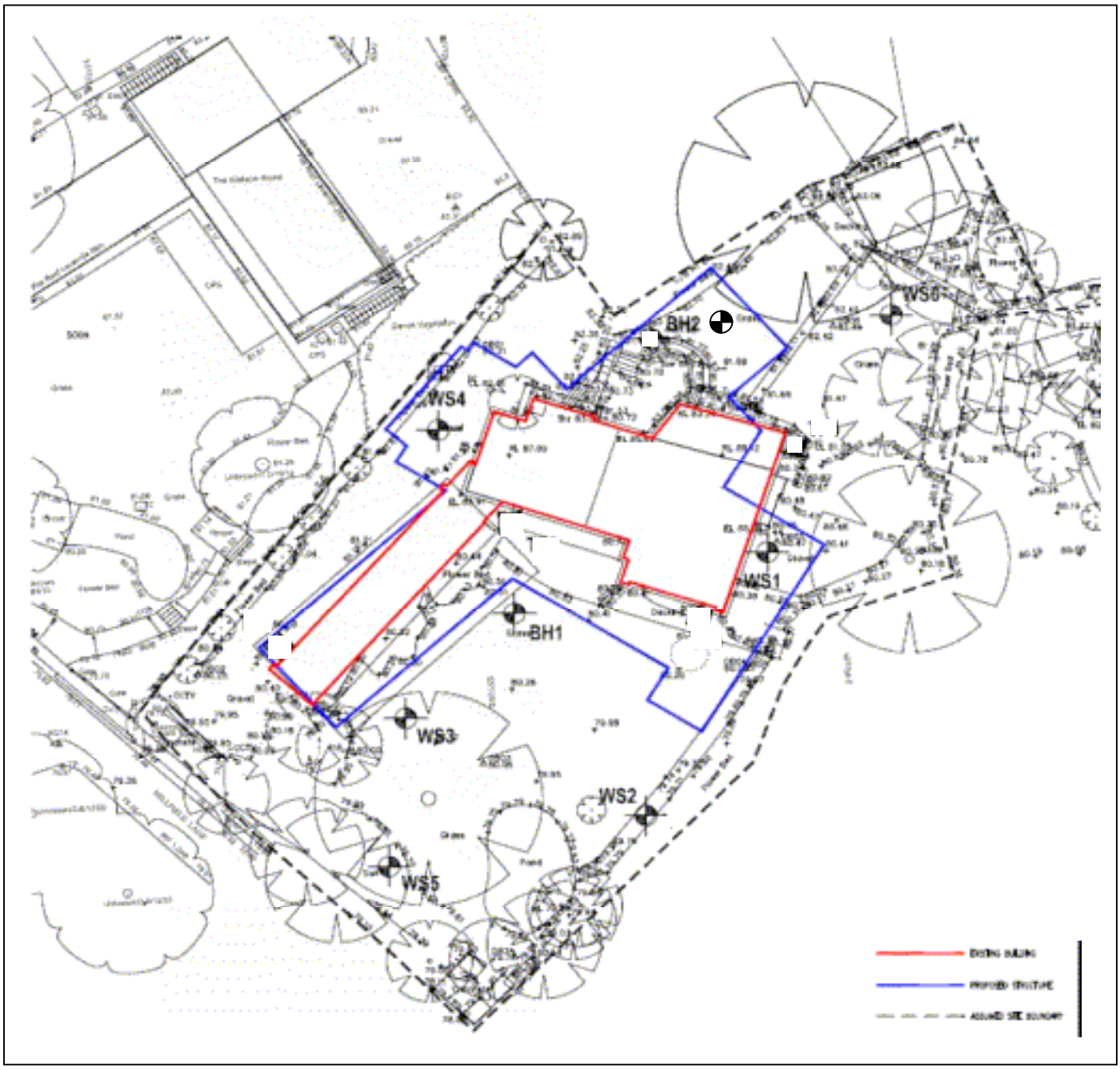
An area of water-bearing Made Ground was encountered in the southeast of the site close to the small pond. Water was encountered at a depth of 1.7m bgl (rising to 1.0m bgl), whilst the depth of the pond is believed to be constrained to approximately 0.4m. No redevelopment works are planned for this area of the site that would intrude into the groundwater environment, although it is proposed to alter site levels in this area of the site and possibly infill the existing pond. It is, therefore, recommended that this area of the site is further investigated to ensure that no unforeseen ground conditions or drainage lines are encountered during construction. It is recommended that a ground penetrating radar (GPR) survey be undertaken to establish whether any drainage lines enter or exit the pond and it is recommended that the encountered area of water-bearing Made Ground is excavated to elucidate the nature of the encountered water strike.

The results of chemical testing of groundwater from the site and pond water from the pond indicates distinct ‘water-types’ with significantly different concentrations of major ions. It is therefore considered that groundwater beneath the site is unlikely to make any significant contribution to the pond, which is more likely to be fed by surface water.

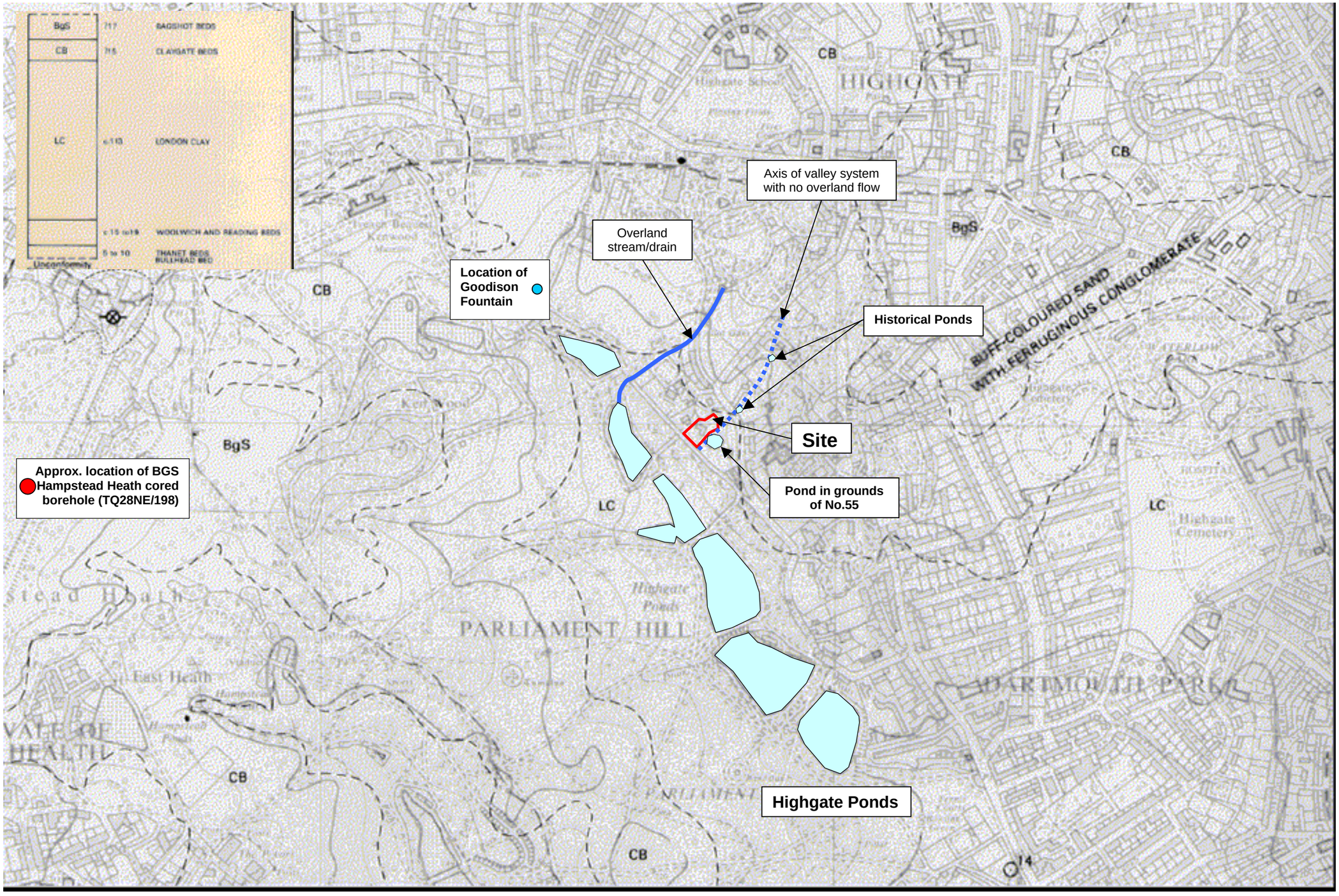
FIGURES



RSK GROUP PLC	**SITE LOCATION PLAN**	**Client: Mr and Mrs Munford**	**Figure No: 1**
		Site: The Waterhouse	**Job No: 241830-01 (00)**
		Scale: See scale bar	**Source: OS**



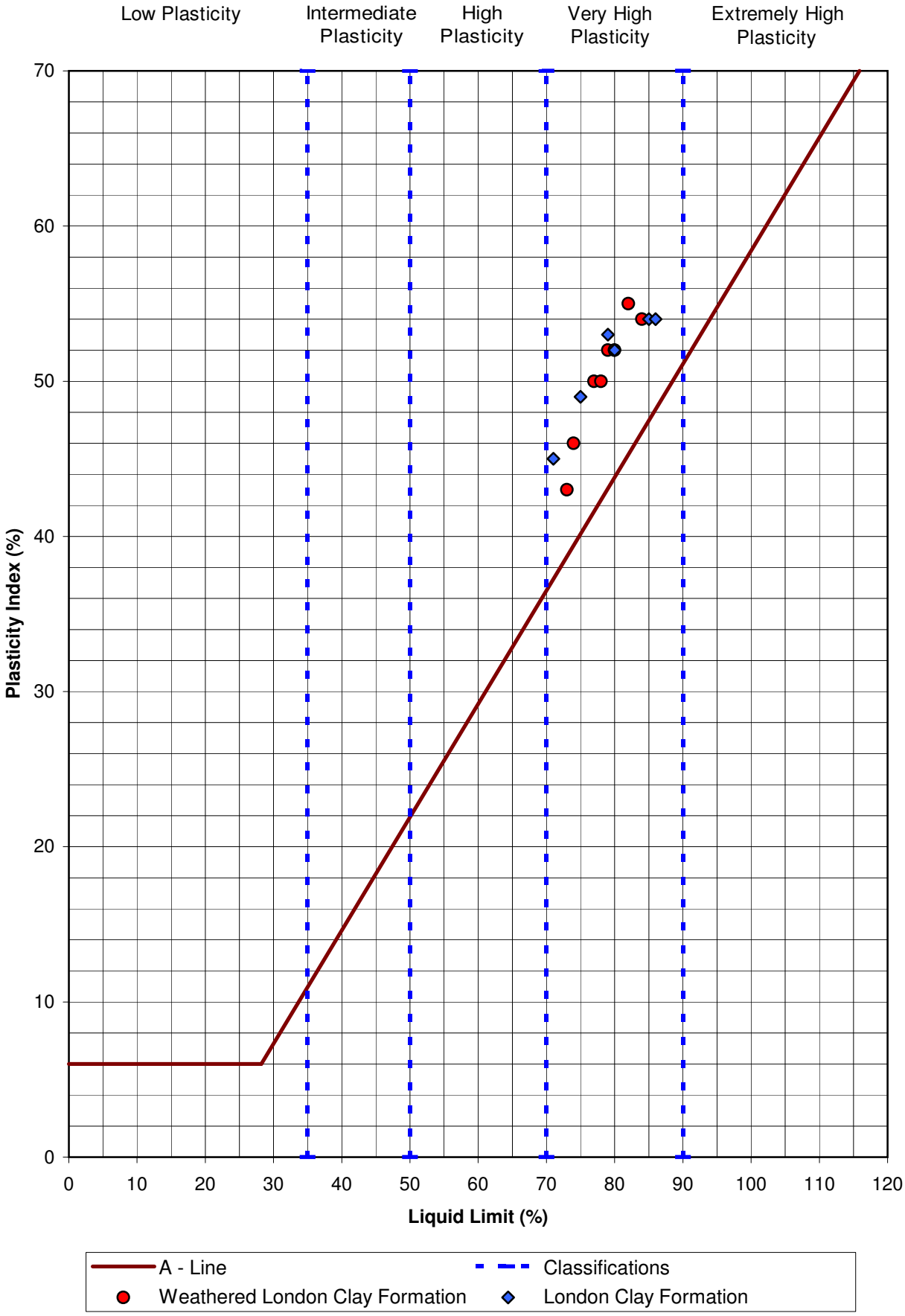
RSK GROUP PLC	**SITE LAYOUT AND EXPLORATORY POINT LOCATION PLAN**	**Client: Mr and Mrs Munford**	**Figure No: 2**
		Site: The Waterhouse	**Job No: 241830-01 (00)**
		Scale: NTS	**Source: Client**



RSK GROUP PLC	**GEOLOGICAL MAP EXTRACT**	Client:	Mr and Mrs Munford	Figure No:	3
		Site:	The Waterhouse, Fitzroy Park	Job No:	241830-01 (00)
		Scale:	NTS	Source:	BGS 1:10560 Sheet TQ28NE

PLASTICITY CLASSIFICATION CHART

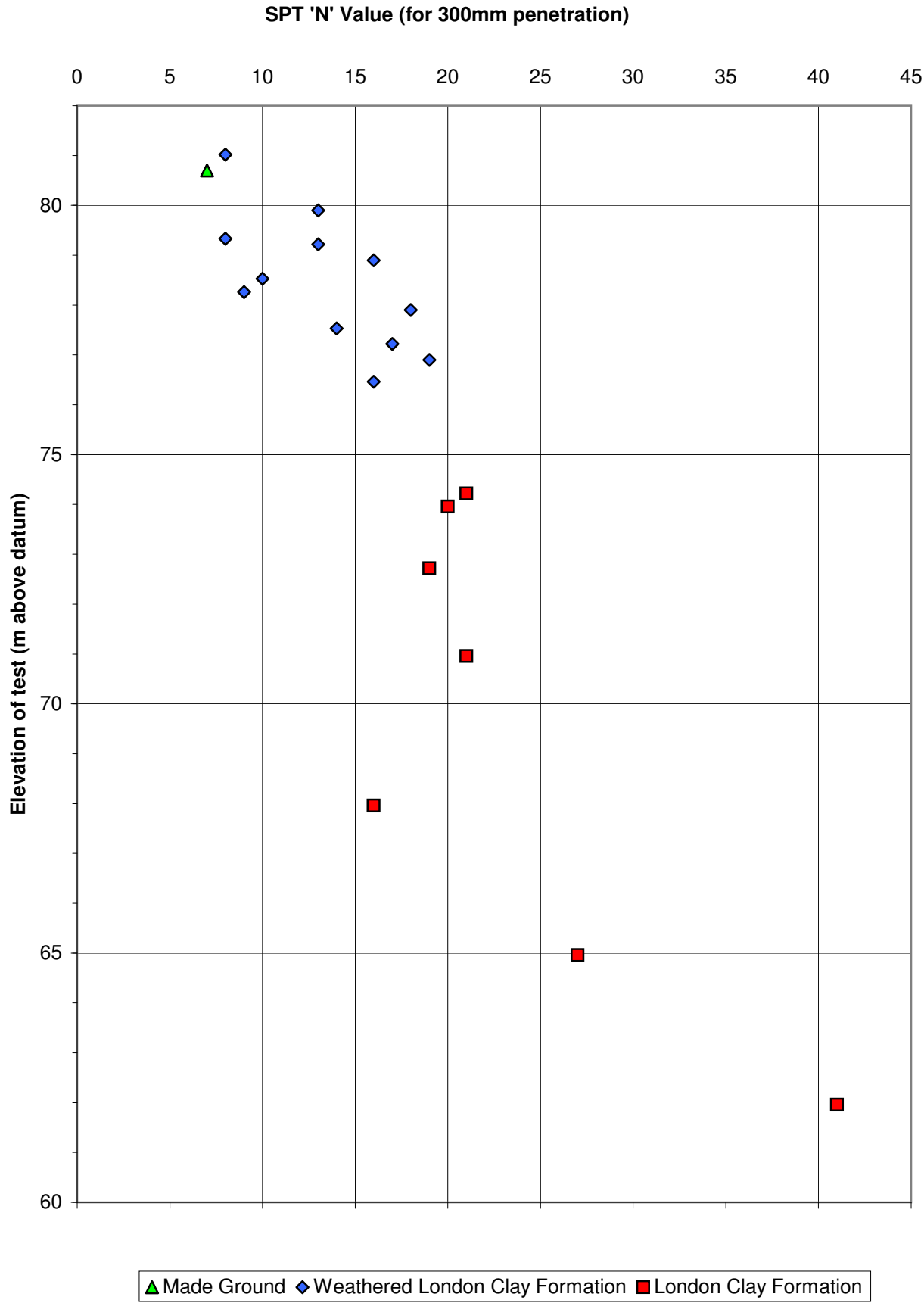
Site:	Client:	Job Number:	241830
The Waterhouse	Mr and Mrs Munford	Figure:	4



RSK GROUP PLC

SPT 'N' VALUES vs Elevation

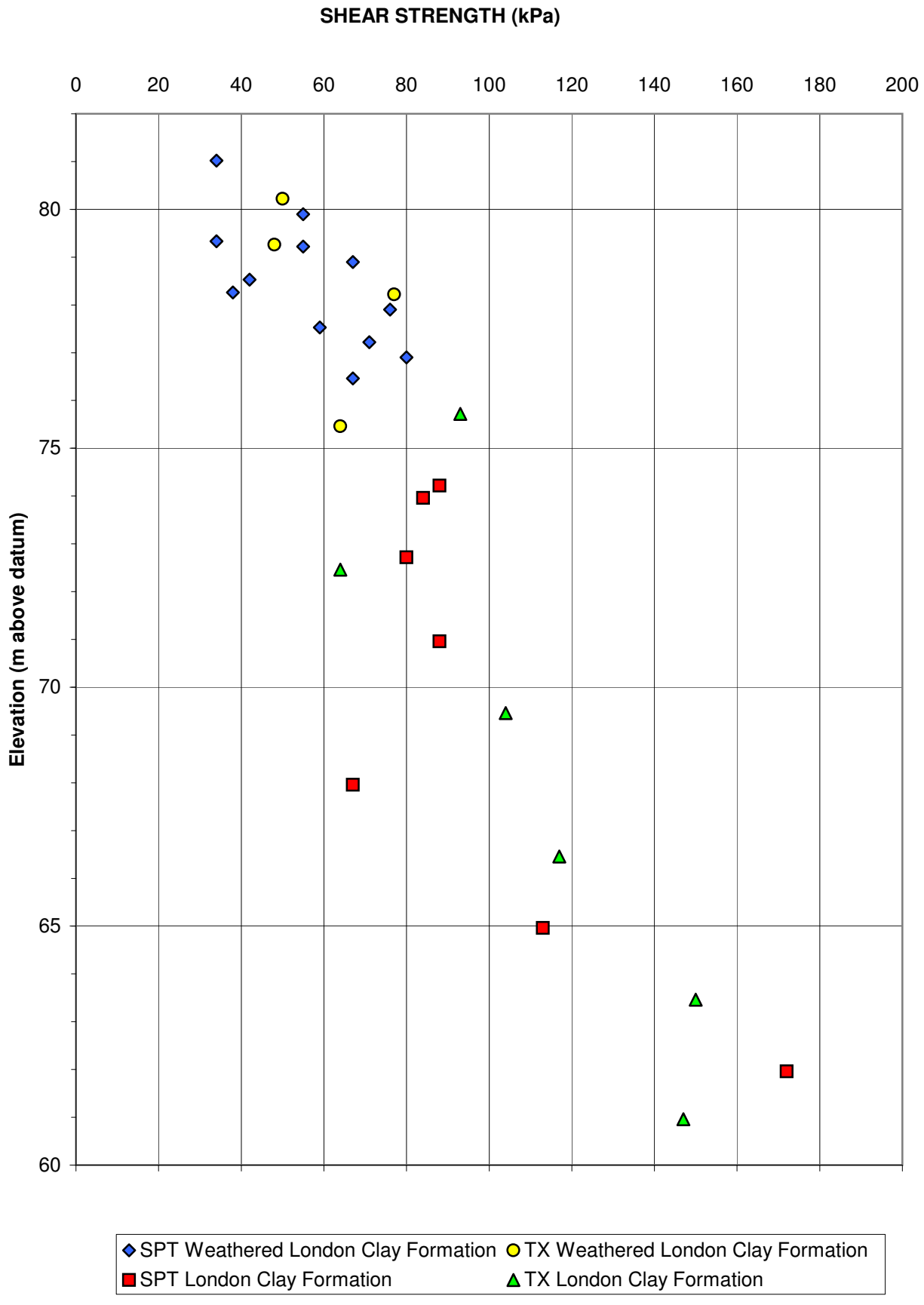
Site:	Client:	Job Number:	241830
The Waterhouse	Mr and Mrs Munford	Figure:	5



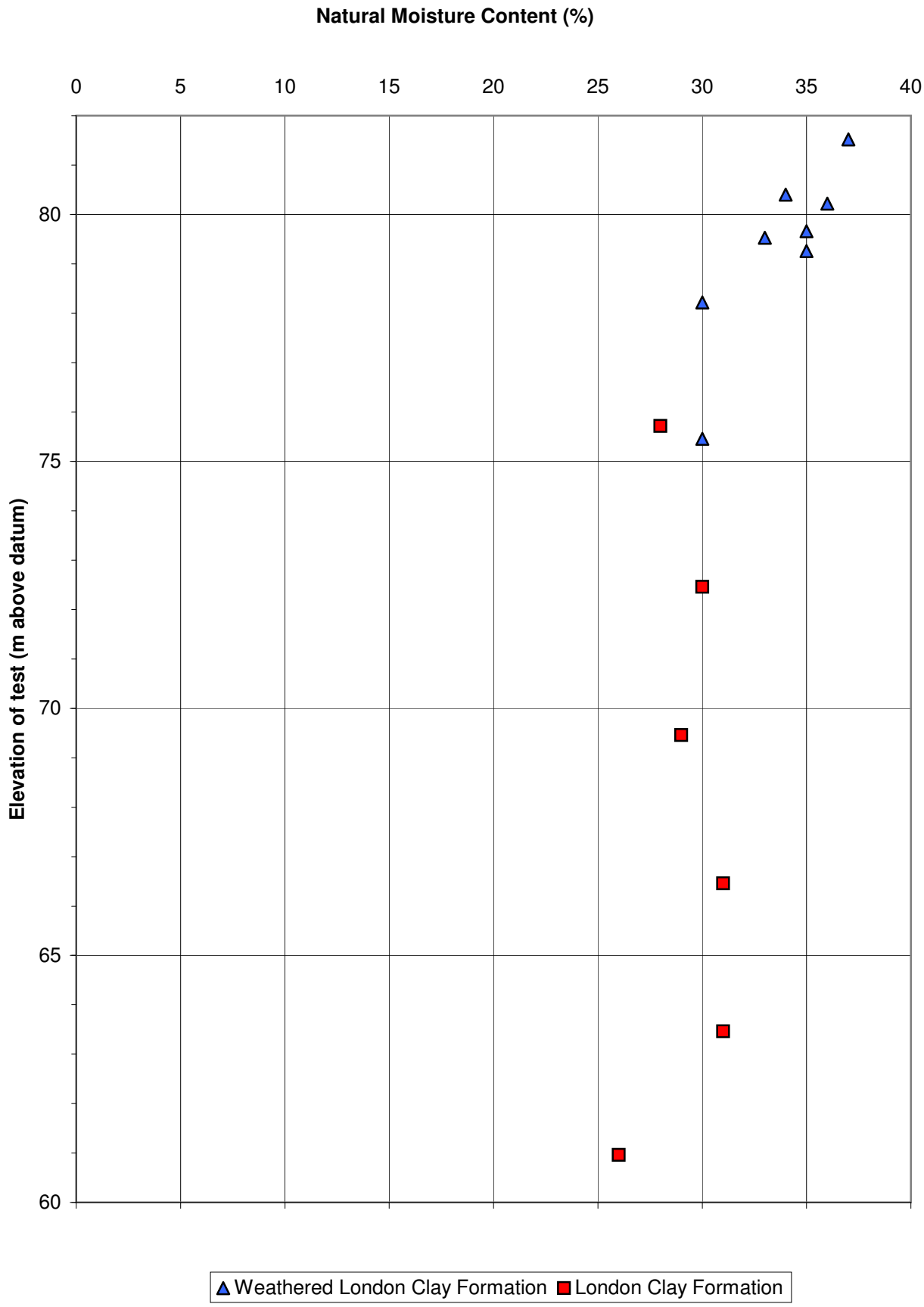
RSK GROUP PLC

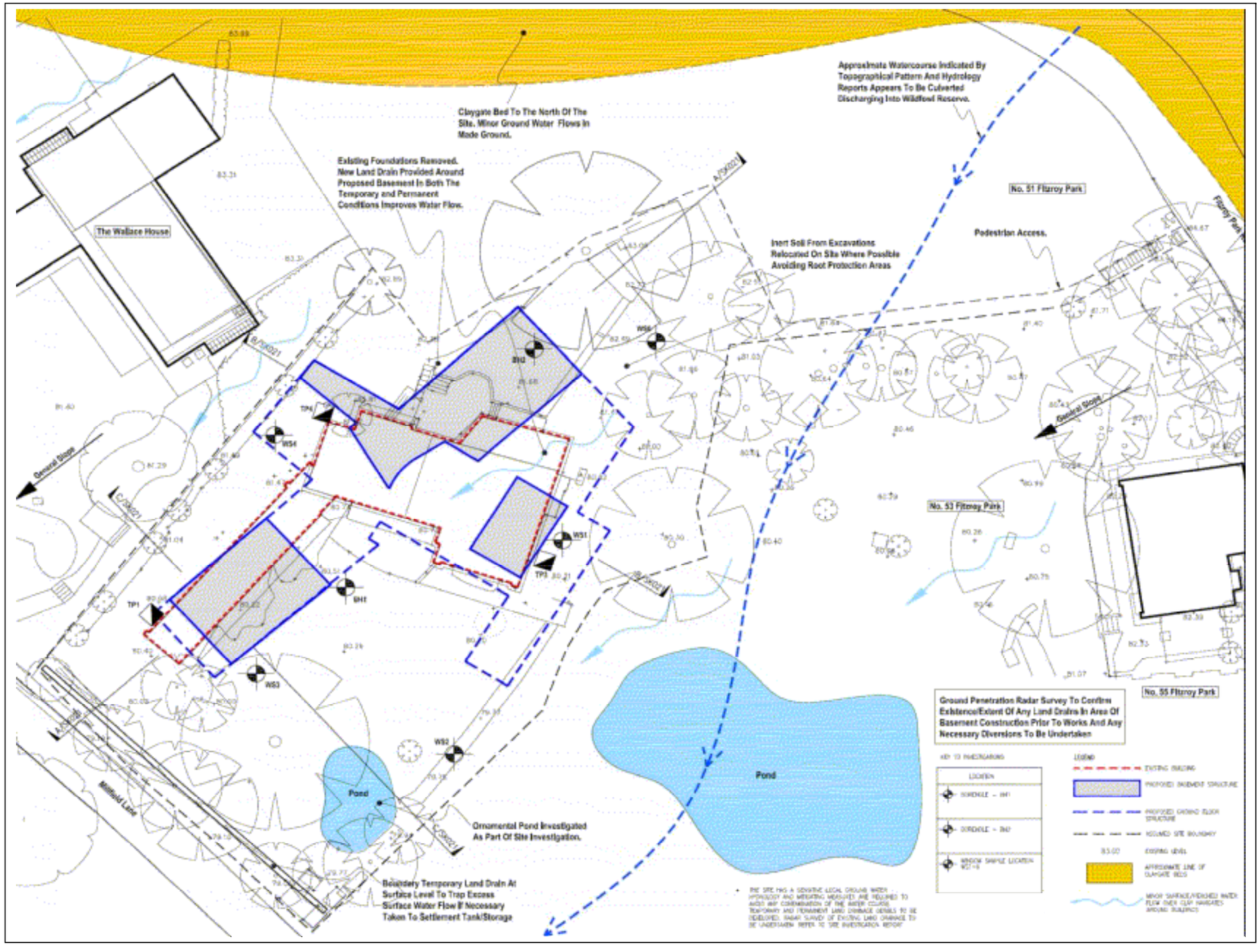
SHEAR STRENGTH vs ELEVATION

Site:	Client:	Job Number:	241830
The Waterhouse	Mr and Mrs Munford	Figure:	6

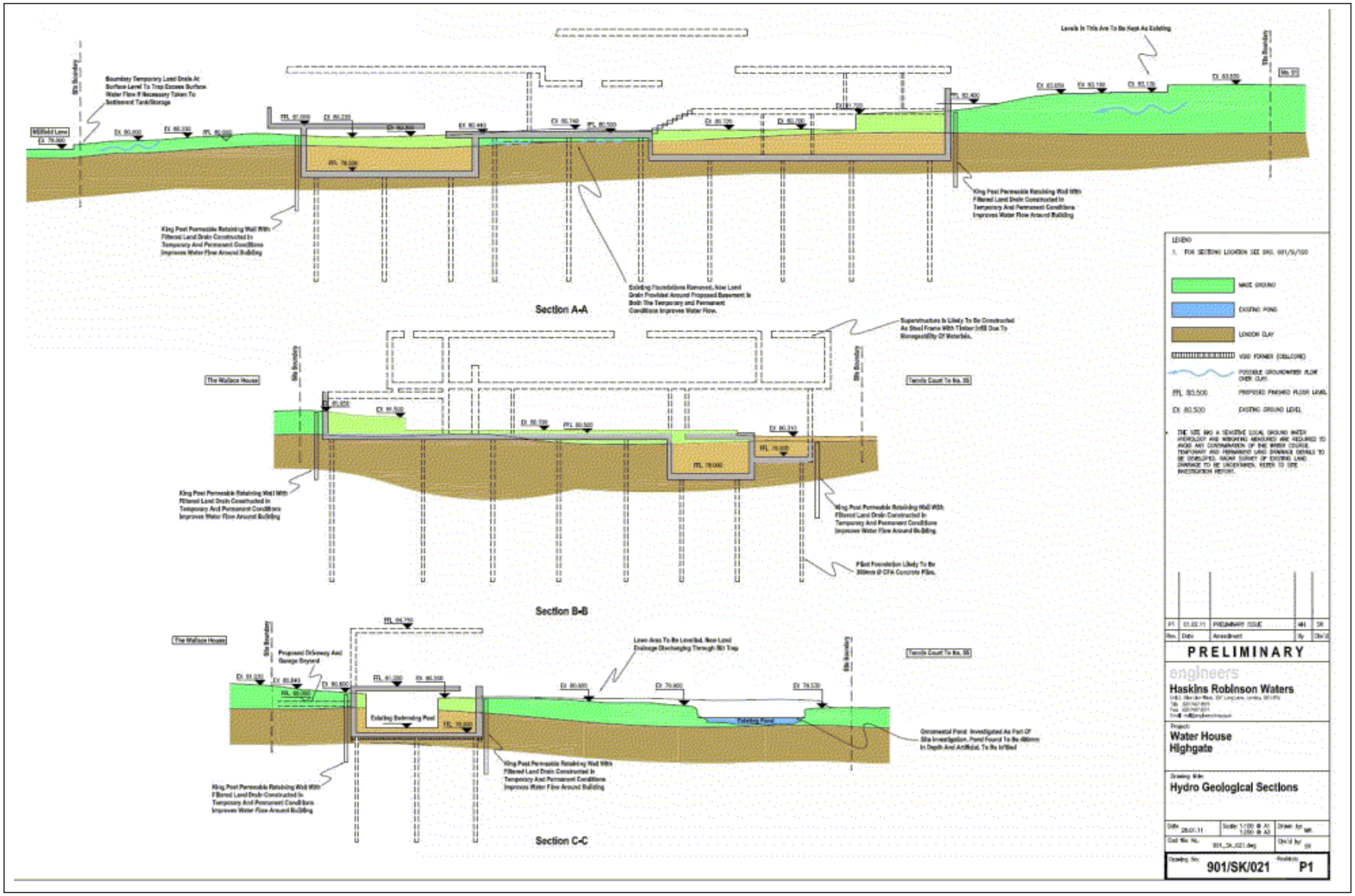


RSK GROUP PLC	MOISTURE CONTENT vs ELEVATION		
Site: The Waterhouse	**Client:** Mr and Mrs Munford	**Job Number:**	241830
		Figure:	7





RSK GROUP PLC	**PROPOSED SITE LAYOUT PLAN**	Client:	Mr and Mrs Munford	Figure No:	**8**
		Site:	**The Waterhouse, Fitzroy Park**	Job No:	**241830-01 (00)**
		Scale:	**NTS**	Source:	**Client**



RSK GROUP PLC	**PROPOSED SITE LAYOUT SECTION**	Client:	**Mr and Mrs Munford**	Figure No:	**9**
		Site:	**The Waterhouse, Fitzroy Park**	Job No:	**241830-01 (00)**
		Scale:	**NTS**	Source:	**Client**

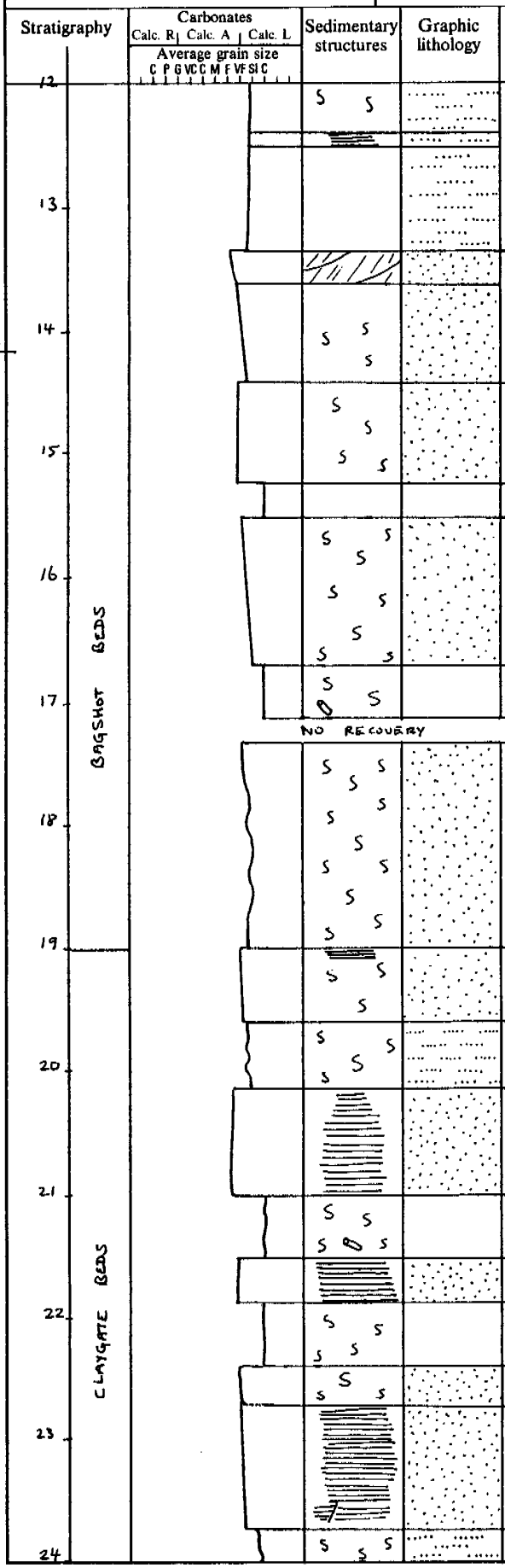
APPENDIX A

Desk Study

(this appendix contains 7 pages, including this one, and one CD)

BRITISH GEOLOGICAL SURVEY

Borehole/Well No.	Location	NGR/Lat. & Long.
TQ 28 NW /198	HAMPSTEAD HEATH	26455 86890
	KB/Ground level +128.71m	Logged by P J STRANGE



13.35 SAND, fine-grained, yellowish brown, 10YR 5/6, Cross bedded fining downwards

SAND, Very fine-grained, yellowish brown, 10YR 5/6, ? bioturbated, fining downwards

14.42 SAND, very fine-grained, light olive brown, 2.5Y 5/4, bioturbated

15.25 CLAY, olive yellow, 2.5Y 6/8

15.50 SAND, Very fine grained, brownish yellow, 10YR 6/8, but greyish wedge in top 10cm, fining downwards to silt size at base. Base is sharp and irregular, bioturbated throughout

16.70 CLAY, silty, medium grey to yellow brown, 10YR 5/4, sandy filled burrows at 17.08

17.11 NO RECOVERY

17.33 SAND, Very fine-grained, light olive brown, 2.5 Y 5/4, with silty greyish brown patches. Ferruginous stained vertical joint 18.30 to 18.90. Fining downwards to base. Bioturbated.

19.00 SAND, Very fine grained, Silty, olive, 5 Y 4/3, laminated in top 10cm

19.63 SILT, light olive grey 5Y 6/1 and dark clay patches at 20.00 sandstone lenses

20.15 SAND, Fine-grained, well laminated, particularly towards base, sharp base of unit at 21.00.

21.00 CLAY, dark yellowish brown, 10YR 4/2, bioturbated, with sandy wisps and sand filled burrows.

21.50 SAND, Very fine-grained, light olive grey, 5Y 6/1, well laminated, roughly horizontal

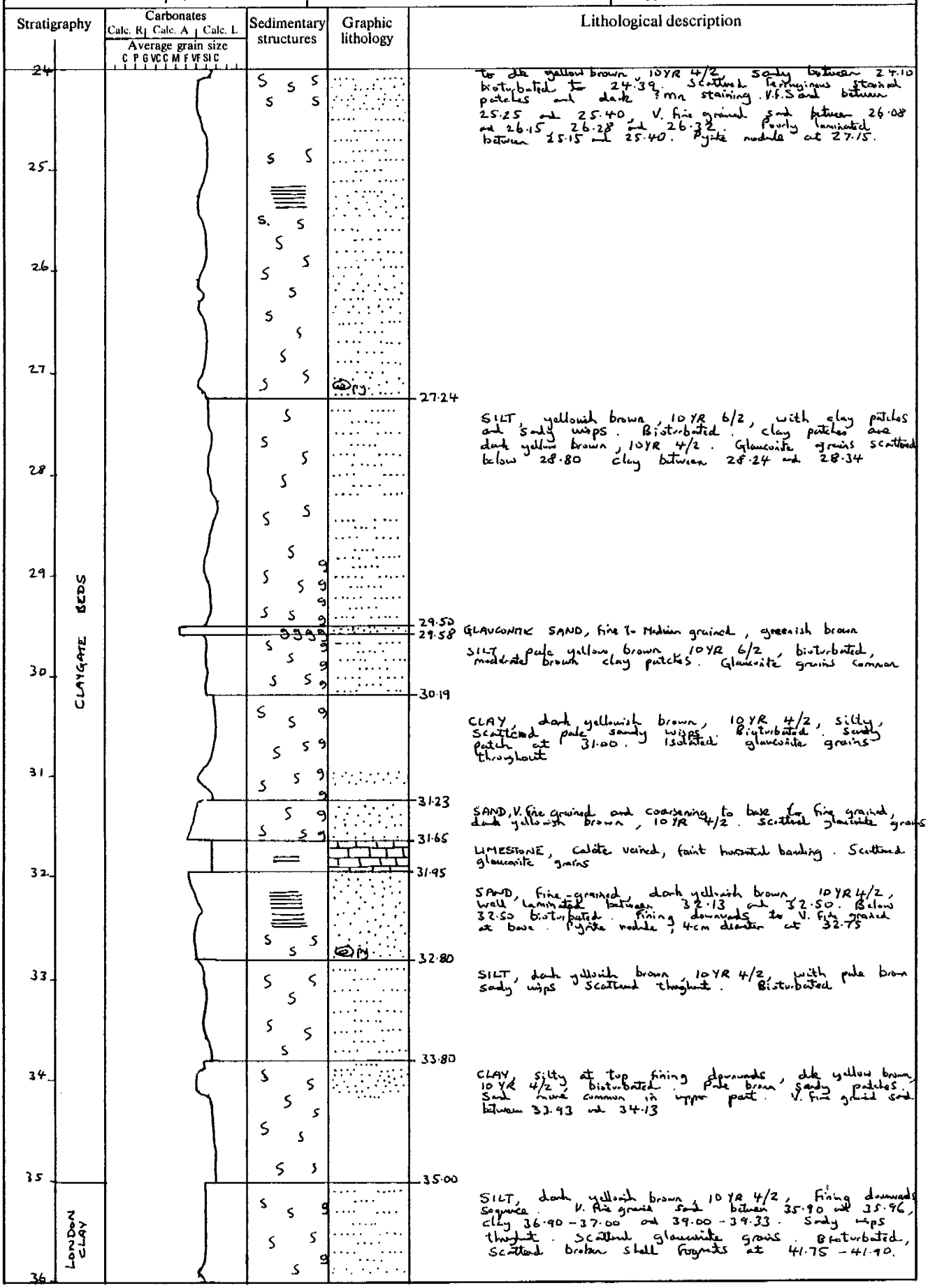
21.86 CLAY, silty, dark yellow brown, 10YR 4/2, bioturbated

22.40 SAND, Very fine-grained, light olive grey, 5Y 6/1, fining downwards. Bioturbated

22.70 SAND, Very fine-grained, light olive grey 5Y 6/1, well laminated with colour contrast laminations. Small scale penecontemporaneous faulting displaying. Laminae at 23.10.

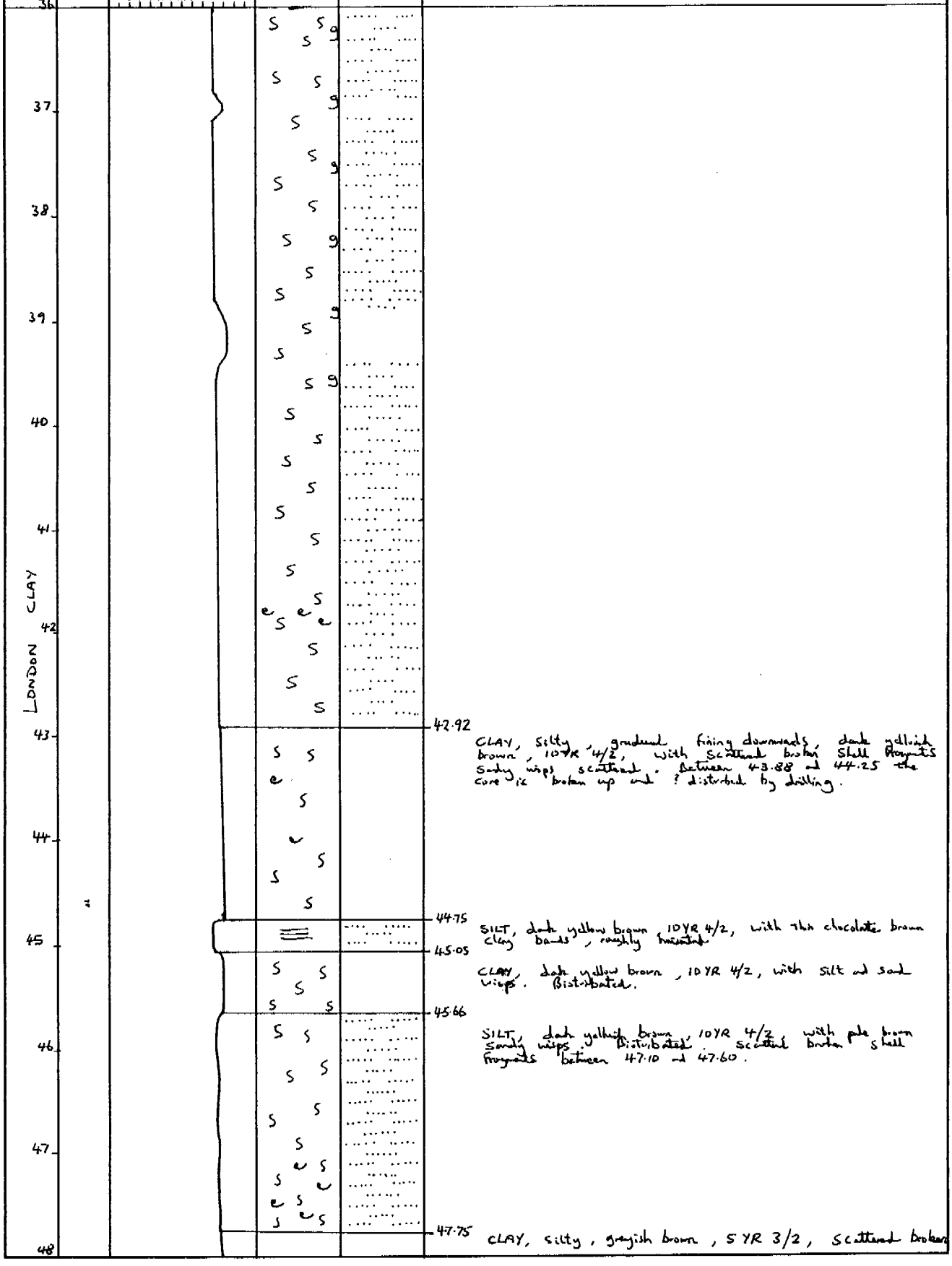
23.72 SILT, clayey with sandy patches, greyish brown, 5YR 3/2,

Borehole/Well No.	Location	NGR/Lat. & Long.
TQ 28 NE /198	HAMPSTEAD HEATH	26455 86890
	KB/Ground level + 128.71 m	Logged by P. J. STRANGE



BRITISH GEOLOGICAL SURVEY

Borehole/Well No.	Location	NGR/Lat. & Long.
TQ 28 NW /198	HAMPSTEAD HEATH	26455 86890
	KB/Ground level +128.71m	Logged by P.J. STRANGE



Borehole/Well No.	Location	NGR/Lat. & Long.
TQ 28 NE /198	HAMPSTEAD HEATH	26455 86890
	KB/Ground level + 128·71 m	Logged by P. J. STRANGE

Stratigraphy | Carbonates (Calc. R | Calc. A | Calc. L; Average grain size C P G VC C M F VF S I C) | Sedimentary structures | Graphic lithology

48 49 50 51 52 53 54 55 56 57 58 59 60

Shell fragments throughout. Bioturbated. Discontinuous roughly horizontal silty layering at 48.35. Large carbonate nodule, 4–5 cm across at 48.80. Discontinuous silt band at 49.26 – 49.32, paler colour clay below. Scattered pyrite particles, e.g. at 49.70. Silty band at 49.76. Smooth clay below 49.80. Silty between 51.10 and 51.20. Irregular shaped silty patches between 51.20 and base at 53.25.

53.25

SILT, dark yellowish brown, 10YR 4/2, poorly laminated in part. Limestone nodule at 53.75 to 53.84. Fining downwards to base.

53.90

CLAY, silty, greyish brown, 5YR 3/2, bioturbated. Scattered broken shell fragments. Fining downwards.

55.35

CLAY, pure, greyish brown, 5YR 3/2, uniform and structureless.

56.53

SILT, dark yellow brown, 10YR 4/2, scattered glauconite grains, fining downwards, bioturbated.

56.92

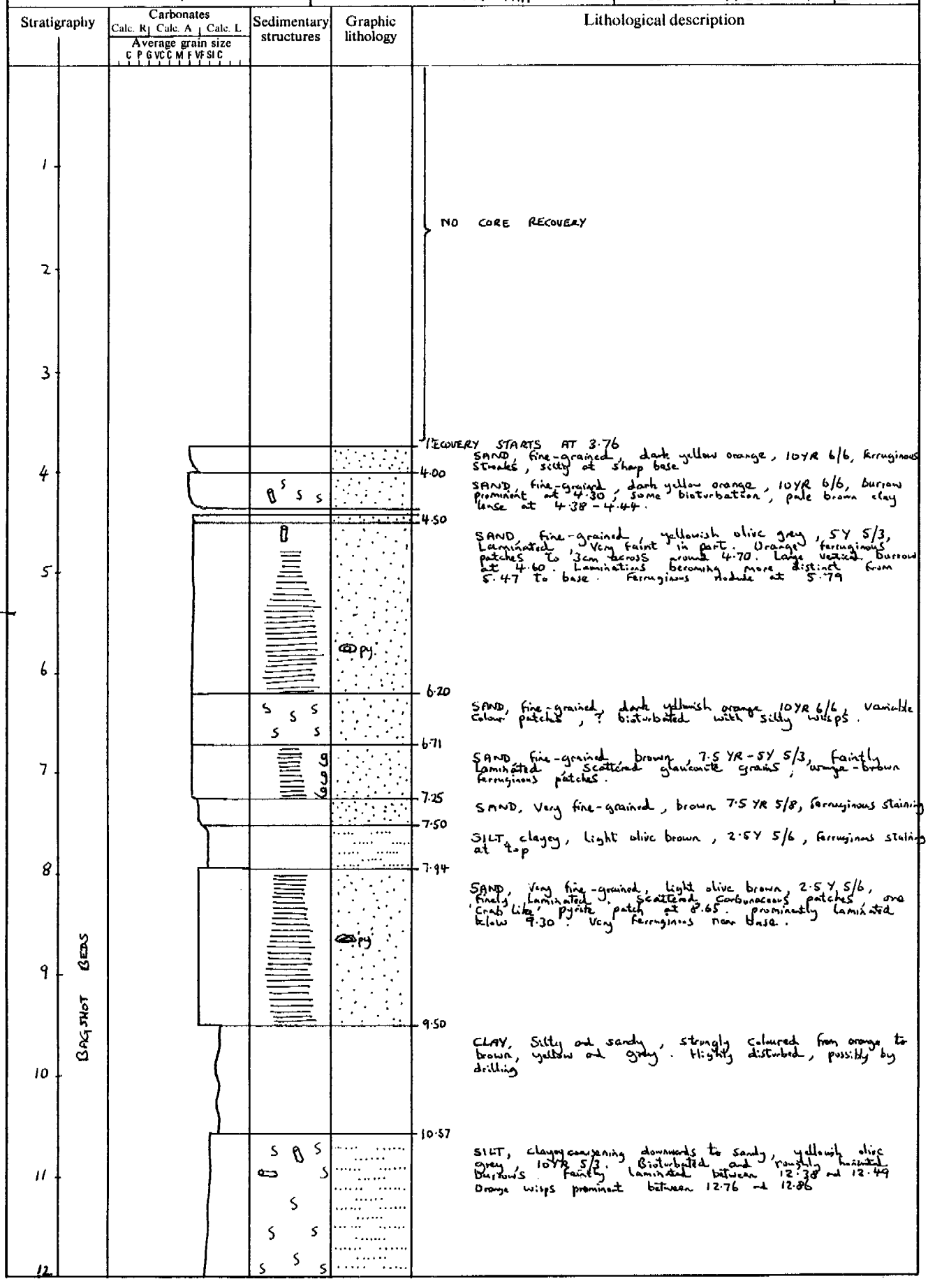
CLAY, slightly silty, greyish brown, 5YR 3/2, glauconitic sandy grains to base of unit, v. fine to fine grained glauconite.

57.70

SILT, dark yellowish brown, 10YR 4/2, pale brown sandy wisps. Clayey between 58.40 and 59.10 VF Sandy patches common between 58.20 and 58.35 and 60.30 and 60.60. Bioturbated.

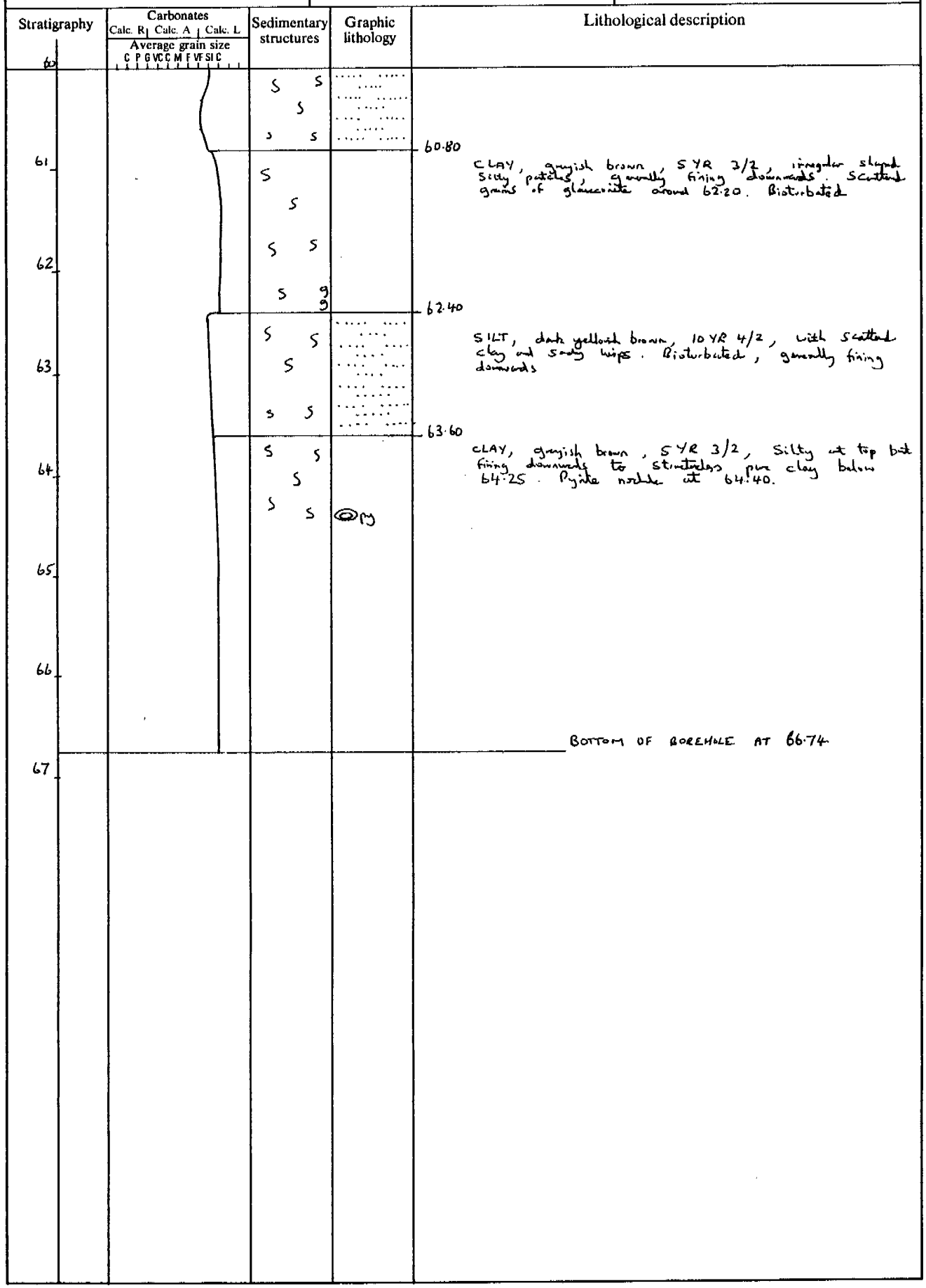
BRITISH GEOLOGICAL SURVEY Sheet 1 of 6

Borehole/Well No.	Location	NGR/Lat. & Long.
TQ 28 NE/198	HAMPSTEAD HEATH	26455 86890
	KB/Ground level +128.71m	Logged by P. J. STRANGE



BRITISH GEOLOGICAL SURVEY

Borehole/Well No.	Location	NGR/Lat. & Long.
TQ28NE/198	HAMPSTEAD HEATH	26455 86890
	KB/Ground level + 128.71m	Logged by P. J. STRANGE



Envirocheck® Report:

Datasheet

Order Details:

Order Number:
33075032_1_1

Customer Reference:
241830

National Grid Reference:
527750, 186990

Slice:
A

Site Area (Ha):
0.23

Search Buffer (m):
1000

Site Details:

The Water House, Millfield Lane
London
N6 6HQ

Client Details:

MR A Stocker
RSK STATS Geoconsult Ltd
18 Frogmore Road
Hemel Hempstead
Herts
HP3 9RT

Prepared For:

Corporate City Developments No. 2 Limited

Contents

Introduction

The Environment Act 1995 has made site sensitivity a key issue, as the legislation pays as much attention to the pathways by which contamination could spread, and to the vulnerable targets of contamination, as it does the potential sources of contamination.
For this reason, Landmark's Site Sensitivity maps and Datasheet(s) place great emphasis on statutory data provided by the Environment Agency and the Scottish Environment Protection Agency; it also incorporates data from Natural England (and the Scottish and Welsh equivalents) and Local Authorities; and highlights hydrogeological features required by environmental and geotechnical consultants. It does not include any information concerning past uses of land. The datasheet is produced by querying the Landmark database to a distance defined by the client from a site boundary provided by the client.

In the attached datasheet the National Grid References (NGRs) are rounded to the nearest 10m in accordance with Landmark's agreements with a number of Data Suppliers.

Copyright Notice

Natural England Copyright Notice

Ove Arup Copyright Notice

Peter Brett Associates Copyright Notice

Radon Potential dataset Copyright Notice

Report Version v47.0

Summary

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Agency & Hydrological					
Contaminated Land Register Entries and Notices					
Discharge Consents	pg 1				1
Enforcement and Prohibition Notices					
Integrated Pollution Controls					
Integrated Pollution Prevention And Control					
Local Authority Integrated Pollution Prevention And Control					
Local Authority Pollution Prevention and Controls	pg 1				2
Local Authority Pollution Prevention and Control Enforcements					
Nearest Surface Water Feature	pg 1		Yes		
Pollution Incidents to Controlled Waters	pg 1			2	1
Prosecutions Relating to Authorised Processes					
Prosecutions Relating to Controlled Waters					
Registered Radioactive Substances					
River Quality					
River Quality Biology Sampling Points					
River Quality Chemistry Sampling Points					
Substantiated Pollution Incident Register	pg 2			1	1
Water Abstractions					
Water Industry Act Referrals					
Groundwater Vulnerability	pg 2	Yes	n/a	n/a	n/a
Source Protection Zones					
Extreme Flooding from Rivers or Sea without Defences				n/a	n/a
Flooding from Rivers or Sea without Defences				n/a	n/a
Areas Benefiting from Flood Defences				n/a	n/a
Flood Water Storage Areas				n/a	n/a
Flood Defences				n/a	n/a
Waste					
BGS Recorded Landfill Sites					
Historical Landfill Sites					
Integrated Pollution Control Registered Waste Sites					
Licensed Waste Management Facilities (Landfill Boundaries)					
Licensed Waste Management Facilities (Locations)					
Local Authority Recorded Landfill Sites					
Registered Landfill Sites					
Registered Waste Transfer Sites					
Registered Waste Treatment or Disposal Sites					

Summary

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Hazardous Substances					
Control of Major Accident Hazards Sites (COMAH)					
Explosive Sites					
Notification of Installations Handling Hazardous Substances (NIHHS)					
Planning Hazardous Substance Consents					
Planning Hazardous Substance Enforcements					
Geological					
BGS Recorded Mineral Sites					
BGS 1:625,000 Solid Geology	pg 4	Yes	n/a	n/a	n/a
Brine Compensation Area			n/a	n/a	n/a
Coal Mining Affected Areas			n/a	n/a	n/a
Mining Instability			n/a	n/a	n/a
Man-Made Mining Cavities					
Natural Cavities					
Non Coal Mining Areas of Great Britain				n/a	n/a
Potential for Collapsible Ground Stability Hazards				n/a	n/a
Potential for Compressible Ground Stability Hazards				n/a	n/a
Potential for Ground Dissolution Stability Hazards				n/a	n/a
Potential for Landslide Ground Stability Hazards	pg 4	Yes	Yes	n/a	n/a
Potential for Running Sand Ground Stability Hazards	pg 4	Yes	Yes	n/a	n/a
Potential for Shrinking or Swelling Clay Ground Stability Hazards	pg 4	Yes		n/a	n/a
Radon Potential - Radon Affected Areas			n/a	n/a	n/a
Radon Potential - Radon Protection Measures			n/a	n/a	n/a
Industrial Land Use					
Contemporary Trade Directory Entries	pg 5			4	18
Fuel Station Entries	pg 6				1

Summary

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Sensitive Land Use					
Areas of Adopted Green Belt					
Areas of Unadopted Green Belt					
Areas of Outstanding Natural Beauty					
Environmentally Sensitive Areas					
Forest Parks					
Local Nature Reserves					
Marine Nature Reserves					
National Nature Reserves					
National Parks					
Nitrate Sensitive Areas					
Nitrate Vulnerable Zones					
Ramsar Sites					
Sites of Special Scientific Interest	pg 7			1	
Special Areas of Conservation					
Special Protection Areas					

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
1	**Discharge Consents** Operator: Thames Water Utilities Ltd Property Type: Reservoir/Borehole Site Location: Highgate Authority: Environment Agency, Thames Region Catchment Area: Not Supplied Reference: Temp.0148 Permit Version: 1 Effective Date: 15th September 1989 Issued Date: 15th September 1989 Revocation Date: 5th October 2000 Discharge Type: Trade Effluent Discharge Environment: Freshwater Stream/River Receiving Water: River Thames **Status: Authorisation revokedRevoked** Positional Accuracy: Located by supplier to within 100m	A14NW (NE)	578	1	528300 187300
2	**Local Authority Pollution Prevention and Controls** Name: John Nichol Location: 31 North Road, LONDON, N6 4BF Authority: London Borough of Haringey, Planning and Environmental Health Permit Reference: 11 Dated: 17th April 2001 Process Type: Local Authority Air Pollution Control Description: PG1/14 Petrol filling station **Status: Authorised** Positional Accuracy: Manually positioned to the address or location	A19SW (NE)	778	2	528296 187611
3	**Local Authority Pollution Prevention and Controls** Name: First Choice Location: 5 Highgate High Street, London, N6 5jr Authority: London Borough of Camden, Pollution Projects Team Permit Reference: PPC/DC3 Dated: 12th January 2007 Process Type: Local Authority Pollution Prevention and Control Description: PG6/46 Dry cleaning **Status: Permitted** Positional Accuracy: Located by supplier to within 10m	A19SE (NE)	841	3	528575 187336
	Nearest Surface Water Feature	A13SE (SE)	4	-	527755 186980
4	**Pollution Incidents to Controlled Waters** Property Type: Not Given Location: FINCHLEY Authority: Environment Agency, Thames Region Pollutant: Oils - Unknown Note: Confirmed As A Pollution Incident Incident Date: 28th October 1993 Incident Reference: NE930729 Catchment Area: Not Given Receiving Water: Not Given Cause of Incident: Not Given Incident Severity: Category 2 - Significant Incident Positional Accuracy: Located by supplier to within 100m	A13NE (N)	265	1	527800 187280
5	**Pollution Incidents to Controlled Waters** Property Type: Not Given Location: Regents Canal, Camden Authority: Environment Agency, Thames Region Pollutant: Unknown Sewage Note: Not Supplied Incident Date: 20th February 1997 Incident Reference: THN11997031084 Catchment Area: Not Given Receiving Water: Not Given Cause of Incident: Not Given Incident Severity: Category 3 - Minor Incident Positional Accuracy: Located by supplier to within 100m	A12NE (W)	402	1	527300 187000

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
6	**Pollution Incidents to Controlled Waters** Property Type: Not Given Location: Highgate View Road Authority: Environment Agency, Thames Region Pollutant: Oils - Unknown Note: Confirmed As A Pollution Incident Incident Date: 19th May 1992 Incident Reference: N1920289 Catchment Area: Not Given Receiving Water: Not Given Cause of Incident: Not Given Incident Severity: Category 3 - Minor Incident Positional Accuracy: Located by supplier to within 100m	A23SE (N)	983	1	527800 188000
7	**Substantiated Pollution Incident Register** Authority: Environment Agency - Thames Region, North East Area Incident Date: 22nd July 2004 Incident Reference: 252851 Water Impact: Category 2 - Significant Incident Air Impact: Category 4 - No Impact Land Impact: Category 4 - No Impact Positional Accuracy: Located by supplier to within 10m Pollutant: General Biodegradable Materials and WastesAlgae	A8NE (S)	421	1	527851 186553
8	**Substantiated Pollution Incident Register** Authority: Environment Agency - Thames Region, North East Area Incident Date: 23rd September 2003 Incident Reference: 191922 Water Impact: Category 2 - Significant Incident Air Impact: Category 4 - No Impact Land Impact: Category 4 - No Impact Positional Accuracy: Located by supplier to within 10m Pollutant: Pollutant Not Identified: Not Identified	A7SE (SW)	974	1	527254 186101
	Groundwater Vulnerability Geological Classification: Minor Aquifer (Variably permeable) - These can be fractured or potentially fractured rocks, which do not have a high primary permeability, or other formations of variable permeability including unconsolidated deposits. Although not producing large quantities of water for abstraction, they are important for local supplies and in supplying base flow to rivers Soil Classification: Soils of High Leaching Potential (U) - Soil information for restored mineral workings and urban areas is based on fewer observations than elsewhere. A worst case vulnerability classification (H) assumed, until proved otherwise Map Sheet: Sheet 39 West London Scale: 1:100,000	A13NE (NE)	0	1	527761 186999
	Groundwater Vulnerability Geological Classification: Non Aquifer (Negligibly permeable) - Formations which are generally regarded as containing insignificant quantities of groundwater. However, groundwater flow through such rocks, although imperceptible, does take place and needs to be considered in assessing the risk associated with persistent pollutants Soil Classification: Not classified Map Sheet: Sheet 39 West London Scale: 1:100,000	A13NW (S)	0	1	527750 186990
	Drift Deposits None				
	Extreme Flooding from Rivers or Sea without Defences None				
	Flooding from Rivers or Sea without Defences None				
	Areas Benefiting from Flood Defences None				
	Flood Water Storage Areas None				
	Flood Defences None				

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
	Local Authority Landfill Coverage Name: London Borough of Camden - Has no landfill data to supply		0	6	527750 186990
	Local Authority Landfill Coverage Name: London Borough of Haringey - Has supplied landfill data		499	7	527769 187517

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
	BGS 1:625,000 Solid Geology Description: London Clay	A13NW (S)	0	4	527750 186990
	Coal Mining Affected Areas In an area which may not be affected by coal mining				
	Non Coal Mining Areas of Great Britain No Hazard				
	Potential for Collapsible Ground Stability Hazards No Hazard				
	Potential for Compressible Ground Stability Hazards Hazard Potential: No Hazard Source: British Geological Survey, National Geoscience Information Service	A13NW (S)	0	4	527750 186990
	Potential for Ground Dissolution Stability Hazards No Hazard				
	Potential for Landslide Ground Stability Hazards Hazard Potential: Very Low Source: British Geological Survey, National Geoscience Information Service	A13NW (S)	0	4	527750 186990
	Potential for Landslide Ground Stability Hazards Hazard Potential: Low Source: British Geological Survey, National Geoscience Information Service	A13SE (SE)	70	4	527800 186925
	Potential for Landslide Ground Stability Hazards Hazard Potential: Low Source: British Geological Survey, National Geoscience Information Service	A13SE (E)	95	4	527875 186950
	Potential for Landslide Ground Stability Hazards Hazard Potential: Low Source: British Geological Survey, National Geoscience Information Service	A13NE (E)	101	4	527900 187025
	Potential for Landslide Ground Stability Hazards Hazard Potential: Low Source: British Geological Survey, National Geoscience Information Service	A13SE (SE)	126	4	527825 186875
	Potential for Landslide Ground Stability Hazards Hazard Potential: Low Source: British Geological Survey, National Geoscience Information Service	A13NW (W)	152	4	527550 186990
	Potential for Landslide Ground Stability Hazards Hazard Potential: Low Source: British Geological Survey, National Geoscience Information Service	A13SE (SE)	160	4	527850 186850
	Potential for Running Sand Ground Stability Hazards Hazard Potential: Very Low Source: British Geological Survey, National Geoscience Information Service	A13NE (E)	0	4	527800 186990
	Potential for Running Sand Ground Stability Hazards Hazard Potential: No Hazard Source: British Geological Survey, National Geoscience Information Service	A13NW (S)	0	4	527750 186990
	Potential for Running Sand Ground Stability Hazards Hazard Potential: Low Source: British Geological Survey, National Geoscience Information Service	A13NE (E)	210	4	528000 187075
	Potential for Shrinking or Swelling Clay Ground Stability Hazards Hazard Potential: Moderate Source: British Geological Survey, National Geoscience Information Service	A13NW (S)	0	4	527750 186990
	Radon Potential - Radon Affected Areas Affected Area: The property is not in a radon affected area, as less than 1% of homes are above the action level Source: British Geological Survey, National Geoscience Information Service	A13NW (S)	0	4	527750 186990
	Radon Potential - Radon Protection Measures Protection Measure: No radon protective measures are necessary in the construction of new dwellings or extensions Source: British Geological Survey, National Geoscience Information Service	A13NW (S)	0	4	527750 186990

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
9	**Contemporary Trade Directory Entries** Name: 24hr Abacus Location: 40, Highgate West Hill, London, N6 6LS Classification: Air Conditioning Equipment & Systems **Status: Inactive** Positional Accuracy: Manually positioned to the address or location	A14NW (NE)	325	-	528098 187139
9	**Contemporary Trade Directory Entries** Name: Hygi Seat Location: 40, Highgate West Hill, London, N6 6LS Classification: Hygiene & Cleansing Services **Status: Inactive** Positional Accuracy: Manually positioned to the address or location	A14NW (NE)	325	-	528098 187139
10	**Contemporary Trade Directory Entries** Name: Electrocoin Location: 1, Oakeshott Avenue, London, N6 6NT Classification: Electronic Engineers **Status: Active** Positional Accuracy: Automatically positioned to the address	A14SW (SE)	410	-	528136 186773
11	**Contemporary Trade Directory Entries** Name: Athlone House Location: Hampstead Lane, London, N6 4RX Classification: Hospitals **Status: Inactive** Positional Accuracy: Automatically positioned to the address	A18SE (N)	492	-	527795 187509
12	**Contemporary Trade Directory Entries** Name: Antique Bronze Ltd Location: 44, Hillway, London, N6 6EP Classification: Antiques - Repairing & Restoring **Status: Active** Positional Accuracy: Automatically positioned to the address	A14SW (E)	651	-	528391 186736
13	**Contemporary Trade Directory Entries** Name: On Reflection Location: Highgate West Hill, London, N6 6AP Classification: Mirrors & Decorative Glass **Status: Active** Positional Accuracy: Manually positioned within the geographical locality	A9NW (SE)	692	-	528256 186488
14	**Contemporary Trade Directory Entries** Name: A Man With A Van Highgate Location: 47, Highgate High Street, London, N6 5JX Classification: Rubbish Clearance **Status: Active** Positional Accuracy: Automatically positioned to the address	A19SW (NE)	717	-	528408 187390
14	**Contemporary Trade Directory Entries** Name: Smart Line Location: Highgate High St, London, N6 5JX Classification: Dry Cleaners **Status: Active** Positional Accuracy: Manually positioned to the road within the address or location	A19SE (NE)	742	-	528434 187396
15	**Contemporary Trade Directory Entries** Name: Simply For You Location: 8, Stormont Road, London, N6 4NL Classification: Cleaning Services - Domestic **Status: Inactive** Positional Accuracy: Automatically positioned to the address	A18NW (N)	737	-	527493 187708
16	**Contemporary Trade Directory Entries** Name: Highgate Cemetery Location: Swains Lane, London, N6 6PJ Classification: Cemeteries & Crematoria **Status: Active** Positional Accuracy: Automatically positioned to the address	A14SE (E)	742	-	528541 186964
17	**Contemporary Trade Directory Entries** Name: John Nichol (Cars) Ltd Location: 33, North Road, London, N6 4BE Classification: Car Dealers **Status: Active** Positional Accuracy: Automatically positioned to the address	A19SW (NE)	782	-	528292 187620
18	**Contemporary Trade Directory Entries** Name: Brookfield Garage Location: 5, Swains Lane, London, N6 6QX Classification: Garage Services **Status: Inactive** Positional Accuracy: Automatically positioned to the address	A9NW (SE)	792	-	528303 186397

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
18	**Contemporary Trade Directory Entries** Name: Cavours Location: 110, Highgate West Hill, London, N6 6AP Classification: Hardware **Status: Inactive** Positional Accuracy: Automatically positioned to the address	A9NW (SE)	800	-	528287 186374
19	**Contemporary Trade Directory Entries** Name: Liquivite Vetfoods Location: 3, Bromwich Avenue, London, N6 6QH Classification: Veterinary Equipment Manufacturers **Status: Active** Positional Accuracy: Automatically positioned to the address	A9NE (SE)	809	-	528467 186551
20	**Contemporary Trade Directory Entries** Name: First Choice Dry Cleaining Location: 5, Highgate High Street, London, N6 5JR Classification: Dry Cleaners **Status: Active** Positional Accuracy: Automatically positioned to the address	A19SE (NE)	840	-	528574 187337
20	**Contemporary Trade Directory Entries** Name: Petroleum Development Consultants Location: 4-8, Highgate High Street, London, N6 5JL Classification: Oil & Gas Exploration Supplies & Services **Status: Active** Positional Accuracy: Automatically positioned to the address	A19SE (NE)	888	-	528617 187358
21	**Contemporary Trade Directory Entries** Name: Vagabond Bags Ltd Location: 7, Broadbent Close, London, N6 5JW Classification: Bags, Belts & Accessories - Manufacturers & Suppliers **Status: Inactive** Positional Accuracy: Automatically positioned to the address	A19SE (NE)	847	-	528551 187402
21	**Contemporary Trade Directory Entries** Name: Sally Poppy Location: 4, Broadbent Close, London, N6 5JW Classification: Lingerie Manufacturers & Wholesalers **Status: Inactive** Positional Accuracy: Automatically positioned to the address	A19SE (NE)	865	-	528569 187406
21	**Contemporary Trade Directory Entries** Name: Highgate Motors Location: 9, Broadbent Close, London, N6 5JW Classification: Garage Services **Status: Active** Positional Accuracy: Automatically positioned to the address	A19SE (NE)	882	-	528587 187410
22	**Contemporary Trade Directory Entries** Name: Pack Line (Uk) Ltd Location: Flat 1, Hylda Court, 3-5, St. Albans Road, London, NW5 1RE Classification: Packaging & Wrapping Equipment & Supplies **Status: Inactive** Positional Accuracy: Automatically positioned to the address	A9SE (SE)	956	-	528429 186288
23	**Contemporary Trade Directory Entries** Name: Southwood Hospital Location: Southwood Lane, London, N6 5SP Classification: Hospitals **Status: Inactive** Positional Accuracy: Automatically positioned to the address	A19NW (NE)	988	-	528418 187782
24	**Contemporary Trade Directory Entries** Name: Stratstone Of Highgate Location: 1, North Hill, London, N6 4AB Classification: Car Dealers **Status: Inactive** Positional Accuracy: Automatically positioned in the proximity of the address	A19NW (NE)	993	-	528228 187907
25	**Fuel Station Entries** Name: John Nichol Cars Location: 31-33 North Road, Highgate, LONDON, Greater London, N6 4BE Brand: Total Premises Type: Petrol Station **Status: Open** Positional Accuracy: Manually positioned to the address or location	A19SW (NE)	778	-	528296 187611

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
26	**Sites of Special Scientific Interest** Name: Hampstead Heath Woods Multiple Areas: Y Total Area (m2): 161715.25 Source: Natural England Reference: 1003451 Designation Details: Not Supplied Designation Date: 18th April 1990 Date Type: Notified	A13NW (W)	284	5	527421 187024

Agency & Hydrological	Version	Update Cycle
Contaminated Land Register Entries and Notices		
London Borough of Waltham Forest - Environmental Health Department	April 2009	Annual Rolling Update
London Borough of Barnet - Environmental Health Department	April 2010	Annual Rolling Update
London Borough of Camden - Pollution Projects Team	August 2009	Annual Rolling Update
London Borough of Enfield - Environmental Services	August 2009	Annual Rolling Update
London Borough of Islington - Public Protection	August 2009	Annual Rolling Update
London Borough of Haringey - Planning and Environmental Health	February 2010	Annual Rolling Update
London Borough of Brent - Environmental Health Department	July 2010	Annual Rolling Update
Westminster City Council - Environmental Health Department	March 2010	Annual Rolling Update
London Borough of Hackney - Environmental Health Department	September 2010	Annual Rolling Update
Discharge Consents		
Environment Agency - Thames Region	July 2010	Quarterly
Enforcement and Prohibition Notices		
Environment Agency - Thames Region	August 2010	Quarterly
Integrated Pollution Controls		
Environment Agency - Thames Region	October 2008	Not Applicable
Integrated Pollution Prevention And Control		
Environment Agency - Thames Region	July 2010	Quarterly
Local Authority Integrated Pollution Prevention And Control		
London Borough of Barnet - Environmental Health Department	April 2010	Annual Rolling Update
London Borough of Islington - Environmental Health Department	April 2010	Annual Rolling Update
London Borough of Haringey - Planning and Environmental Health	January 2010	Annual Rolling Update
London Borough of Hackney - Environmental Health Department	June 2010	Annual Rolling Update
London Borough of Enfield - Environmental Health Department	May 2010	Annual Rolling Update
London Borough of Waltham Forest - Environmental Health Department	May 2010	Annual Rolling Update
Westminster City Council - Environmental Health Department	May 2010	Annual Rolling Update
London Borough of Brent - Environmental Health Department	October 2010	Annual Rolling Update
London Borough of Camden - Pollution Projects Team	October 2010	Annual Rolling Update
Local Authority Pollution Prevention and Controls		
London Borough of Barnet - Environmental Health Department	April 2010	Annual Rolling Update
London Borough of Islington - Environmental Health Department	April 2010	Annual Rolling Update
London Borough of Haringey - Planning and Environmental Health	January 2010	Annual Rolling Update
London Borough of Hackney - Environmental Health Department	June 2010	Annual Rolling Update
London Borough of Enfield - Environmental Health Department	May 2010	Annual Rolling Update
London Borough of Waltham Forest - Environmental Health Department	May 2010	Annual Rolling Update
Westminster City Council - Environmental Health Department	May 2010	Annual Rolling Update
London Borough of Camden - Pollution Projects Team	October 2010	Annual Rolling Update
London Borough of Brent - Environmental Health Department	September 2010	Annual Rolling Update
Local Authority Pollution Prevention and Control Enforcements		
London Borough of Barnet - Environmental Health Department	April 2010	Annual Rolling Update
London Borough of Haringey - Planning and Environmental Health	January 2010	Annual Rolling Update
London Borough of Hackney - Environmental Health Department	June 2010	Annual Rolling Update
London Borough of Islington - Environmental Health Department	March 2010	Annual Rolling Update
London Borough of Enfield - Environmental Health Department	May 2010	Annual Rolling Update
London Borough of Waltham Forest - Environmental Health Department	May 2010	Annual Rolling Update
Westminster City Council - Environmental Health Department	May 2010	Annual Rolling Update
London Borough of Brent - Environmental Health Department	October 2010	Annual Rolling Update
London Borough of Camden - Pollution Projects Team	October 2010	Annual Rolling Update
Nearest Surface Water Feature		
Ordnance Survey	April 2010	Quarterly
Pollution Incidents to Controlled Waters		
Environment Agency - Thames Region	September 1999	Not Applicable
Prosecutions Relating to Authorised Processes		
Environment Agency - Thames Region	October 2010	Monthly

Agency & Hydrological	Version	Update Cycle
Prosecutions Relating to Controlled Waters Environment Agency - Thames Region	October 2010	Monthly
Registered Radioactive Substances Environment Agency - Thames Region	July 2010	Quarterly
River Quality Environment Agency - Head Office	November 2001	Not Applicable
River Quality Biology Sampling Points Environment Agency - Head Office	January 2010	Annually
River Quality Chemistry Sampling Points Environment Agency - Head Office	January 2010	Annually
Substantiated Pollution Incident Register Environment Agency - Thames Region - North East Area	July 2010	Quarterly
Water Abstractions Environment Agency - Thames Region	July 2010	Quarterly
Water Industry Act Referrals Environment Agency - Thames Region	January 2010	Quarterly
Groundwater Vulnerability Environment Agency - Head Office	January 1999	Not Applicable
Drift Deposits Environment Agency - Head Office	January 1999	Not Applicable
Source Protection Zones Environment Agency - Head Office	June 2010	Quarterly
Extreme Flooding from Rivers or Sea without Defences Environment Agency - Head Office	August 2010	Quarterly
Flooding from Rivers or Sea without Defences Environment Agency - Head Office	August 2010	Quarterly
Areas Benefiting from Flood Defences Environment Agency - Head Office	March 2010	Quarterly
Flood Water Storage Areas Environment Agency - Head Office	March 2010	Quarterly
Flood Defences Environment Agency - Head Office	March 2010	Quarterly

Data Currency

Waste	Version	Update Cycle
BGS Recorded Landfill Sites		
British Geological Survey - National Geoscience Information Service	June 1996	Not Applicable
Historical Landfill Sites		
Environment Agency - Thames Region - North East Area	October 2010	Quarterly
Integrated Pollution Control Registered Waste Sites		
Environment Agency - Thames Region	October 2008	Not Applicable
Licensed Waste Management Facilities (Landfill Boundaries)		
Environment Agency - Thames Region - North East Area	July 2010	Quarterly
Licensed Waste Management Facilities (Locations)		
Environment Agency - Thames Region - North East Area	July 2010	Quarterly
Local Authority Landfill Coverage		
London Borough of Barnet	May 2000	Not Applicable
London Borough of Brent - Environmental Health Department	May 2000	Not Applicable
London Borough of Camden	May 2000	Not Applicable
London Borough of Enfield - Environmental Health Department	May 2000	Not Applicable
London Borough of Hackney	May 2000	Not Applicable
London Borough of Haringey - Planning Department	May 2000	Not Applicable
London Borough of Islington - Environmental Health Department	May 2000	Not Applicable
London Borough of Waltham Forest - Environmental Health Department	May 2000	Not Applicable
Westminster City Council - Environmental Health Department	May 2000	Not Applicable
Local Authority Recorded Landfill Sites		
London Borough of Enfield - Environmental Health Department	February 2003	Not Applicable
London Borough of Barnet	May 2000	Not Applicable
London Borough of Brent - Environmental Health Department	May 2000	Not Applicable
London Borough of Camden	May 2000	Not Applicable
London Borough of Hackney	May 2000	Not Applicable
London Borough of Haringey - Planning Department	May 2000	Not Applicable
London Borough of Islington - Environmental Health Department	May 2000	Not Applicable
London Borough of Waltham Forest - Environmental Health Department	May 2000	Not Applicable
Westminster City Council - Environmental Health Department	May 2000	Not Applicable
Registered Landfill Sites		
Environment Agency - Thames Region - North East Area	March 2003	Not Applicable
Registered Waste Transfer Sites		
Environment Agency - Thames Region - North East Area	March 2003	Not Applicable
Registered Waste Treatment or Disposal Sites		
Environment Agency - Thames Region - North East Area	March 2003	Not Applicable

Hazardous Substances	Version	Update Cycle
Control of Major Accident Hazards Sites (COMAH)		
Health and Safety Executive	May 2010	Bi-Annually
Explosive Sites		
Health and Safety Executive	January 2009	Bi-Annually
Notification of Installations Handling Hazardous Substances (NIHHS)		
Health and Safety Executive	November 2000	Not Applicable
Planning Hazardous Substance Enforcements		
London Borough of Islington	August 2010	Annual Rolling Update
London Borough of Enfield - Planning Department	July 2010	Annual Rolling Update
London Borough of Barnet	March 2010	Annual Rolling Update
London Borough of Camden	March 2010	Annual Rolling Update
London Borough of Hackney	March 2010	Annual Rolling Update
London Borough of Haringey	March 2010	Annual Rolling Update
London Borough of Waltham Forest - Environmental Services	March 2010	Annual Rolling Update
Westminster City Council	March 2010	Annual Rolling Update
London Borough of Brent	October 2010	Annual Rolling Update
Planning Hazardous Substance Consents		
London Borough of Islington	August 2010	Annual Rolling Update
London Borough of Enfield - Planning Department	July 2010	Annual Rolling Update
London Borough of Barnet	March 2010	Annual Rolling Update
London Borough of Camden	March 2010	Annual Rolling Update
London Borough of Hackney	March 2010	Annual Rolling Update
London Borough of Haringey	March 2010	Annual Rolling Update
London Borough of Waltham Forest - Environmental Services	March 2010	Annual Rolling Update
Westminster City Council	March 2010	Annual Rolling Update
London Borough of Brent	October 2010	Annual Rolling Update

Geological	Version	Update Cycle
BGS Recorded Mineral Sites British Geological Survey - National Geoscience Information Service	October 2010	Bi-Annually
BGS 1:625,000 Solid Geology British Geological Survey - National Geoscience Information Service	August 1996	Not Applicable
Brine Compensation Area Cheshire Brine Subsidence Compensation Board	November 2002	Not Applicable
Coal Mining Affected Areas The Coal Authority - Mining Report Service	January 2006	As notified
Mining Instability Ove Arup & Partners	October 2000	Not Applicable
Non Coal Mining Areas of Great Britain British Geological Survey - National Geoscience Information Service	February 2009	Not Applicable
Potential for Collapsible Ground Stability Hazards British Geological Survey - National Geoscience Information Service	January 2010	Annually
Potential for Compressible Ground Stability Hazards British Geological Survey - National Geoscience Information Service	January 2010	Annually
Potential for Ground Dissolution Stability Hazards British Geological Survey - National Geoscience Information Service	January 2010	Annually
Potential for Landslide Ground Stability Hazards British Geological Survey - National Geoscience Information Service	January 2010	Annually
Potential for Running Sand Ground Stability Hazards British Geological Survey - National Geoscience Information Service	January 2010	Annually
Potential for Shrinking or Swelling Clay Ground Stability Hazards British Geological Survey - National Geoscience Information Service	January 2010	Annually
Radon Potential - Radon Affected Areas British Geological Survey - National Geoscience Information Service	May 2007	As notified
Radon Potential - Radon Protection Measures British Geological Survey - National Geoscience Information Service	May 2007	As notified
Industrial Land Use	**Version**	**Update Cycle**
Contemporary Trade Directory Entries Thomson Directories	August 2010	Quarterly
Fuel Station Entries Catalist Ltd - Experian Catalist	April 2010	Quarterly

Sensitive Land Use	Version	Update Cycle
Areas of Adopted Green Belt		
London Borough of Barnet	March 2010	As notified
London Borough of Enfield	March 2010	As notified
London Borough of Haringey	March 2010	As notified
London Borough of Waltham Forest	March 2010	As notified
Areas of Unadopted Green Belt		
London Borough of Barnet	March 2010	As notified
London Borough of Enfield	March 2010	As notified
London Borough of Haringey	March 2010	As notified
London Borough of Waltham Forest	March 2010	As notified
Areas of Outstanding Natural Beauty		
Natural England	July 2010	Bi-Annually
Environmentally Sensitive Areas		
Natural England	July 2010	Annually
Forest Parks		
Forestry Commission	April 1997	Not Applicable
Local Nature Reserves		
Natural England	October 2010	Bi-Annually
Marine Nature Reserves		
Natural England	September 2010	Bi-Annually
National Nature Reserves		
Natural England	October 2010	Bi-Annually
National Parks		
Natural England	August 2010	Bi-Annually
Nitrate Sensitive Areas		
Department for Environment, Food and Rural Affairs (DEFRA - formerly FRCA)	December 2009	Not Applicable
Nitrate Vulnerable Zones		
Department for Environment, Food and Rural Affairs (DEFRA - formerly FRCA)	February 2009	Annually
Ramsar Sites		
Natural England	August 2010	Bi-Annually
Sites of Special Scientific Interest		
Natural England	August 2010	Bi-Annually
Special Areas of Conservation		
Natural England	October 2010	Bi-Annually
Special Protection Areas		
Natural England	August 2010	Bi-Annually

Data Suppliers

A selection of organisations who provide data within this report

Data Supplier	Data Supplier Logo
Ordnance Survey	
Environment Agency	
Scottish Environment Protection Agency	
The Coal Authority	
British Geological Survey	
Centre for Ecology and Hydrology	
Countryside Council for Wales	
Scottish Natural Heritage	
Natural England	
Health Protection Agency	
Ove Arup	
Peter Brett Associates	

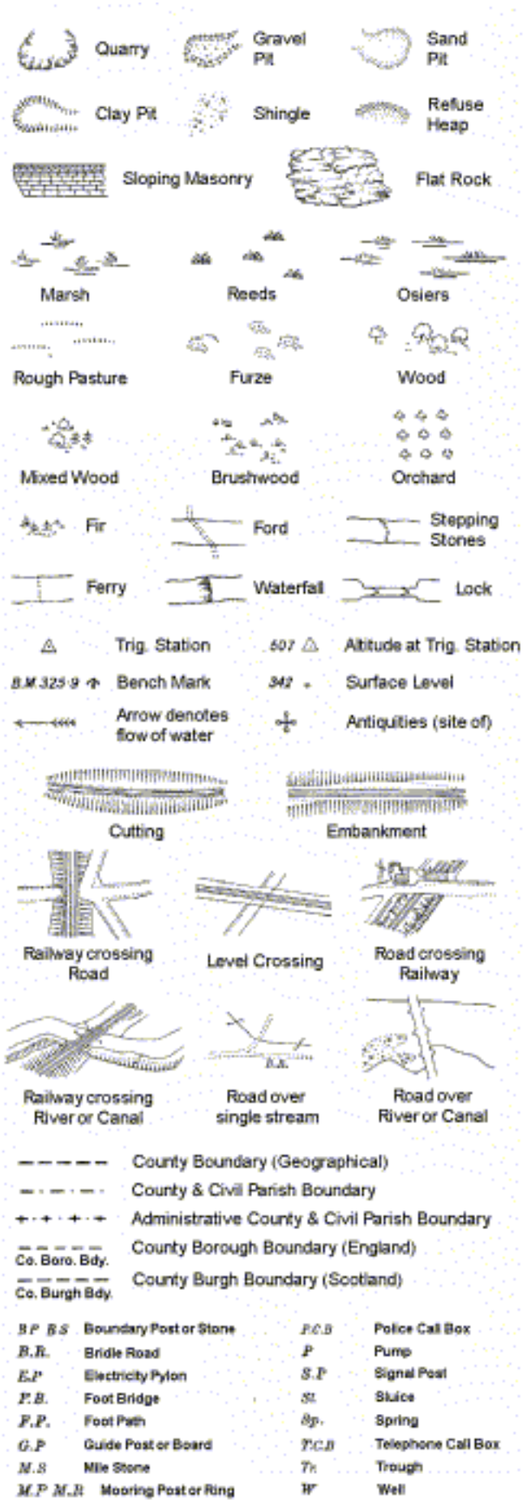
Useful Contacts

Contact	Name and Address	Contact Details
1	**Environment Agency - National Customer Contact Centre (NCCC)** PO Box 544, Templeborough, Rotherham, S60 1BY	Telephone: 08708 506 506 Email: enquiries@environment-agency.gov.uk
2	**London Borough of Haringey - Planning and Environmental Health** 639 High Road, Tottenham, London, N17 8BD	Telephone: 0208 489 5183 Fax: 0208 489 5117 Website: www.haringey.gov.uk
3	**London Borough of Camden - Pollution Projects Team** Seventh Floor, Town Hall Extension, Argyle Street, London, WC1H 8EQ	Telephone: 020 7278 4444 Fax: 020 7860 5713 Website: www.camden.gov.uk
4	**British Geological Survey - Enquiry Service** British Geological Survey, Kingsley Dunham Centre, Keyworth, Nottingham, Nottinghamshire, NG12 5GG	Telephone: 0115 936 3143 Fax: 0115 936 3276 Email: enquiries@bgs.ac.uk Website: www.bgs.ac.uk
5	**Natural England** Northminster House, Northminster Road, Peterborough, Cambridgeshire, PE1 1UA	Telephone: 0845 600 3078 Fax: 01733 455103 Email: enquiries@naturalengland.org.uk Website: www.naturalengland.org.uk
6	**London Borough of Camden** Town Hall, Judd Street, London, WC1H 9JE	Telephone: 020 7974 4444 Fax: 020 7974 6866 Email: info@camden.gov.uk Website: www.camden.gov.uk
7	**London Borough of Haringey - Planning Department** Civic Centre, 639 High Road, Tottenham, London, N17 8BD	Website: www.haringey.gov.uk
-	**Health Protection Agency - Radon Survey, Centre for Radiation, Chemical and Environmental Hazards** Chilton, Didcot, Oxfordshire, OX11 0RQ	Telephone: 01235 822622 Fax: 01235 833891 Email: radon@hpa.org.uk Website: www.hpa.org.uk
-	**Landmark Information Group Limited** The Smith Centre, Henley On Thames, Oxfordshire, RG9 6AB	Telephone: 0844 844 9952 Fax: 0844 844 9951 Email: customerservices@landmarkinfo.co.uk Website: www.landmarkinfo.co.uk

Please note that the Environment Agency / SEPA have a charging policy in place for enquiries.

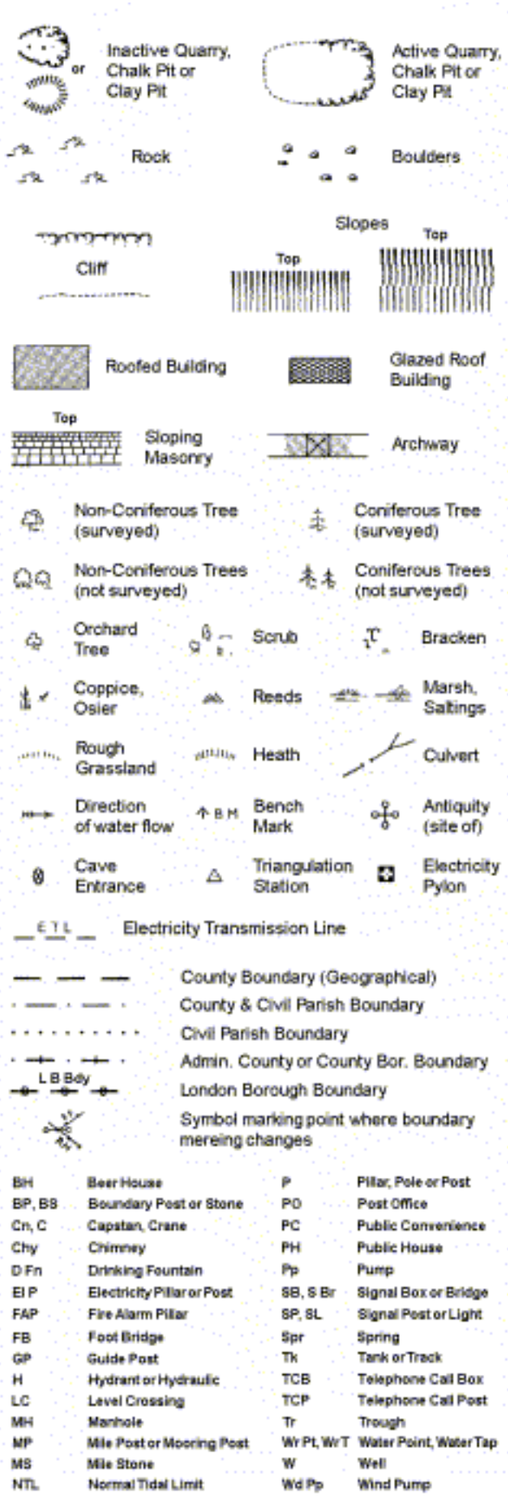
Historical Mapping Legends

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



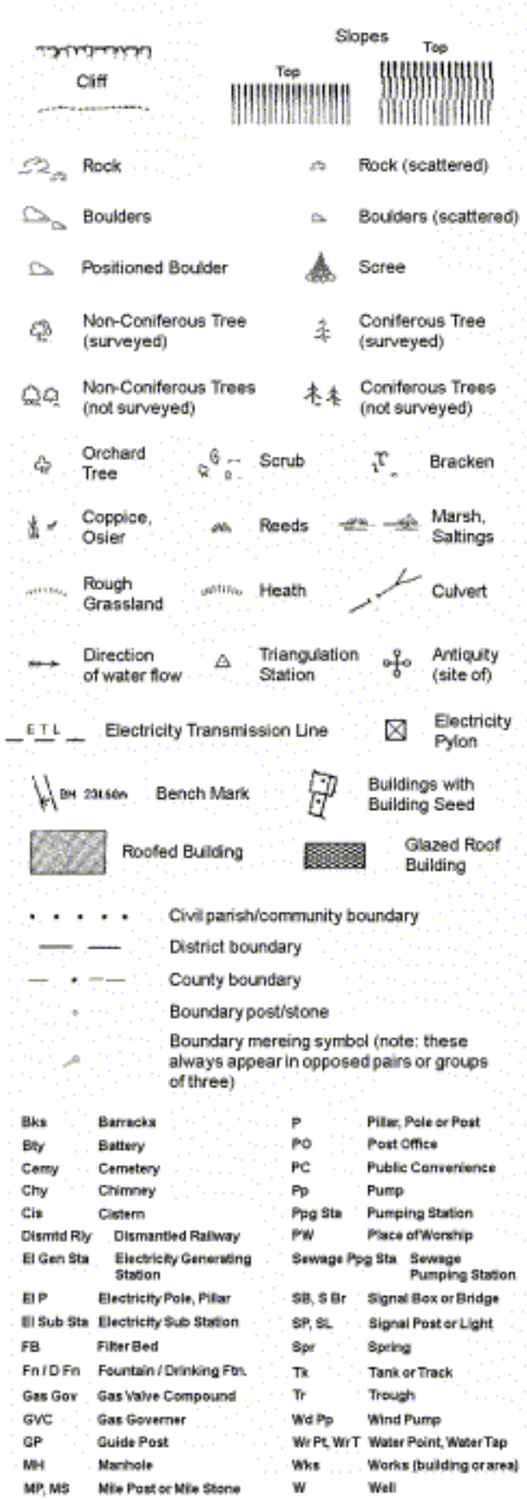
B.P B.S	Boundary Post or Stone	P.C.B	Police Call Box
B.R.	Bridle Road	P	Pump
E.P	Electricity Pylon	S.P	Signal Post
F.B.	Foot Bridge	Sl.	Sluice
F.P.	Foot Path	Sp.	Spring
G.P	Guide Post or Board	T.C.B	Telephone Call Box
M.S	Mile Stone	Tr.	Trough
M.P M.R	Mooring Post or Ring	W	Well

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



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

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



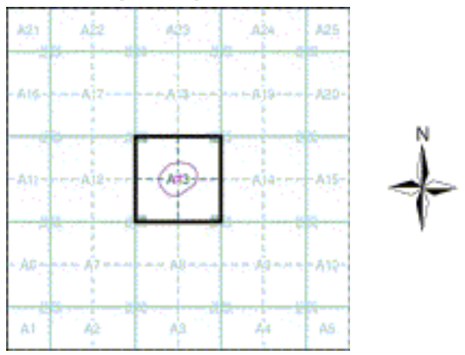
Bks	Barracks	P	Pillar, Pole or Post
Bty	Battery	PO	Post Office
Cemy	Cemetery	PC	Public Convenience
Chy	Chimney	Pp	Pump
Cis	Cistern	Ppg Sta	Pumping Station
Dismtd Rly	Dismantled Railway	PW	Place of Worship
El Gen Sta	Electricity Generating Station	Sewage Ppg Sta	Sewage Pumping Station
El P	Electricity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

STATS

Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Middlesex	1:2,500	1866	2
London	1:2,500	1870 - 1879	3
Middlesex	1:2,500	1894	4
Middlesex	1:2,500	1894	5
London	1:2,500	1896	6
London	1:2,500	1915	7
London	1:2,500	1934 - 1936	8
Historical Aerial Photography	1:1,250	1946 - 1949	9
Ordnance Survey Plan	1:2,500	1952 - 1953	10
Ordnance Survey Plan	1:1,250	1952	11
Additional SIMs	1:1,250	1952	12
Additional SIMs	1:2,500	1953	13
Ordnance Survey Plan	1:1,250	1962 - 1980	14
Additional SIMs	1:1,250	1968	15
Ordnance Survey Plan	1:2,500	1970	16
Supply of Unpublished Survey Information	1:1,250	1974	17
Supply of Unpublished Survey Information	1:1,250	1976	18
Ordnance Survey Plan	1:1,250	1979	19
Large-Scale National Grid Data	1:1,250	1991	20
Large-Scale National Grid Data	1:1,250	1996	21

Historical Map - Segment A13



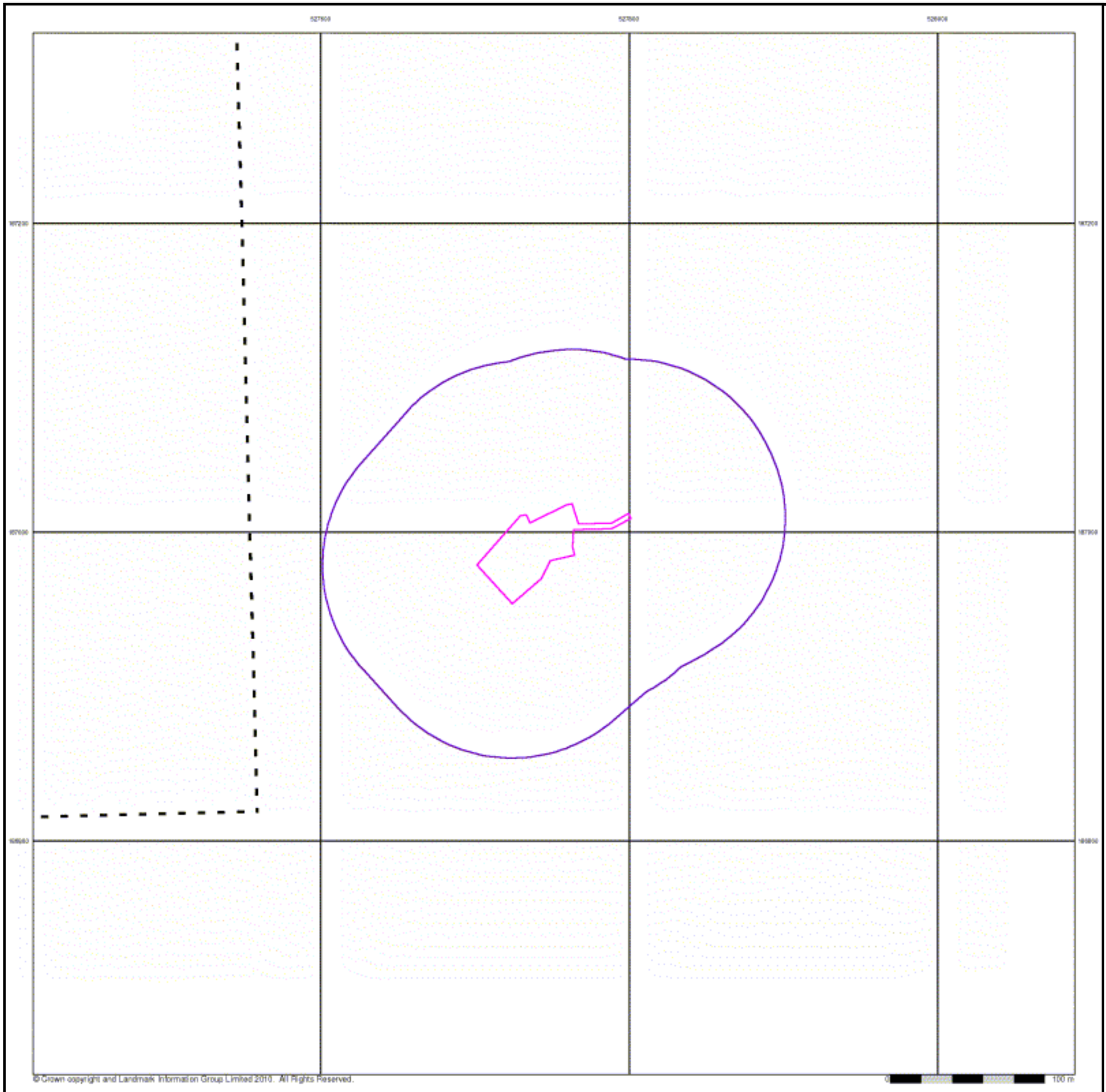
Order Details

Order Number: 33075032_1_1
Customer Ref: 241830
National Grid Reference: 527750, 186990
Slice: A
Site Area (Ha): 0.23
Search Buffer (m): 100

Site Details

The Water House, Millfield Lane, London, N6 6HQ

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



STATS

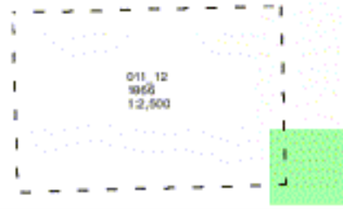
Middlesex

Published 1866

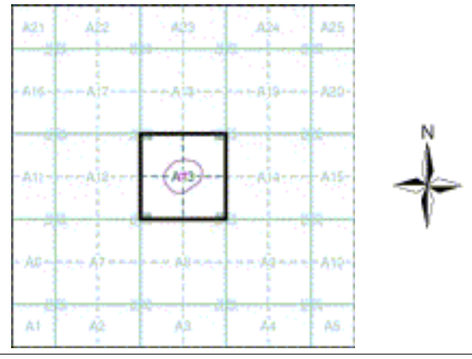
Source map scale - 1:2,500

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:	33075032_1_1
Customer Ref:	241830
National Grid Reference:	527750, 186990
Slice:	A
Site Area (Ha):	0.23
Search Buffer (m):	100

Site Details

The Water House, Millfield Lane, London, N6 6HQ

Landmark Information Group

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

STATS

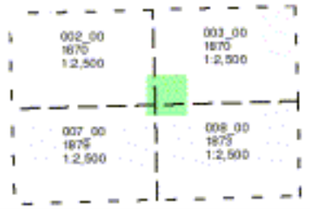
London

Published 1870 - 1879

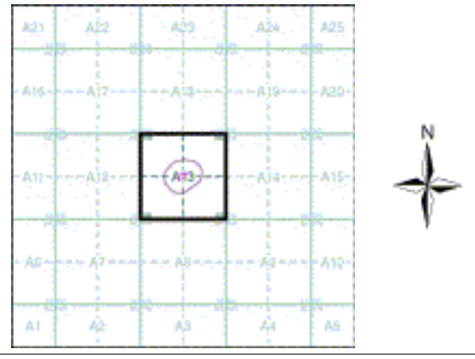
Source map scale - 1:2,500

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

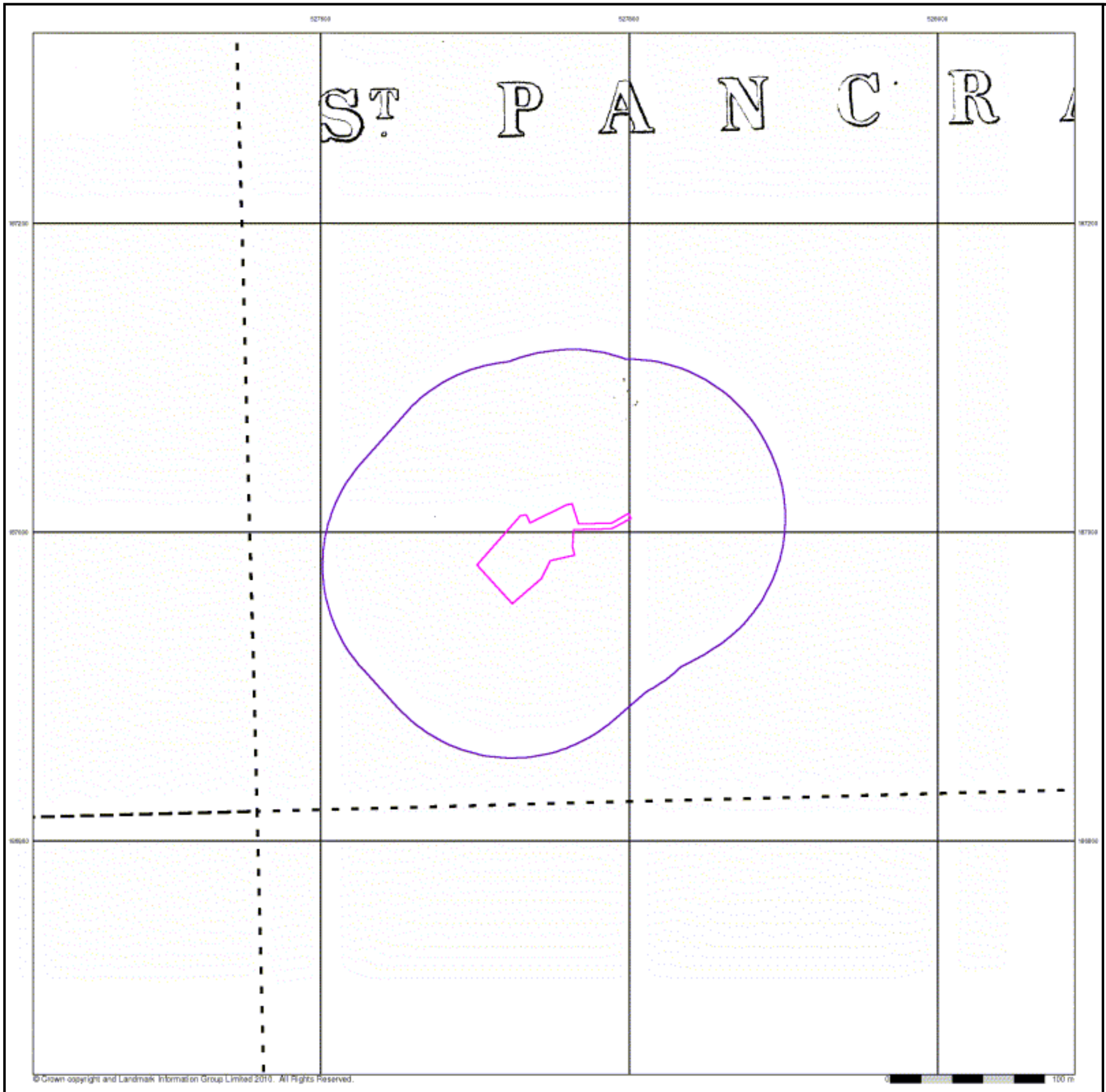
Order Number:	33075032_1_1
Customer Ref:	241830
National Grid Reference:	527750, 186990
Slice:	A
Site Area (Ha):	0.23
Search Buffer (m):	100

Site Details

The Water House, Millfield Lane, London, N6 6HQ

Landmark Information Group

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



STATS

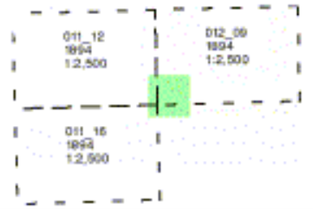
Middlesex

Published 1894

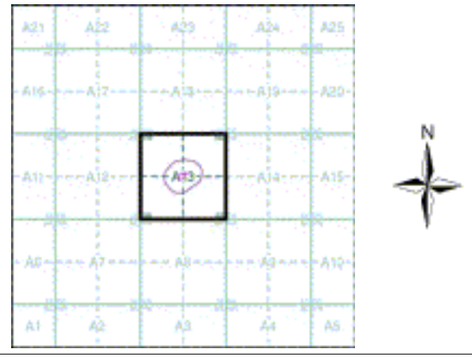
Source map scale - 1:2,500

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

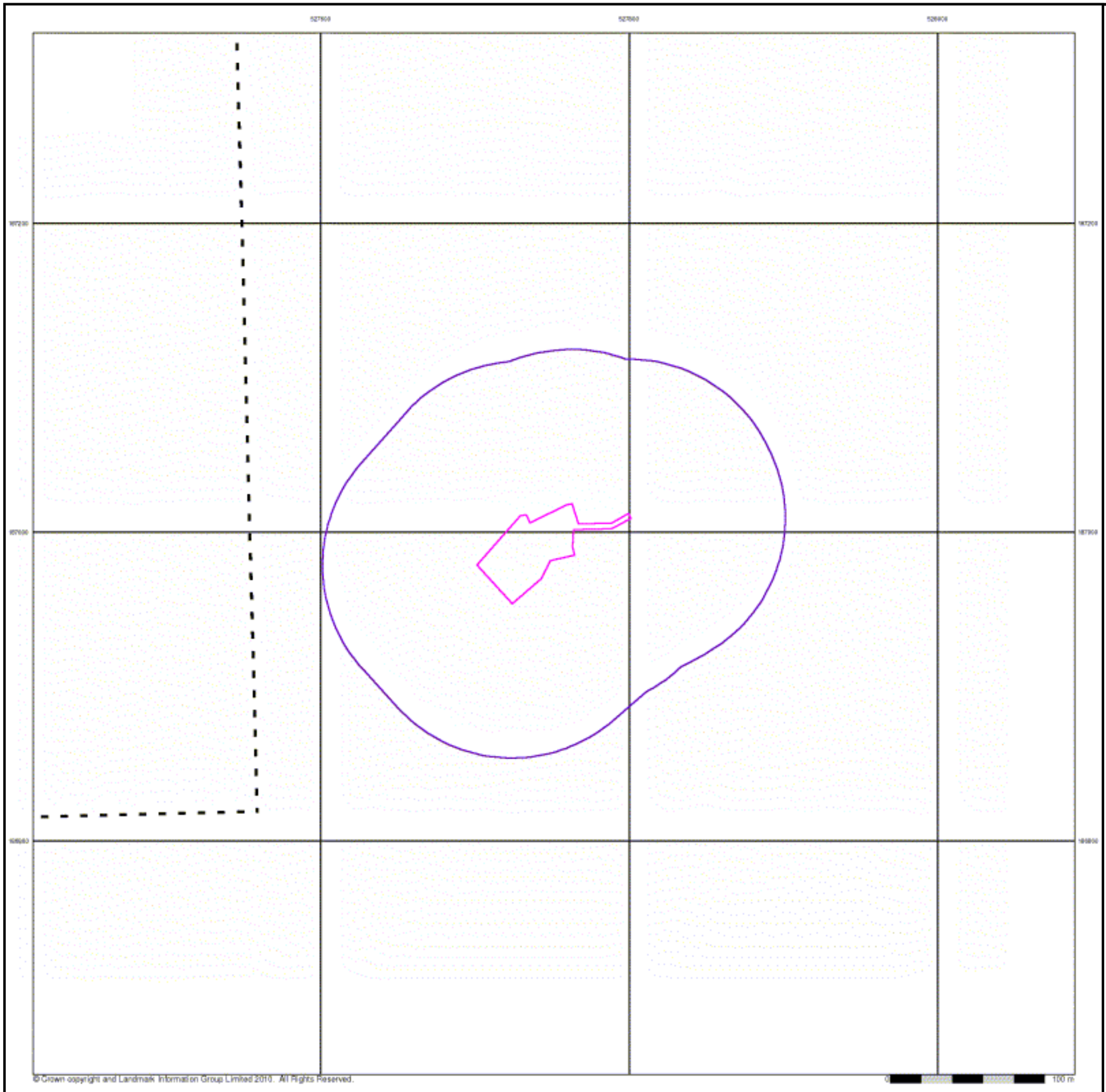
Order Number:	33075032_1_1
Customer Ref:	241830
National Grid Reference:	527750, 186990
Slice:	A
Site Area (Ha):	0.23
Search Buffer (m):	100

Site Details

The Water House, Millfield Lane, London, N6 6HQ

Landmark Information Group

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



STATS

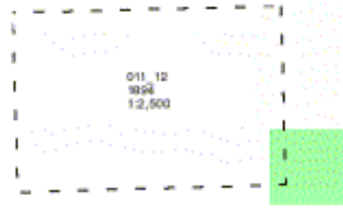
Middlesex

Published 1894

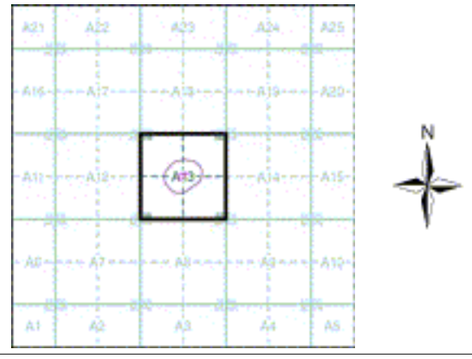
Source map scale - 1:2,500

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

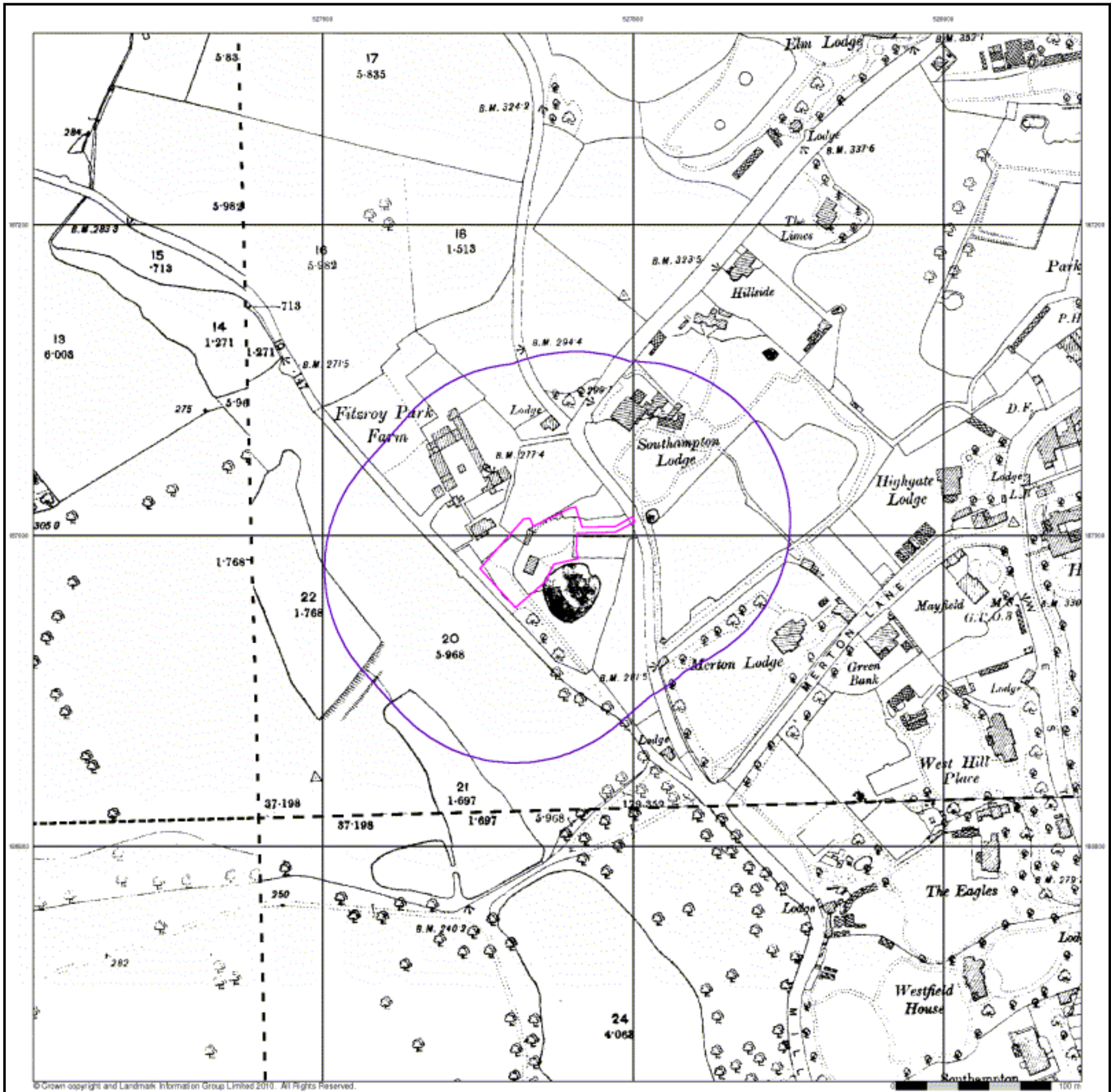
Order Number:	33075032_1_1
Customer Ref:	241830
National Grid Reference:	527750, 186990
Slice:	A
Site Area (Ha):	0.23
Search Buffer (m):	100

Site Details

The Water House, Millfield Lane, London, N6 6HQ

Landmark Information Group

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



STATS

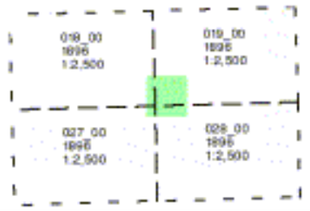
London

Published 1896

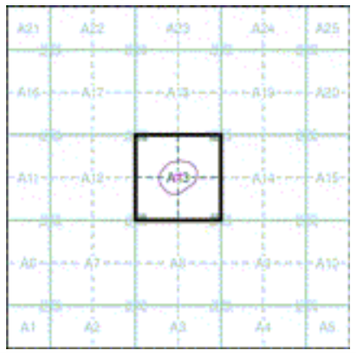
Source map scale - 1:2,500

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

Map Name(s) and Date(s)



Historical Map - Segment A13



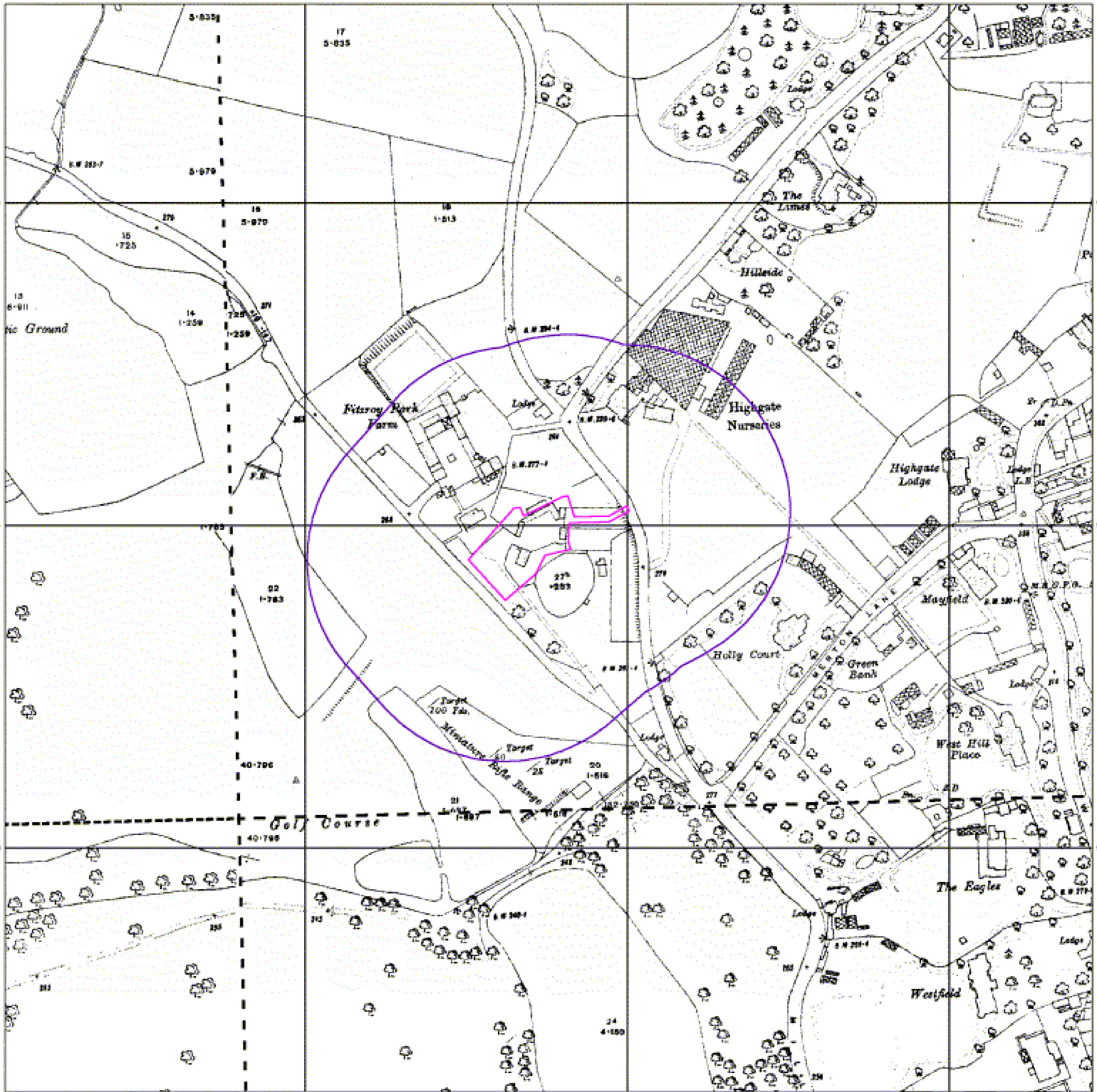
Order Details

Order Number:	33075032_1_1
Customer Ref:	241830
National Grid Reference:	527750, 186990
Slice:	A
Site Area (Ha):	0.23
Search Buffer (m):	100

Site Details

The Water House, Millfield Lane, London, N6 6HQ

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



STATS

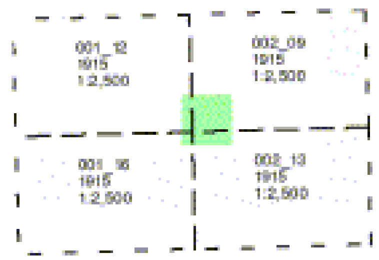
London

Published 1915

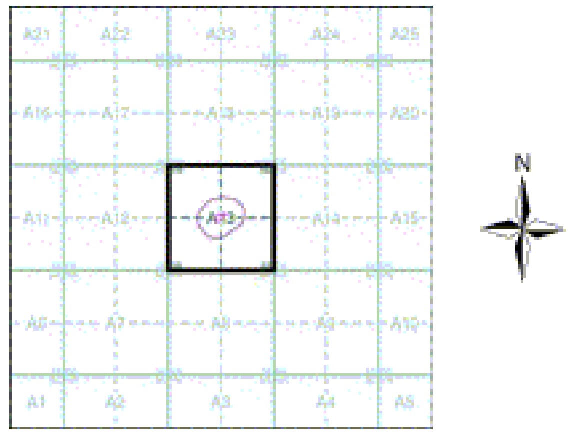
Source map scale - 1:2,500

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

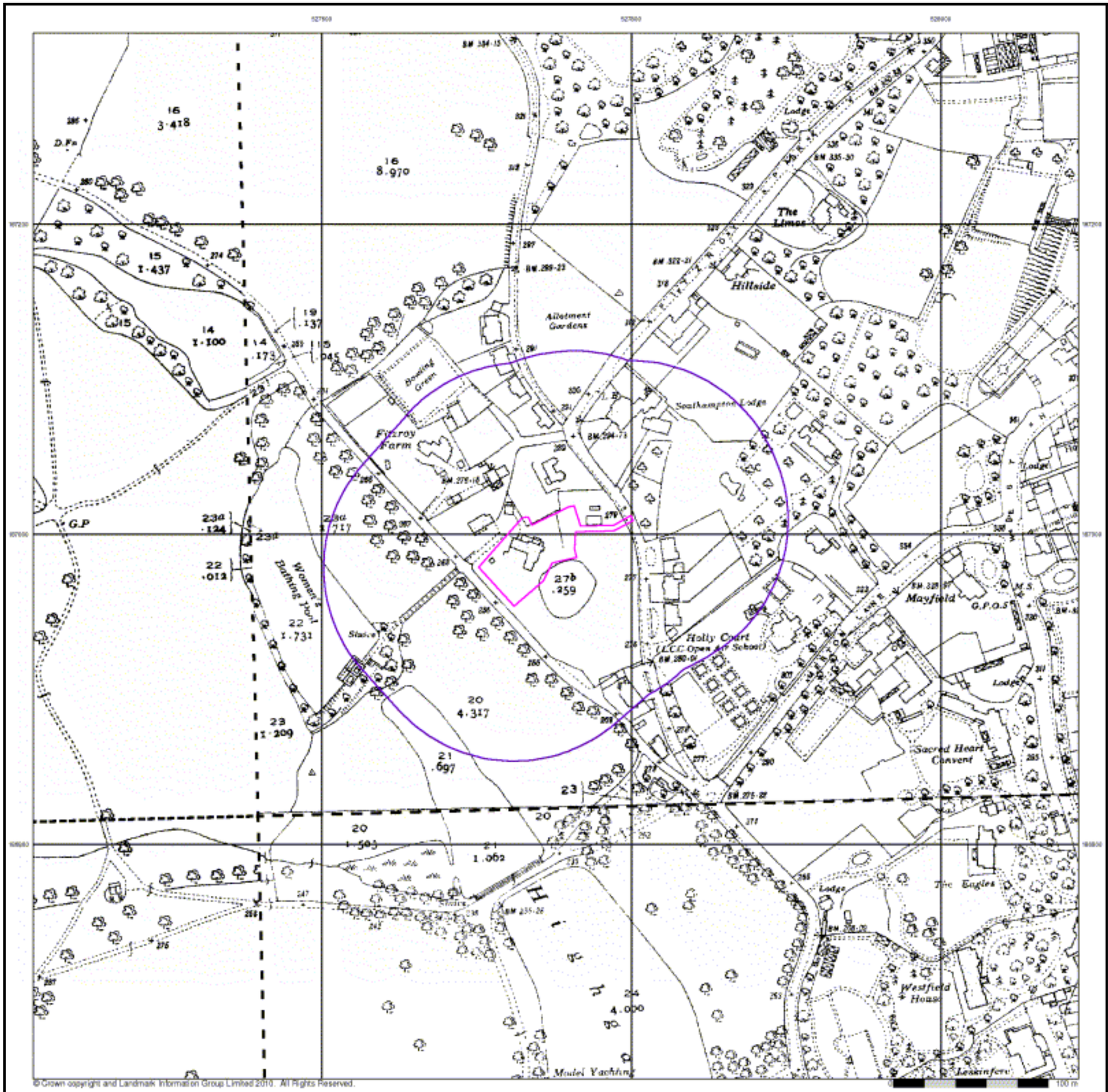
Order Number: 33075032_1_1
Customer Ref: 241830
National Grid Reference: 527750, 186990
Slice: A
Site Area (Ha): 0.23
Search Buffer (m): 100

Site Details

The Water House, Millfield Lane, London, N6 6HQ

Landmark Information Group

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



STATS

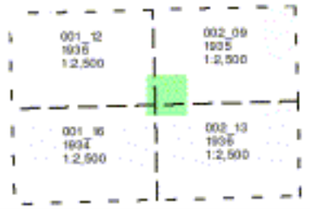
London

Published 1934 - 1936

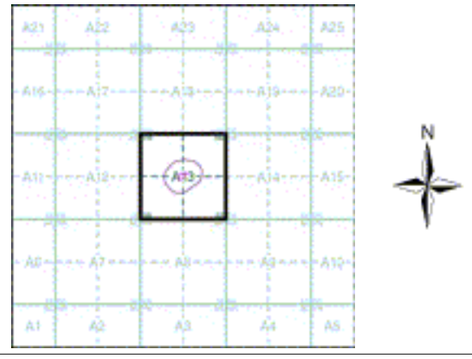
Source map scale - 1:2,500

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



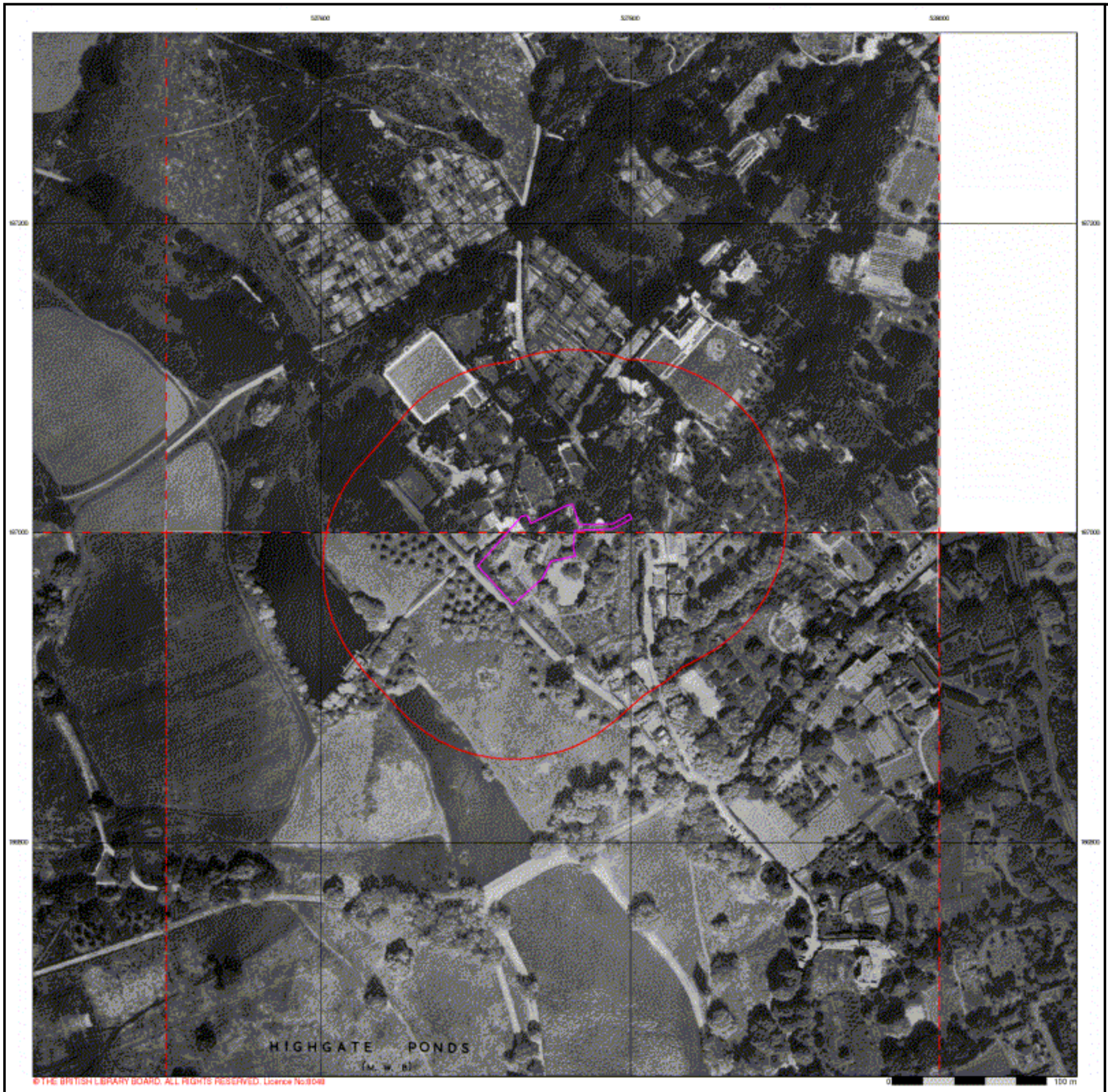
Order Details

Order Number:	33075032_1_1
Customer Ref:	241830
National Grid Reference:	527750, 186990
Slice:	A
Site Area (Ha):	0.23
Search Buffer (m):	100

Site Details

The Water House, Millfield Lane, London, N6 6HQ

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



STATS

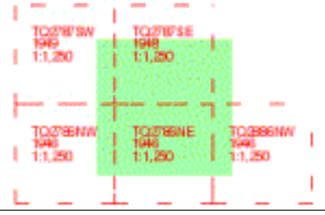
Historical Aerial Photography

Published 1946 - 1949

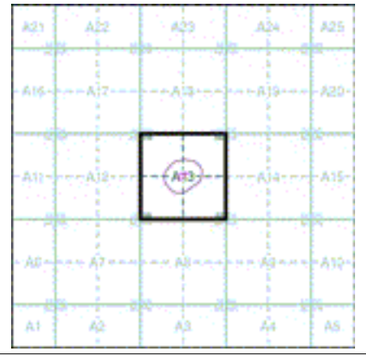
Source map scale - 1:1,250

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

Map Name(s) and Date(s)



Historical Aerial Photography - Segment A13



Order Details

Order Number:	33075032_1_1
Customer Ref:	241830
National Grid Reference:	527750, 186990
Slice:	A
Site Area (Ha):	0.23
Search Buffer (m):	100

Site Details

The Water House, Millfield Lane, London, N6 6HQ

Landmark Information Group

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

STATS

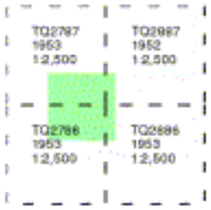
Ordnance Survey Plan

Published 1952 - 1953

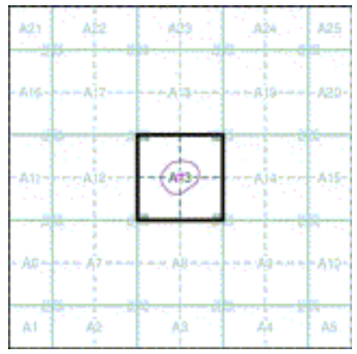
Source map scale - 1:2,500

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



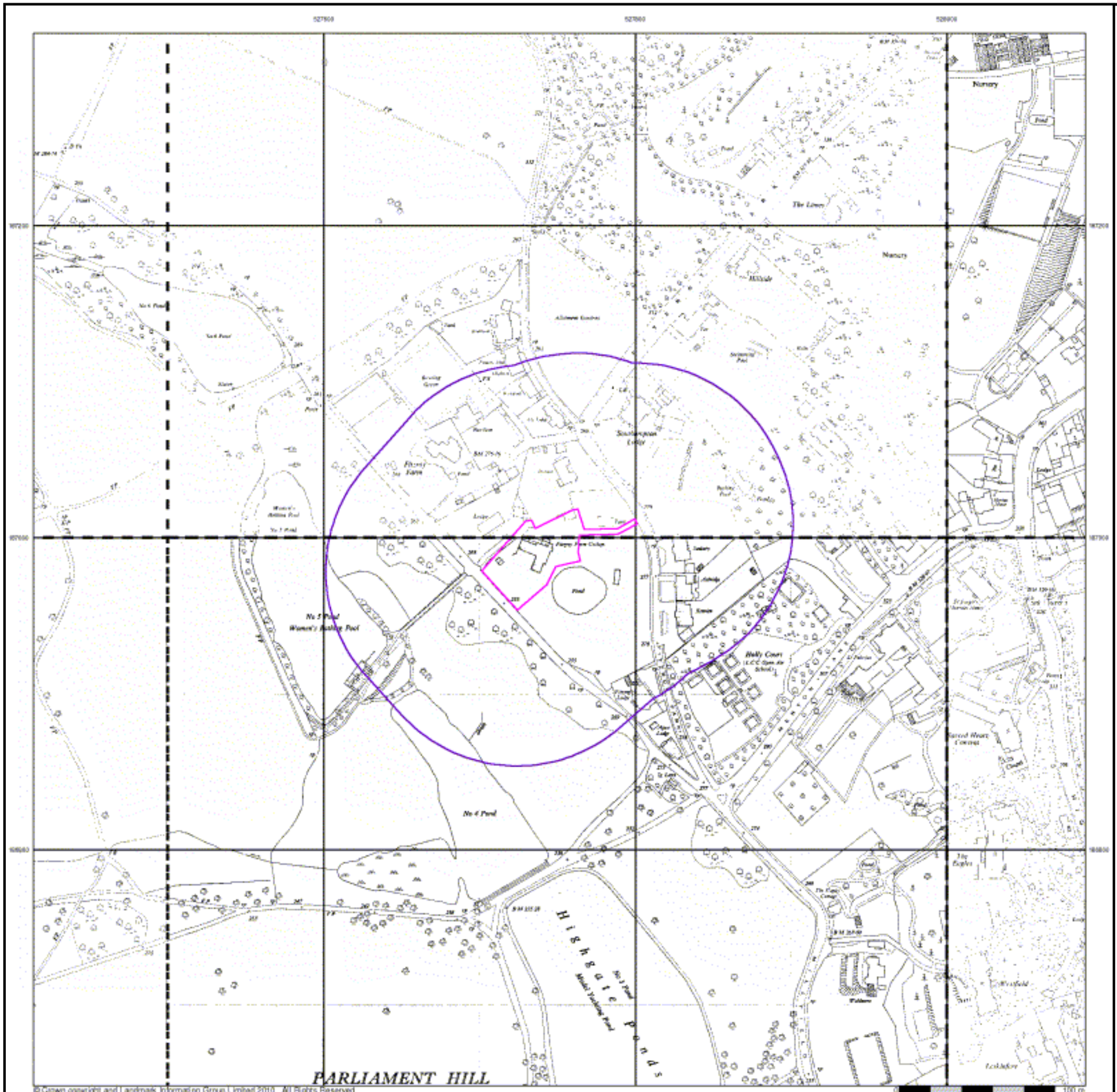
Order Details

Order Number:	33075032_1_1
Customer Ref:	241830
National Grid Reference:	527750, 186990
Slice:	A
Site Area (Ha):	0.23
Search Buffer (m):	100

Site Details

The Water House, Millfield Lane, London, N6 6HQ

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



STATS

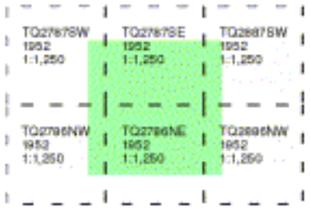
Ordnance Survey Plan

Published 1952

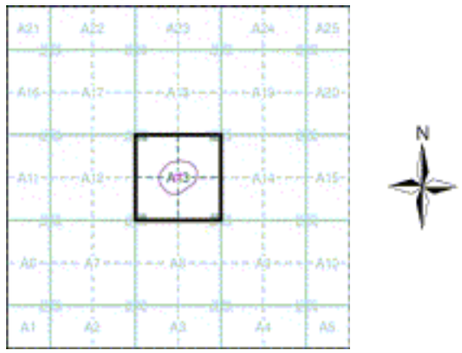
Source map scale - 1:1,250

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

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

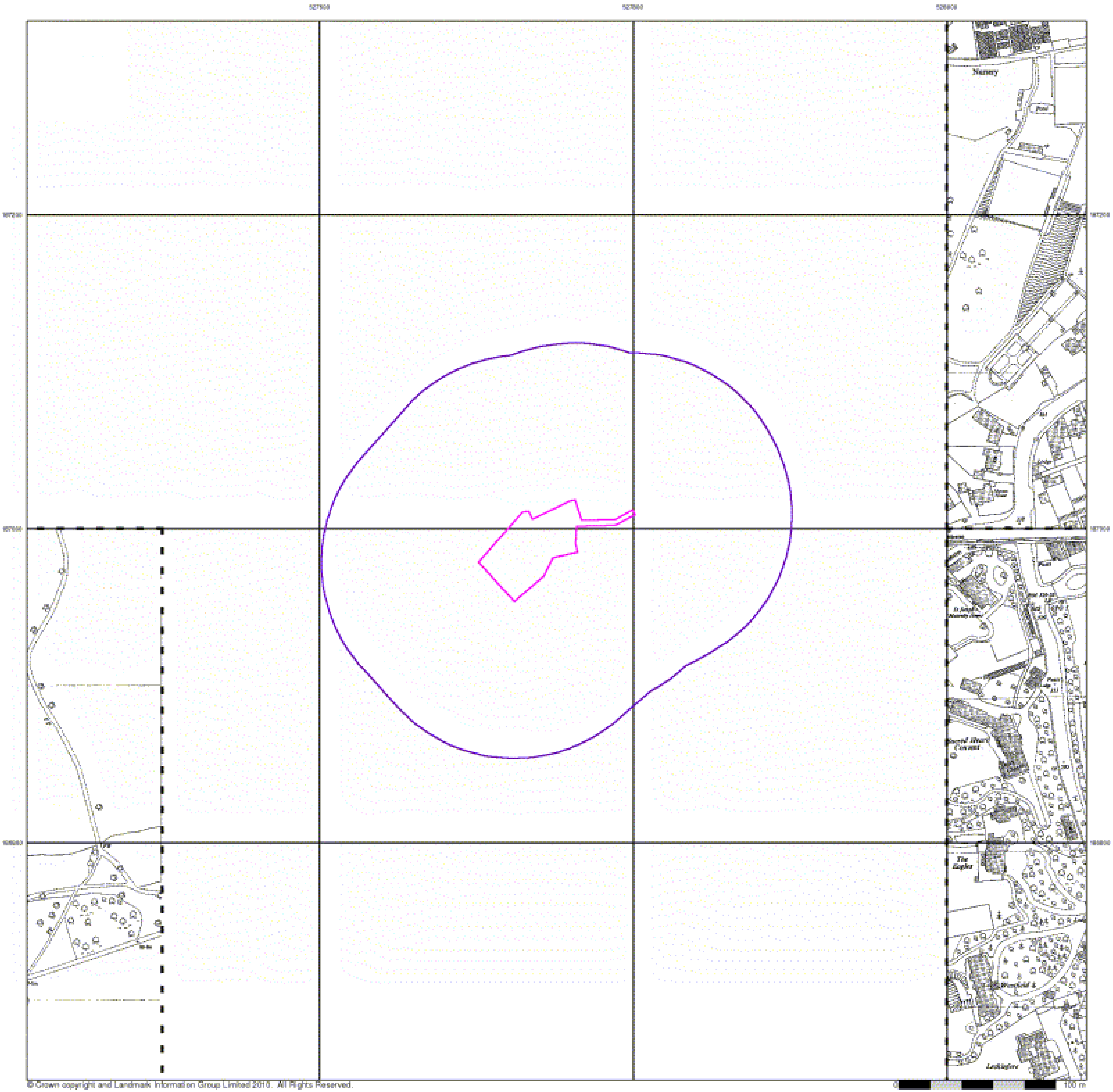
Order Number:	33075032_1_1
Customer Ref:	241830
National Grid Reference:	527750, 186990
Slice:	A
Site Area (Ha):	0.23
Search Buffer (m):	100

Site Details

The Water House, Millfield Lane, London, N6 6HQ

Landmark Information Group

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



STATS

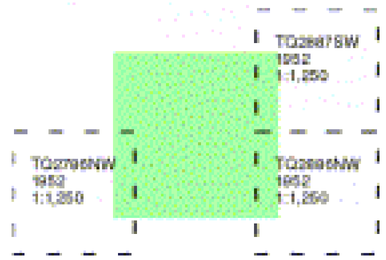
Additional SIMs

Published 1952

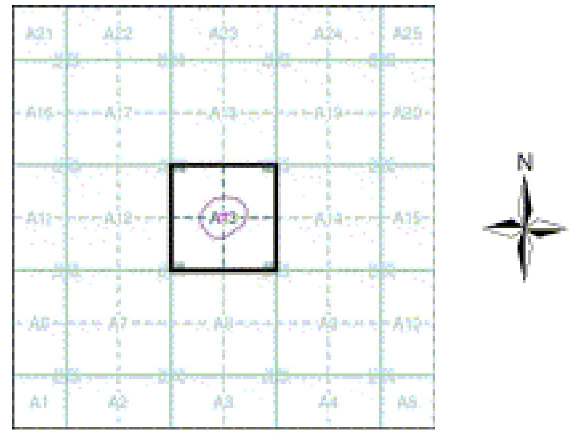
Source map scale - 1:1,250

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

Map Name(s) and Date(s)



Historical Map - Segment A13



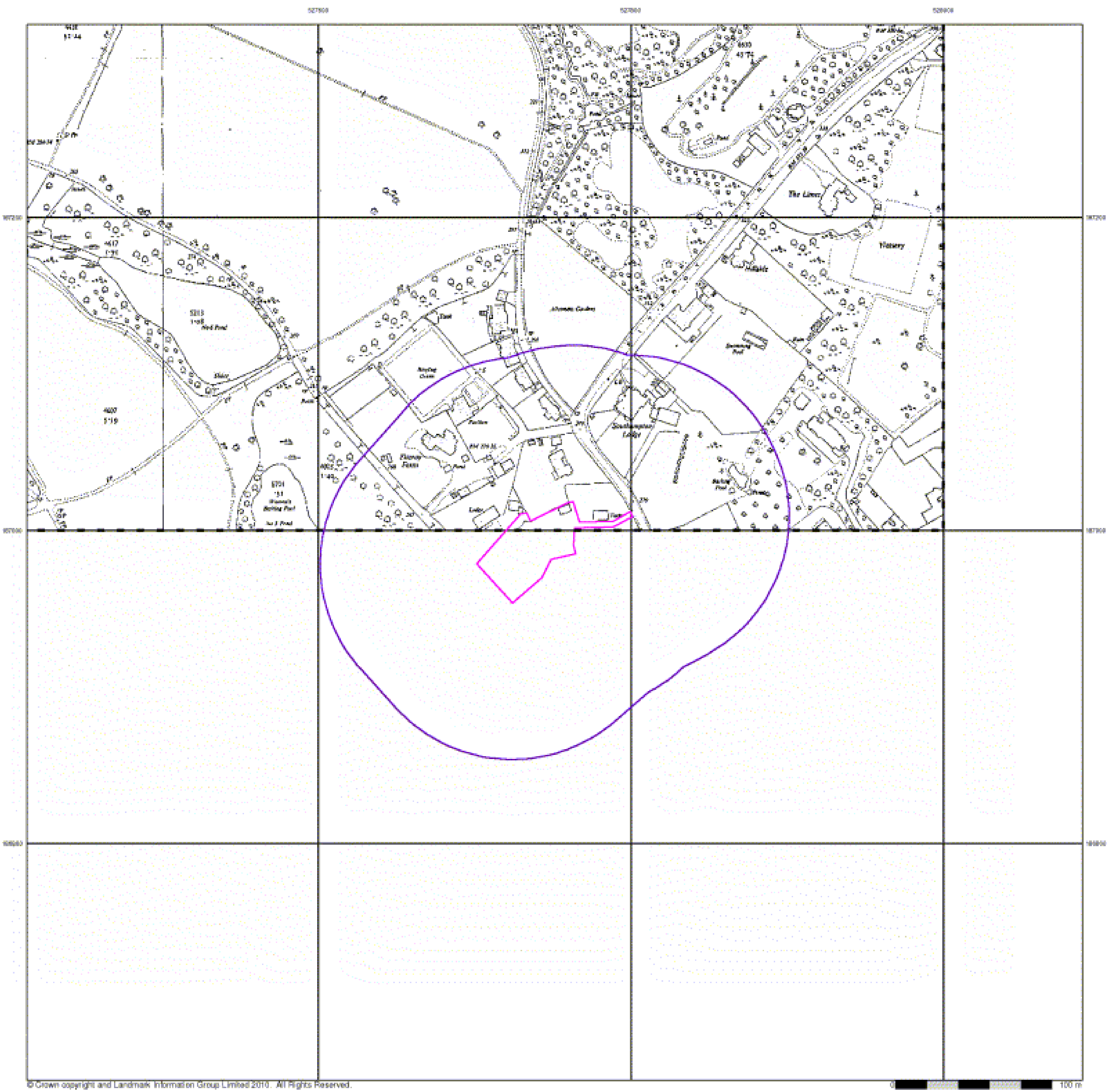
Order Details

Order Number: 33075032_1_1
Customer Ref: 241830
National Grid Reference: 527750, 186990
Slice: A
Site Area (Ha): 0.23
Search Buffer (m): 100

Site Details

The Water House, Millfield Lane, London, N6 6HQ

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



STATS

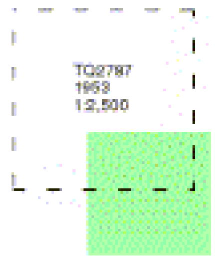
Additional SIMs

Published 1953

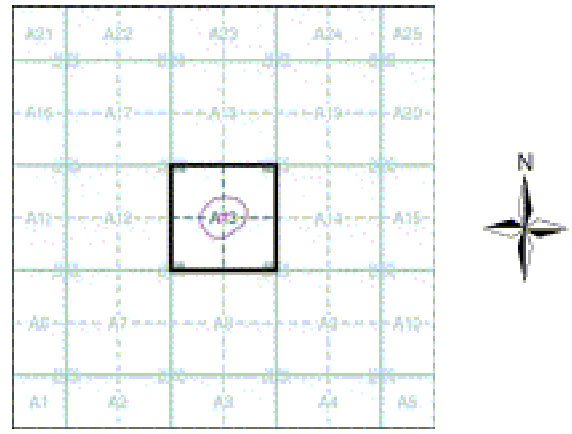
Source map scale - 1:2,500

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

Map Name(s) and Date(s)



Historical Map - Segment A13



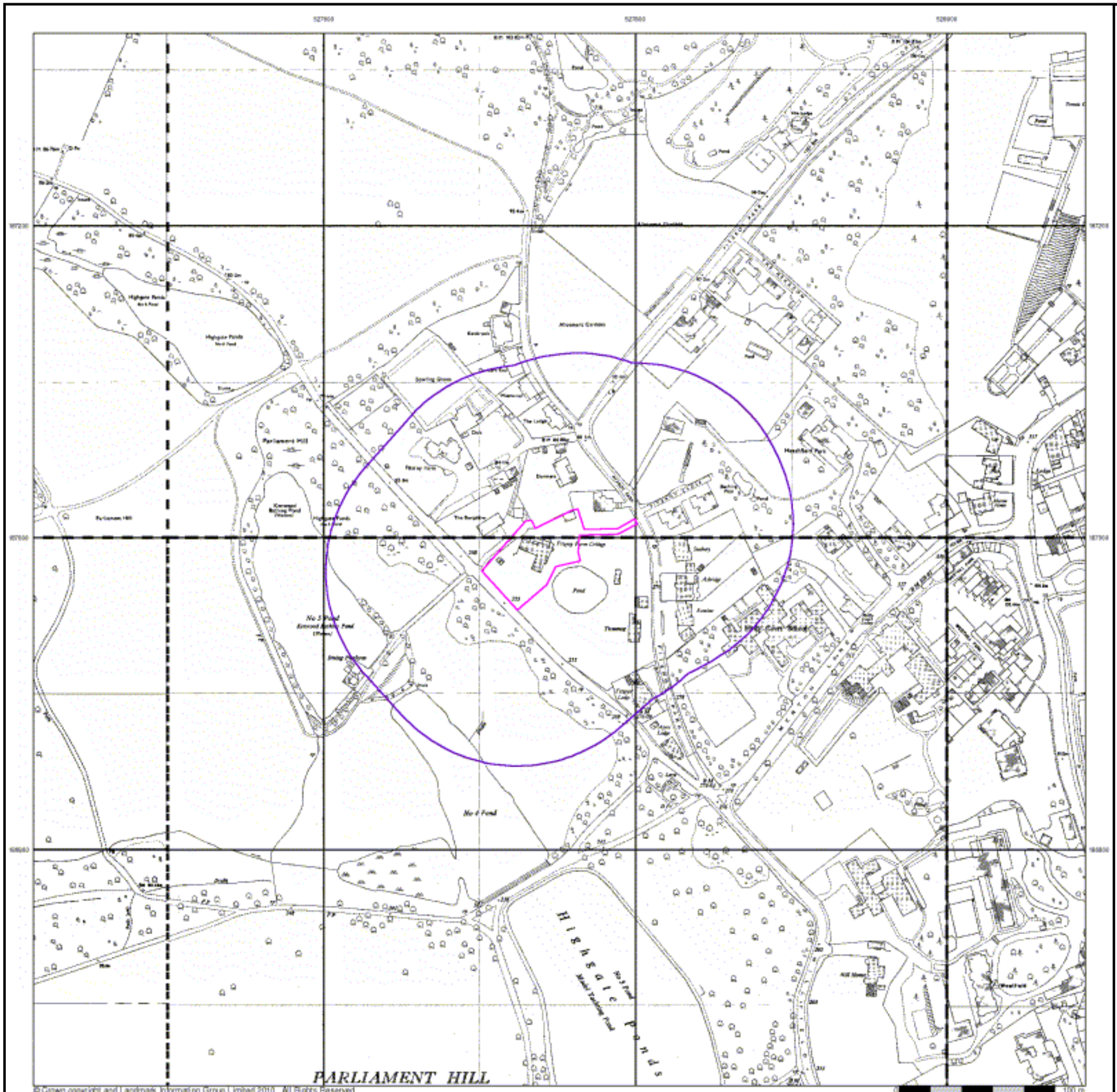
Order Details

Order Number: 33075032_1_1
Customer Ref: 241830
National Grid Reference: 527750, 186990
Slice: A
Site Area (Ha): 0.23
Search Buffer (m): 100

Site Details

The Water House, Millfield Lane, London, N6 6HQ

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



STATS

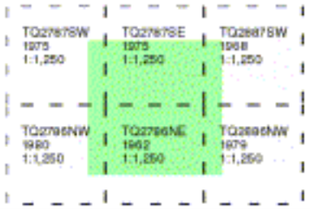
Ordnance Survey Plan

Published 1962 - 1980

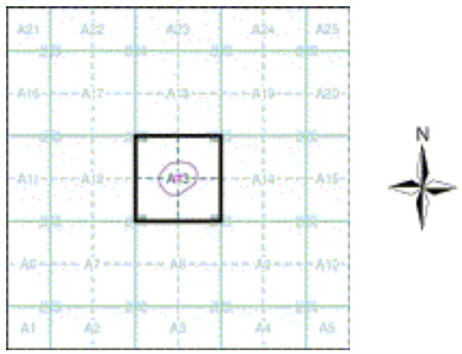
Source map scale - 1:1,250

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

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

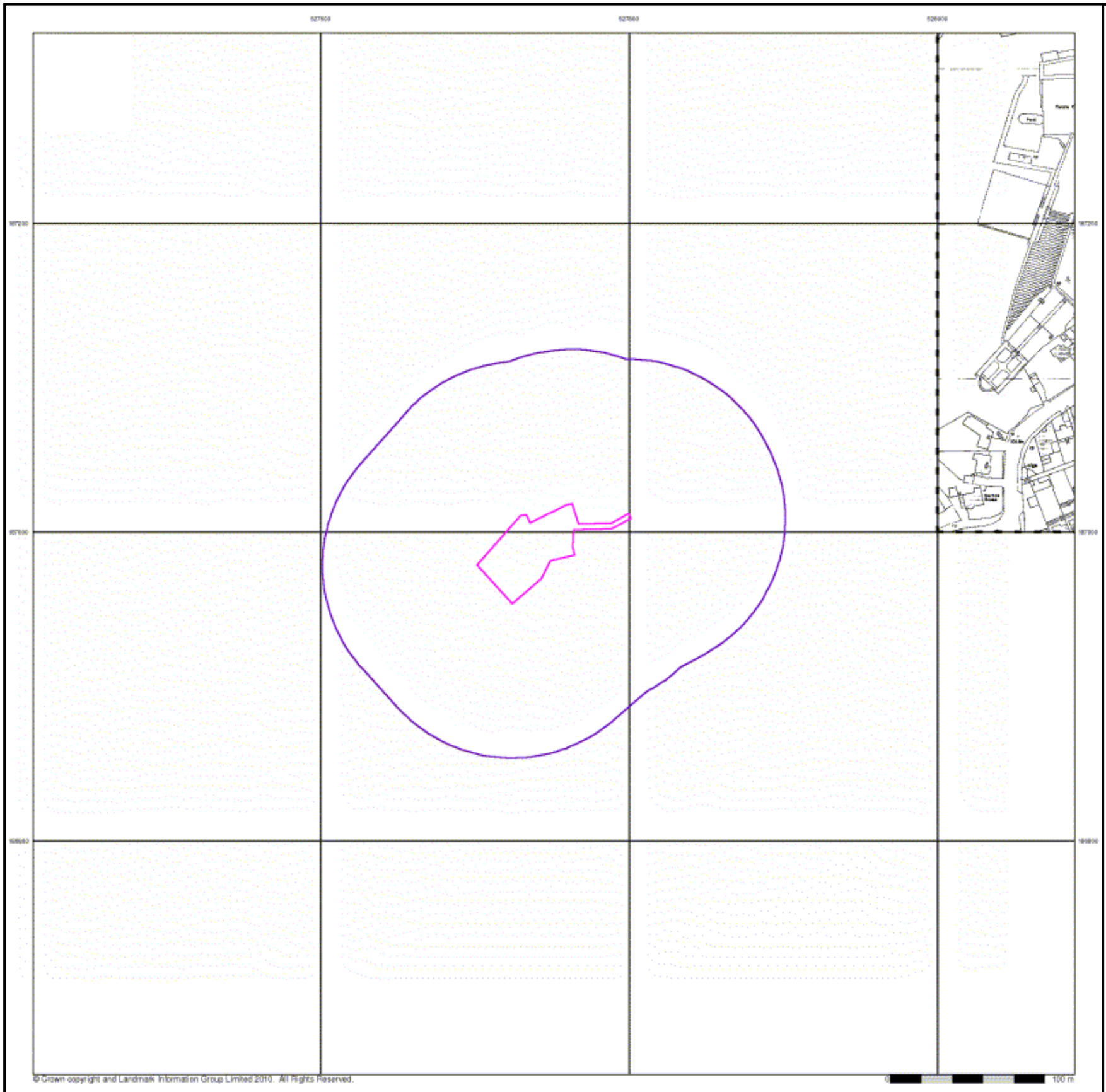
Order Number:	33075032_1_1
Customer Ref:	241830
National Grid Reference:	527750, 186990
Slice:	A
Site Area (Ha):	0.23
Search Buffer (m):	100

Site Details

The Water House, Millfield Lane, London, N6 6HQ

Landmark Information Group

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



STATS

Additional SIMs

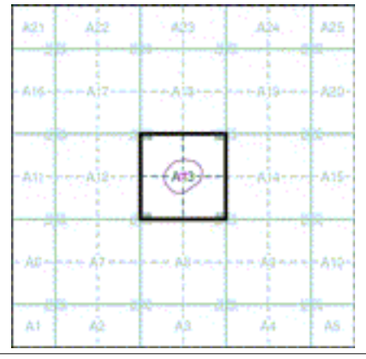
Published 1968

Source map scale - 1:1,250

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

Map Name(s) and Date(s)

Historical Map - Segment A13



Order Details

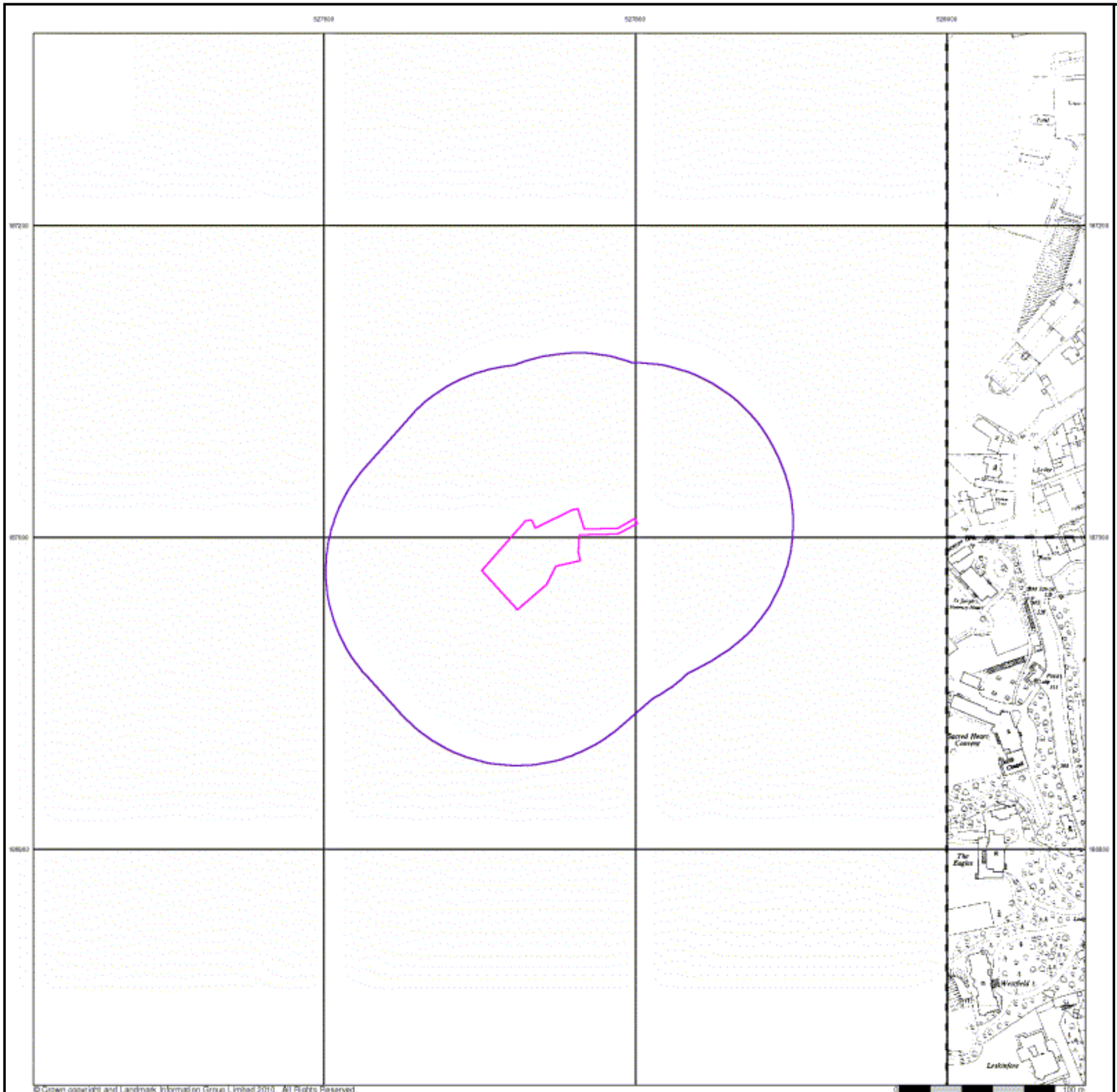
Order Number:	33075032_1_1
Customer Ref:	241830
National Grid Reference:	527750, 186990
Slice:	A
Site Area (Ha):	0.23
Search Buffer (m):	100

Site Details

The Water House, Millfield Lane, London, N6 6HQ

Landmark Information Group

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



STATS

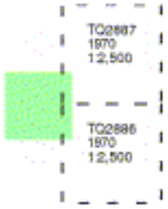
Ordnance Survey Plan

Published 1970

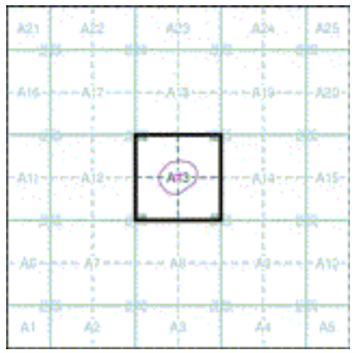
Source map scale - 1:2,500

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

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

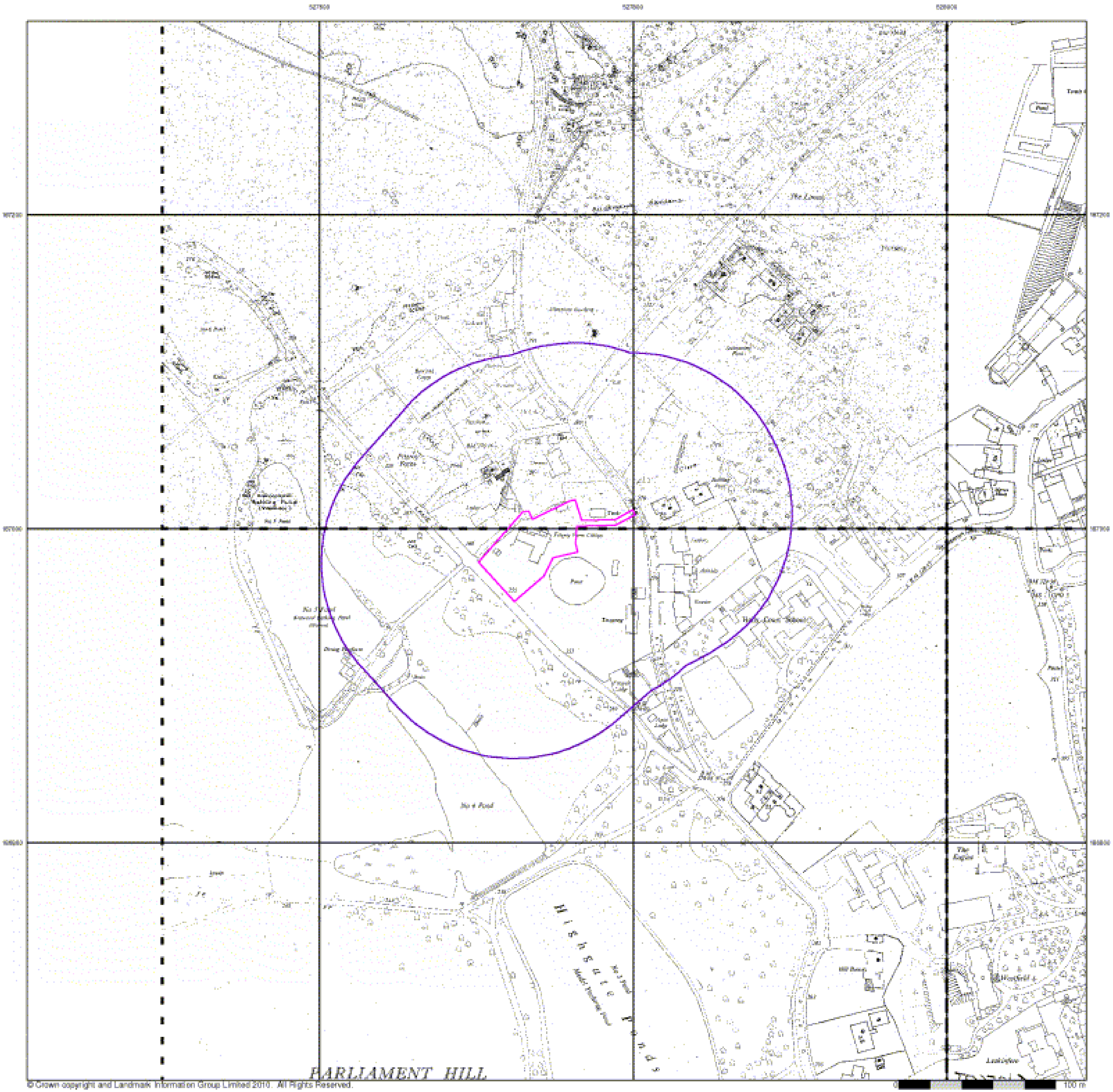
Order Number:	33075032_1_1
Customer Ref:	241830
National Grid Reference:	527750, 186990
Slice:	A
Site Area (Ha):	0.23
Search Buffer (m):	100

Site Details

The Water House, Millfield Lane, London, N6 6HQ

Landmark Information Group

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



STATS

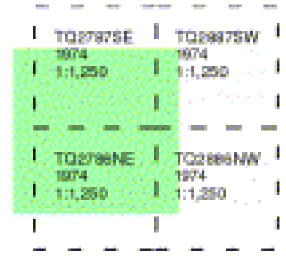
Supply of Unpublished Survey Information

Published 1974

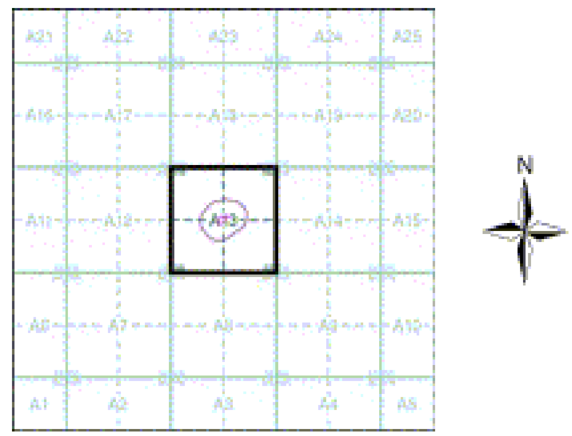
Source map scale - 1:1,250

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

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

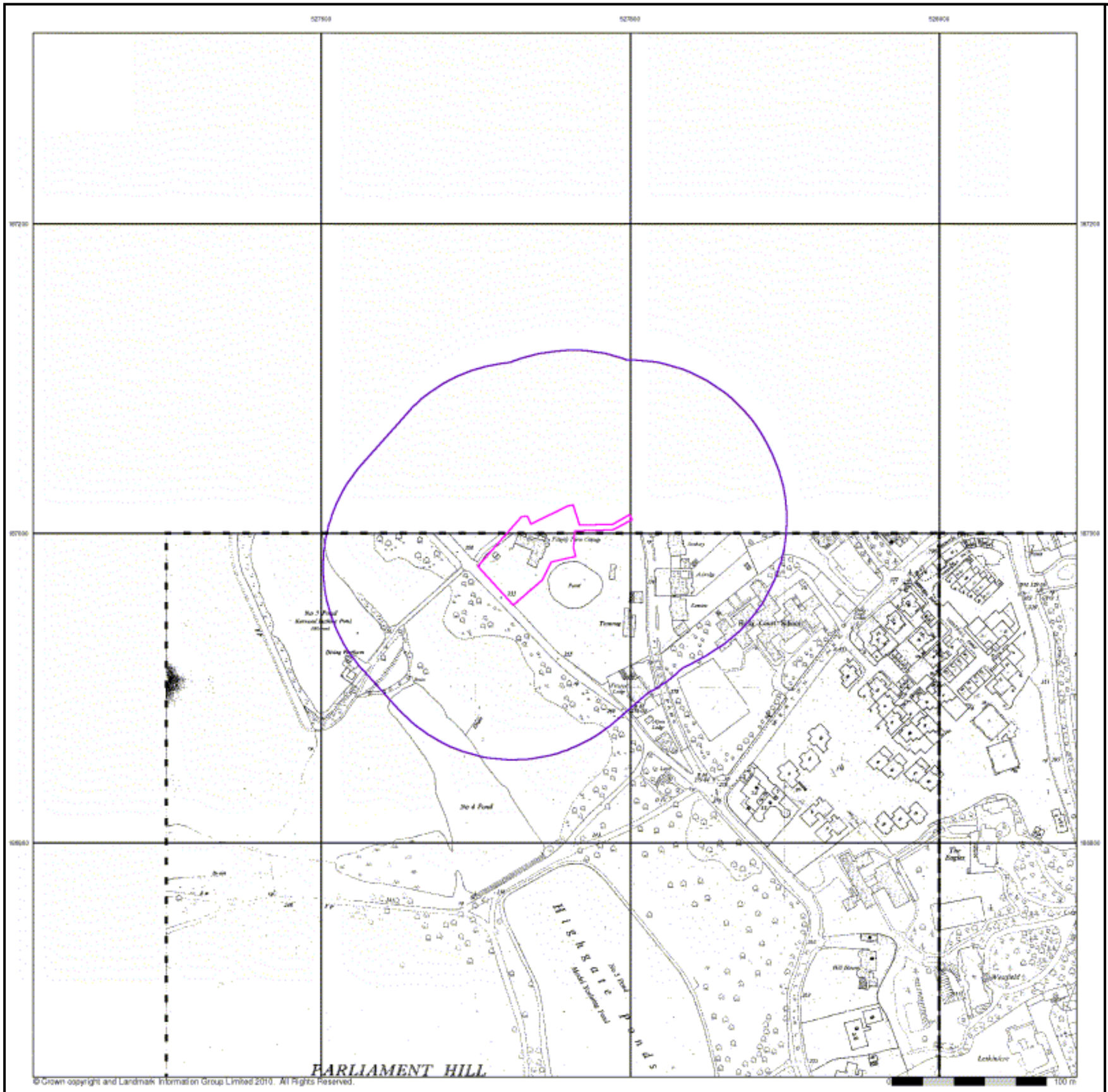
Order Number:	33075032_1_1
Customer Ref:	241830
National Grid Reference:	527750, 186990
Slice:	A
Site Area (Ha):	0.23
Search Buffer (m):	100

Site Details

The Water House, Millfield Lane, London, N6 6HQ

Landmark Information Group

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



STATS

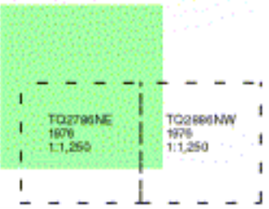
Supply of Unpublished Survey Information

Published 1976

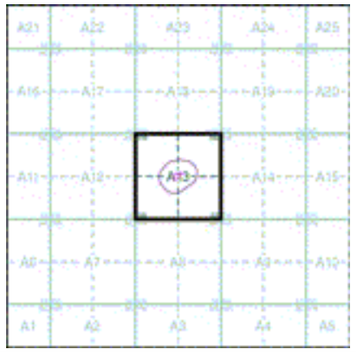
Source map scale - 1:1,250

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

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	33075032_1_1
Customer Ref:	241830
National Grid Reference:	527750, 186990
Slice:	A
Site Area (Ha):	0.23
Search Buffer (m):	100

Site Details

The Water House, Millfield Lane, London, N6 6HQ

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

STATS

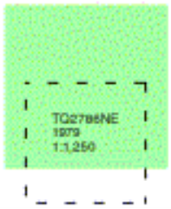
Ordnance Survey Plan

Published 1979

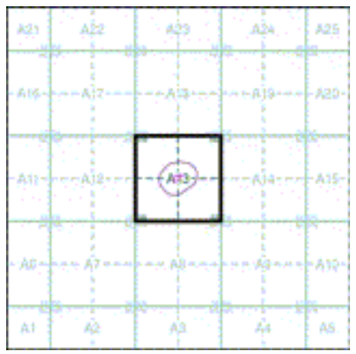
Source map scale - 1:1,250

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

Map Name(s) and Date(s)



Historical Map - Segment A13



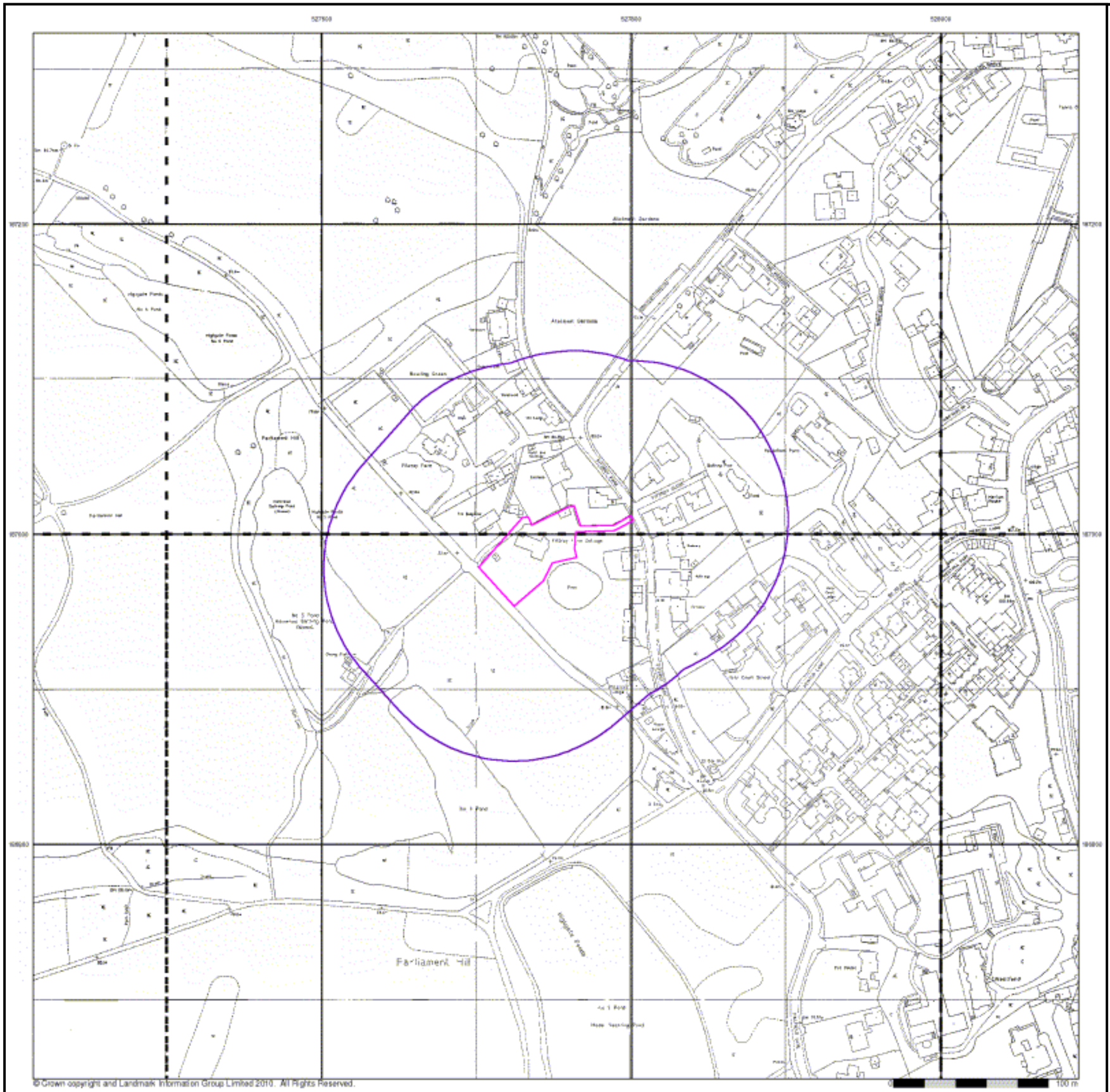
Order Details

Order Number:	33075032_1_1
Customer Ref:	241830
National Grid Reference:	527750, 186990
Slice:	A
Site Area (Ha):	0.23
Search Buffer (m):	100

Site Details

The Water House, Millfield Lane, London, N6 6HQ

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



STATS

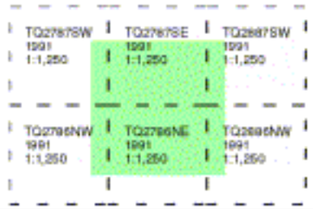
Large-Scale National Grid Data

Published 1991

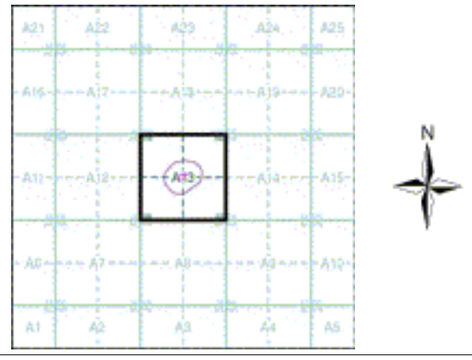
Source map scale - 1:1,250

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

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

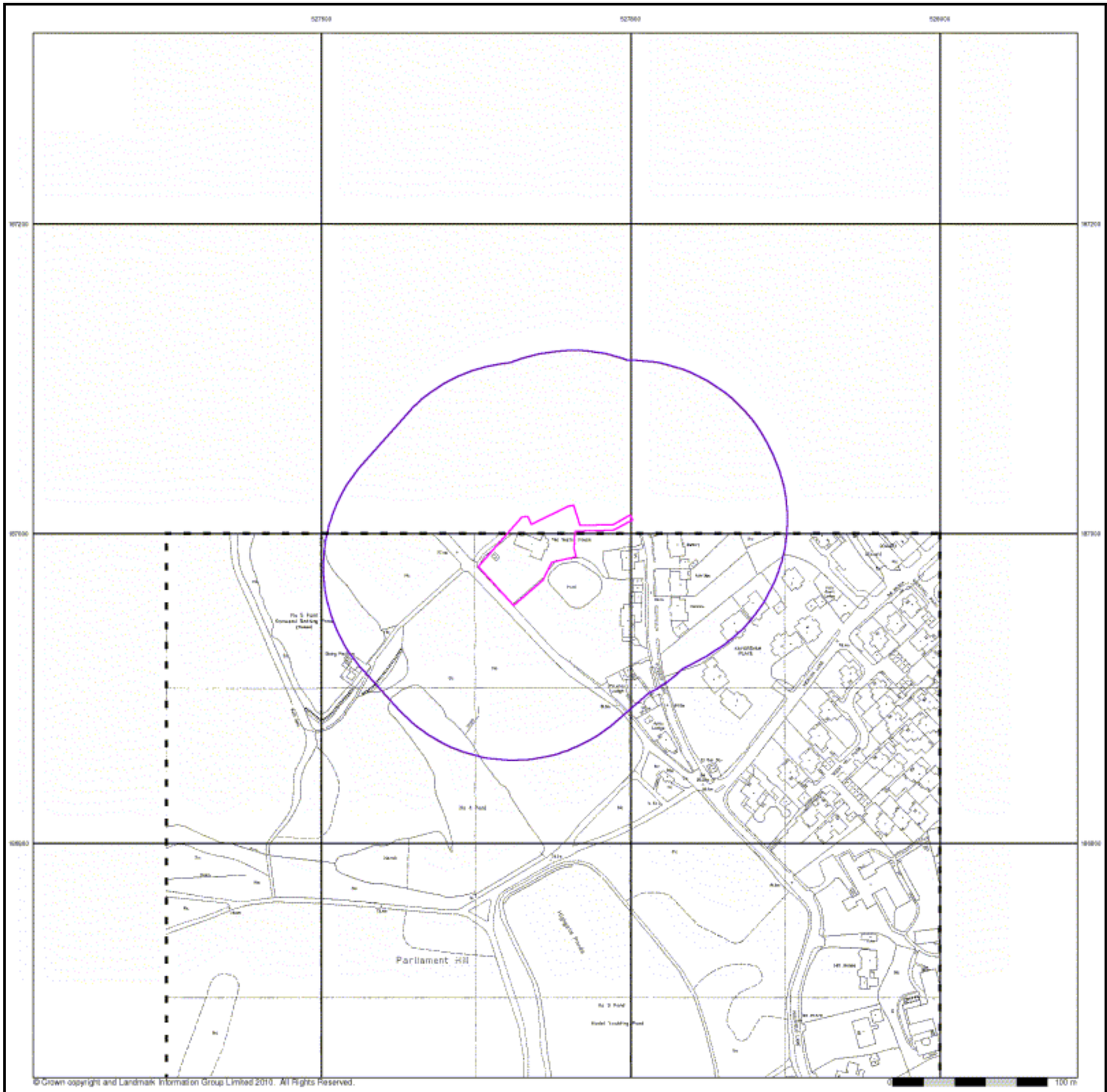
Order Number:	33075032_1_1
Customer Ref:	241830
National Grid Reference:	527750, 186990
Slice:	A
Site Area (Ha):	0.23
Search Buffer (m):	100

Site Details

The Water House, Millfield Lane, London, N6 6HQ

Landmark Information Group

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



STATS

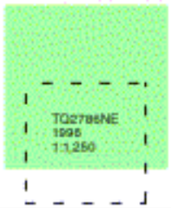
Large-Scale National Grid Data

Published 1996

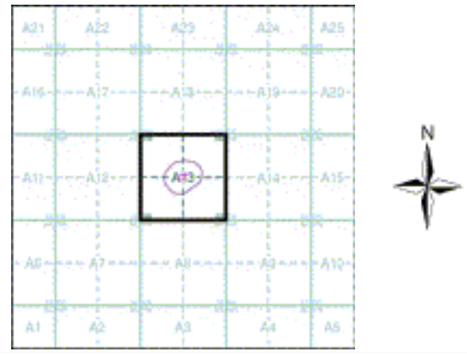
Source map scale - 1:1,250

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

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	33075032_1_1
Customer Ref:	241830
National Grid Reference:	527750, 186990
Slice:	A
Site Area (Ha):	0.23
Search Buffer (m):	100

Site Details

The Water House, Millfield Lane, London, N6 6HQ

Landmark Information Group

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