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SITE INVESTIGATION REPORT

29 ABERDARE GARDENS
SOUTH HAMPSTEAD
LONDON NW6

Report Reference No. C12761

On behalf of:-

Graffham Properties
17 Greencroft Gardens
London
NW6 3LN

October 2012

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REPORT ON A SITE INVESTIGATION

AT

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INTRODUCTION

Graffham Properties proposes to extend the existing semi-detached residential building at 29 Aberdare Gardens, South Hampstead, London NW6. A basement is to be constructed beneath most of the existing house and will extend beneath the rear garden. The single-storey basement will extend to approximately 3.0m below the existing ground floor level, and beneath the existing rear garden the basement will house a swimming pool where it will locally extend to a depth in the order of 5.0m below existing ground level. The basement will provide an underground link to a single-storey home office positioned at the far end of the garden. It is proposed to construct the basement within contiguous piled retaining walls.

A site investigation was undertaken by Ground Engineering Limited on behalf of Graffham Properties, following instructions from Integrated Solutions, Chartered Building Surveyors. The purpose was to provide information on the underlying ground conditions in relation to the proposed development, including a brief contamination assessment. In addition a desk study is included to provide details on geology, hydrogeology, hydrology and site history, and a search of available information for any potential environmental issues.

SITE DESCRIPTION

Location

Number 29 Aberdare Gardens is located on the north side of Aberdare Gardens, approximately 260m north-east of St. Mary's Church and 500m west of South Hampstead railway station. The semi-detached three-storey house has about 10m frontage along Aberdare Gardens and extends north by about 50m to the rear boundary of adjacent properties fronting Greencroft Gardens. The site is centred at National Grid Reference TQ 2589 8416 as shown on the site location plans included on pages 1 and 2 of Appendix 3.

The southern half of the site was occupied by a three-storey semi-detached house having a small block-paved front drive between the front of the building and the adjacent pavement. The northern half of the site was occupied by a lawned garden flanked by shrubberies and boundary fences, with several trees within or just beyond the site boundaries including Cypress, Apple, Laurel, Spruce, London Plane, Lime, Beech and Cherry.

At the time of the investigation a rearward extension was under construction.

Topography & Hydrology

The property stands on a relatively level plot at an elevation of about 40.5mOD on land gently sloping down to the south and south-east, where it locally falls to about 37mOD to the south of the railway cutting, some 350m distant. More generally, the ground rises to the north and north-east, to above 130mOD at Hampstead Heath and Parliament Hill, some 2.5km away. Regionally, the ground falls towards the River Thames, which flows generally from west to east, approximately 6km to the south of the site.

Aberdare Gardens rises slightly to the west to about 42.0mOD at its junction with Goldhurst Terrace.

The lower ground within the subdued valley to the south of the site delineates the former course of a stream flowing southwards to become the 'Westbourne' or 'Ranelagh Brook'. This brook is shown on the 1934 geological map (Appendix 1) and N. Barton's 'Lost Rivers of

London' (Appendix 1) to be fed by several tributaries. One of the south-flowing tributaries flows along the route of Priory Road about 230m to the west; and another is shown to cross Aberdare Gardens about 240m to the east. These two streams both converged and formed the southern boundary of the properties fronting the south side of Goldhurst Terrace, about 170m to the south of the site.

The historical surface water, field drainage system was modified several times, but the ditches drained to either the south-east or south-west, with a significant southward draining stream about 200m to the east (Appendix 2 – Figures A-C). It is possible that former drainage ditches crossed the site area, but if present would be discontinuous and not likely to form a significant flow pathway.

A combined sewer (991mm x 610mm) is routed beneath the centre of Aberdare Gardens, immediately south of the site, draining to the east. This has an invert level of 4.61m (35.92mOD) beneath the road to the front of No.35. This sewer is likely to intercept water from older surface water drainage features and would serve to carry any surface or sub-surface waters.

Geology & Hydrogeology

The 1934 geological map for the area at 6 inches to 1 mile scale (Appendix 1) was based on the 1919 Ordnance Survey London sheet IV NE and illustrates the site directly underlain by the solid geology of the London Clay. The higher ground about 1km to the north-east is shown to be capped by the Claygate Beds. This map indicates the London Clay in the general area to have been 'formerly dug'.

The 2006 geological map for the area at 1:50,000 scale, Sheet 256, confirms the site to be underlain directly by the solid geology of the London Clay Formation. This map shows a propensity for Head Deposits around the flanks of the hills about 800m to the west and east of the site. The Head Deposits were formed by the downslope movement of saturated soils under periglacial climatic conditions.

A well record from the district indicates the London Clay to be 73m thick. The underlying deposits of the Lambeth Group are indicated to be 15m thick. About 8m of Thanet

Sand underlies the Lambeth Group, below which is the Chalk from an elevation of approximately -44mOD.

The London Clay Formation is designated by the Environment Agency (EA) as 'Unproductive' strata. The Camden Geological, Hydrogeological and Hydrological Study 'Guidance for Subterranean Development' (2010) designates the strata beneath the London Clay as the 'Lower Aquifer' comprising the Reading Beds (Lambeth Group) and the Thanet Sand (Thanet Formation). This 'Lower Aquifer' also includes the underlying Upper Chalk (Chalk Group) which is designated as a 'Principal Aquifer' by the EA, and is present from an elevation below about -44mOD (approximately 96m depth).

It is expected that sub-surface water flow at the site will occur more readily within the near-surface made ground (within 1m of the ground surface) than in the deeper materials and that the Head Deposit will show a higher permeability than the underlying London Clay, but actual sub-surface flow rates would be slow at all depths. The general topography falls to the south and south-east, whilst the combined sewer beneath Aberdare Gardens drains eastwards. The anticipated direction of sub-surface flow is therefore to the south-east, but is likely to be controlled by local variations in levels, man-made structures, vegetation and in particular drainage provisions.

SITE HISTORY

Historical maps, including Ordnance Survey (OS) maps, aerial photographs and historical information obtained on the internet, dating between 1827 and the most recent map have been reviewed as part of this desk study. Selected map extracts are reproduced in Appendix 2 as Figures A to Q with relevant descriptions given below.

Map Extract Studied	*Description*
1827 Greenwood's Map of London Scale: 1:7920 **Figure A**	This map, surveyed between 1824 and 1826, shows the site in the south-western corner of a field, with ditches to the south and west of the plot. These ditches drain south towards small streams representing tributaries to the Westbourne River which is illustrated to the south at Kilburn, where the stream has a series of ponds close to the location of a former abbey.
1830 Greenwood's Map of London Scale: 1:7920 **Figure B**	This map was a revision of the previous edition, and it shows the neighbouring drainage ditches and field boundaries to have been completely altered. The site is indicated at the north-eastern corner of a field, with ditches immediately north and east of the plot. These ditches appear to drain east and south to a brook representing a tributary to the Westbourne River further to the east, fed by a pond and other ditches.
1862 Stanford's Map of London & Suburbs Scale: 1:10,560 **Figure C**	The site remained within the north-eastern corner of a field, although the ditch on its eastern side had been re-aligned southwards, closer to the plot. This ditch drained south to another ditch forming the rear boundary to a row of properties (Clarendon Terrace) that had been built at the western end of Belsize Road to the south-east. St. Mary's R. C. Church is shown at the south-west corner of the field fronting the northern end of Priory Road. A railway line is depicted to the south.
1868 OS Sheet Town Plan Scale: 1:1056 **Figure D**	This map details the site area close to the southward trending tree-lined ditch.
1871 OS Sheet London XV Scale: 1:2500 **Figure E**	The site area remained unchanged within the large field. A pond is shown at the far south-eastern corner of the field. Immediately south of the drainage ditch forming the southern field boundary, were residential properties fronting the now extended Belsize Road. A public house is shown at the crossroads at the western end of Belsize Road.
1893 OS Sheet Town Plan Scale: 1:1056 **Figure F**	By the time of this map Aberdare Gardens and Greencroft Gardens to the north, were shown. Rows of semi-detached houses fronting the north side of Aberdare Gardens had been constructed to the west of the undeveloped and undefined site. The rear boundary of the plot was delineated by the rear boundaries of houses to the north. There was no evidence of the former ditch immediately east of the site.
1896 OS Sheet London XXXVII Scale: 1:2500 **Figure G**	The site layout remained unchanged. Widespread housing development was evident to the north and west of the site area. The east-west drainage ditch to the south marked the northern limit of housing development fronting Belsize Road and Abbey Road.

Map Extract Studied	*Description*
1915 OS Sheet London IV.4 Scale: 1:2500 **Figure H**	By the time of this map, the site and surrounding areas to the south and east had been developed with housing. The site was occupied by the western part of a pair of semi-detached houses (No.29). A single large plot remained undeveloped on the south side of Goldhurst Terrace to the south.
1935 OS Sheet London IV.4 Scale: 1:2500 **Figure I**	The site and immediate surrounding area remained unchanged. Four houses had been constructed on the last vacant plot on the south side of Goldhurst Terrace.
1946-7 Aerial Photograph **Figure J**	This photograph illustrates the flat-roofed house with extensive rear garden bounded to the rear by trees. Both No.29 and adjacent No.31 to the east appear to have small extensions to their rearward wings.
1953 OS Sheet: TQ2584SE Scale: 1:1250 **Figure K**	The site and immediate area remained unchanged on this map and there appears to be no evidence of bomb damage in the immediate vicinity. This map depicts the small extensions on the northern sides of No.29 and No.31.
1957 OS Sheet: TQ28SE Scale: 1:10,560 **Figure L**	The site and surrounding area remained unchanged on this map. An area of approximately two properties is shown cleared about 200m to the south-east on the south side of Goldhurst Terrace, possibly as a result of bomb-damage.
1968 OS Sheet TQ28SE Scale: 1:10,560 **Figure M**	The site and surrounding area remained unchanged. A large area to the south fronting Belsize Road and Abbey Road had been cleared of houses, whilst a row of houses had been built on the former vacant site to the south-east.
1970 OS Sheet TQ2584SE Scale: 1:1250 **Figure N**	The site and surrounding area remained unchanged on this map
1974 OS Sheet TQ28SE Scale: 1:10,560 **Figure O**	The site and immediate surrounding area were unchanged. A large property within wooded grounds occupied the former vacant site fronting Belsize Road and Abbey Road.
1991 OS Sheet TQ2584SE Scale: 1:1250 **Figure P**	The site and surrounding area remained unchanged.
2012 OS Sheet TQ2584SE Scale: 1:1250 **Figure Q**	The site and immediate surrounding area were unchanged.
Undated (2012) Aerial Photograph on page 2 of GroundSure Report (Appendix 3)	The latest available aerial photograph shows the property with the grass surfaced rear garden flanked to the north by some large trees. It appears that the single storey rear part of the house has been further extended.

Summary of Historical Background

Throughout the 1800s, the site was located within an area of fields drained by a series of ditches. The pattern of ditches appears to have been modified around 1830 when they were re-cut to drain to tributaries or headwaters of the south-flowing Westbourne River which flowed through Kilburn to the south. The site was located close to several field boundary ditches.

The site and surrounding area were developed around the turn of the 20th century, with No.29 erected in the early 1900s. The house and its neighbouring properties have been subsequently extended to their rear, but the houses have remained essentially unchanged to the present day.

ENVIRONMENTAL DATABASE INFORMATION

Appendix 3 contains information derived from Environmental Databases for a radius of up to 2000m from the site. The information covers various datasets and contributors include the Environment Agency, Local Authorities, British Geological Survey, Ordnance Survey and the Coal Authority. The results obtained are presented together with a detailed search on selected areas of enquiry, and have been described below for a radius of up to 250m from the site.

Environmental Permits, Incidents & Registers

The following is a summary of the main points for environmental authorisations:

Statutory Authorisations

IPC & IPPC Regulations: There are no (0) recorded sites authorised by the Environment Agency under Part I of the Environmental Protection Act 1990, to carry out processes subject to Integrated Pollution Control (IPC) or Integrated Pollution Prevention and Control (IPPC) on, or within 250m of the site. There are no (0) recorded IPC Registered Waste Sites on, or within 250m of the site.

Water Industry Act Referrals: There are no (0) recorded referrals under the Water Industry Act on, or within 250m of the site.

Local Authority Pollution Prevention and Control Enforcements: There are no (0) recorded enforcements under Part I of the Environmental Protection Act 1990 on, or within 250m of the site.

Enforcement Notices and Authorised Processes: There are no (0) recorded enforcement or prohibition notice issued by the Environment Agency under Part I of the Environmental Protection Act 1990 on, or within 250m of the site.

Keeping of Radioactive Substances or Dangerous Substances: There are no (0) recorded sites registered by the Environment Agency under the Radioactive Substances Act 1993, to keep or use radioactive materials within 250m of the site.

Discharge Consents

Discharges to Water: There are no (0) recorded consents issued, by the Environment Agency, to discharge to watercourses in accordance with the Water Resources Act 1991 within 250m of the site.

Storage of Hazardous Substances

Storage of Hazardous Substances: There are no (0) recorded sites subject to hazardous substances consents granted by the relevant local authority under the Planning (Hazardous Substances) Act 1990 on, or within 250m of the site.

Control of Major Accidents: There are no (0) recorded sites regulated by the Health and Safety Executive under the Control of Major Accident Hazards (COMAH) regulations 1999, on, or within 250m of the site.

Storage of Dangerous Substances: There are no (0) recorded sites regulated by the Health and Safety Executive for storing specific dangerous substances under the NIHHS regulations 1982, within 250m of the site.

Pollution Incidents

Pollution Incidents and Prosecutions: There are no (0) recorded incidents or prosecutions on, or within 250m of the site, relating to either authorised processes or controlled waters on, or within 250m of the site.

Contaminated Land Register Entries & Notices: There are no (0) recorded entries or notices on the Contaminated Land Register listed on, or within 250m of the site.

Landfill & Waste Sites

The following is a summary of the main points for the Waste section:

Landfill Sites: There are no (0) recorded current or former landfill sites licensed by the Environment Agency under Part II of the Environmental Protection Act 1990 within 250m of the site.

Registered Landfill or Local Authority Recorded Landfill Sites: There are no (0) recorded operational or non-operational landfills located on or within 250m of the site.

Registered Waste Transfer Site: There are no (0) recorded operational waste transfer sites recorded on, or within 250m of the site.

Waste Treatment, Transfer and Disposal: There are no (0) non-operational waste treatment, transfer and disposal sites, located within 250m of the site, licensed by the Environment Agency under Part II of the Environmental Protection Act 1990.

Potentially Contaminative Uses

Current Industrial Sites: There are four (4) potentially contaminative uses recorded within 250m of the site. All are for electricity sub-stations, the closest record being 101m to the south-east.

Fuel Station Entries: There are no (0) recorded fuel station entries within 250m of the site.

High Pressure Oil & Gas Pipelines: There are no (0) recorded underground high pressure oil and gas pipelines within 250m of the site.

Geology & Hydrogeology – Pathways & Receptors

The following is a summary of the main points for the sensitivity section:

Artificial Ground & Made Ground: The site is not recorded as being covered by artificial or made ground.

Drift Deposits & Solid Geology: The site is not recorded as being covered by superficial or drift deposits. The site is underlain by the solid geology of the London Clay Formation.

Groundwater Vulnerability: The aquifer designation for the site is 'Unproductive' for the underlying solid geology of the London Clay Formation.

Water Abstractions: There are no (0) water abstraction licenses held on, or within 250m of the site.

Source Protection Zones: The site does not lie within 250m of a Source Protection Zone.

River Network & Surface Water Features: There are no river network entries nor surface water features listed within 250m of the site.

Flood Risk: The site is not within a floodplain as indicated by the EA. The site is in an area with a 'Negligible' susceptibility to groundwater flooding. The site is not within a zone benefiting from flood defences or used for flood storage.

Environmentally Sensitive Receptors

Environmentally Sensitive Areas: There are no environmentally sensitive areas listed within 1500m of the site.

Protected Countryside Areas: There are no (0) National Parks or other protected areas or parks recorded as being either on or within 500m of the site.

Natural & Mining Hazards

Natural Subsidence Risk: According to the British Geological Survey there is a 'Negligible' hazard for Soluble Rocks, Compressible Ground, Running Sand and Shallow Mining. There is a 'Very Low' hazard for Collapsible Rocks and Landslides. There is 'Moderate' hazard for Shrinkage and Swelling.

Coal Mining: The site is not within 75m of any areas affected by coal mining.

Radon Affected Area: The site lies within an area where less than 1% of properties are above the action level for radon.

Radon Protection Measures: The site lies within an area where no radon protection measures are necessary for new dwellings or extensions in accordance with Building Research Establishment report BR211 (1999).

PRELIMINARY RISK ASSESSMENT

In order to assess the risks associated with the presence of ground contamination the linkages between the sources and potential receptors to contamination need to be established and evaluated. This is in accordance with the Environmental Protection Act 1990, which provides a statutory definition of Contaminated Land. To fall within this definition it is necessary that, as a result of the condition of the land, substances may be present on or under the land such that

- *Significant harm is being caused or there is a significant possibility of such harm being caused; or*
- *Pollution of controlled waters is being, or is likely to be, caused*

There are three principal factors that are assessed whilst undertaking a qualitative risk assessment for any site. These are the presence of a contamination source, the existence of migration pathways and the presence of a sensitive target(s). It should be noted that it is necessary for each element of source, pathway and target to be present in order for exposure of a human or environmental receptor to occur.

UK Government guidance on the assessment of contaminated land, requires risk to human health and the environment to be reviewed using source – pathway – target relationships. If each of these elements is present, the linkage provides a potential risk to the identified targets. ***Contaminants or potential pollutants*** identified as ***sources*** in relation to the identified previous uses are listed below in Table 1.

Table 1: Identified Potential Contaminant Sources

Contaminant Source	*Comments*
Drainage	Effluent from existing drains could provide a contaminant source.
Soil Beneath Site	Contamination may be present within made ground on the site.
Soil Gas	Potential soil gas generated from made ground or underlying geology.
Ground Contamination Outside Site Boundary	Ground contamination migrating from adjacent or neighbouring sites.

A ***Pathway*** is defined as one or more routes through which a receptor is being, or could be, exposed to, or affected by, a given contaminant.

Potential ***Target or Receptors*** fall within the categories of Human Health, Water Environment, Flora and Fauna, and Building Materials.

There are a number of possible pathways for the contaminants identified on the site to impact human and/or environmental receptors and these are summarised in Tables 2 and 3.

Table 2: Human Receptors and Pathways

Human Receptor-Mechanism	*Typical Exposure Pathway*
Human Inhalation	Breathing Dust and Fumes Breathing Gas emissions
Human Ingestion	Eating -contaminated soil, for example by small children -plants grown on contaminated soil Ingesting dust or soil on fruit or vegetables Drinking contaminated water
Human Contact	Direct skin contact with contamination Direct skin contact with contaminated liquids

Table 3: Water Receptors and Pathways

Receptor-Water Environment	*Typical Exposure Pathway*
Groundwater The site is underlain by the London Clay, with an aquifer designation of 'Unproductive'. The site does not lie within a source protection zone.	Surface infiltration of atmospheric waters into the soils beneath the site could wash or dissolve potential contaminants and migrate to underlying groundwater. Contamination leads to restriction/prevention of use as a resource, for example, drinking water, and can have secondary impacts on other resources, which depend on it.
Surface Water There are no surface water or river network features within 250m of the site.	Surface infiltration of atmospheric waters into the soils beneath the site could wash or dissolve potential contaminants and laterally migrate. Contamination leads to a restriction/prevention of use: -as drinking water resource -for amenity use Effects on aquatic life

Preliminary Conceptual Model

Assessment of the potential linkage between ground contamination sources, human and environmental receptors have been assessed based on the desk study research documented in the preceding sections of this report. A generalised preliminary conceptual model relative to the construction phase and completed development is presented below in Table 4.

Table 4: Preliminary Conceptual Model Relative to Construction & Use of Residential Development

Receptors	Pathway	Estimated Potential for Linkage with Contaminant Sources			
		Drainage	Soil Beneath Site	Soil Gas	Ground Contamination Outside Site Boundary
Human Health – groundworkers	Ingestion and Inhalation of contaminated Soil, Dust and Vapour	Unlikely	Low likelihood	Low likelihood	Low likelihood
Human Health – users of completed development	Ingestion and Inhalation of contaminated Soil, Dust and Vapour	Unlikely	Low likelihood	Low likelihood	Low likelihood
Water Environment	Migration through ground into surface water or groundwater	Unlikely	Low likelihood	Unlikely	Low likelihood
Flora	Vegetation on site growing on contaminated soil	Unlikely	Low likelihood	Unlikely	Unlikely
Building Materials	Contact with contaminated soil	Unlikely	Low likelihood	N/A	Unlikely

Key to Table 4 Estimated Potential for Linkage with Contaminant Source	Definition
High likelihood	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term or there is evidence at the receptor of harm or pollution.
Likely	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such an event would take place, and is less likely in the shorter term.
Unlikely	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long term.
N/A	Not Applicable

SITE WORK

The site work consisted of a single cable percussive borehole (BH1) positioned in the front drive, and two dismantleable continuous dynamic sampled boreholes (WSA and WSB) positioned in the rear garden. The site work was conducted between 16th and 24th August 2012 at the positions shown on the borehole location plan.

Public utility service drawings were sourced and consulted prior to determining the exploratory hole positions. These drawings are available from Ground Engineering Limited on request. Prior to excavation, a service scan was made at each position using a CAT (Cable Avoidance Tool) to check for the absence of detectable buried services that may otherwise have been damaged by the investigation.

The borehole records give the descriptions and depths of the various strata encountered, details of all samples taken, in-situ testing, installation details and the groundwater conditions observed during boring, excavation, on completion and within the standpipe installations.

Cable Percussive Borehole

The cable percussive borehole was sunk to 15.00m depth by a cable percussion boring rig. The borehole was formed using weighted shell and claycutter boring tools suspended from a light winch cable and working within 150mm diameter steel casing inserted to 2.25m depth.

Prior to boring, an inspection pit was hand excavated to 1.20m in order to confirm the absence of any buried services.

Representative small disturbed or large bulk samples of soil were taken from the boring tools at regular intervals throughout the depth of the borehole. Undisturbed samples 100mm in diameter were taken at regular intervals in clay. The ends of the samples were sealed to maintain them in as representative condition as possible during transit to the laboratory.

On completion of borehole BH1, a 50mm diameter gas and groundwater monitoring standpipe was installed to 7.00m depth. This borehole was backfilled with arisings from the base of the hole to the base of the standpipe. The pipe was perforated to within 1.00m of ground level and the annulus backfilled with pea gravel. A bentonite seal was placed from ground surface to 1.00m depth and a gas tap fitted. A protective stopcock cover was concreted in place at ground level above the installation.

Window Sampled Boreholes

Borehole WSA and WSB were sunk within the rear garden to depths of 9.45m and 6.45m respectively by a dismantleable super heavy dynamic sampling and probing rig. The equipment consisted of drive-in sample tubes of specially constructed and strengthened steel, lined with a plastic core-liner. The borehole was advanced by sampling barrels initially of 87mm internal diameter and reduced in diameter with increasing depth. Upon extraction, a continuous profile of the soil was obtained within the plastic liners. The plastic liners were subsequently split by a geotechnical engineer who sub-sampled them, with the remaining samples re-sealed within the plastic liners.

Standard penetration tests were undertaken at regular intervals in order to give an indication of in-situ strength of the soils. The test was made by driving a split-spoon sampler, 50mm diameter, into the soil at the base of the borehole by means of an automatic trip hammer weighing 63.50kg falling freely through 750mm. The penetration resistance was determined as the number of blows required to drive the tool the final 300mm of a total penetration of 450mm into the soil ahead of the borehole.

Values of apparent shear strength were determined using a hand shear vane meter. The average of two or three readings is presented on the borehole records.

On completion of each window sampled borehole, a 42mm diameter gas and groundwater monitoring standpipe was installed to 7.50m and 6.00m depth respectively. Each pipe was perforated to within 1.00m below ground level and a bentonite seal was placed to 1.00m

depth and a gas tap fitted. A protective stopcock cover was concreted in place at ground level above each installation.

Return Gas/Groundwater Monitoring Visits

Two return visits were made to monitor the gas and groundwater levels within the installations in BH1, WSA and WSB on 3rd and 11th October 2012. The results are provided following the borehole records.

LABORATORY WORK

The samples were inspected in the laboratory and assessments of the soil characteristics have been taken into account during preparation of the borehole records. The soil descriptions have been made in accordance with BS5930:1999 and laboratory testing in accordance with BS1377:1990 and other industry standards.

The moisture contents of selected soil samples were determined. These have been plotted against depth in Figure 1.

The index properties of selected soil samples were determined as a guide to soil classification and behaviour. The liquid limit was determined by a cone penetrometer.

Test specimens were prepared at full diameter from selected undisturbed clay samples. Immediate undrained triaxial compression tests were undertaken on the specimens under single confining cell pressures. The moisture content and bulk density of each specimen was also determined. The values of apparent cohesion have been plotted against depth in Figure 2.

Selected samples of soil and groundwater were analysed to determine the concentration of soluble sulphates. The pH values were also determined.

An indication of the swelling and settlement characteristics of a selected sample of clay were obtained from the consolidation apparatus or oedometer. The test was performed on a specimen approximately 19mm thick, contained in a steel ring. The sample was saturated and the swelling pressure balanced prior to applying a constant load with drainage allowed at both ends. When primary compression was complete, the load was increased and this repeated for three increments of load. The sample was then unloaded. The rate and total amount of consolidation were continually monitored using a computer controlled E.L.E. Datasystem 7 Unit. The results were plotted and analysed by the computer for each increment of load to obtain the coefficients of compressibility (m_v), and of consolidation (c_v), which govern the amount and rate of settlement respectively.

Chemical analysis of three soil samples recovered from the exploratory holes was undertaken, by an independent laboratory, primarily for characterisation purposes. The samples were tested for a suite which encompassed a wide range of potential contaminants outlined by the Environment Agency (EA) and National House Building Council (NHBC) document R & D 66:2008 'Guidance for the Safe Development of Housing on Land Affected by Contamination'.

GROUND CONDITIONS

The ground conditions found by the exploratory holes have been plotted against depth as a soil profile in Figure 3. This shows a surface layer of made ground underlain by a thin superficial Head Deposit, with the anticipated London Clay Formation encountered from depths of 1.20m and 1.30m. The London Clay was found to at least the base of each borehole and extended below the base of the deepest borehole BH1, terminated at 15.00m below ground level. Groundwater was found perched within the Head Deposit or London Clay at depths between 0.48m and 1.75m.

Made Ground

The borehole sunk in the driveway passed through a surface 0.10m thick covering of block paviors. The surface paving in BH1 was laid on a sub-base layer of yellow brown sand to 0.15m depth. To the rear of the house WSB found a surface layer of 'sand covered hardcore fill' to 0.20m depth.

Beneath these surface layers and from ground level at the northern end of the rear garden (WSA), made ground was encountered, extending to depths of 0.70m (WSA) and a maximum depth of 0.80m (BH1 and WSB). The made ground comprised a soft or firm, dark brown, brown, dark grey and locally green mottled, slightly gravelly clay which contained flint, quartz gravel and occasional fragments of brick and ash. This soil resembled former or buried topsoil and in WSB was locally carbonaceous.

Head Deposit

Beneath the made ground at 0.70m to 0.80m depth, the boreholes entered a 0.40m to 0.60m thick superficial Head Deposit consisting of a brown, orange brown and grey mottled, slightly gravelly clay. The gravel fraction was angular to sub-rounded flint and quartz. This clay was typically firm in BH1 and WSB, but was slightly desiccated to stiff in WSA. This soil has been interpreted as a Head Deposit, formed by the gradual downslope movement of saturated soil

under periglacial climatic conditions. This deposit was found to extend to depths of 1.20m and 1.30m below existing ground level.

London Clay Formation

Beneath the Head Deposit, all holes entered the solid geology of the London Clay Formation at depths of 1.20m and 1.30m. This clay was initially weathered to a firm (stiff in WSA), brown, orange brown and grey mottled clay containing gravel size calcareous concretions.

From depths between 1.80m and 2.50m, the London Clay was a firm or stiff, fissured, brown, orange brown and grey mottled clay and contained occasional selenite (hydrated calcium sulphate) and rare silt partings. A layer of concretionary limestone was encountered in BH1 at 3.50m. With increasing depth, the fissures within the clay became orange brown stained. Borehole WSB was terminated within the weathered London Clay at 6.45m depth.

The two deeper boreholes (BH1 and WSA) entered stiff, closely fissured, dark brown and dark grey clay at 7.00m depth. This London Clay contained occasional silt and fine sand partings. These boreholes were terminated within the London Clay at depths of 9.45m (WSA) and 15.00m (BH1) below ground level. In the deeper BH1, the London Clay became very stiff below 10.00m and contained occasional silt and fine sand partings up to 5mm thick.

Groundwater

Water seepages were noted from layers of concretionary limestone within the London Clay within the borehole BH1 at 3.50m and 10.60m depth.

Boreholes BH1 and WSB remained dry on completion, as was WSA to 6.00m depth when a break-down forced boring to be suspended. On resuming this borehole eight days later water stood within the hole at 1.00m depth. This was subsequently bailed from the borehole and on completion it was dry.

The two monitoring visits on 3rd and 11th October 2012, found groundwater standing within the standpipe installations at depths between 0.48m (WSB) and 1.75m (WSA).

Live Roots

Fibrous live roots were observed within each of the holes, extending to depths of 1.30m in BH1 and WSB, and a maximum of 1.70m depth in WSA. The latter borehole was positioned close to trees and shrubs at the northern end of the plot.

Evidence of Contamination

Based on inspection, the made ground contained occasional ash fragments, which could provide a source of elevated concentrations of contaminants. Olfactory evidence of contamination was not noted within the soils beneath this site. No asbestos containing materials were observed.

COMMENTS ON THE GROUND CONDITIONS IN RELATION TO FOUNDATION AND BASEMENT DESIGN AND CONSTRUCTION

The investigation found a thin surface layer of made ground covering a firm Head Deposit, which at 1.20m to 1.30m depth rested on the anticipated initially firm becoming stiff London Clay, which extended to at least 15.00m below existing ground level.

The proposed swimming pool excavation beneath the rear garden area would extend to approximately 5.00m depth and the remaining basement extension will be taken to about 3.00m below existing ground level. These excavations will penetrate both made ground and root affected clays. The basement structures may allow traditional pad, strip or basement raft foundations to be used.

However, the groundwater table, found at 1.75m depth at the northern end of the site and perched in the made ground within 1.00m depth in the area of the house, could present a problem for the proposed basement excavations for the development. The presence of groundwater together with the proximity of the existing adjacent house foundations to the east and west will mean that piled basement walls will be favoured for the proposed sub-structure. These should be installed prior to excavation. The clay soils should provide an ideal material for the support of contiguous bored or secant piled retaining walls.

Basement Excavations

The 3.00m to 5.00m depth of the basement structure will ensure that all made ground and any root infested clay is penetrated. Excavations for the basements should be easily achieved with mechanical plant, although restricted areas will probably need to be hand excavated. Groundwater was found to stand at 1.75m beneath the northern part of the site, which is considered to represent the perched groundwater table in this region. Inflows of shallow groundwater perched on the relatively impermeable London Clay or Head Deposit are likely to occur, particularly during wetter periods, from the made ground or Head Deposit as found in

WSB and BH1. Inflows are likely to be limited and should be dealt with by pumping from screened sumps.

The clay soils, particularly where fissured, will require close side support to maintain stability and provide protection to the adjacent properties. Such support could be achieved by using either interlocking steel sheet piles, contiguous or secant piled walls or mass concrete trench fill retaining walls, most of which could then be incorporated into the structures. Such piled walls could be adopted for all sides of the excavations and would overcome the requirement for close side support where personnel are to enter such excavations, as well as providing a 'cut-off' barrier for groundwater ingress from relatively permeable concretionary limestone layers. The layer of weak, concretionary limestone found in BH1 at 3.50m depth, may locally coincide with the base of the proposed basement excavation. Consideration should therefore be given to adopting appropriate precautions to prevent flooding where inflows occur from this concretionary rock layer.

It may be possible in areas away from the site boundaries such as along the northern side of the proposed structure, to batter the excavation sides to a safe angle in the order of 30°, although consideration should be given to the presence of locally desiccated and fissured clays which could result in failure of cut sides. Gravity retaining structures could then be adopted for these basement walls, installed within a battered excavation if space permits.

The base of excavations should be inspected on completion to ensure that the condition of the soil complies with that assumed in design. Should pockets of inferior material be present, they should be removed and replaced with well-graded hardcore or lean mix concrete. Any old foundations, buried services or concrete obstructions should be grubbed out and removed. The excavated surface should be protected from deterioration using a blinding layer of concrete, since the firm clays are prone to rapid deterioration if exposed to water, with resulting loss of their favourable bearing properties. Care should therefore be exercised to ensure that neither surface water nor groundwater is allowed to collect in the base of excavations.

The basement structures should be constructed such that they are water-proofed to ensure future water tightness with regard to the structure extending below any perched groundwater or the groundwater table.

Potential flotation of the basement structure when empty below the groundwater table should not present a problem due to the weight of the structure. Providing that the basement floor is adequately tied into the walls, such flotation should not be problematic. Consideration should be given to the hydrostatic uplift pressure on the base of the basement floor, which is likely to be in the order of 15kPa to 30kPa for the 3.0m and 5.0m structures respectively. This uplift, together with the net maximum theoretical swelling pressure possible within the London Clay due to pressure relief, could total in the order of 100kPa beneath the basement structure.

Some heave may occur within the base of unconfined basement excavations if left open. Based on the oedometer test result the anticipated base heave in the centre of the unconfined 7m by 4m wide, 5m deep excavation resulting from the relief of approximately 90kPa of overburden pressure, is estimated to be in the order of 30mm, reducing towards the edges of the excavation. Similarly the anticipated base heave in the centre of the 23m by 9m wide, 3m deep basement excavation is estimated to be in the order of 40mm, also reducing towards the edges of the excavation. Heave within the London Clay would begin to take place soon after excavation but would be confined by the basement floor once it had been constructed and further by any loads carried by it.

Foundation Depths

The near-surface clays have modified plasticity indices of 41% and 45% and are rated as having a high volume change potential. The presence of several trees, including moderate water demand London Plane, Lime, Beech and Cherry, and high water demand Cypress, will need to be considered in relation to installation of foundations, piles or basement retaining walls in order to ensure that they penetrate the zones of root influence and are not subjected to future horizontal and vertical heave movements.

Based on the National House Building Council (NHBC) Standards Chapter 4.2 'Building near trees' (2010), foundations within 20m of the nearest moderate water demand trees, and within 7m of the nearest high water demand Cypress trees would require deepening below the minimum recommended foundation depth of 1.00m with suitable precautions taken to offer protection against volume changes within the clays.

Live roots were observed within all of the boreholes, reaching a maximum depth of 1.70m in WSA, which was positioned close to the trees at the far northern end of the garden, about 6m from the nearest Apple tree. The moisture content/depth plot (Figure 1) confirmed evidence of significant moisture deficit within the 2.50m depth at WSA and WSB compared with the condition of the clays in BH1 which was relatively remote from any trees.

Some void forming or compressible material should be placed against the sides of basement walls within the zones of influence of tree roots in clay or ensure that piles are sufficiently reinforced, in order to accommodate or withstand any vertical and horizontal forces caused by heave of the clay. Potentially high swelling pressures could damage foundations or below ground structures by exerting both lateral and upward heave movements over long periods following removal of trees or severance of their roots.

Bearing Properties

Beneath the existing house the creation of the basement approximately 3.00m deep will mean that the existing foundations will need to be underpinned accordingly. Details of the existing foundations were unknown.

The weathered London Clay at about 3.00m below existing ground level has a net safe bearing capacity of 180kN/m^2 beneath a 1.20m wide pad and incorporating a factor of safety of 3.0 against shear failure. Similarly the clay could offer a net safe bearing capacity of 160kN/m^2 for a 0.60m wide strip footing cast at the same depth. Anticipated consolidation settlements would be within 25mm and within tolerable limits, since the clay will have effectively been pre-loaded by at least 50kN/m^2 where 3.00m of soil is to be removed. Similarly at this depth, the clay beneath a 9m wide basement raft foundation would have a net maximum

safe bearing capacity of 140kN/m^2 (F=3.0), although its bearing pressure would have to be limited to a net increase of 30kN/m^2 (approximately 80kN/m^2) in order to maintain settlement within 30mm. This does not consider any net effect of base heave.

The clay at 5.00m depth beneath the deeper swimming pool and plant room, beneath a 7m by 4m basement raft foundation has a net maximum safe bearing capacity of 135kN/m^2 (F=3.0), although its pressure would have to be limited to a net increase of 5kN/m^2 (approximately 95kN/m^2) in order to maintain settlement within 30mm. This does not consider any net effect of base heave.

The London Clay anticipated at the proposed basement levels would be capable of providing support for a ground bearing basement floor slab, providing that the sub-grade is inspected and not softened. Any softened clay should be removed and replaced with well graded, compacted coarse-grained fill material.

Piled Foundations & Retaining Structures

The requirement for excavations to depths up to 5.00m, extending close to the site margins and therefore close to the existing adjacent properties, and the presence of a shallow perched groundwater table, will mean that driven interlocking sheet piled, secant or contiguous bored piled or underpinned mass concrete retaining walls acting as cofferdams will be required. Such walls could be incorporated as part of the permanent structure and it is likely to be economical to also use a piled foundation scheme to support the structural loads if a bored or CFA piled retaining structure is adopted.

The predominantly clay ground conditions favour the use of bored or CFA piles, which would be preferred to driven piles, the latter having the potential for vibration damage effects to the neighbouring structures during pile installation. In order to avoid the piles being subjected to the effect of future seasonal and tree root-induced moisture content and volume changes it will be necessary to either sleeve the piles at least through the zones of root influence or maximum root depth encountered, or ensure that the piles are reinforced sufficiently to withstand any uplift forces due to such changes. This is particularly relevant where any trees are

to be removed or where their roots are severed. In addition, void forming or compressible material should be placed alongside any beams or pile caps within the zones of root affected clay.

Horizons of concretionary limestone or siltstone may be present within the London Clay and may locally impede pile installation. The advice of specialist piling contractors should be sought regarding pile type selection on this site with limited accessibility.

Preliminary working loads for a single bored pile may be estimated for design and cost purposes using the pile bearing coefficients given overleaf which are based on the following assumptions:

1) The ultimate load on a pile would be the sum of the shaft adhesion acting on the pile shaft together with the end bearing load.

2) Ultimate shaft adhesion within the made ground and any root affected clay within 3.00m of existing ground level, is ignored.

3) The shaft adhesion and end bearing would be a function of the apparent cohesion of the clay taken from the values of apparent cohesion (Figure 2) and the SPT 'N-values'.

4) A factor of safety (F) of at least 2.0 would be used to assess pile working loads. If test loading of selected piles were not practical, the factor of safety would be increased to at least 2.5.

Item	**Ultimate Pile Bearing Value (kN/m^2)**
Shaft adhesion in made ground or clay to 3m	Ignored
Shaft adhesion London Clay, 3m to 5m	40
Shaft adhesion in London Clay, 5m to 10m	45
Shaft adhesion in London Clay, 10m to 15m	55
End bearing in London Clay, 5m to 10m	800
End bearing in London Clay, 10m to 15m	1000

Based on these coefficients it is estimated that a 300mm diameter bored pile, 9m long at the position of the 3.00m deep basement, would have a working load of 120kN (F=2.5) which ignores any adhesion within the upper 3.00m. If the same diameter pile was installed to 13m depth, the working load would be 205kN (F=2.5). Larger pile diameters or deeper piles would give higher working loads. For example, the same piles at 450mm diameter would offer working loads of 200kN (F=2.5) at 9m depth and 330kN (F=2.5) at 13m depth respectively.

For the purposes of design of the retaining walls around the basement structure, the following tabulated total and assumed effective stress soil parameters could be used.

Soil Type	Bulk Density (Mg/m^3)	c' (kPa)	ϕ' (degrees)	Undrained Shear Strength cu (kPa)
Made ground	1.70	0	26	25
Head Deposit	1.90	0	27	40-60
London Clay	1.95	2	26	45-100

The basement walls and floor should be adequately 'tanked' in order to seal the below ground structures from any ingress of groundwater.

Sulphate Conditions

Sulphate analyses on samples of soil and groundwater yielded concentrations within Design Sulphate Classes DS-3 and DS-4 of the appended BRE Special Digest 1 (2005), Table C1 (Appendix 4). The pH of the samples ranged between 7.1 and 7.9 indicating alkaline conditions. These results indicate an Aggressive Chemical Environment for Concrete (ACEC) Class of AC-4 which should be considered when specifying a Design Chemical Class (DC Class) for buried concrete on this site, as detailed in the above document.

The London Clay Formation commonly contains sulphides, such as pyrite, and so following oxidation after disturbance during excavation for the basement or foundations, there may be an increased total potential sulphate content. There was no visual evidence of pyrite in the London Clay.

Whilst there is a possibility that oxidation of the London Clay could occur, such as during exposure in basement excavations, this is likely to be exposed for a very short period and it is considered that an ACEC Class of AC-4 should be adopted where there is no risk of the clay being exposed and oxidised. These ACEC classes should be used in determining a Design Chemical Class (DC Class) for buried concrete on this site, as detailed in the above document.

Impact of the Development and Land Drainage

The proposed basement development beneath the site would only be considered likely to affect the drainage system of the site itself. However, drainage and sewerage records for the surrounding buildings will need to be referenced, if available, or perhaps surveyed to confirm that the site does not share a communal drainage system that runs beneath the site.

The permeability of the Head Deposit and the London Clay is such that there will be no significant lateral sub-surface flow within the depth to which the basements would be constructed, and therefore there is no realistic probability that the proposed development will adversely reduce the lateral flow, even if the adjacent properties also contain basements.

The presumed south or south-east direction of groundwater flow beneath this general area should not be impacted by the approximately north to south aligned basement development. However, if a number of the adjoining properties also have deepened or extended basements then there could be an increase in the local drainage path, which could result in marginally higher water levels on the northern side of these basements. This is unlikely to impact negatively on the surrounding properties.

Since there is no shallow aquifer at the site, and the deep aquifer is confined by the very low permeability London Clay, there is no credible risk of groundwater flooding of the site. The only credible source of surface flooding is from high intensity precipitation.

Further information on the proposals and their impact is available in a Basement Impact Assessment undertaken by Integrated Solutions (May 2012).

COMMENTS ON THE CHEMICAL TEST RESULTS OF SOIL

The results of the laboratory chemical testing from the investigation have been compared to CLEA Soil Screening Values (SSVs) which have been used as screening tools for use in the assessment of land affected by contamination.

Atkins Limited has derived ATRISKsoil SSVs based on the default assumptions provided in SR3, which have been used in the development of the Soil Guideline Values (SGVs) published by the Environment Agency in 2009. Atkins SSVs have been derived in line with the Environment Agency 2009 guidance (SR2, SR3, SR4 & SR7) using the CLEA v1.04 and CLEA v1.06 software. These are provided under licence to Ground Engineering Limited, and respective toxicology reports and technical details on the derivation of the SSVs can be provided on request.

The following standard land uses form the basis of the assessment in relation to soils:

- Residential uses both with and without home grown produce, representative of the most sensitive land uses.
- Commercial and industrial usage representative of buildings and areas covered by hardstanding and landscaping.

The intended purpose of the SSVs are as "intervention values" in the regulatory framework for assessment of human health risks in relation to land use. These values are not binding standards, but are intended to inform judgements about the need for action to ensure that a new use of land does not pose any unacceptable risks to the health of the intended users.

In summary Table 5 compares the test results with the SSVs in relation to the specified usage. The number of test results, which exceed these values, are also provided.

Table 5: Comparison of Chemical Test Results for Made Ground Soils with SSVs

Determinand	Number of Samples	Min Value mg/kg	Max Value mg/kg	Number of Samples Exceeding SSV for			Assessment Method	Soil Screening Criteria SSV 1% SOM		
				Residential with home grown produce	Residential without home grown produce	Commercial/ Industrial		Residential with home grown produce mg/kg	Residential without home grown produce mg/kg	Commercial/ Industrial mg/kg
Organic Matter	3	1.7	6.6	-	-	-	-	-	-	-
Arsenic	3	8.0	11	0	0	0	SSV	32	35	640
Cadmium	3	<0.10	<0.10	0	0	0	SSV	10	83	230
Chromium (III)*	3	20	28	0	0	0	SSV	12,800	15,500	21,300
Chromium (VI)	3	<0.5	<0.5	0	0	0	SSV	14	38	330
Lead	3	66	120	0	0	0	SSV	276	383	6490
Mercury	3	<0.10	<0.10	0	0	0	SSV	6	7	66
Selenium	3	<0.20	<0.20	0	0	0	SSV	350	595	13,000
Nickel	3	10	19	0	0	0	SSV	130	130	1800
Phenols	3	<0.3	<0.3	0	0	0	SSV	162	262	686
Benzo[a]pyrene	3	<0.1	16	1	1	1	SSV	0.8	0.9	14
Copper	3	16	19	0	0	0	SSV	3970	8370	109,000
Zinc	3	42	51	0	0	0	SSV	16,900	46,800	917,000
Free Cyanide	3	<0.5	<0.5	0	0	0	SSV	34	34	34

Notes * The concentration of Trivalent Chromium is assumed to be equivalent to the Total Chromium concentration. This is because most naturally occurring chromium is in the trivalent (chromic) state.

Discussion of Soil Results

The results of the laboratory analysis indicate that the made ground at the position of WSA contained an elevated concentration of benzo[a]pyrene, which exceeded the SSVs set for residential with home grown produce, residential without home grown produce and for a commercial/industrial end use. Levels of all remaining elements and compounds were within the associated soil screening values for both residential and commercial/industrial end uses.

Statistical analysis has not been undertaken on such a small dataset, since it not be meaningful.

The made ground encountered during this investigation was not noted to have olfactory or visual evidence of contamination. No asbestos containing materials (ACM) were noted within the made ground soils.

SOIL GAS MONITORING RESULTS

The results of soil gas monitoring of the installations within each of the boreholes during the return visits on 3rd and 11th October 2012, found less than 0.1% methane and up to 1.5% carbon dioxide, with near atmospheric oxygen levels. The in-situ measurements recorded flow rates of <0.1l/hr. The results are tabulated following the borehole records. These in-situ measurements indicate a gas screening value (GSV) of 0.0015l/h.

The GSV falls within the modified Wilson and Card Characteristic Situation 1 or 'Green' classification of the NHBC traffic light system, as defined by the Construction Industry Research and Information Association, CIRIA Report C665, 'Assessing risks posed by hazardous ground gasses to buildings'.

UPDATED CONCEPTUAL MODEL

Assessment of the potential linkage between ground contamination sources, human and environmental receptors have been assessed based on the desk study research and the intrusive ground investigation documented in the preceding sections of this report.

A generalised conceptual model, updated following the intrusive works, monitoring and testing, and targeted to provide coverage across the site, relative to the construction phase and completed development, is presented below in Table 6.

Table 6: Updated Conceptual Model Relative to Construction and Future Use as a Residential Property

Receptors	Pathway	Estimated Potential for Linkage with Contaminant Sources			
		Drainage	Soil Beneath Site	Soil Gas	Ground Contamination Outside Site Boundary
Human Health – ground workers	Ingestion and Inhalation of contaminated Soil, Dust and Vapour	Low	Moderate	Moderate	Very Low
Human Health – users of completed development	Ingestion and Inhalation of contaminated Soil, Dust and Vapour	N/A	Very Low/Moderate	Low	Very Low
Water Environment	Migration through ground into surface water or groundwater	Very Low	Very Low	Very Low	Very Low
Flora	Vegetation on site growing on contaminated soil	Very Low	Low	Very Low	Very Low
Building Materials	Contact with contaminated soil	Very Low	Low	Very Low	Very Low

Key to Table 6 Risk	Definition
Very High	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, or, there is evidence that severe harm to a designated receptor is currently happening. The risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required.
High	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) and remedial works may be necessary in the short term and likely over the long term.
Moderate	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild.
Low	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very Low	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.
N/A	Not Applicable because the proposed development will remove the source.

COMMENTS ON GROUND CONTAMINATION IN RELATION TO PROPOSED DEVELOPMENT

Anticipated exposure scenarios relating to the site and future redevelopment works including remedial options as applicable, in the context of the conceptual model, are discussed as follows.

This investigation may not have revealed the full extent of contamination on the site and appropriate professional advice should be sought if subsequent site works reveal materials that may appear to be contaminated.

Contaminated Soil

The small front and larger rear garden to the site are underlain by up to 0.80m of made ground, which in the latter rear garden contained an elevated concentration of benzo[a]pyrene. The benzo[a]pyrene results statistically exceeded the soil screening values for both residential end uses and the SSV for a commercial/industrial end use. Levels of all remaining elements and compounds were within the associated soil screening values for both residential and commercial/industrial end uses. The made ground will be removed from the areas of basement excavation.

Existing Drainage

Redundant foul or surface water drain runs, should be removed from beneath the site of the proposed basement and precautions should ensure that any remaining effluent is directly disposed off-site. The integrity of existing drainage should be checked, and where they are to be retained, any damaged sections should be replaced prior to development. The latter measures should remove any future risk to human health and to the water environment.

Human Health - Construction Workers

The presence of benzo[a]pyrene contamination within the made ground soils indicates that there is a moderate risk that a pathway could develop affecting groundworkers during the construction phase of development.

No special precautions would be required during the development of the site by workers who may come into contact with the soil during groundworks, providing standard precautions are adopted which should generally include the procedures given by the Health and Safety Executive (The Blue Book) HS(G)66.

For the protection of workers during groundworks the following is recommended:

a) Limit repeated or prolonged skin contact with soils by wearing gloves with sleeves rolled down.

b) Washing facilities should be made available to groundworkers, so as to minimise the potential for inadvertent ingestion of soil.

c) If any soils are revealed which are different to those encountered by this ground investigation, the advice of a specialist should be sought in view of classifying the material and ascertaining its risk to groundworkers.

d) Dust suppression measures such as 'damping down', could also be adopted to prevent the creation of dust and the spread of soil contaminants.

e) Consideration should be given to gas monitoring within deep excavations or confined spaces to ensure safety of personnel entering them, since carbon dioxide could accumulate within excavations, service chambers or sub-structures.

Human Health - Users of Completed Development

The risk of site end users coming into contact with the made ground is considered to be very low as the walls and floors of the 3.0m deep basement would prevent physical contact between them and so no pathway would exist. Indeed it is likely that most of the made ground would be removed during basement construction. However, there is considered a moderate risk

of site users coming into contact with contaminated soils in the highly unlikely event that the made ground from beneath the site either remained in-situ or was to be reused within garden areas.

The presence of locally elevated benzo[a]pyrene within the made ground means that the existing made ground soils should not be retained within gardens and soft landscaping in the proposed redevelopment. These soils will need to be removed and either disposed of off-site, covered with an adequate capping layer, or placed beneath areas of hardstanding, if geotechnically suitable.

The gas monitoring has determined that a Wilson and Card Characteristic Situation 1 or NHBC 'Green' classification would apply and that no special precautions are required to protect likely proposed basement structure from ingress of soil gases. No precautionary measures are required to protect the development from radon gas.

Water Environment

The site is underlain by 'Unproductive' strata of the solid geology of the London Clay Formation and is not within a Source Protection Zone, or an area susceptible to flooding.

There is a very low risk from former drainage across the site, including infilled field drainage ditches, providing a possible source of contaminants. It was not known if the former neighbouring drainage ditches, passing close to the site area, had been culverted or piped. However, a combined sewer (991mm x 610mm) is routed along the centre of Aberdare Gardens, draining to the east with an invert level of about 4.61m (35.92mOD) to the front of No.35.

Significant contamination was not identified by the investigative works and with the groundwater table presumed to be about 1.75m below site level within clay of very low permeability, the risk of any contamination within the thin surface layer of made ground affecting groundwater is considered to be very low. It is unlikely that the proposed development, including the installation of the basement and foundations including piles, would impact the quality of the water environment.

Effects on Building Materials & Services

The sulphate requirements for buried concrete have been discussed in the previous section of this report.

Consideration should be given to upgrading service materials, particularly for water supply pipes, if proposed, where they are to be in contact with made ground containing elevated concentrations of benzo[a]pyrene, or ensure that the made ground is not used as a backfill around such water supply pipes.

Off-Site Disposal of Soil Arisings

The results of chemical analysis can be used for the basic characterisation of the soil destined for landfill. The Environment Agency publication Hazardous Waste, Technical Guidance WM2 outlines the methodology for classifying wastes and should be referenced for guidance. The test results (total metals, hydrocarbons and cyanide) should be compared to the relevant thresholds to determine whether they fall into the primary categories of non-hazardous waste or hazardous waste and will help indicate the likely European Waste Catalogue (EWC) code, which is determined by the waste type. The results of Waste Acceptance Criteria (WAC) leachate testing should be used to check whether if categorised as non-hazardous waste it could be disposed of at an inert waste landfill; or if categorised as hazardous waste whether it could qualify as stable non-reactive hazardous waste for disposal in non-hazardous landfill.

Excavated material and excess spoil should always be classified prior to removal from site as required by 'Duty of Care' (Environmental Protection Act, 1990) legislation. This means that material has to be given a proper description and waste classification prior to removal. Basic characterisation is the responsibility of the waste producer, whilst compliance checking and on-site verification are generally the responsibility of the landfill operator. The landfill operator will need to liaise with the waste producer as the approach relies on the information from basic characterisation.

It is expected that clean arisings from foundation excavations into the natural soils across this site would fall into the inert category under the European Waste Catalogue description 'Soil and Stones', EWC code 17 05 04 with restrictions excluding topsoil and peat.

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Site: 29 ABERDARE GARDENS, LONDON NW6

BOREHOLE
BH1

Date: 23/08/12

Hole Size: 150mm dia to 15.00m

Ground Level:

Samples and in-situ Tests			(Date) Casing	Inst.	Description of Strata	Legend	Depth m	O.D. Level m
Depth m	Type	Blows						
0.20-0.70	B1				MADE GROUND - BLOCK PAVIORS.		0.10	
					MADE GROUND - Yellow brown SAND.		0.15	
					MADE GROUND - Firm, brown/dark brown gravelly CLAY. Gravel consisting of sub-angular to rounded flint, brick and ash fragments.			
0.80-1.20	B2		▼s				0.80	
0.82	W1				Firm, orange brown/grey mottled slightly gravelly CLAY. Gravel consisting of angular to sub-rounded flint and quartz. (HEAD DEPOSIT)			
1.20-1.65	U1	35			Firm brown/orange brown/grey mottled CLAY with occasional gravel size calcareous concretions. (WEATHERED LONDON CLAY)		1.20	
1.65	D1							
2.00-2.45	U2	35	1.50		Firm, becoming stiff below 4.00m, fissured brown/ orange brown/grey mottled CLAY with occasional selenite. Concretionary limestone layer at 3.50m.		2.00	
2.45	D2							
3.00-3.45	U3	40	2.25					
3.45	D3			▽1				
3.50-3.70	B3							
4.10-4.55	U4	42	2.25					
4.55	D4							
5.10-5.55	U5	50	2.25		...Becoming brown with orange brown stained fissures below 5.00m.			
5.55	D5				(WEATHERED LONDON CLAY)			
6.10-6.55	U6	50	2.25					
6.55	D6							
7.00-7.45	U7	55	2.25	BENEATH INSTALLATION	Stiff, fissured, dark grey/dark brown CLAY with occasional silt partings.		7.00	
7.45	D7			BENEATH INSTALLATION				
8.00	D8			BENEATH INSTALLATION	(LONDON CLAY)			
8.50-8.95	U8	67	2.25	BENEATH INSTALLATION				
8.95	D9			BENEATH INSTALLATION				
9.50	D10			BENEATH INSTALLATION				
10.00-10.45	U9	70	2.25	BENEATH INSTALLATION			10.00	

REMARKS
1. Excavating starter pit from 0.00m to 1.20m for 1 hour
2. Fibrous live roots observed to 1.30m depth
3. Borehole cased to 2.25m depth
4. Gas monitoring standpipe installed to 7.00m depth

Project No 12761

Scale 1:50 | Page 1/2

KEY
D - Disturbed Sample
B - Bulk Sample
U - Undisturbed Sample
W - Water Sample
S/C - SPT Spoon/Cone
▽ - Water Strike
▼ - Water Rise
N - SPT Blows for 0.3m
* - Blows for quoted penetration
V - Vane Shear Test Cohesion ( ) kPa
▼c - Level on completion
c▼w - Level casing withdrawn
▼s - Standpipe Level

Groundwater Strikes

No	Depth m Struck	Rose to	Rate	Cased	Sealed
1	3.50		seepage	2.25	not
2	10.60		seepage	2.25	not

Groundwater Observations

Date	Depth m Hole	Casing	Water
23/08/12	15.00	2.25	dry
23/08/12	15.00	0.00	dry
03/10/12	7.00	0.00	0.82
11/10/12	7.00	0.00	0.83

GROUND ENGINEERING LIMITED

Tel: 01733-566566
www.groundengineering.co.uk

Site: 29 ABERDARE GARDENS, LONDON NW6

BOREHOLE BH1

Date: 23/08/12

Hole Size: 150mm dia to 15.00m

Ground Level:

Samples and in-situ Tests			(Date) Casing	Inst.	Description of Strata	Legend	Depth m	O.D. Level m
Depth m	Type	Blows						
				BENEATH INSTALLATION	Very stiff, closely fissured, dark grey/dark brown CLAY with occasional dark green silt and fine sand partings up to 5mm thick. Concretionary limestone layer at 10.60m.		10.00	
10.45	D11		2 ▽	BENEATH INSTALLATION				
11.00	D12			BENEATH INSTALLATION				
11.50-11.95	U10	67	2.25	BENEATH INSTALLATION				
11.95	D13			BENEATH INSTALLATION	(LONDON CLAY)			
12.50	D14			BENEATH INSTALLATION				
13.00-13.45	U11	75	2.25	BENEATH INSTALLATION				
13.45	D15			BENEATH INSTALLATION				
14.00	D16			BENEATH INSTALLATION				
14.60-15.00	U12	80	2.25	BENEATH INSTALLATION				
15.00	D17			BENEATH INSTALLATION			15.00	
					Borehole completed at 15.00m depth			

REMARKS

Project No 12761

Scale 1:50

Page 2/2

KEY

D - Disturbed Sample
B - Bulk Sample
U - Undisturbed Sample
W - Water Sample
S/C - SPT Spoon/Cone
▽ Water Strike
▼ Water Rise

N - SPT Blows for 0.3m
* - Blows for quoted penetration
V - Vane Shear Test Cohesion ( ) kPa
▼c Level on completion
c▼w Level casing withdrawn
▼s Standpipe Level

Groundwater Strikes						Groundwater Observations			
	Depth m						Depth m		
No	Struck	Rose to	Rate	Cased	Sealed	Date	Hole	Casing	Water

GROUND ENGINEERING LIMITED

Tel: 01733-566566
www.groundengineering.co.uk

Site: 29 ABERDARE GARDENS, LONDON NW6

WINDOW SAMPLE
WSA

Date: 16/08/12 to 24/08/12

Hole Size: 87mm dia to 4.00m
77mm dia to 6.00m
57mm dia to 9.45m

Ground Level:

Samples and in-situ Tests			(Date) Water	Inst.	Description of Strata	Legend	Depth m	O.D. Level m
Depth m	Type	Result						
0.30	D1				MADE GROUND - Firm, friable dark brown/dark grey slightly gravelly CLAY. Gravel consisting of fine sub-angular flint, brick and ash fragments.			
0.60	D2							
							0.70	
0.90	D3				Stiff, brown/orange brown/grey mottled slightly gravelly CLAY. Gravel consisting of fine sub-rounded flint. (HEAD DEPOSIT)			
1.20	D4							
1.20-2.00	U1						1.30	
1.25	V1	(92)			Stiff, fissured brown/orange brown/grey mottled CLAY with occasional silt partings and rare fine gravel size calcareous concretions. (WEATHERED LONDON CLAY)			
1.35-1.65	S	N7						
1.60	V2	(102)	▼s				1.80	
1.75	W1							
1.90	V3	(106)			Stiff, fissured brown/orange brown/grey mottled CLAY with occasional selenite.			
2.00-3.00	U2							
2.10	D5							
2.40	V4	(78)						
2.50	D6							
2.90	D7				(WEATHERED LONDON CLAY)			
3.00	V5	(104)						
3.25-3.40	U3							
3.80	V6	(113)						
4.00	D8						4.00	
4.15-4.45	S	N13			Stiff, closely fissured, brown/orange brown CLAY with occasional silt partings, selenite and orange stained fissures.			
4.50-4.65	U4							
4.70	V7	(106)						
5.25-5.40	U5				(WEATHERED LONDON CLAY)			
5.60	V8	(124)						
6.00	V9	(119)						
6.80-6.95	U6							
7.00-8.00	U7						7.00	
7.00	V10	(135+)			Stiff, closely fissured, dark grey/dark brown CLAY with rare silt partings.			
7.15-7.45	S	N30						
8.25-8.40	U8				(LONDON CLAY)			
9.00	D9							
9.15-9.45	S	N28					9.45	
					Hole completed at 9.45m depth			

REMARKS
1. Starter pit excavated from GL to 1.20m depth
2. Fibrous live roots observed to 1.70m depth
3. Gas monitoring standpipe installed to 7.50m depth

Project No 12761

Scale 1:50 | Page 1/1

KEY
D - Disturbed Sample
B - Bulk Sample
U - Undisturbed Sample
W - Water Sample
▼ Water Strike
▼ Depth to Water on completion
J - Jar Sample
M - Mackintosh Probe
V - Vane Shear Test Cohesion ( ) kPa
P( ) - Hand Penetrometer Cohesion ( ) kPa
▼s Standpipe Level

Groundwater Strikes						Groundwater Observations			
		Depth m					Depth m		
No	Struck	Rose to	Rate	Cased	Sealed	Date	Hole	Casing	Water
						16/08/12	6.00		dry
						24/08/12	6.00		1.00
						24/08/12	9.45		dry
						03/10/12	7.50		1.75
						11/10/12	7.50		1.75

GROUND ENGINEERING LIMITED

Tel: 01733-566566
www.groundengineering.co.uk

Site: **29 ABERDARE GARDENS, LONDON NW6**

WINDOW SAMPLE
WSB

Date: 16/08/12

Hole Size: 87mm dia to 2.00m
77mm dia to 4.00m
57mm dia to 6.45m

Ground Level:

Samples and in-situ Tests			(Date) Water	Inst.	Description of Strata	Legend	Depth m	O.D. Level m
Depth m	Type	Result						
					MADE GROUND - SAND covered HARDCORE FILL. (Driller's Description)		0.20	
0.30	D1				MADE GROUND - Soft dark brown/grey/green/brown mottled slightly gravelly CLAY with occasional carbonaceous mottling. Gravel consisting of angular to sub-rounded flint, quartz and brick fragments.			
0.48	W1		▼s					
0.60	D2		▼s				0.80	
0.90	D3				Firm grey/brown mottled slightly gravelly CLAY. Gravel consisting of angular to sub-angular flint gravel. (HEAD DEPOSIT)			
1.20	D4						1.30	
1.35-1.65	S	N4			Firm brown/grey mottled CLAY with rare fine and medium gravel size calcareous concretions.			
1.30	V1	(41)						
1.60	D5				(WEATHERED LONDON CLAY)			
1.70	V2	(56)						
1.80-1.95	U1							
2.00	D6							
2.40-2.55	U2						2.50	
2.90	D7				Stiff, fissured brown/orange brown/grey mottled CLAY with occasional selenite and rare silt partings.			
2.90	V3	(123)						
3.00-4.00	U3							
3.00	D8							
3.15-3.45	S	N11						
4.10	V4	(102)			(WEATHERED LONDON CLAY)			
4.90	V5	(102)						
5.90	V6	(113)						
6.00	D9			BENEATH INSTALLATION				
6.15-6.45	S	N20					6.45	
					Hole completed at 6.45m depth			

REMARKS
1. Starter pit excavated from GL to 1.20m depth
2. Fibrous live roots observed to 1.30m depth
3. Gas monitoring standpipe installed to 6.00m depth

Project No 12761

Scale 1:50 | Page 1/1

KEY
D - Disturbed Sample
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▼ Water Strike
▼ Depth to Water on completion
J - Jar Sample
M - Mackintosh Probe
V - Vane Shear Test Cohesion ( ) kPa
P( ) - Hand Penetrometer Cohesion ( ) kPa
▼s Standpipe Level

Groundwater Strikes						Groundwater Observations			
	Depth m						Depth m		
No	Struck	Rose to	Rate	Cased	Sealed	Date	Hole	Casing	Water
						16/08/12	6.45		dry
						03/10/12	6.00		0.48
						11/10/12	6.00		0.67

Gas Monitoring Record

Site: **29 Aberdare Gardens, London NW6**

Report Ref: **C12761**

Date	Borehole No.	Methane (% v/v)		Methane LEL %		Carbon Dioxide (% v/v)		Oxygen (% v/v)		Flow Rate (l/hr)	Atmosph. Pressure (mb)	Depth of Well (mbgl)	Depth to Groundwater (mbgl)	Comments
		Peak	Steady	Peak	Steady	Peak	Steady	Min.	Max.					
03/10/2012	BH1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	20.7	20.7	<0.1	1006	7.00	0.82	
	WSA	<0.1	<0.1	<0.1	<0.1	1.5	1.3	19.4	20.1	<0.1	1006	7.50	1.75	
	WSB	<0.1	<0.1	<0.1	<0.1	0.5	0.5	20.3	20.3	<0.1	1006	6.00	0.48	
11/10/2012	BH1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	20.6	20.6	<0.1	1005	7.00	0.83	
	WSA	<0.1	<0.1	<0.1	<0.1	0.9	0.9	19.9	19.9	<0.1	1005	7.50	1.75	
	WSB	<0.1	<0.1	<0.1	<0.1	0.2	0.1	20.2	20.2	<0.1	1005	6.00	0.67	

LEL – Lower Explosive Limit

LABORATORY TEST RESULTS

CONTRACT 29 ABERDARE GARDENS, LONDON NW6

Bore-hole	Sample	Depth m	Classification				Density		Triaxial Compression					Sulphates (SO_4)				Remarks
			Liquid Limit %	Plastic Limit %	Plasticity Index %	Moisture Content %	Bulk Mg/m^3	Dry Mg/m^3	Type	Principal Stress Difference kPa	Cell Pressure kPa	Shear Strength kPa	Angle of Shear Resistance degrees	Soil Total % Dry Wt.	Soil Aqueous Extract mg/l	Water mg/l	pH	
BH1	W1	0.82														2922	7.5	
	U1	1.20 - 1.65				34	1.96	1.46	Q	93	50	46	0					
	U2	2.00 - 2.45	71	26	45	31	1.95	1.49	Q	122	50	61	0					SOIL CLASSIFICATION = CV 0% retained on 425μm sieve
	U3	3.00 - 3.45				34	1.94	1.45	Q	139	60	70	0					
	U4	4.10 - 4.55				36	1.91	1.40	Q	156	90	78	0					
	U5	5.10 - 5.55				33	1.94	1.46	Q	206	100	103	0		3355		7.5	
	U7	7.00 - 7.45				29	2.01	1.56	Q	209	140	105	0					
	U8	8.50 - 8.95				27	2.05	1.61	Q	258	170	129	0					
	U9	10.00 - 10.45				31	2.02	1.55	Q	234	200	117	0					
	U11	13.00 - 13.45				29	2.02	1.57	Q	468	200	234	0					

U - UNDISTURBED SAMPLE
D - DISTURBED SAMPLE
B - BULK SAMPLE
W - WATER SAMPLE

C.U. - CONSOLIDATED UNDRAINED
C.D. - CONSOLIDATED DRAINED
Q. - IMMEDIATE UNDRAINED
Q.M. - IMMEDIATE UNDRAINED MULTISTAGE

Aqueous Extract 2:1 Water:Soil

12761

GROUND ENGINEERING LIMITED
Tel: 01733-566566
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LABORATORY TEST RESULTS

CONTRACT 29 ABERDARE GARDENS, LONDON NW6

Bore-hole	Sample	Depth m	Classification				Density		Triaxial Compression					Sulphates (SO_4)				Remarks
			Liquid Limit %	Plastic Limit %	Plasticity Index %	Moisture Content %	Bulk Mg/m^3	Dry Mg/m^3	Type	Principal Stress Difference kPa	Cell Pressure kPa	Shear Strength kPa	Angle of Shear Resistance degrees	Soil: Total % Dry Wt.	Soil: Aqueous Extract mg/l	Water mg/l	pH	
BH1	U12	14.60 - 15.00				29	2.00	1.55	Q	229	300	115	0					

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Aqueous Extract 2:1 Water:Soil

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LABORATORY TEST RESULTS

CONTRACT 29 ABERDARE GARDENS, LONDON NW6

Bore-hole	Sample	Depth m	Classification				Density		Triaxial Compression					Sulphates (SO_4)				Remarks
			Liquid Limit %	Plastic Limit %	Plasticity Index %	Moisture Content %	Bulk Mg/m^3	Dry Mg/m^3	Type	Principal Stress Difference kPa	Cell Pressure kPa	Shear Strength kPa	Angle of Shear Resistance degrees	Soil: Total % Dry Wt.	Soil: Aqueous Extract mg/l	Water mg/l	pH	
WSA	D3	0.90				31												
	D4	1.20	65	24	41	28												SOIL CLASSIFICATION = CH 0% retained on 425μm sieve
	U1	1.70 - 1.85				28	1.99	1.55	Q	200	50	100	0					
	W1	1.75														2988	7.6	
	D5	2.10				29									2804		7.5	
	D6	2.50				31												
	D7	2.90																
	U3	3.25 - 3.40				33	1.88	1.41	Q	126	70	63	0					
	U4	4.50 - 4.65				33	1.90	1.42	Q	182	90	91	0					
	U5	5.25 - 5.40				33	1.91	1.43	Q	225	110	113	0					
	U6	6.80 - 6.95				34	1.88	1.41	Q	165	110	83	0					
	U8	8.25 - 8.40				33	1.89	1.42	Q	211	170	105	0					

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Aqueous Extract 2:1 Water:Soil

12761

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LABORATORY TEST RESULTS

CONTRACT 29 ABERDARE GARDENS, LONDON NW6

Bore-hole	Sample	Depth m	Classification				Density		Triaxial Compression					Sulphates (SO_4)				Remarks
			Liquid Limit %	Plastic Limit %	Plasticity Index %	Moisture Content %	Bulk Mg/m^3	Dry Mg/m^3	Type	Principal Stress Difference kPa	Cell Pressure kPa	Shear Strength kPa	Angle of Shear Resistance degrees	Soil: Total % Dry Wt.	Soil: Aqueous Extract mg/l	Water mg/l	pH	
WSB	D4	1.20				31												
	D5	1.60				31												
	U1	1.80 - 1.95				30	1.92	1.48	Q	84	50	42	0					
	D6	2.00				33												
	U2	2.40 - 2.55				33	1.99	1.50	Q	116	50	58	0					
	D7	2.90				32												
	D9	4.40													3622		7.4	
	U7	4.50 - 4.65				34	1.88	1.40	Q	278	90	139	0					
	U5	5.50 - 5.65				33	1.94	1.46	Q	297	110	148	0					

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B - BULK SAMPLE
W - WATER SAMPLE

C.U. - CONSOLIDATED UNDRAINED
C.D. - CONSOLIDATED DRAINED
Q. - IMMEDIATE UNDRAINED
Q.M. - IMMEDIATE UNDRAINED MULTISTAGE

Aqueous Extract 2:1 Water:Soil

12761

GROUND ENGINEERING LIMITED
Tel: 01733-566566
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Enverity

Newark Road Peterborough

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e: peterborough@enverity.co.uk

TEST CERTIFICATE

One-Dimensional Consolidation Properties

(Tested in accordance with BS1377 : Part 5 1990)

Client:	Ground Engineering
Client Address:	Newark Road
	Peterborough
	Cambridgeshire
Postcode:	PE1 5UA
Contact:	Chris Ebeling
Site Name:	29 Aberdare Gardens
Site Address:	London NW6

Certificate Number:	PL3859-1-4/731
Client Reference Number:	C12761
Date Sampled:	Unknown
Date Received:	11.09.2012
Date Tested:	04.10.2012
Sampling Certificate No:	N/A
Certificate of Sampling:	N/A
Sampled By:	Client

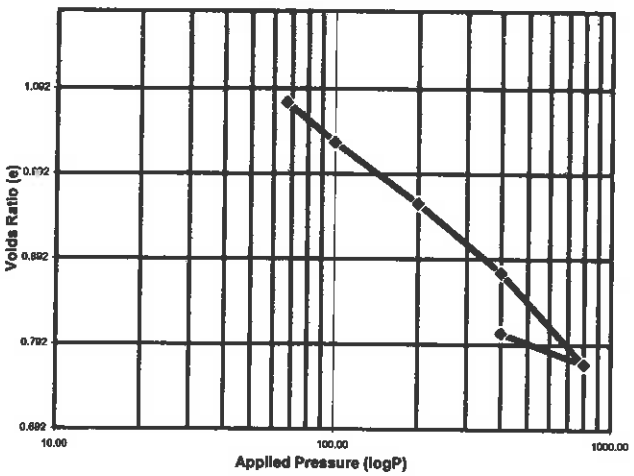
Test Details

Location:	BH1	
Sample Ref:	U4	
Sample Description:	Firm brown orange-brown slightly silty CLAY	
Particle Density (Mg/m^3):	2.74	Assumed
Mean Lab Temp. (°C):	22	
Variations from Standard:	None	
Lab Reference:	PL3859-1-4	
Depth (m):	4.10 m	

Specimen Details

	INITIAL	FINAL
Height (mm):	18.93	16.46
Bulk Density (Mg/m^3):	1.80	2.04
Moisture Content (%):	36	34
Dry Density (Mg/m^3):	1.32	1.52
Voids Ratio:	1.076	0.805
Degree of Saturation (%):	92.3	117.3
Diameter (mm):	74.99	N/A
Swelling Pressure (kPa):	67	N/A
Method of time fitting used:	Log Time	N/A

Voids Ratio against logarithm of Applied Pressure



Applied Pressure (kPa)	Coefficient of Compressibility m_v (m^2/MN)	Coefficient of Consolidation c_v (m^2/year)
67		
100	0.68	1.24
200	0.35	1.00
400	0.21	0.42
800	0.14	0.31
400	0.05	---

Comments:

Approved Signatory: [x] M.Hartnup - Laboratory Manager

[ ] G.Meadows - Team Leader

Signed:

for and on behalf of Enverity Ltd

Date Reported: 04/10/2012

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Newmarket CB8 7SQ

Chemtest
The right chemistry to deliver results

Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070

Ground Engineering Limited
Newark Road
Peterborough

PE1 5UA

FAO Chris Ebeling
17 September 2012

Dear Chris Ebeling

Test Report Number **212426**
Your Project Reference **C12761 - 29 Aberdare Garden, London NW6**

Please find enclosed the results of analysis for the samples received 7 September 2012.

All soil samples will be retained for a period of one month and all water samples will be retained for 7 days following the date of the test report. Should you require an extended retention period then please detail your requirements in an email to customerservices@chemtest.co.uk. Please be aware that charges may be applicable for extended sample storage.

If you require any further assistance, please do not hesitate to contact the Customer Services team.

Yours sincerely

Darrell Hall, Director

UKAS TESTING
2183

ISO 14001 sira UKAS ENVIRONMENTAL MANAGEMENT

Notes to accompany report:

- *The sign < means 'less than'*
- *Tests marked 'U' hold UKAS accreditation*
- *Tests marked 'M' hold MCertS (and UKAS) accreditation*
- *Tests marked 'N' do not currently hold UKAS accreditation*
- *Tests marked 'S' were subcontracted to an approved laboratory*
- *n/e means 'not evaluated'*
- *i/s means 'insufficient sample'*
- *u/s means 'unsuitable sample'*
- *Comments or interpretations are beyond the scope of UKAS accreditation*
- *The results relate only to the items tested*
- *All results are expressed on a dry weight basis*
- *The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, phenols*
- *For all other tests the samples were dried at < 37°C prior to analysis*
- *Uncertainties of measurement for the determinands tested are available upon request*
- *None of the test results included in this report have been recovery corrected*

Ground Engineering Limited
Newark Road
Peterborough

PE1 5UA

FAO Chris Ebeling

LABORATORY TEST REPORT

Results of analysis of 3 samples received 7 September 2012

C12761 - 29 Aberdare Garden, London NW6

Chemtest
The right chemistry to deliver results

Report Date
17 September 2012

Login Batch No					212426		
Chemtest LIMS ID					AH71023	AH71024	AH71025
Sample ID					BH1	WSA	WSB
Sample No					B1	D1	D2
Sampling Date					Not Provided	Not Provided	Not Provided
Depth					0.20m - 0.70m	0.30m	0.60m
Matrix					*SOIL*	*SOIL*	*SOIL*
SOP↓	Determinand↓	CAS No↓	Units↓	*			
2010	pH			M	7.9	7.6	7.1
2300	Cyanide (free)	57125	mg kg^{-1}	M	< 0.5	< 0.5	< 0.5
	Cyanide (total)	57125	mg kg^{-1}	M	< 0.5	< 0.5	< 0.5
2325	Sulfide (Easily Liberatable)	18496258	mg kg^{-1}	M	1.6	0.94	4.7
2625	Organic matter		%	M	1.7	6.6	4.5
2120	Boron (hot water soluble)	7440428	mg kg^{-1}	M	0.8	1.8	1.0
	Sulfate (2:1 water soluble) as SO4	14808798	g l^{-1}	M	0.05	0.01	0.22
2490	Chromium (hexavalent)	18540299	mg kg^{-1}	N	<0.5	<0.5	<0.5
2450	Arsenic	7440382	mg kg^{-1}	M	11	8.0	8.5
	Cadmium	7440439	mg kg^{-1}	M	<0.10	<0.10	<0.10
	Chromium	7440473	mg kg^{-1}	M	28	20	22
	Copper	7440508	mg kg^{-1}	M	19	16	17
	Mercury	7439976	mg kg^{-1}	M	<0.10	<0.10	<0.10
	Nickel	7440020	mg kg^{-1}	M	19	10	11
	Lead	7439921	mg kg^{-1}	M	120	66	71
	Selenium	7782492	mg kg^{-1}	M	<0.20	<0.20	<0.20
	Zinc	7440666	mg kg^{-1}	M	51	42	47
2700	Naphthalene	91203	mg kg^{-1}	M	< 0.1	3.8	< 0.1
	Acenaphthylene	208968	mg kg^{-1}	M	< 0.1	0.9	0.17
	Acenaphthene	83329	mg kg^{-1}	M	< 0.1	5.3	0.55
	Fluorene	86737	mg kg^{-1}	M	< 0.1	6.2	0.27
	Phenanthrene	85018	mg kg^{-1}	M	0.22	49	2.1
	Anthracene	120127	mg kg^{-1}	M	< 0.1	10	0.3

All tests undertaken between 07/09/2012 and 14/09/2012

* Accreditation status

This report should be interpreted in conjuction with the notes on the accompanying cover page.

Ground Engineering Limited
Newark Road
Peterborough

PE1 5UA

FAO Chris Ebeling

LABORATORY TEST REPORT

Results of analysis of 3 samples received 7 September 2012

C12761 - 29 Aberdare Garden, London NW6

Chemtest
The right chemistry to deliver results

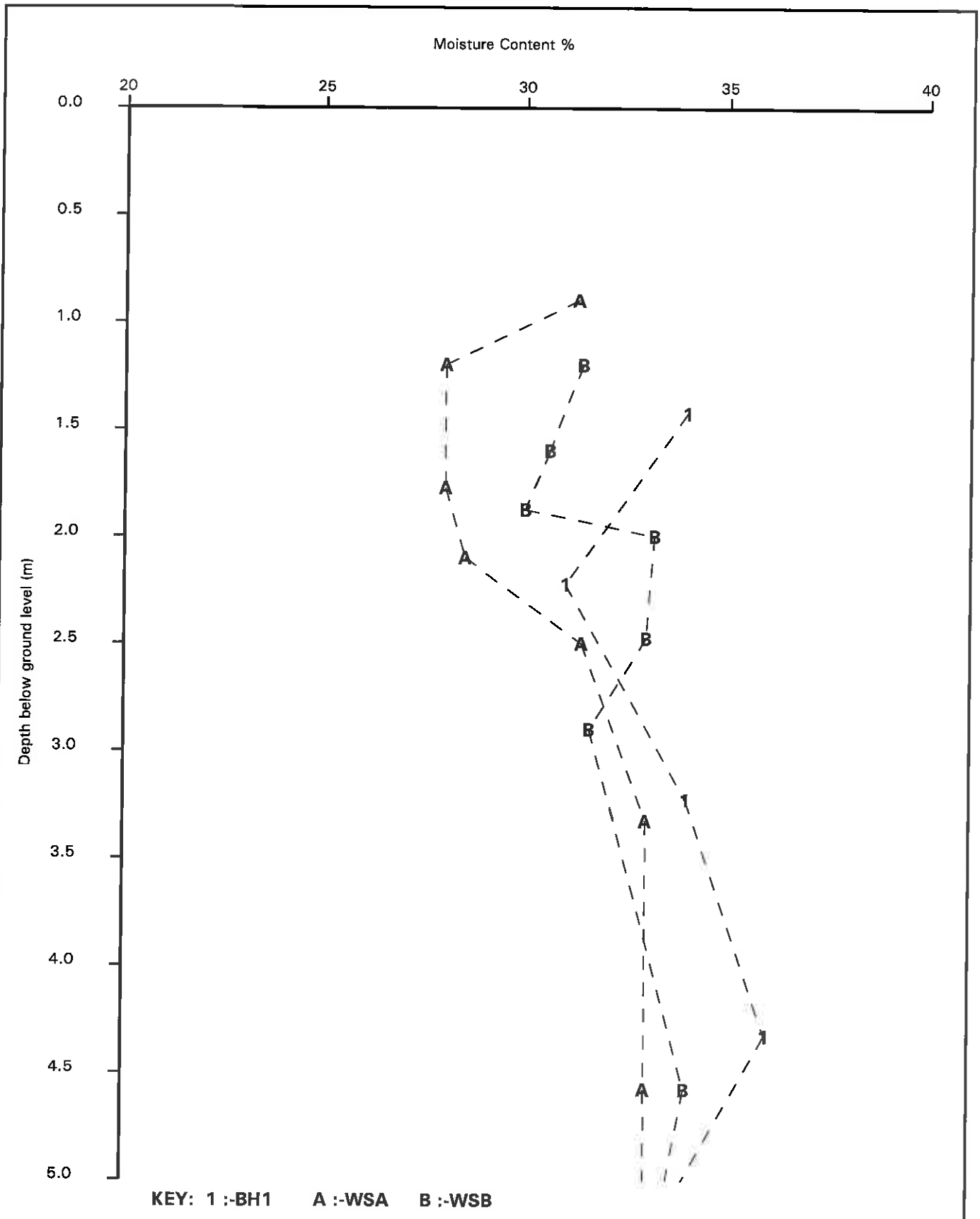
Report Date
17 September 2012

					212426		
					AH71023	AH71024	AH71025
					BH1	WSA	WSB
					B1	D1	D2
					Not Provided	Not Provided	Not Provided
					0.20m - 0.70m	0.30m	0.60m
					SOIL	*SOIL*	*SOIL*
2700	Fluoranthene	206440	mg kg-1	M	0.43	45	1.9
	Pyrene	129000	mg kg-1	M	0.45	34	1.5
	Benzo[a]anthracene	56553	mg kg-1	M	0.21	17	0.62
	Chrysene	218019	mg kg-1	M	0.13	20	0.72
	Benzo[b]fluoranthene	205992	mg kg-1	M	< 0.1	16	0.63
	Benzo[k]fluoranthene	207089	mg kg-1	M	< 0.1	11	0.39
	Benzo[a]pyrene	50328	mg kg-1	M	< 0.1	16	0.43
	Dibenzo[a,h]anthracene	53703	mg kg-1	M	< 0.1	1.7	< 0.1
	Indeno[1,2,3-cd]pyrene	193395	mg kg-1	M	< 0.1	10	< 0.1
	Benzo[g,h,i]perylene	191242	mg kg-1	M	< 0.1	10	< 0.1
	Total (of 16) PAHs		mg kg-1	M	< 2	260	9.6
2920	Phenols (total)		mg kg-1	N	<0.3	<0.3	<0.3

All tests undertaken between 07/09/2012 and 14/09/2012

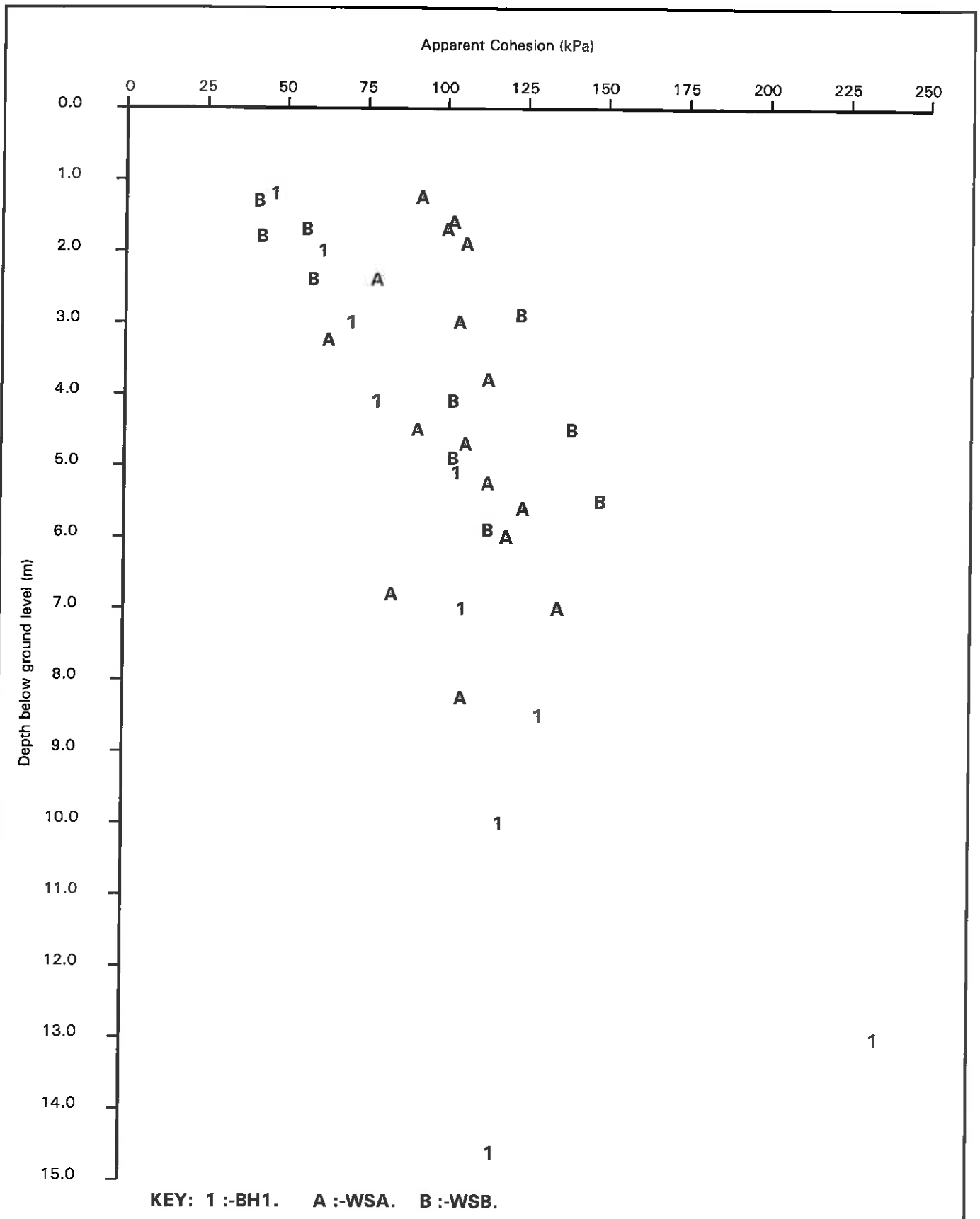
* Accreditation status

This report should be interpreted in conjuction with the notes on the accompanying cover page.



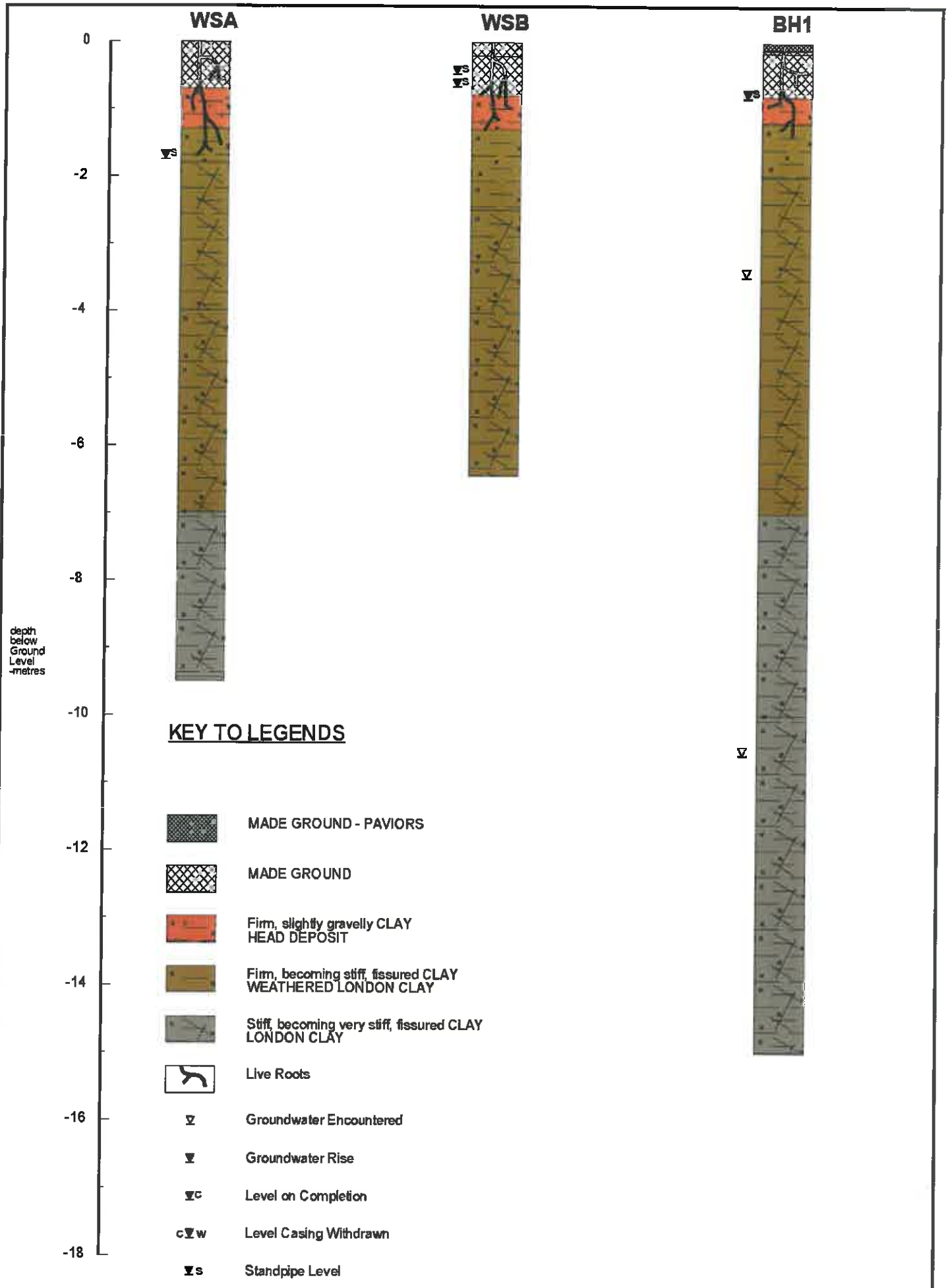
Moisture Content % vs Depth below ground level (m).

SITE	29 ABERDARE GARDENS, LONDON NW6		
CLIENT	GRAFFHAM PROPERTIES	Contract Number	12761
GROUND ENGINEERING LIMITED	Tel: 01733-566566 www.groundengineering.co.uk	Date 11/10/12	Figure 1



Apparent Cohesion (kPa) vs Depth below ground level (m).

SITE	29 ABERDARE GARDENS, LONDON NW6		
CLIENT	GRAFFHAM PROPERTIES		Contract Number 12761
GROUND ENGINEERING LIMITED	Tel: 01733-566566 www.groundengineering.co.uk	Date 11/10/12	Figure 2



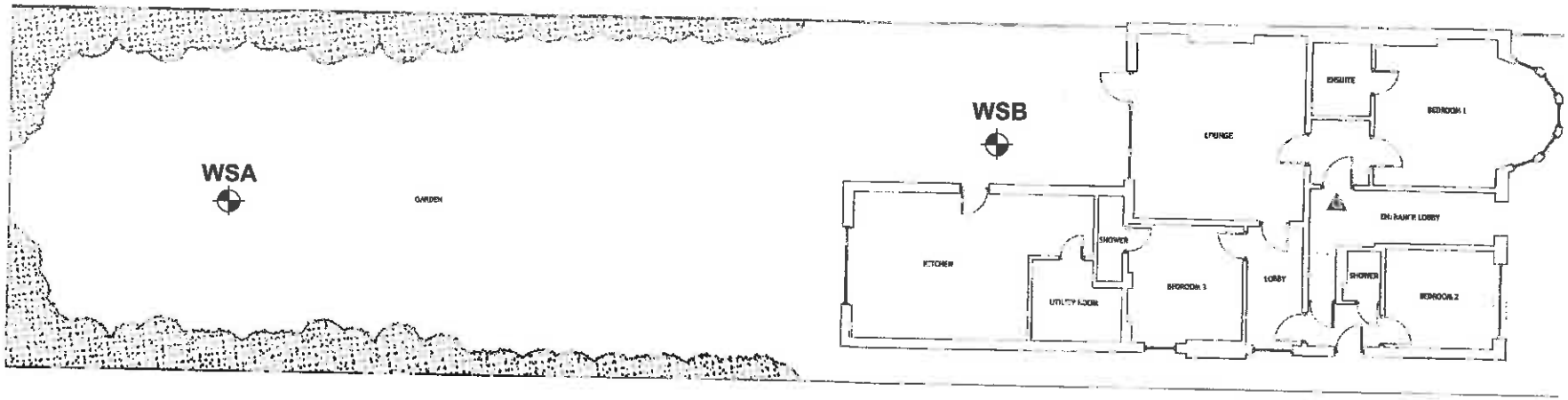
SITE	29 ABERDARE GARDENS, LONDON NW6		Contract No. 12761
CLIENT	GRAFFHAM PROPERTIES	Soil Profile	Vertical Scale 1:75
GROUND ENGINEERING LIMITED, PETERBOROUGH. Tel (01733) 566566		Date 11/10/12	Fig. No 3

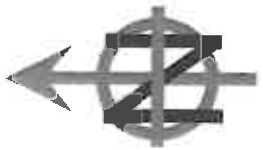
Borehole Location Plan

Not to Scale

KEY

Borehole





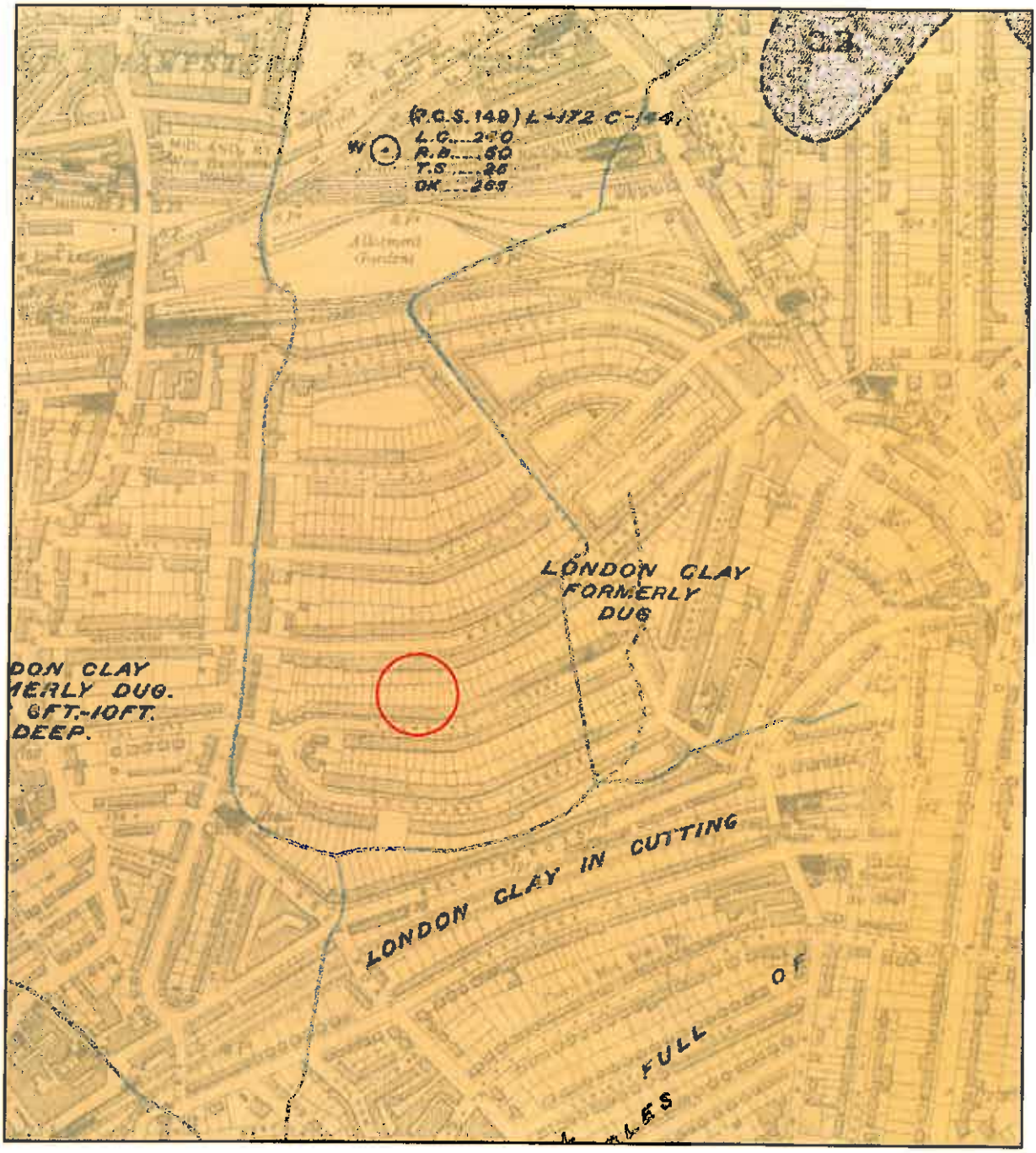
Project	**29 Aberdare Gardens, London NW6**	**GROUND ENGINEERING LIMITED**	**Project No.**
Client	**Graffham Properties**	Peterborough Tel : 01733 566566	**C12761**

APPENDIX 1

MAP EXTRACTS OF GEOLOGY & SURFACE DRAINAGE

Surface Drainage & Geology

Reproduced & enlarged from the **1934** edition Geological Map sheet **London IV.NE** at **1:10,560** scale

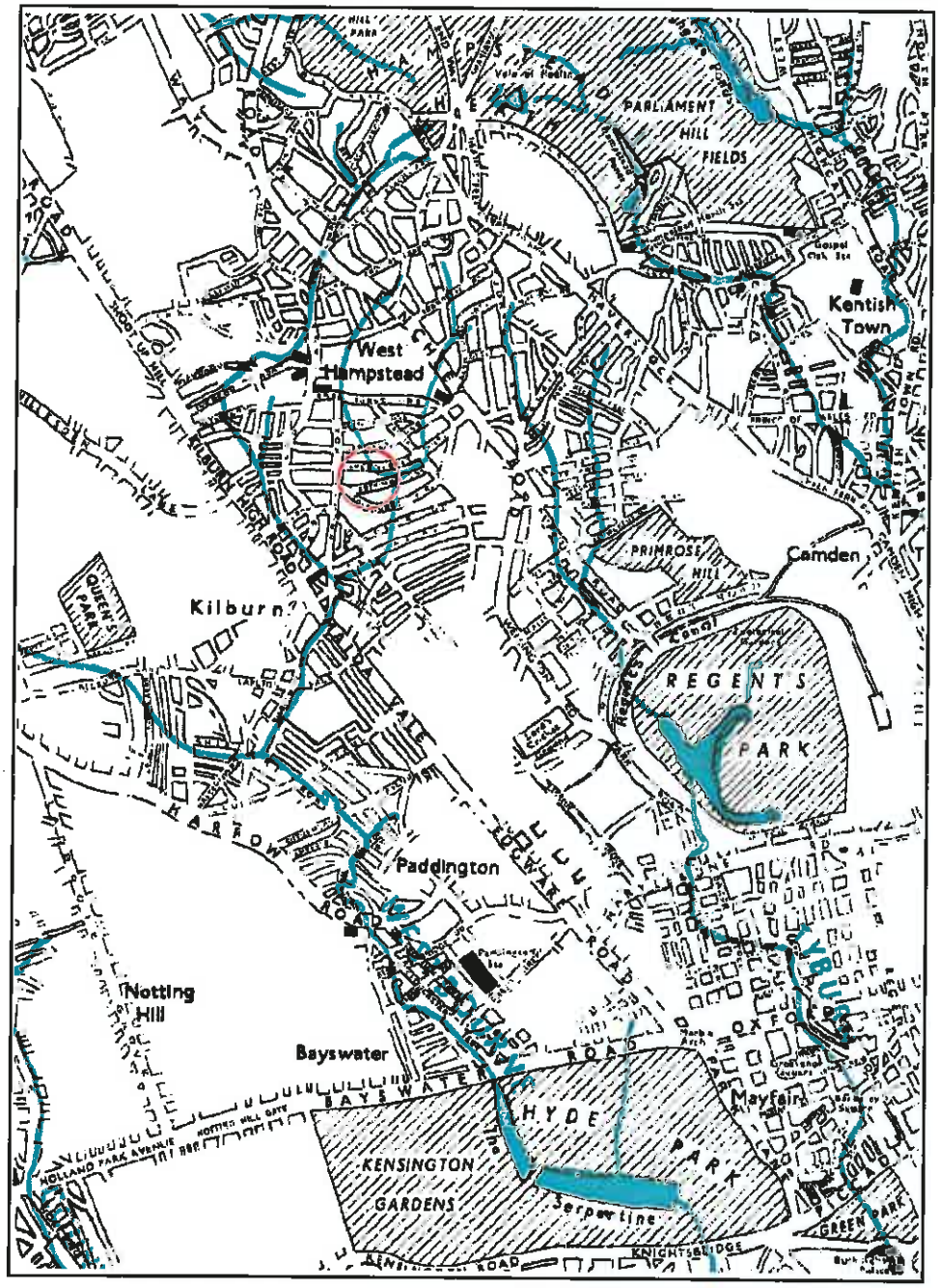


Project : 29 Aberdare Gardens, London NW6 **Client : Graffham Properties**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** **C12761**

Surface Drainage

Reproduced from **N. Barton's 'The Lost Rivers of London'**
Not to Scale

N



Project : 29 Aberdare Gardens, London NW6 **Client : Graffham Properties**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** **C12761**

APPENDIX 2

HISTORICAL MAP & AERIAL PHOTOGRAPH EXTRACTS

Site History

Figure A

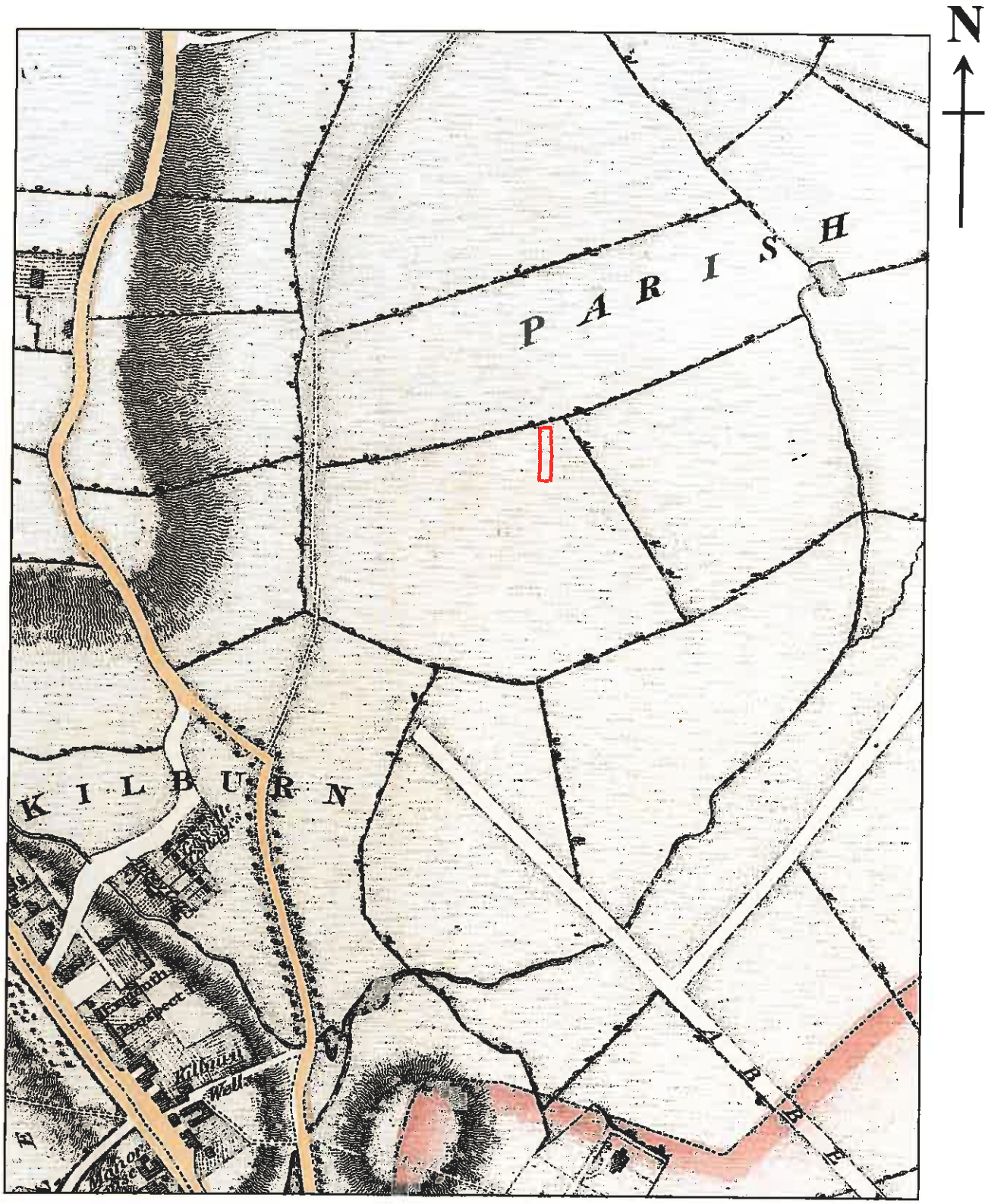
Reproduced from the **1827** edition **Greenwood's Map of London** at **1:7920 scale**.

Project : 29 Aberdare Gardens, London NW6 **Client : Graffham Properties**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** **C12761**

Site History

Figure B

Reproduced from the **1830** edition **Greenwood's Map of London** at **1:7920 scale**.



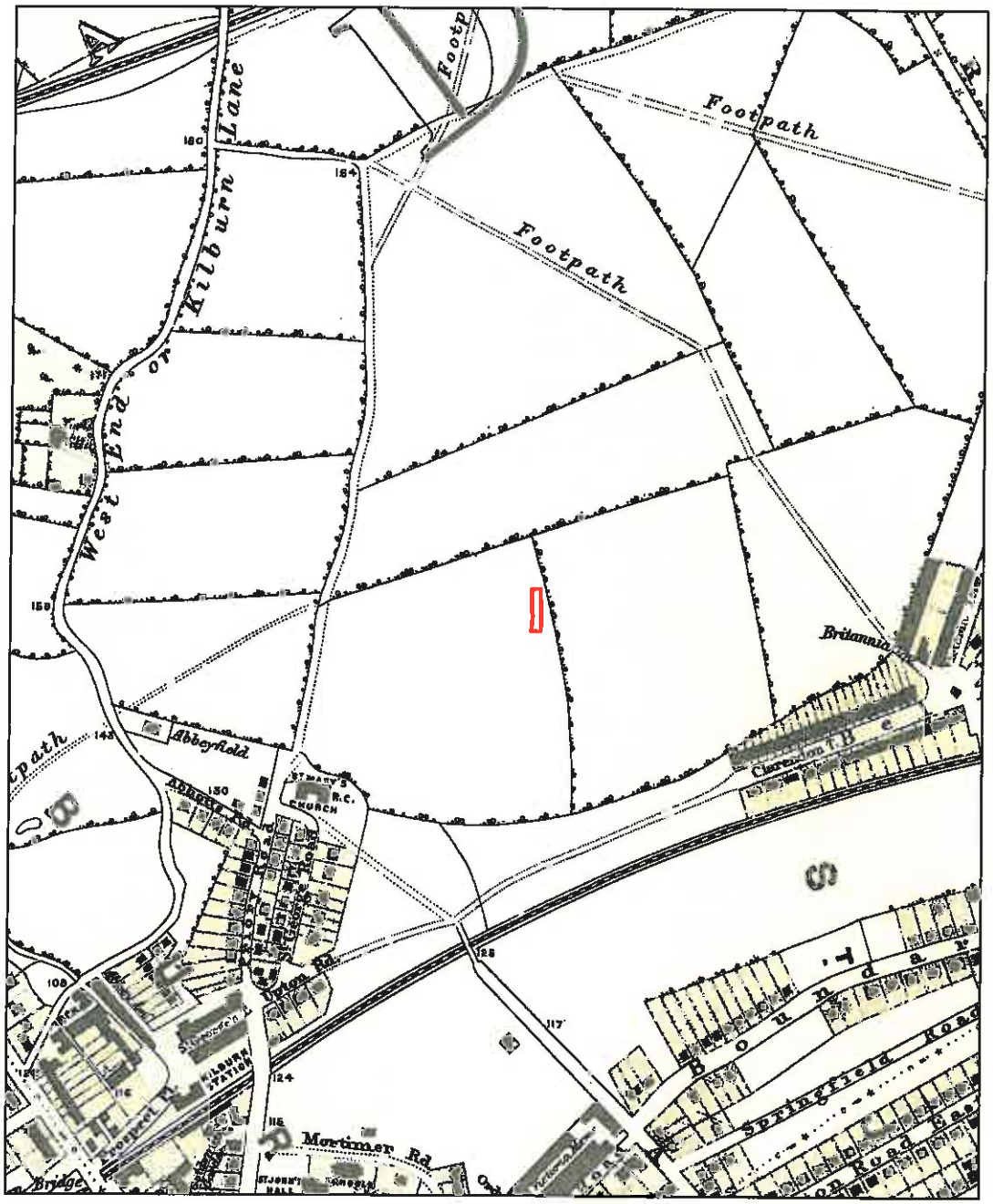
Project : 29 Aberdare Gardens, London NW6 **Client : Graffham Properties**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** **C12761**

Site History

Figure C

Reproduced & enlarged from the **1862** edition **Stanford's Library Map of London and its Suburbs.**
Not to scale.

N

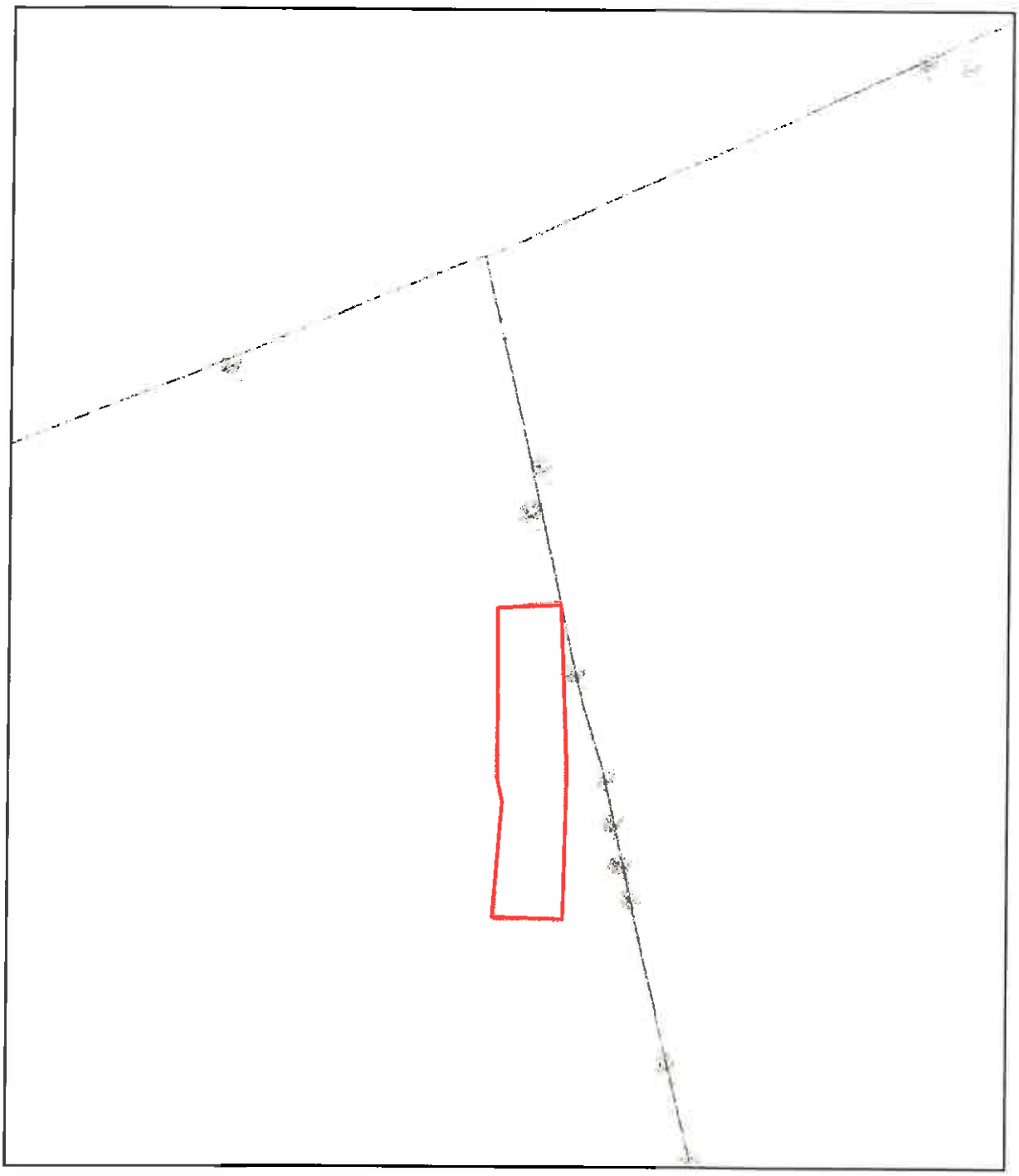


Project : 29 Aberdare Gardens, London NW6 **Client : Graffham Properties**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** **C12761**

Site History

Figure D

Reproduced from the **1868** edition Ordnance Survey **Town Plan** at **1:1056** scale with the permission of the Controller of Her Majesty's Stationery Office, © Crown Copyright. All rights reserved. Licence number AL100005523



Project : 29 Aberdare Gardens, London NW6

Client : Graffham Properties

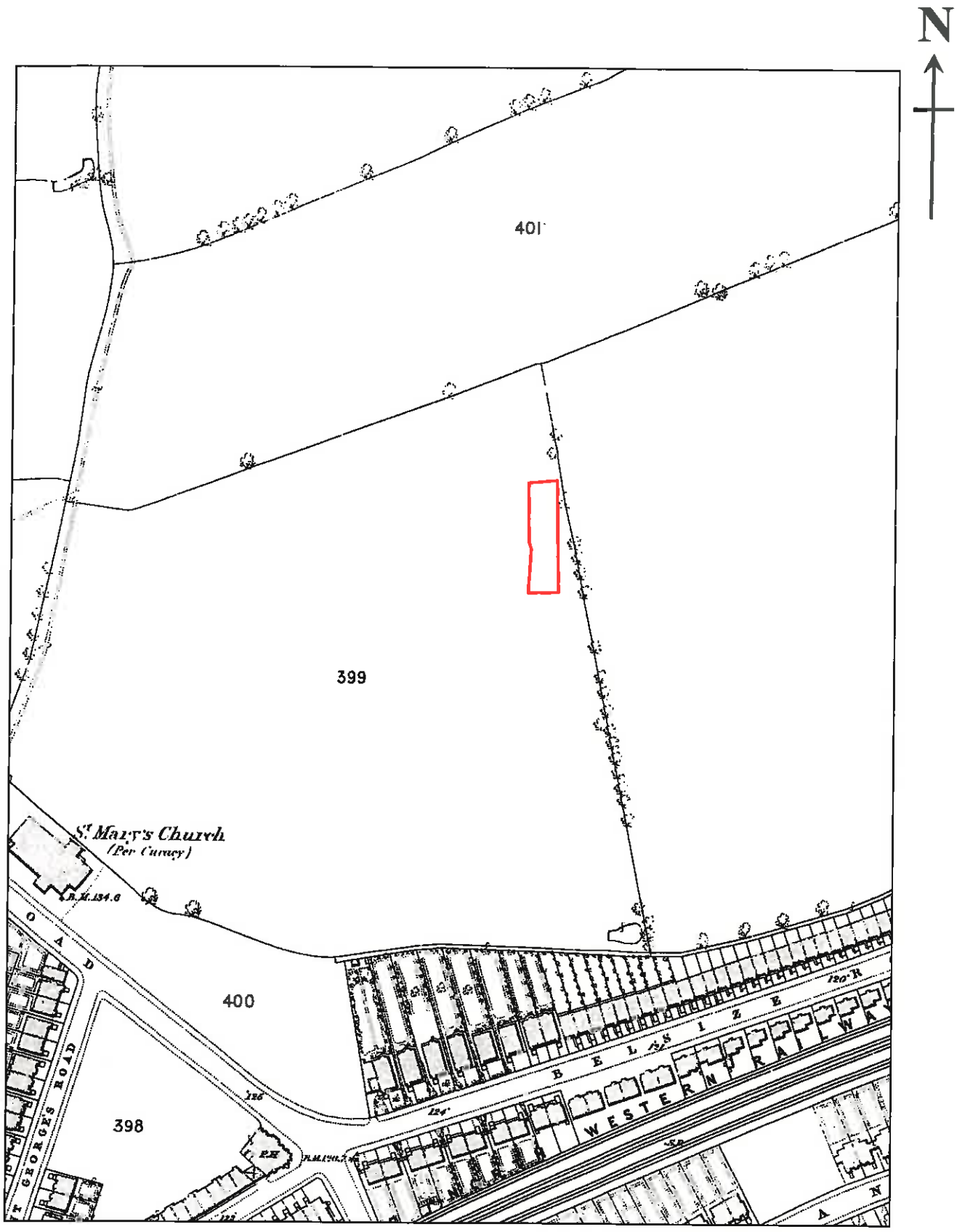
GROUND ENGINEERING LIMITED
Peterborough Tel : 01733 566566

Project No.
C12761

Site History

Figure E

Reproduced from the **1871** edition Ordnance Survey sheet **London XV** at **1:2500** scale with the permission of the Controller of Her Majesty's Stationery Office, © Crown Copyright. All rights reserved. Licence number AL100005523



Project : 29 Aberdare Gardens, London NW6 **Client : Graffham Properties**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** **C12761**

Site History

Figure F

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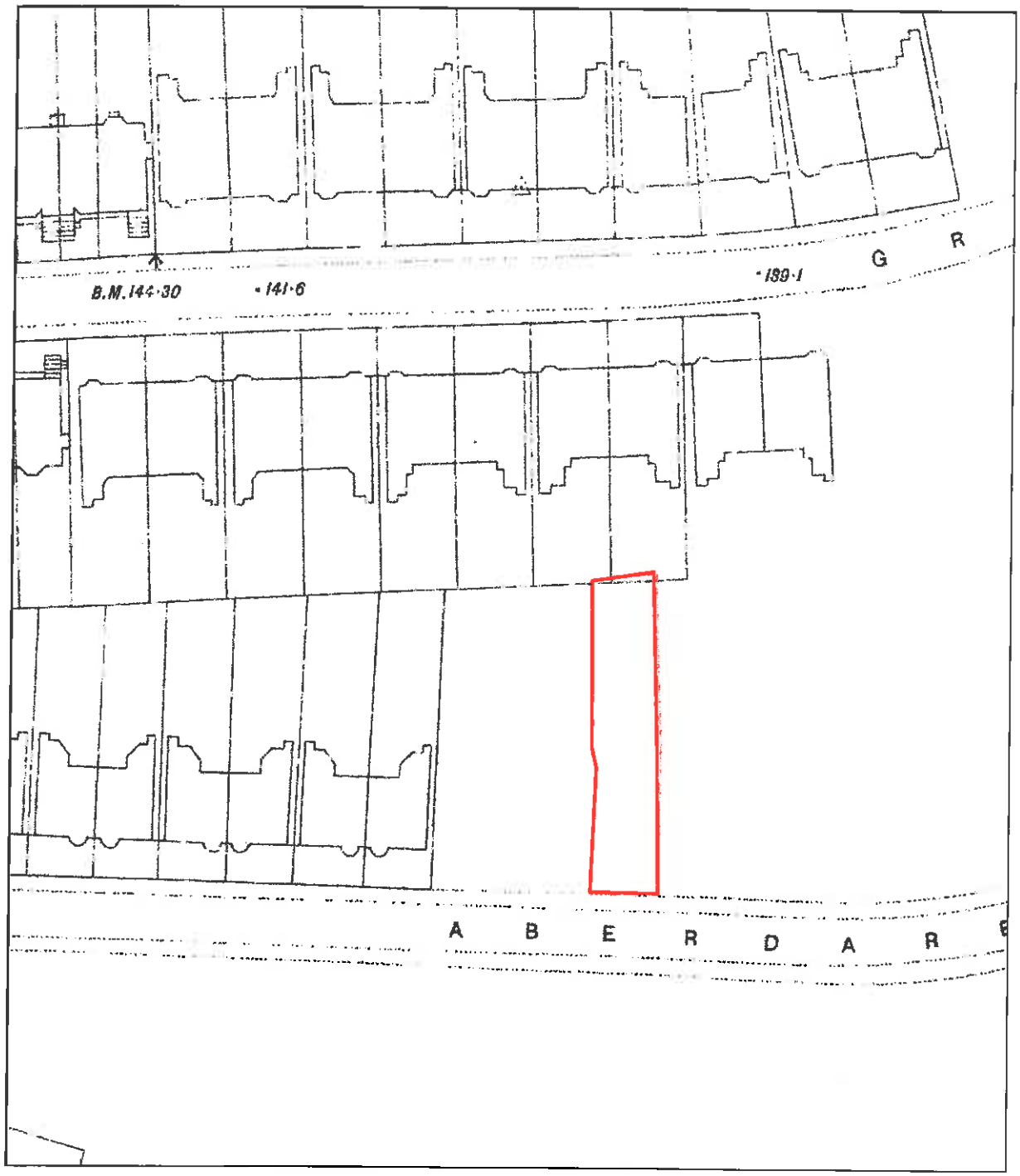
N



Project : 29 Aberdare Gardens, London NW6

Client : Graffham Properties

GROUND ENGINEERING LIMITED
Peterborough Tel : 01733 566566

Project No.
C12761

Site History

Figure G

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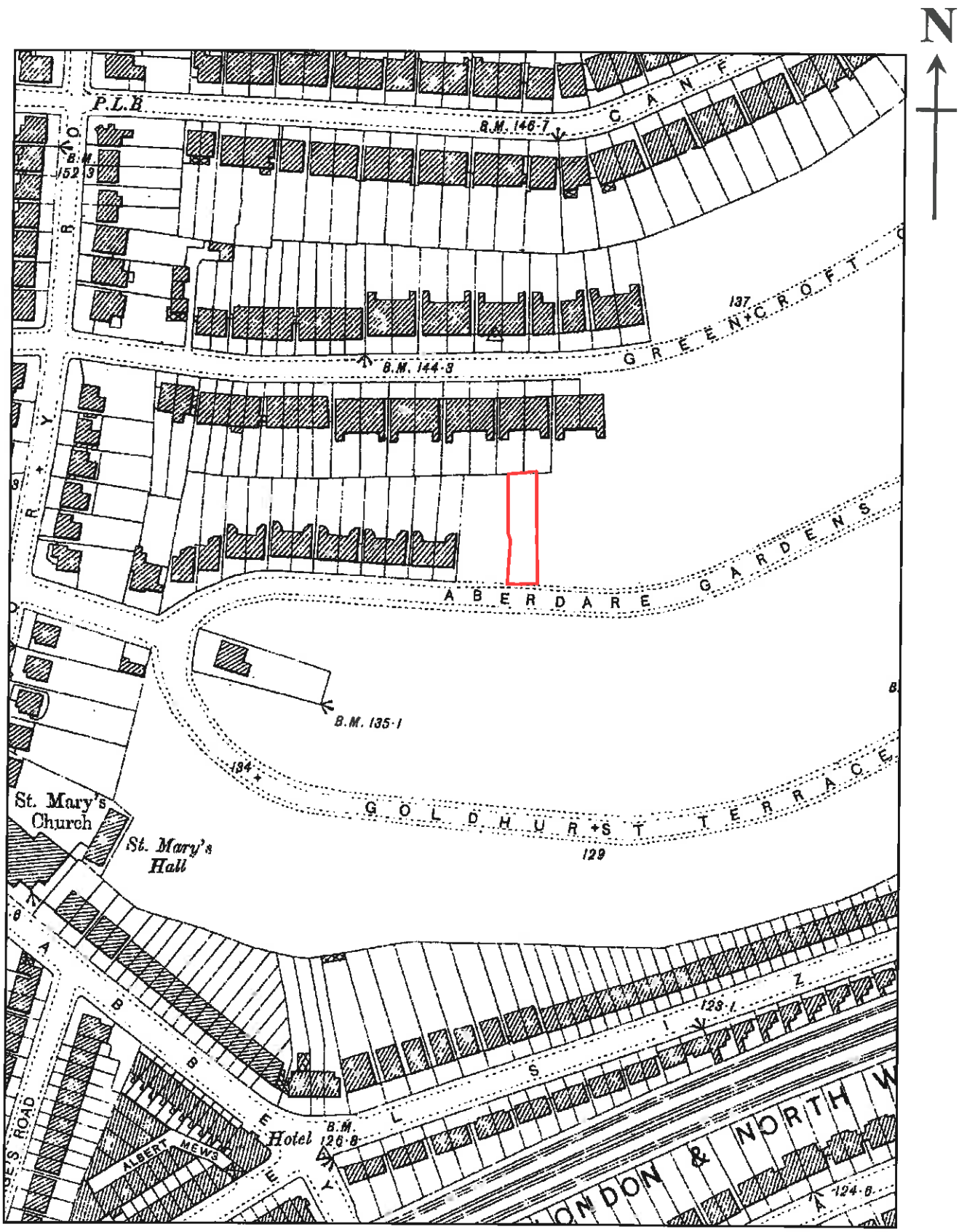

Project : 29 Aberdare Gardens, London NW6 **Client : Graffham Properties**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** **C12761**

Site History

Figure H

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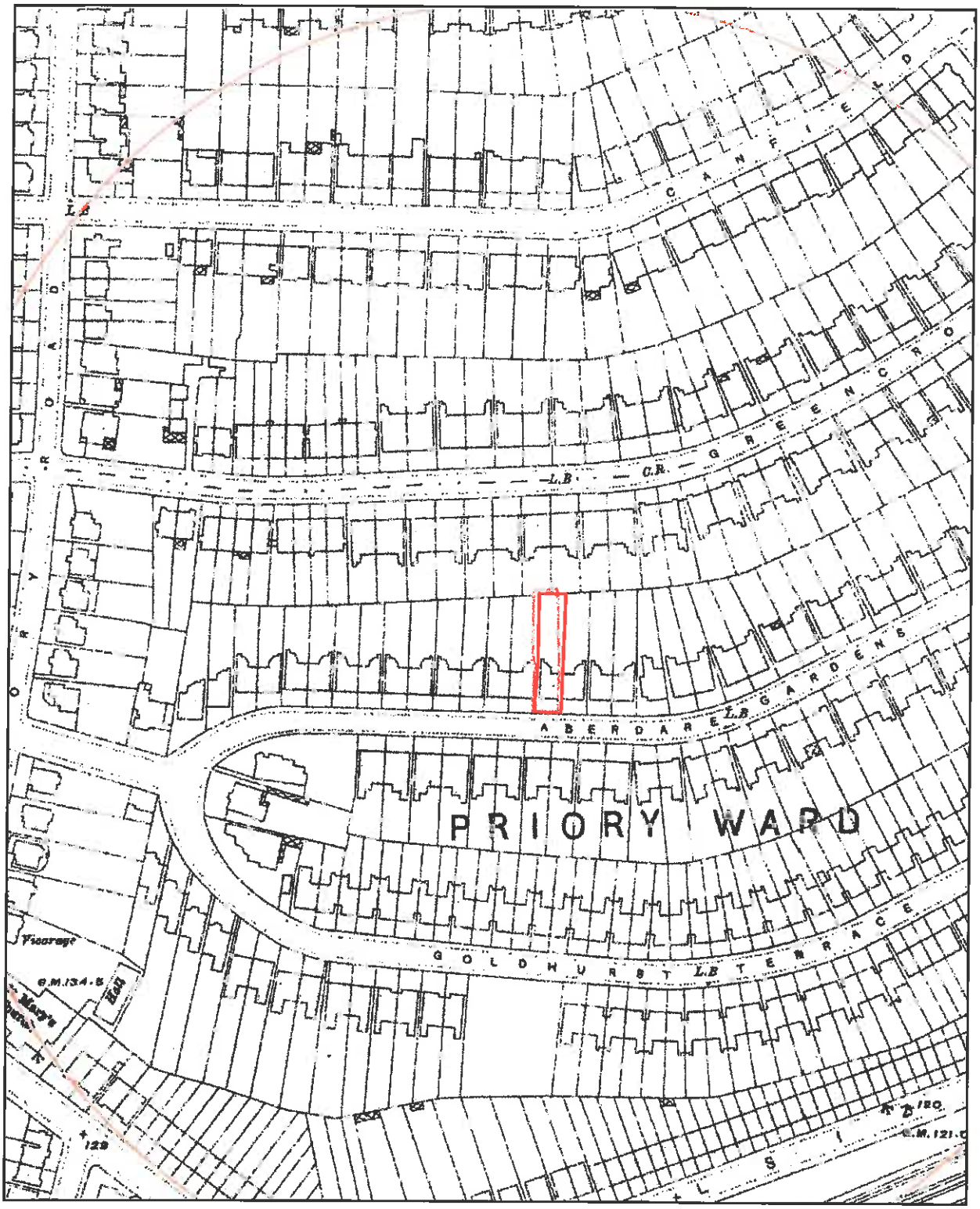
N



Project : 29 Aberdare Gardens, London NW6 **Client : Graffham Properties**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** **C12761**

Site History

Figure I

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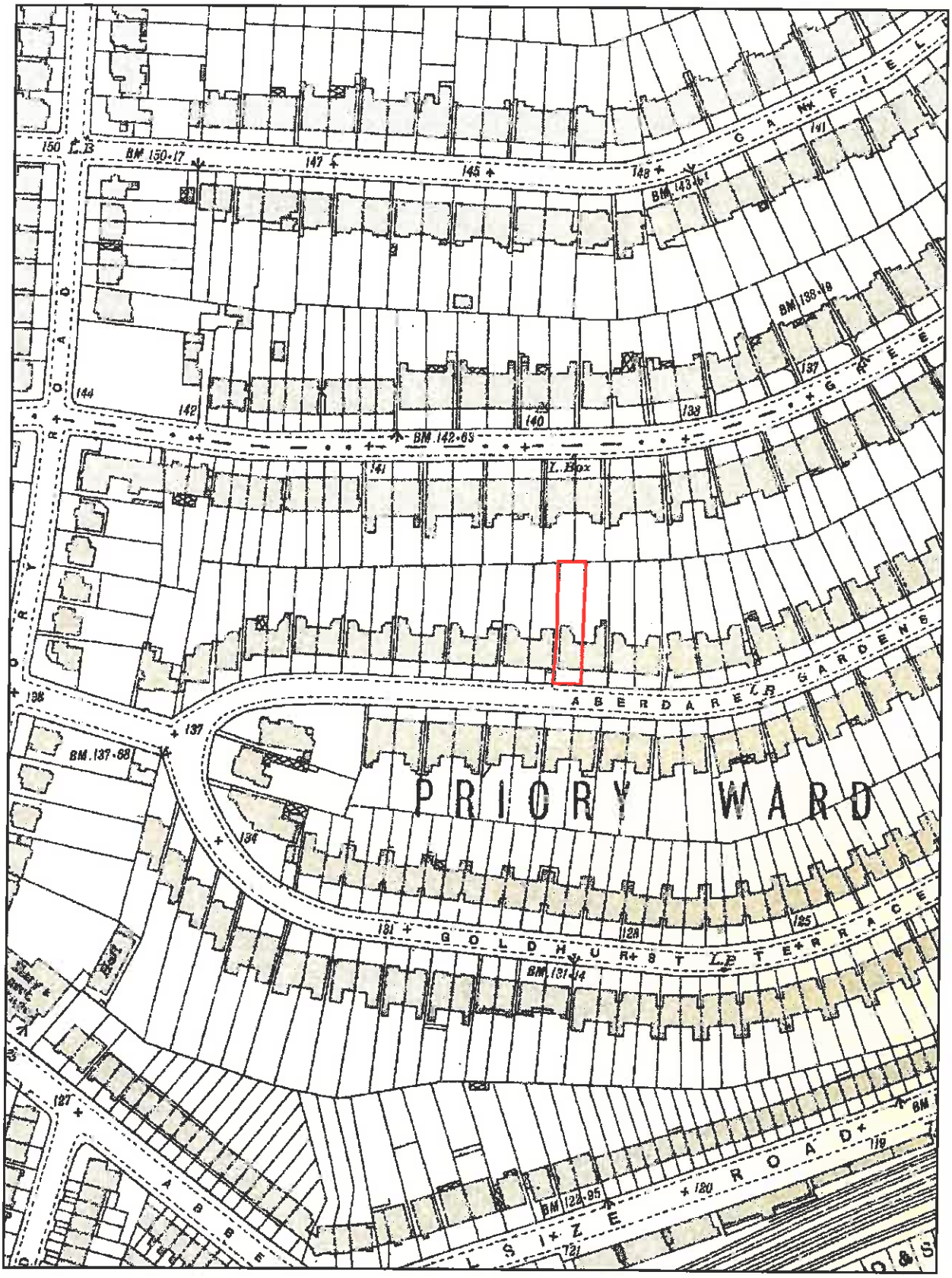


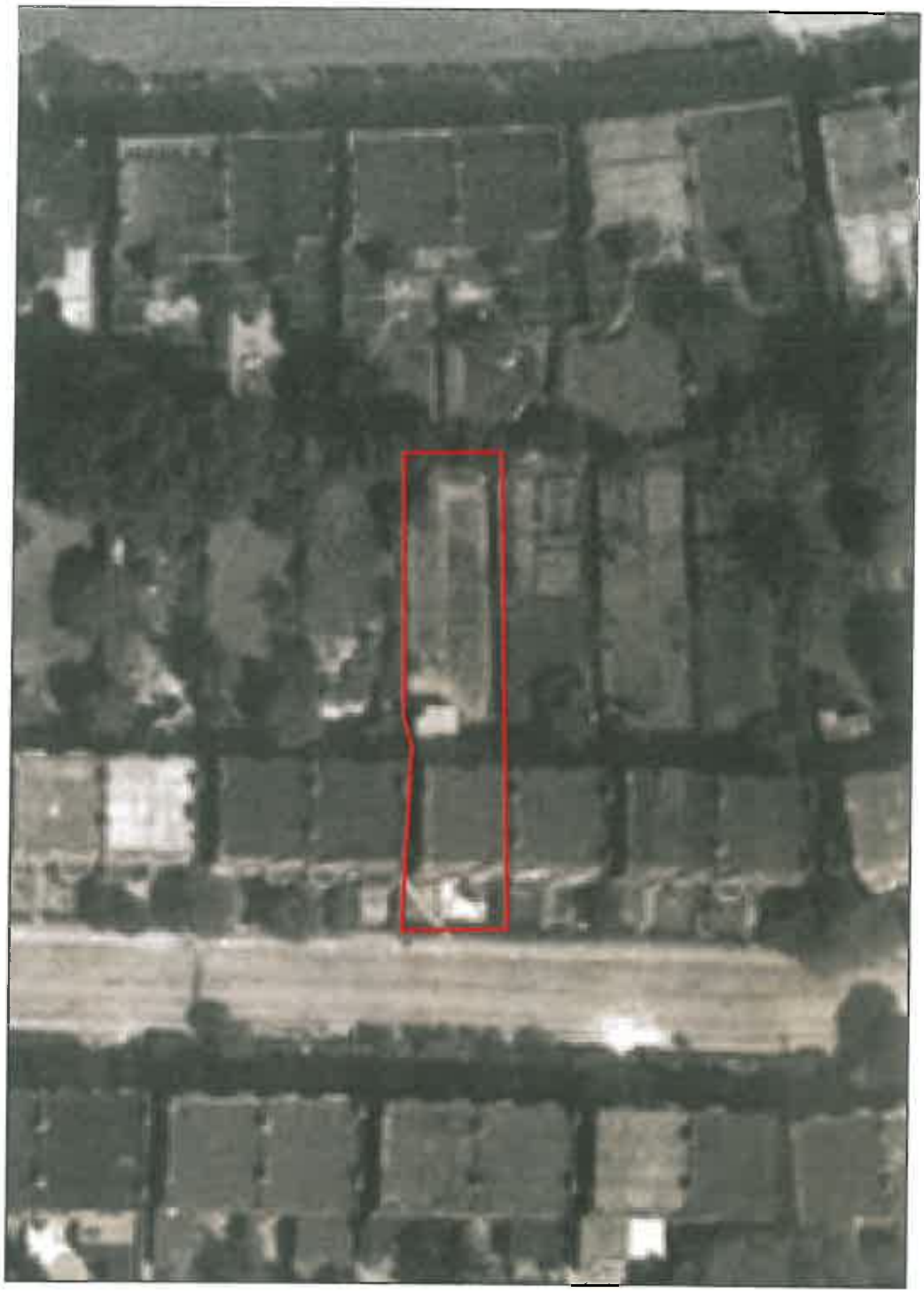
Project : 29 Aberdare Gardens, London NW6 **Client : Graffham Properties**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** **C12761**

Site History

Figure J

Aerial photograph from **1946-7**

N



Project : 29 Aberdare Gardens, London NW6 **Client : Graffham Properties**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** **C12761**

Site History

Figure K

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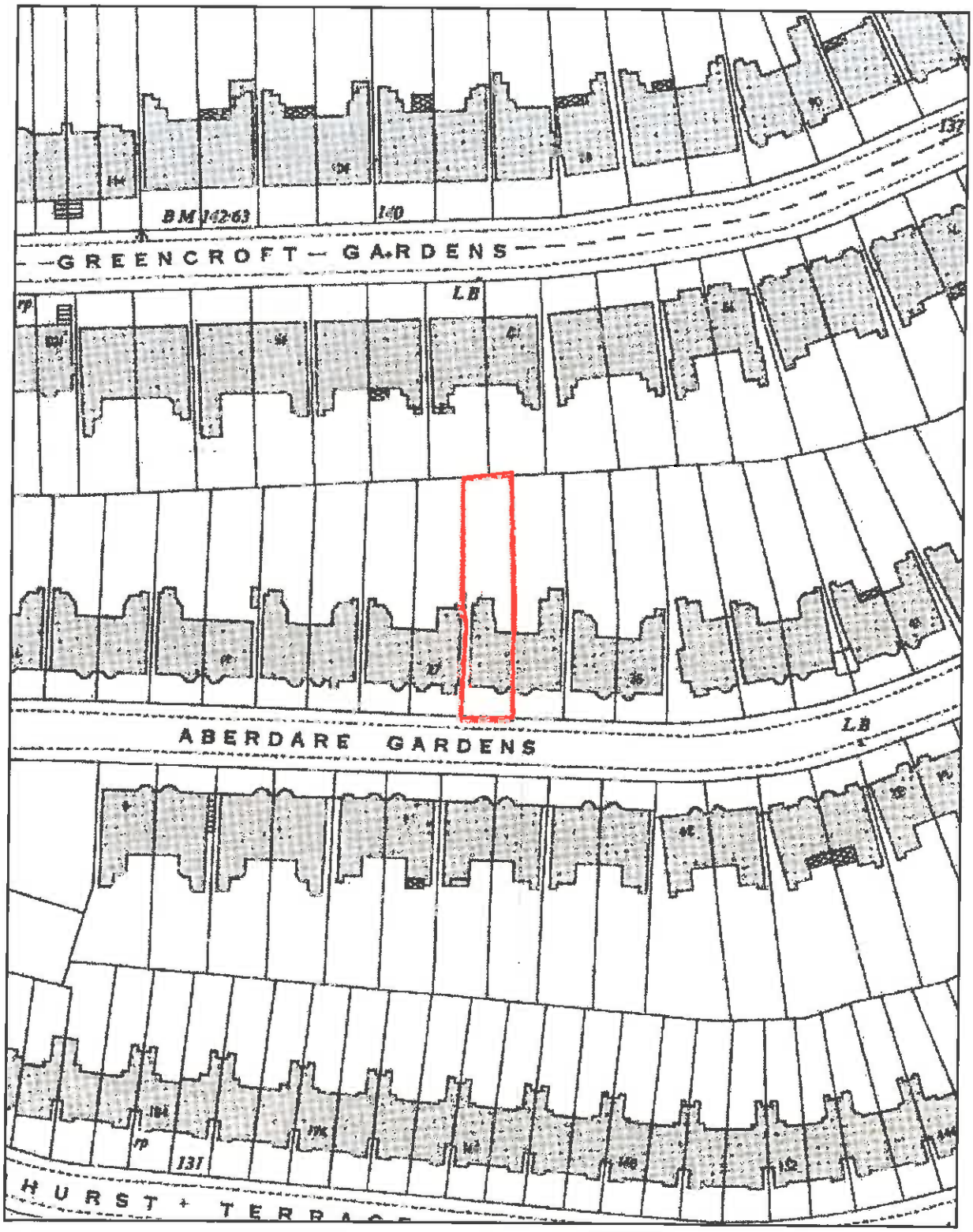
N



Project : 29 Aberdare Gardens, London NW6 **Client : Graffham Properties**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** **C12761**

Site History

Figure L

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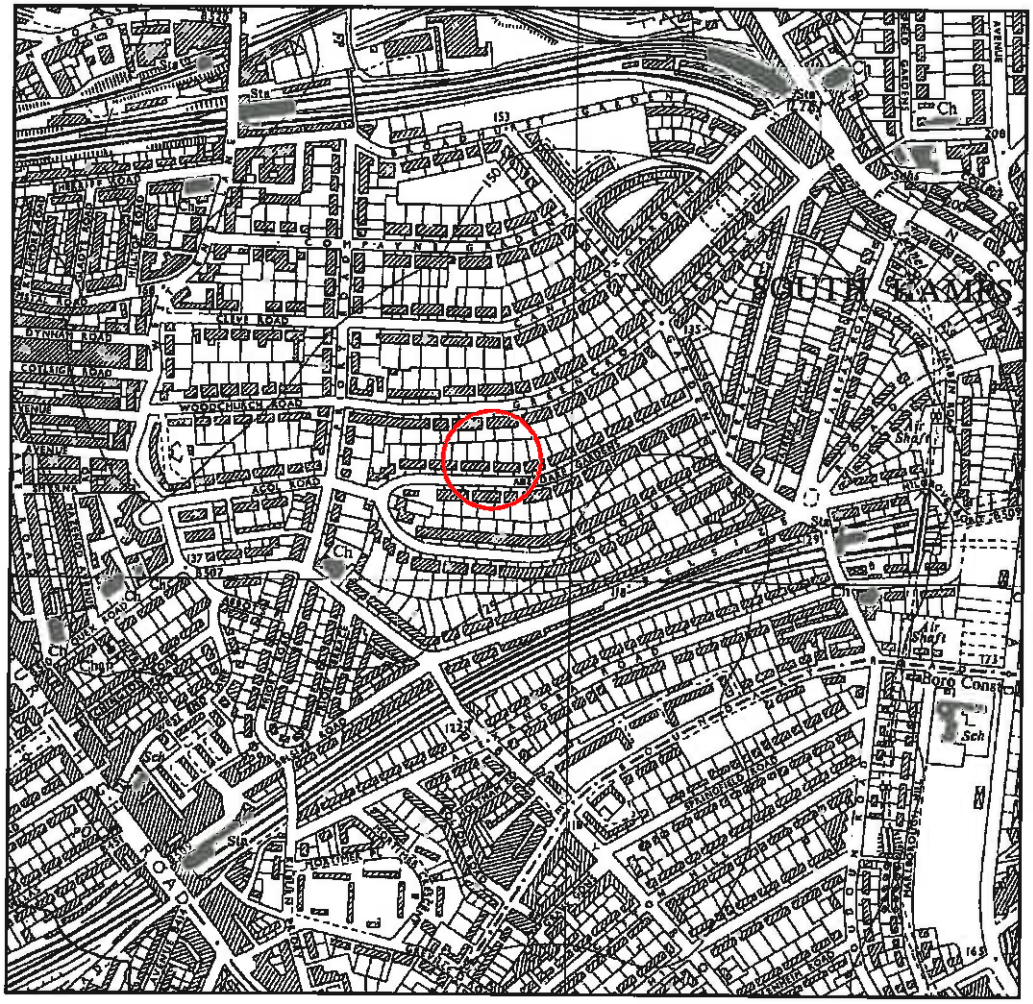
N



Project : 29 Aberdare Gardens, London NW6 **Client : Graffham Properties**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** **C12761**

Site History

Figure M

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N

Project : 29 Aberdare Gardens, London NW6 **Client : Graffham Properties**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** **C12761**

Site History

Figure N

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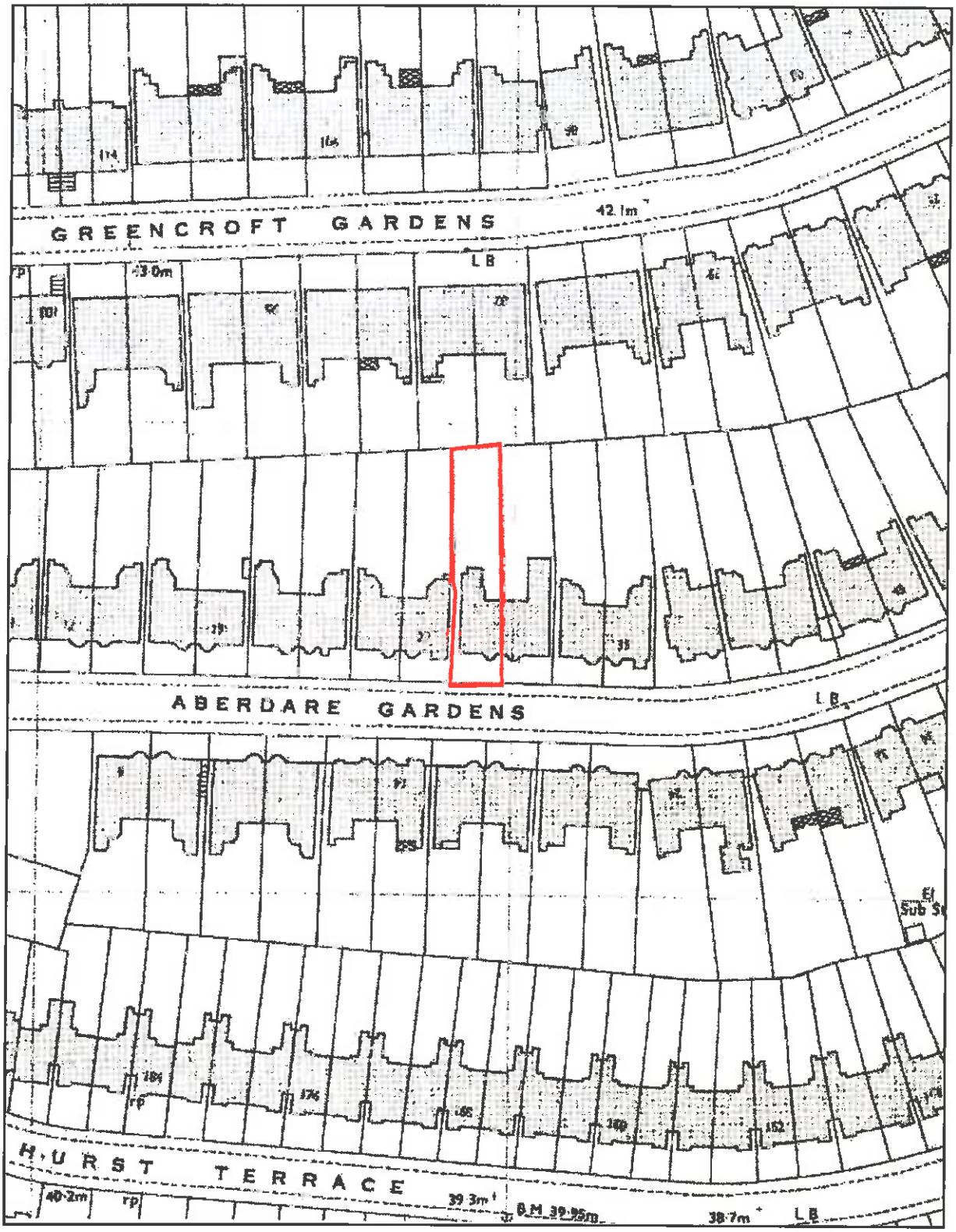

Project : 29 Aberdare Gardens, London NW6 **Client : Graffham Properties**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** **C12761**

Site History

Figure O

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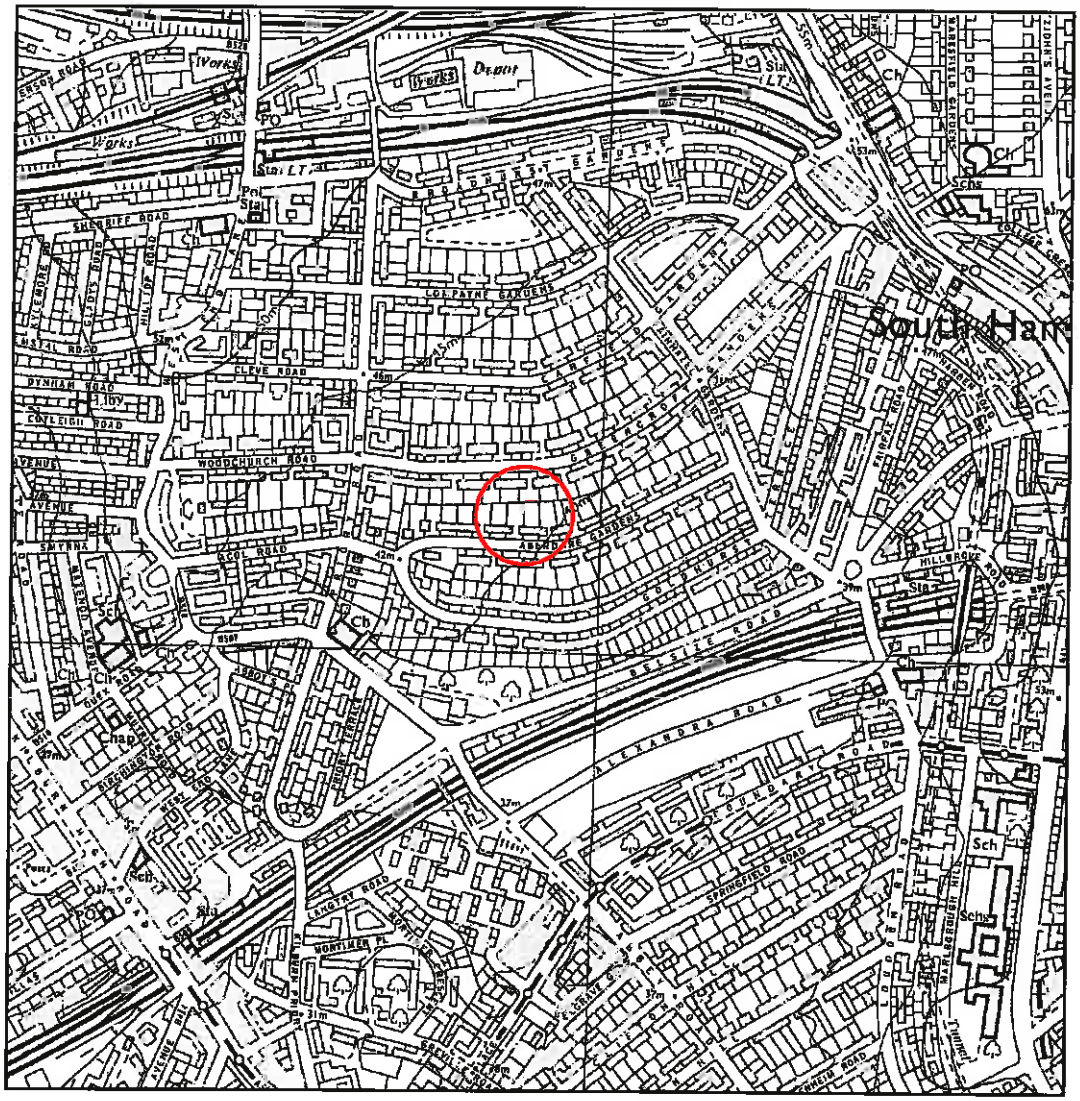
N



Project : 29 Aberdare Gardens, London NW6 **Client : Graffham Properties**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** **C12761**

Site History

Figure P

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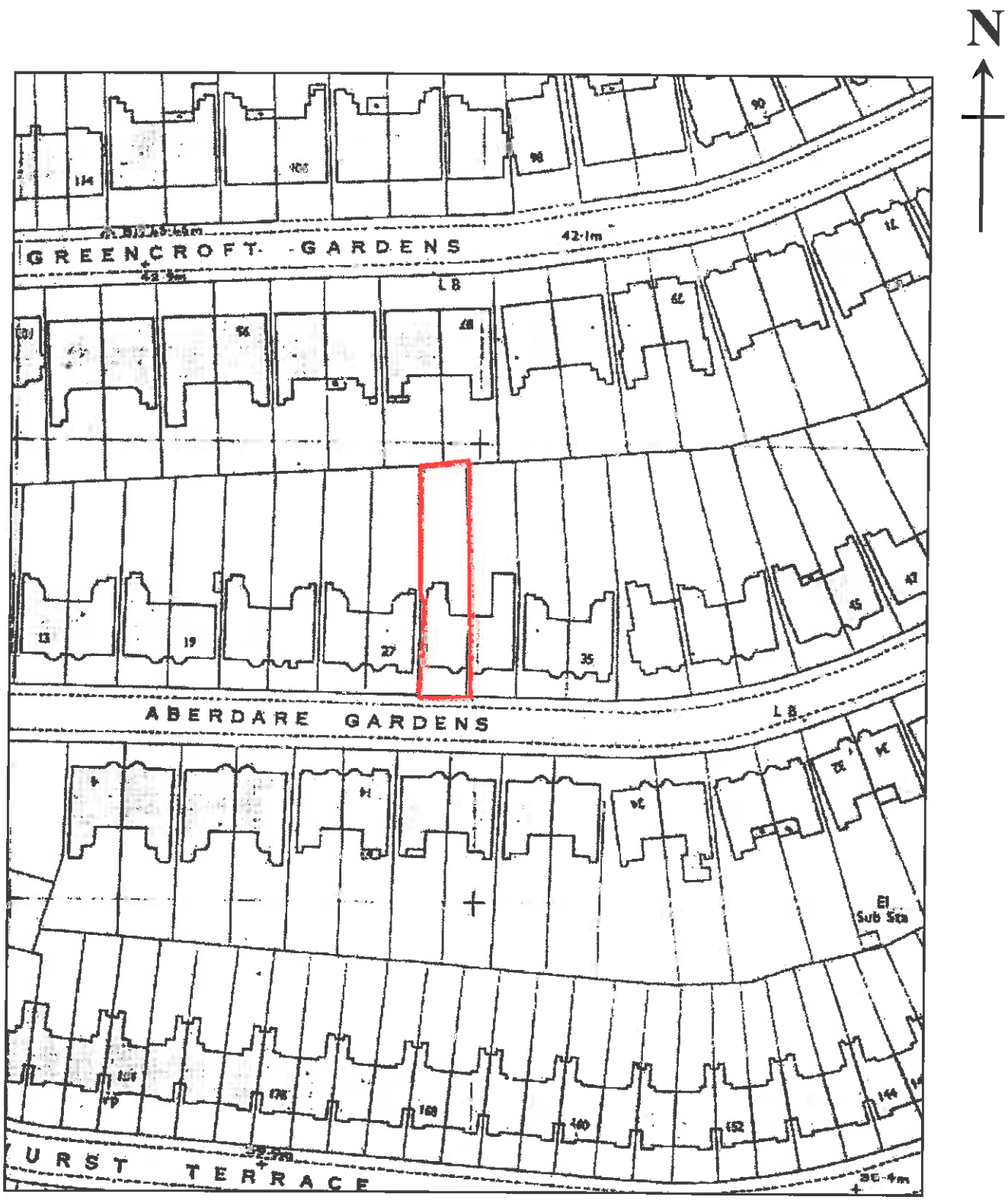

Project : 29 Aberdare Gardens, London NW6 **Client : Graffham Properties**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** **C12761**

Site History

Figure Q

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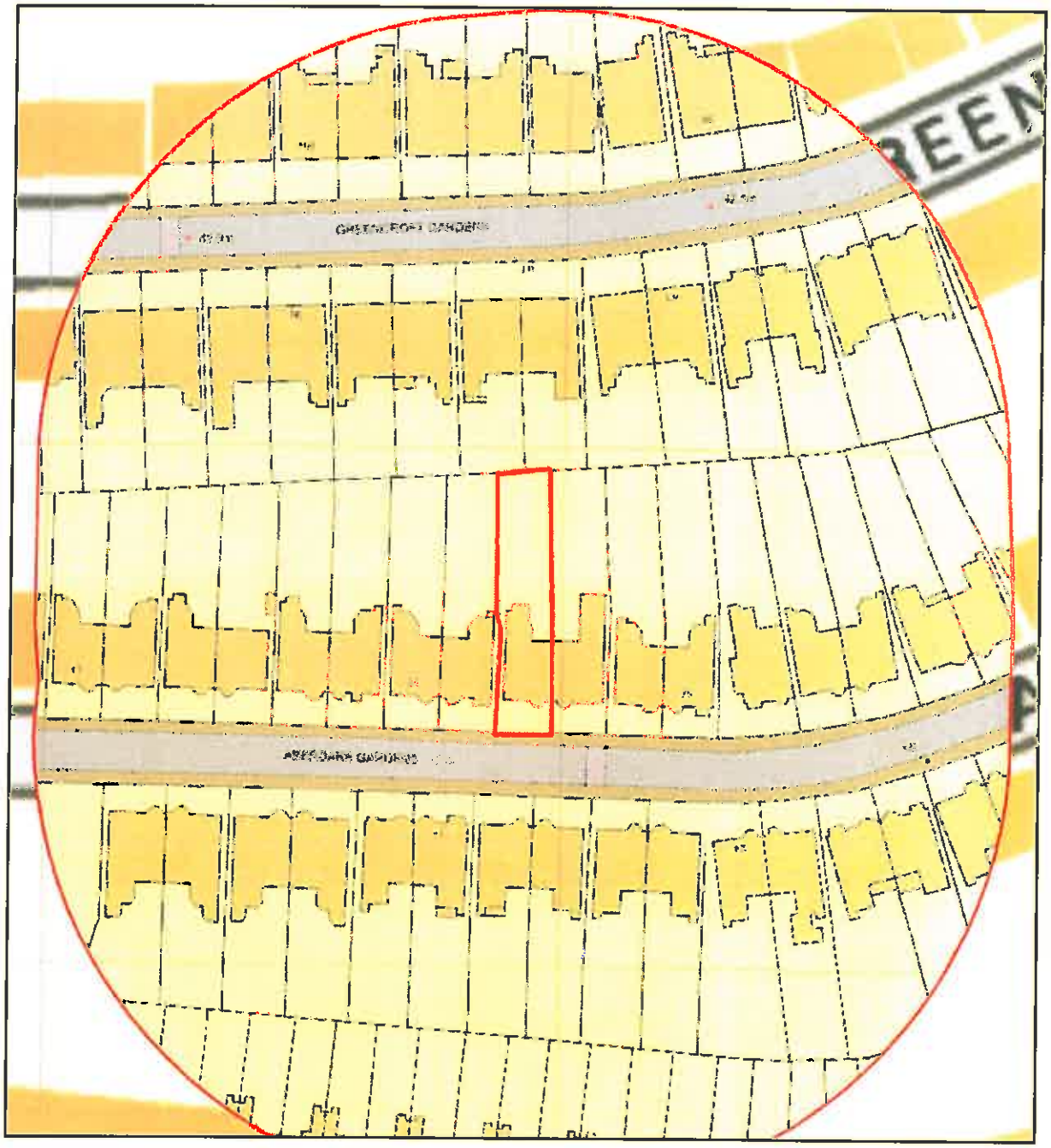
N



Project : 29 Aberdare Gardens, London NW6 **Client : Graffham Properties**	**GROUND ENGINEERING LIMITED** Peterborough Tel : 01733 566566	**Project No.** **C12761**

APPENDIX 3

ENVIRONMENTAL DATABASE SEARCH

GroundSure EnviroInsight

Address: 29 Aberdare Gardens, South Hampstead, London, NW6 3PY

Date: Oct 8, 2012

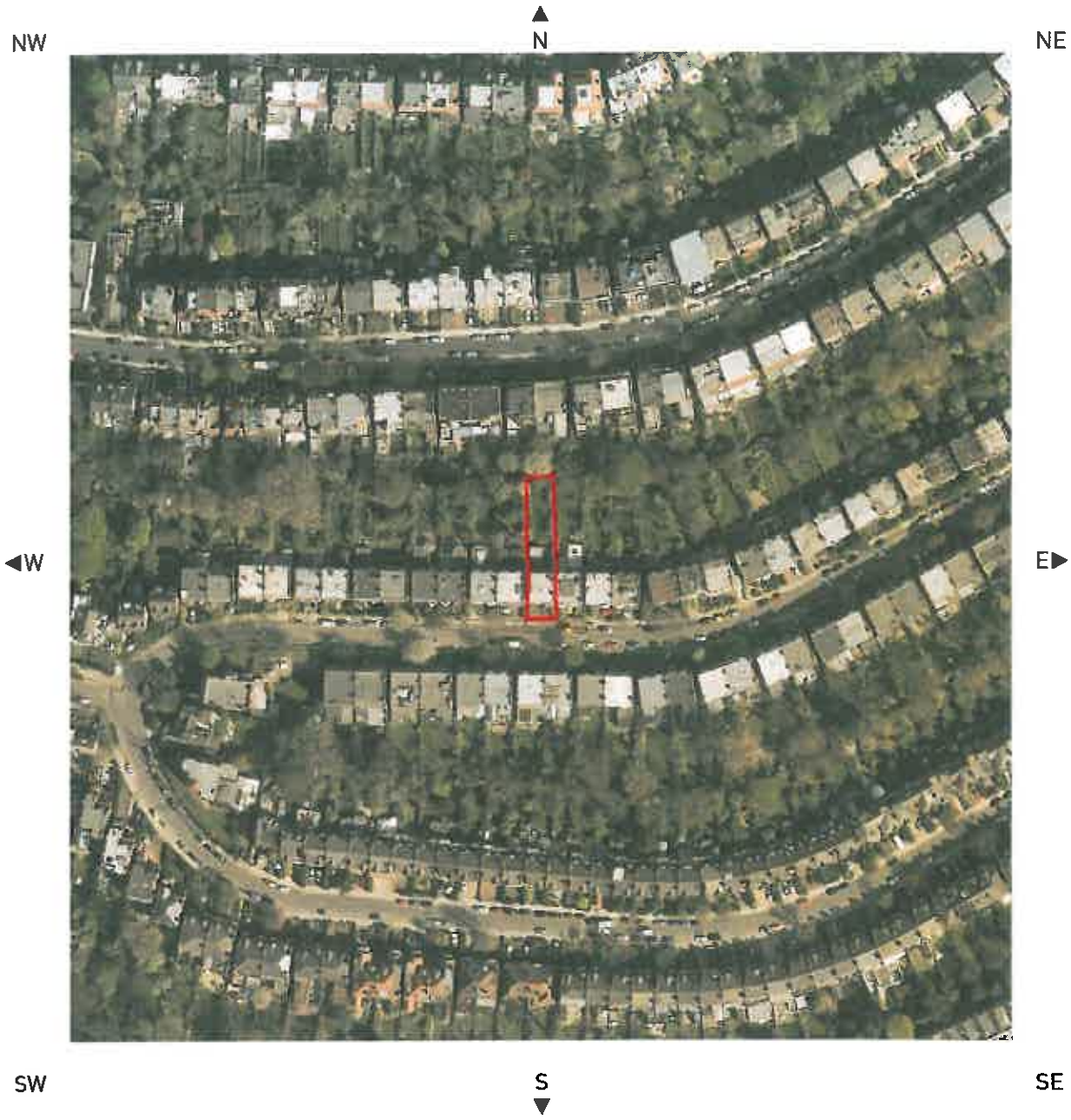
GroundSure Reference: HMD-489206

Your Reference: C12761

Client: Ground Engineering Ltd

Brought to you by GroundSure

Aerial Photograph of Study Site



Aerial photography supplied by Getmapping PLC.
© Copyright Getmapping PLC 2003. All Rights Reserved.

Site Name: 29 Aberdare Gardens, South Hampstead, London, NW6 3PY
Grid Reference: 525894,184158
Size of Site: 0.05 ha

Overview of Findings

For further details on each dataset, please refer to each individual section in the main report as listed. Where the database has been searched a numerical result will be recorded. Where the database has not been searched '-' will be recorded.

Report Section	Number of records found within (X) m of the study site boundary					
1. Environmental Permits, Incidents and Registers	on-site	0-50	51-250	251-500	501-1000	1000-1500
1.1 Industrial Sites Holding Environmental Permits and/or Authorisations						
Records of historic IPC Authorisations	0	0	0	0	-	-
Records of Part A(1) and IPPC Authorised Activities	0	0	0	0	-	-
Records of Water Industry Referrals (potentially harmful discharges to the public sewer)	0	0	0	0	-	-
Records of Red List Discharge Consents (potentially harmful discharges to controlled waters)	0	0	0	0	-	-
Records of List 1 Dangerous Substances Inventory sites	0	0	0	0	-	-
Records of List 2 Dangerous Substances Inventory sites	0	0	0	0	-	-
Records of Part A(2) and Part B Activities and Enforcements	0	0	0	6	-	-
Records of Category 3 or 4 Radioactive Substances Authorisations	0	0	0	0	-	-
Records of Licensed Discharge Consents	0	0	0	0	-	-
Records of Planning Hazardous Substance Consents and Enforcements	0	0	0	0		
1.2 Records of COMAH and NIHHS sites	0	0	0	0	-	-
1.3 Environment Agency Recorded Pollution Incidents						
National Incidents Recording System, List 2	0	0	0	-	-	-
National Incidents Recording System, List 1	0	0	0	-	-	-
1.4 Sites Determined as Contaminated Land under Part IIA EPA 1990	0	0	0	0	-	-

2. Landfill and Other Waste Sites	on-site	0-50	51-250	251-500	501-1000	1000-1500
2.1 Landfill Sites						
Environment Agency Registered Landfill Sites	0	0	0	0	0	-
Landfill Data – Operational Landfill Sites	0	0	0	0	0	-
Environment Agency Historic Landfill Sites	0	0	0	0	1	0
Landfill Data – Non-Operational Landfill Sites	0	0	0	0	0	-
BGS/DoE Landfill Site Survey	0	0	0	0	0	0
GroundSure Local Authority Landfill Sites Data	0	0	0	0	0	0
2.2 Landfill and Other Waste Sites Findings						
Operational Waste Treatment, Transfer and Disposal Sites	0	0	0	0	-	-
Non-Operational Waste Treatment, Transfer and Disposal Sites	0	0	0	0	-	-
Environment Agency Licensed Waste Sites	0	0	0	0	0	0

3. Current Land Uses	on-site	0-50	51-250	251-500	501-1000	1000-1500
3.1 Current Industrial Sites Data	0	0	4	-	-	-
3.2 Records of Petrol and Fuel Sites	0	0	0	0	-	-
3.3 Underground High Pressure Oil and Gas Pipelines	0	0	0	0	-	-

4. Geology	Description
4.1 Are there any records of Artificial Ground and Made Ground present beneath the study site? *	No
4.2 Are there any records of Superficial Ground and Drift Geology present beneath the study site? *	No
4.3 For records of Bedrock and Solid Geology beneath the study site* see the detailed findings section.	

Source: Scale: 1:50,000 BGS Sheet 256

* This includes an automatically generated 50m buffer zone around the site.

5. Hydrogeology and Hydrology	on-site	0-50	51-250	251-500	501-1000	1001-2000
5.1 Are there any records of Productive Strata in the Superficial Geology within 500m of the study site?			No			
5.2 Are there any records of Productive Strata in the Bedrock Geology within 500m of the study site?			Yes			
5.3 Groundwater Abstraction Licences (within 2000m of the study site).	0	0	0	0	1	2
5.4 Surface Water Abstraction Licences (within 2000m of the study site).	0	0	0	0	0	0
5.5 Potable Water Abstraction Licences (within 2000m of the study site).	0	0	0	0	0	2
5.6 Are there any Source Protection Zones within 500m of the study site?					No	

5.7 River Quality	on-site	0-50	51-250	251-500	501-1000	1001-1500
Is there any Environment Agency information on river quality within 1500m of the study site?	No	No	No	No	No	No
5.8 Detailed River Network entries within 500m of the site	0	0	0	0	-	-
5.9 Surface water features within 250m of the study site	No	No	No	-	-	-

6. Flooding	
6.1 Are there any Environment Agency indicative Zone 2 floodplains within 250m of the study site?	No
6.2 Are there any Environment Agency indicative Zone 3 floodplains within 250m of the study site?	No
6.3 Are there any Flood Defences within 250m of the study site?	No
6.4 Are there any areas benefiting from Flood Defences within 250m of the study site?	No
6.5 Are there any areas used for Flood Storage within 250m of the study site?	No
6.6 What is the maximum BGS Groundwater Flooding susceptibility within 50m of the study site?	Negligible
6.7 What is the BGS confidence rating for the Groundwater Flooding susceptibility areas?	Not Applicable

7. Designated Environmentally Sensitive Sites	on-site	0-50	51-250	251-500	501-1000	1001-2000
7.1 Records of Sites of Special Scientific Interest (SSSI)	0	0	0	0	0	0
7.2 Records of National Nature Reserves (NNR)	0	0	0	0	0	0

7.1 Records of Sites of Special Scientific Interest (SSSI)	0	0	0	0	0	0
7.3 Records of Local Nature Reserves (LNR)	0	0	0	0	0	4
7.4 Records of Special Areas of Conservation (SAC)	0	0	0	0	0	0
7.5 Records of Special Protection Areas (SPA)	0	0	0	0	0	0
7.6 Records of Ramsar sites	0	0	0	0	0	0
7.7 Records of World Heritage Sites	0	0	0	0	0	0
7.8 Records of Environmentally Sensitive Areas	0	0	0	0	0	0
7.9 Records of Areas of Outstanding Natural Beauty (AONB)	0	0	0	0	0	0
7.10 Records of National Parks	0	0	0	0	0	0
7.11 Records of Nitrate Sensitive Areas	0	0	0	0	0	0
7.12 Records of Nitrate Vulnerable Zones	0	0	0	0	0	0
7.13 Records of Ancient Woodlands	0	0	0	0	0	0

8. Natural Hazards

8.1 What is the maximum risk of natural ground subsidence?	Moderate

9. Mining

9.1 Are there any coal mining areas within 75m of the study site?	No
9.2 What is the risk of subsidence relating to shallow mining within 150m of the study site?	Negligible
9.3 Are there any brine affected areas within 75m of the study site?	No

Using this Report

The following report is designed by Environmental Consultants for Environmental Professionals bringing together the most up-to-date market leading environmental data. This report is provided under and subject to the Terms & Conditions agreed between GroundSure and the Client. The document contains the following sections:

1. Environmental Permits, Incidents and Registers

Provides information on Regulated Industrial Activities and Pollution Incidents as recorded by Regulatory Authorities, and sites determined as Contaminated Land. This search is conducted using radii up to 500m.

2. Landfills and Other Waste Sites

Provides information on landfills and other waste sites that may pose a risk to the study site. This search is conducted using radii up to 1500m.

3. Current Land Uses

Provides information on current land uses that may pose a risk to the study site in terms of potential contamination from activities or processes. These searches are conducted using radii of up to 500m. This includes information on potentially contaminative industrial sites, petrol stations and fuel sites as well as high pressure underground oil and gas pipelines.

4. Geology

Provides information on artificial and superficial deposits and bedrock beneath the study site.

5. Hydrogeology and Hydrology

Provides information on productive strata within the bedrock and superficial geological layers, abstraction licenses, Source Protection Zones (SPZs) and river quality. These searches are conducted using radii of up to 2000m.

6. Flooding

Provides information on surface water flooding, flood defences, flood storage areas and groundwater flood areas. This search is conducted using radii of up to 250m.

7. Designated Environmentally Sensitive Sites

Provides information on the Sites of Special Scientific Interest (SSSI), National Nature Reserves (NNR), Special Areas of Conservation (SAC), Special Protection Areas (SPA), Ramsar sites, Local Nature Reserves (LNR), Areas of Outstanding Natural Beauty (AONB), National Parks (NP), Environmentally Sensitive Areas, Nitrate Sensitive Areas, Nitrate Vulnerable Zones and World Heritage Sites. These searches are conducted using radii of up to 500m.

8. Natural Hazards

Provides information on a range of natural hazards that may pose a risk to the study site. These factors include natural ground subsidence.

9. Mining

Provides information on areas of coal and shallow mining.

10. Contacts

This section of the report provides contact points for statutory bodies and data providers that may be able to provide further information on issues raised within this report. Alternatively, GroundSure provide a free Technical Helpline (08444 159000) for further information and guidance.

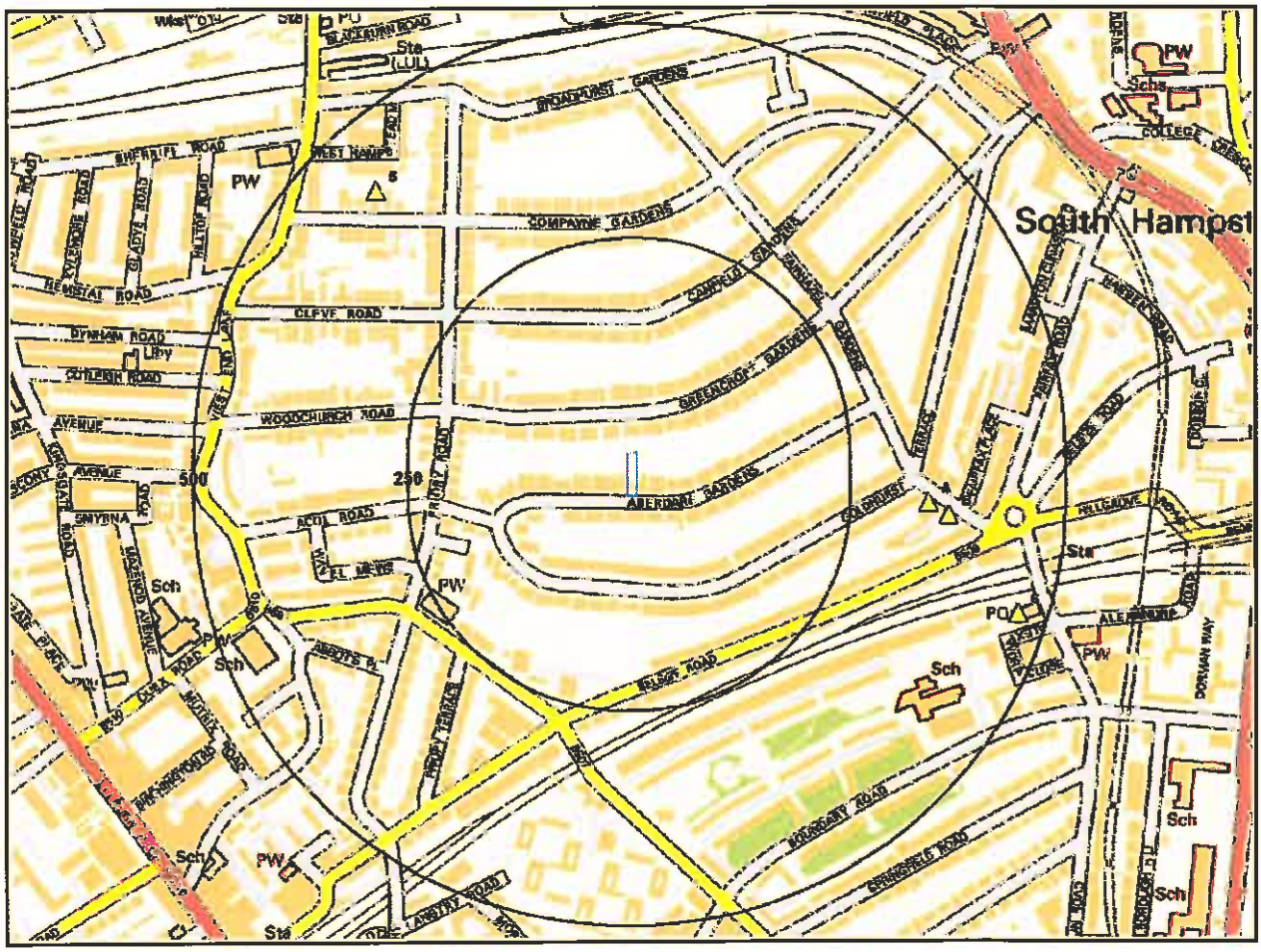
Note: Maps

Only certain features are placed on the maps within the report. All features represented on maps found within this search are given an identification number. This number identifies the feature on the mapping and correlates it to the additional information provided below. This identification number precedes all other information and takes the following format -Id: 1, Id: 2, etc. Where numerous features on the same map are in such close proximity that the numbers would obscure each other a letter identifier is used instead to represent the features. (e.g. Three features which overlap may be given the identifier "A" on the map and would be identified separately as features 1A, 3A, 10A on the data tables provided).

Where a feature is reported in the data tables to a distance greater than the map area, it is noted in the data table as "Not Shown".

All distances given in this report are in Metres (m). Directions are given as compass headings such as N: North, E: East, NE: North East from the nearest point of the study site boundary.

1. Environmental Permits, Incidents and Registers Map



Authorisations,Incidents and Registers Legend

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- Site Outline
- Search Buffers (m) — 250 / 500
- Recorded Pollution Incident
- Dangerous Substances (List 1)
- Dangerous Substances (List 2)
- Water Industry Referrals
- Licenced Discharge Consents
- Red List Discharge Consents
- RAS 3 & 4 Authorisations
- Part A(1) Authorised Processes and Historic IPC Authorisations
- Part A(2) and Part B Authorised Processes
- COMAH / NIHHS Sites
- Sites Determined as Contaminated Land
- Hazardous Substance Consents and Enforcements

1.Environmental Permits, Incidents and Registers

1.1 Industrial Sites Holding Licences and/or Authorisations

Searches of information provided by the Environment Agency and Local Authorities reveal the following information:

Records of historic IPC Authorisations within 500m of the study site: **0**

Database searched and no data found.

Records of Part A(1) and IPPC Authorised Activities within 500m of the study site: **0**

Database searched and no data found.

Records of Water Industry Referrals (potentially harmful discharges to the public sewer) within 500m of the study site: **0**

Database searched and no data found.

Records of Red List Discharge Consents (potentially harmful discharges to controlled waters) within 500m of the study site: **0**

Database searched and no data found.

Records of List 1 Dangerous Substances Inventory Sites within 500m of the study site: **0**

Database searched and no data found.

Records of List 2 Dangerous Substance Inventory Sites within 500m of the study site: **0**

Database searched and no data found.

Records of Part A(2) and Part B Activities and Enforcements within 500m of the study site: **6**

The following Part A(2) and Part B Activities are represented as points on the Authorisations, Incidents and Registers map:

ID	Distance	Direction	NGR	Details	
1A	340.0	E	526238, 184135	Address: Sqweaky Clean Professional Dry Cleaners , 13 Fairhazel Gardens, NW6 3QE Process: Dry Cleaner Status: Historic Permit Type: Part B	Enforcement: No Enforcement Notified Date of Enforcement: No Enforcement Notified Comment: No Enforcement Notified
2A	340.0	E	526238, 184135	Address: Swiss Dry Cleaners , 13 Fairhazel Gardens, NW6 3QE Process: Dry Cleaner Status: Current Permit Type: Part B	Enforcement: No Enforcement Notified Date of Enforcement: No Enforcement Notified Comment: No Enforcement Notified

3B	365.0	E	526262, 184120	Address: Connoisseur Dry Cleaners , 3-5 Fairhazel Gardens Swiss Cottage, NW6 3QE Process: Dry Cleaner Status: Historic Permit Type: Part B	Enforcement: No Enforcement Notified Date of Enforcement: No Enforcement Notified Comment: No Enforcement Notified
4B	365.0	E	526262, 184120	Address: Connoisseur Dry Cleaners , 3-5 Fairhazel Gardens Swiss Cottage, NW6 3QE Process: Dry Cleaner Status: Current Permit Type: Part B	Enforcement: No Enforcement Notified Date of Enforcement: No Enforcement Notified Comment: No Enforcement Notified
5	419.0	NW	525600, 184500	Address: Wj Humpage Loudon Rd Coachworks, West Hampstead Mews, NW6 3BB Process: Vehicle Re-spray Process Status: Historic Permit Type: Part B	Enforcement: No Enforcement Notified Date of Enforcement: No Enforcement Notified Comment: No Enforcement Notified
6	466.0	E	526342, 184005	Address: Masterclean , 6 Langtry Walk, London, NW8 0DU Process: Dry Cleaners Status: Revoked Permit Type: Part B	Enforcement: No Enforcement Notified Date of Enforcement: No Enforcement Notified Comment: No Enforcement Notified

Records of Category 3 or 4 Radioactive Substance Licences within 500m of the study site: **0**

Database searched and no data found.

Records of Licensed Discharge Consents within 500m of the study site: **0**

Database searched and no data found.

Records of Planning Hazardous Substance Consents and Enforcements within 500m of the study site: **0**

Database searched and no data found.

1.2 Dangerous or Hazardous Sites

Records of COMAH & NIHHS sites within 500m of the study site: **0**

Database searched and no data found.

1.3 Environment Agency Recorded Pollution Incidents

Records of National Incidents Recording System, List 2 within 250m of the study site: **0**

Database searched and no data found.

Records of National Incidents Recording System, List 1 within 250m of the study site: **0**

Database searched and no data found.

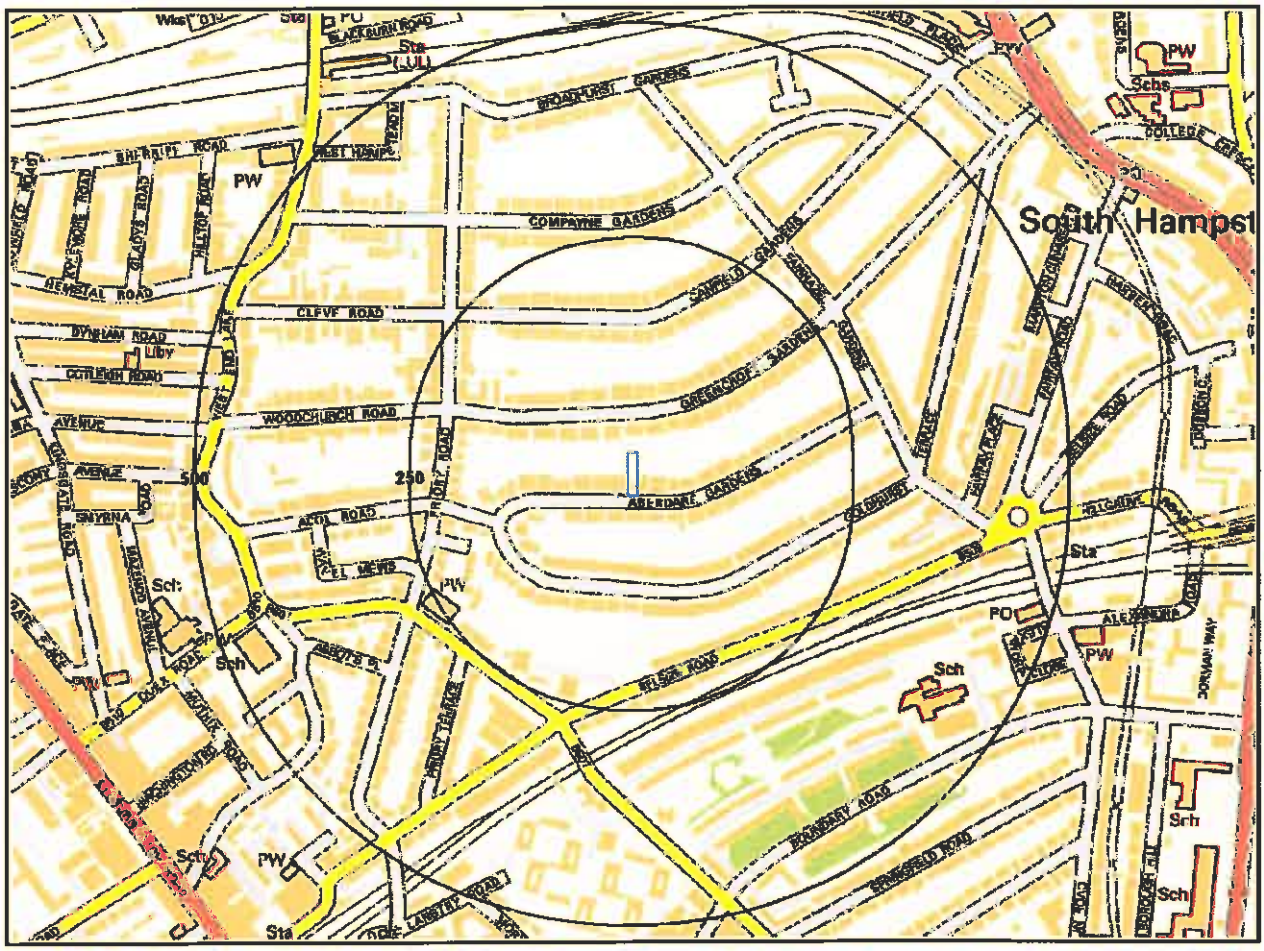
1.4 Sites Determined as Contaminated Land under Part IIA EPA 1990

How many records of sites determined as contaminated land under Section 78R of the Environmental Protection Act 1990 are there within 500m of the study site? **0**

Database searched and no data found.

2. Landfill and Other Waste Sites Map

NW N NE



W E

SW S SE

Landfill & Other Waste Sites Legend

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- Site Outline
- Search Buffers (m) — 250, 500
- E.A. Active Landfill
- E.A. Historic Landfill (Area Data)
- E.A. Historic Landfill (Point Data)
- BGS / DoE Survey Landfill
- Local Authority Landfill (Area Data)
- Local Authority Landfill (Point Data)
- Operational Waste Treatment Licence
- Closed Waste Treatment Licence
- REGIS Waste Licence
- Operational Landfill
- Closed Landfill

2. Landfill and Other Waste Sites

2.1 Landfill Sites

Records from Environment Agency landfill data within 1000m of the study site: **0**

Database searched and no data found.

Records of operational landfill sites sourced from Landmark within 1000m of the study site: **0**

Database searched and no data found.

Records of Environment Agency historic landfill sites within 1500m of the study site: **1**

The following landfill records are represented as either points or polygons on the Landfill and Other Waste Sites map:

ID	Distance	Direction	NGR	Details	
Not shown	606.0	N	526000, 184800	Site Address: Canfield Place, London NW6 Waste Licence: - Site Reference: DON009 Waste Type: - Regis Reference: -	Licence Issue: - Licence Surrendered: - Licence Hold Address: - Operator: -

---

Records of non-operational landfill sites sourced from Landmark within 1000m of the study site: **0**

Database searched and no data found.

Records of BGS/DoE non-operational landfill sites within 1500m of the study site: **0**

Database searched and no data found.

Records of Local Authority landfill sites within 1500m of the study site: **0**

Database searched and no data found.

2.2 Other Waste Sites

Records of operational waste treatment, transfer or disposal sites within 500m of the study site: **0**

Database searched and no data found.

Records of non-operational waste treatment, transfer or disposal sites within 500m of the study site: **0**

Database searched and no data found.

Records of Environment Agency licensed waste sites within 1500m of the study site: **0**

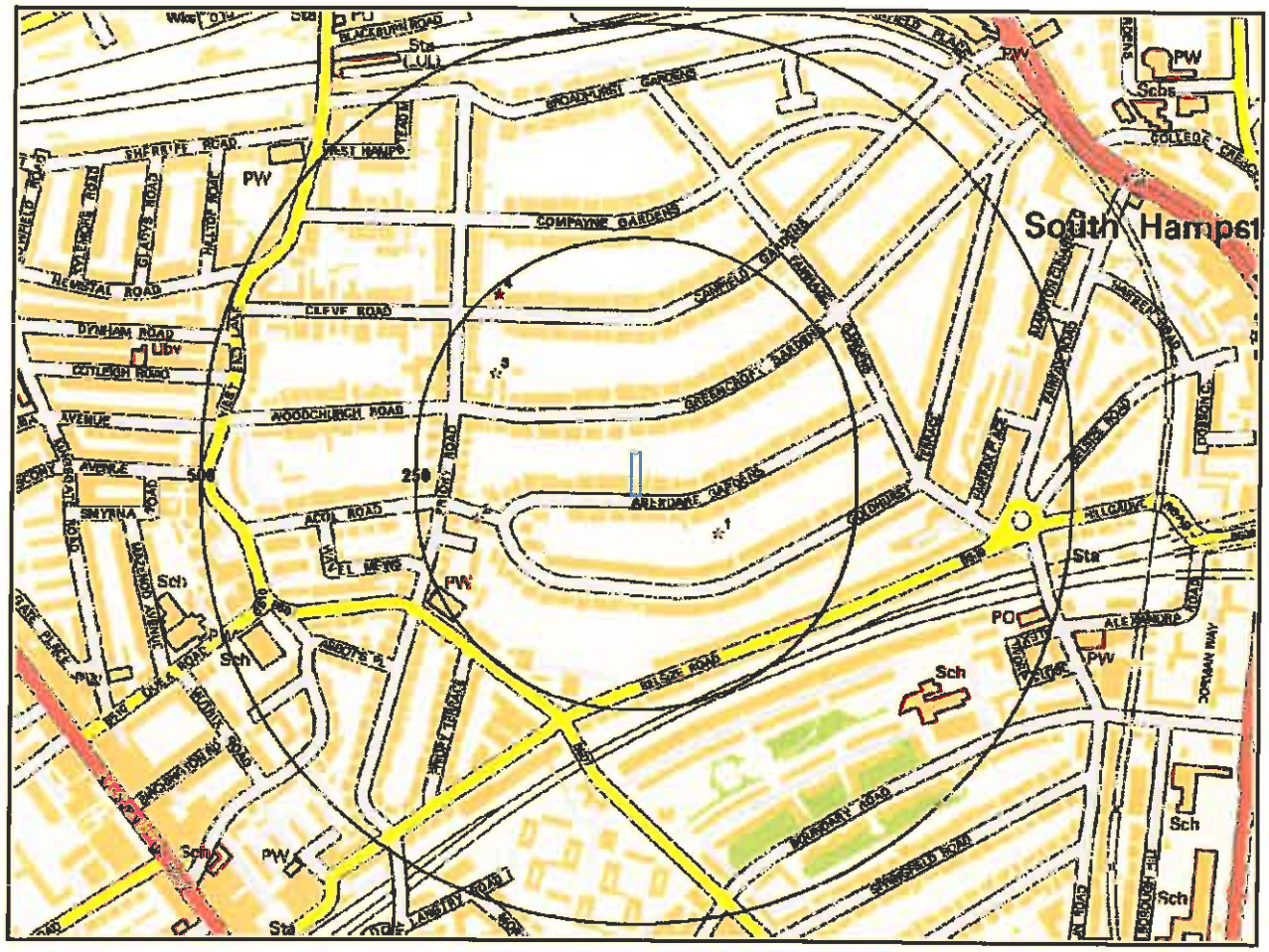
Database searched and no data found.

3. Current Land Use Map

NW N NE

W E

SW S SE



Current Land Use Legend

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Site Outline

250
500
Search Buffers (m)

Current Industrial Sites

Petrol & Fuel Sites

Underground High Pressure Oil & Fuel Pipelines

3. Current Land Uses

3.1 Current Industrial Data

Records of potentially contaminative industrial sites within 250m of the study site: **4**

The following records are represented as points on the Current Land Uses map.

ID	Distance	Direction	Company	Address	Activity	Category
1	101.0	SE	Electricity Sub Station	NW6	Electrical Features	Infrastructure and Facilities
2	180.0	W	Electricity Sub Station	NW6	Electrical Features	Infrastructure and Facilities
3	183.0	NW	Electricity Sub Station	NW6	Electrical Features	Infrastructure and Facilities
4	241.0	NW	Electricity Sub Station	NW6	Electrical Features	Infrastructure and Facilities

3.2 Petrol and Fuel Sites

Records of petrol or fuel sites within 500m of the study site: **0**

Database searched and no data found.

3.3 Underground High Pressure Oil and Gas Pipelines

Records of high pressure underground pipelines within 500m of the study site: **0**

Database searched and no data found.

4. Geology

4.1 Artificial Ground and Made Ground

Database searched and no data found.

The database has been searched on site, including a 50m buffer.

4.2 Superficial Ground and Drift Geology

Database searched and no data found.
The database has been searched on site, including a 50m buffer.

4.3 Bedrock and Solid Geology

The database has been searched on site, including a 50m buffer.

LEX Code	Description	Rock Type
LC-CLSS	LONDON CLAY FORMATION	CLAY, SILT AND SAND

(Derived from the BGS 1:50,000 Digital Geological Map of Great Britain)

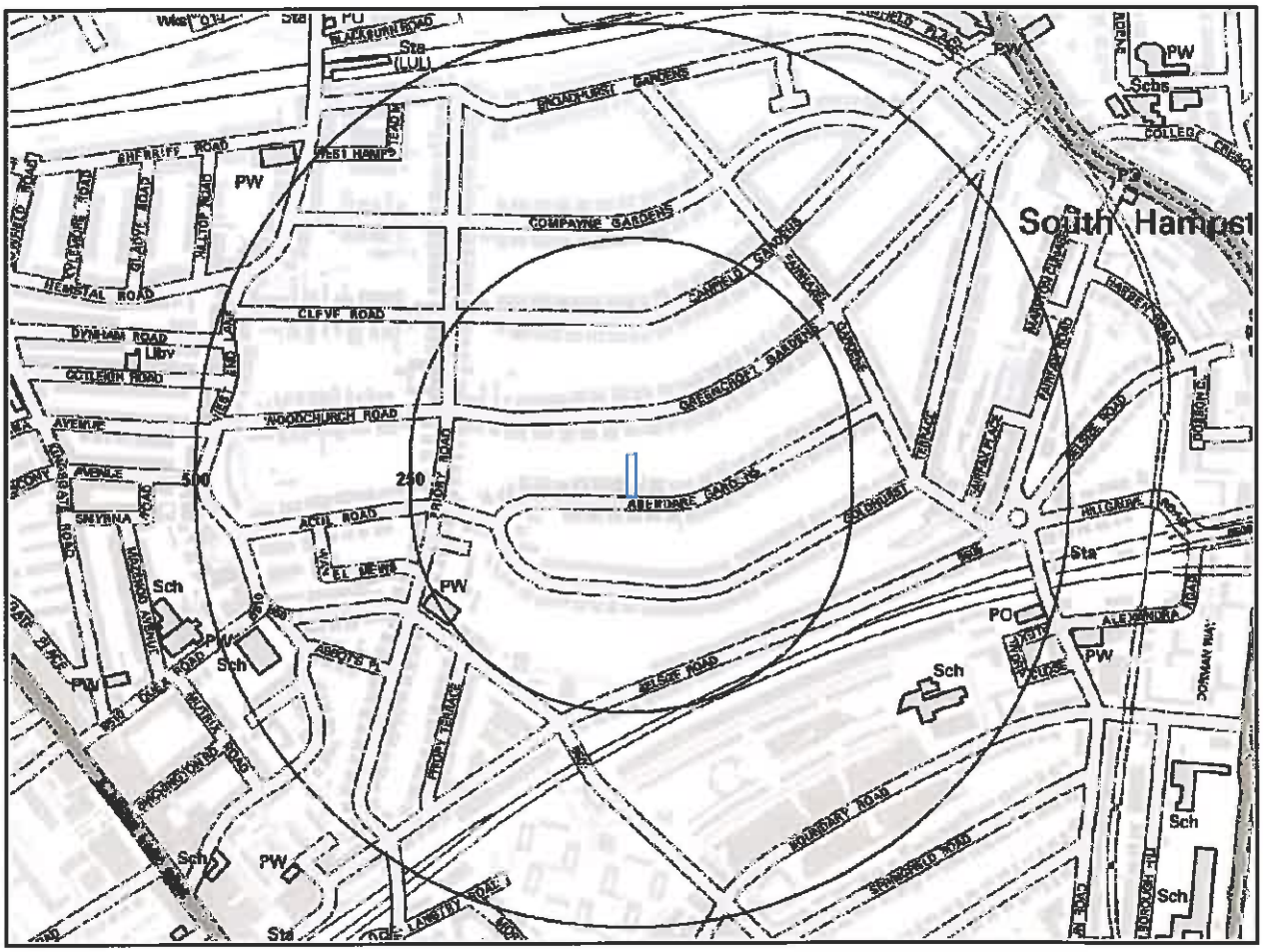
For more detailed geological and ground stability data please refer to the "GroundSure GeoInsight". Available from our website.

5a. Hydrogeology - Aquifer Within Superficial Geology

NW N NE

W E

SW S SE



Aquifer Within Superficial Geology Legend

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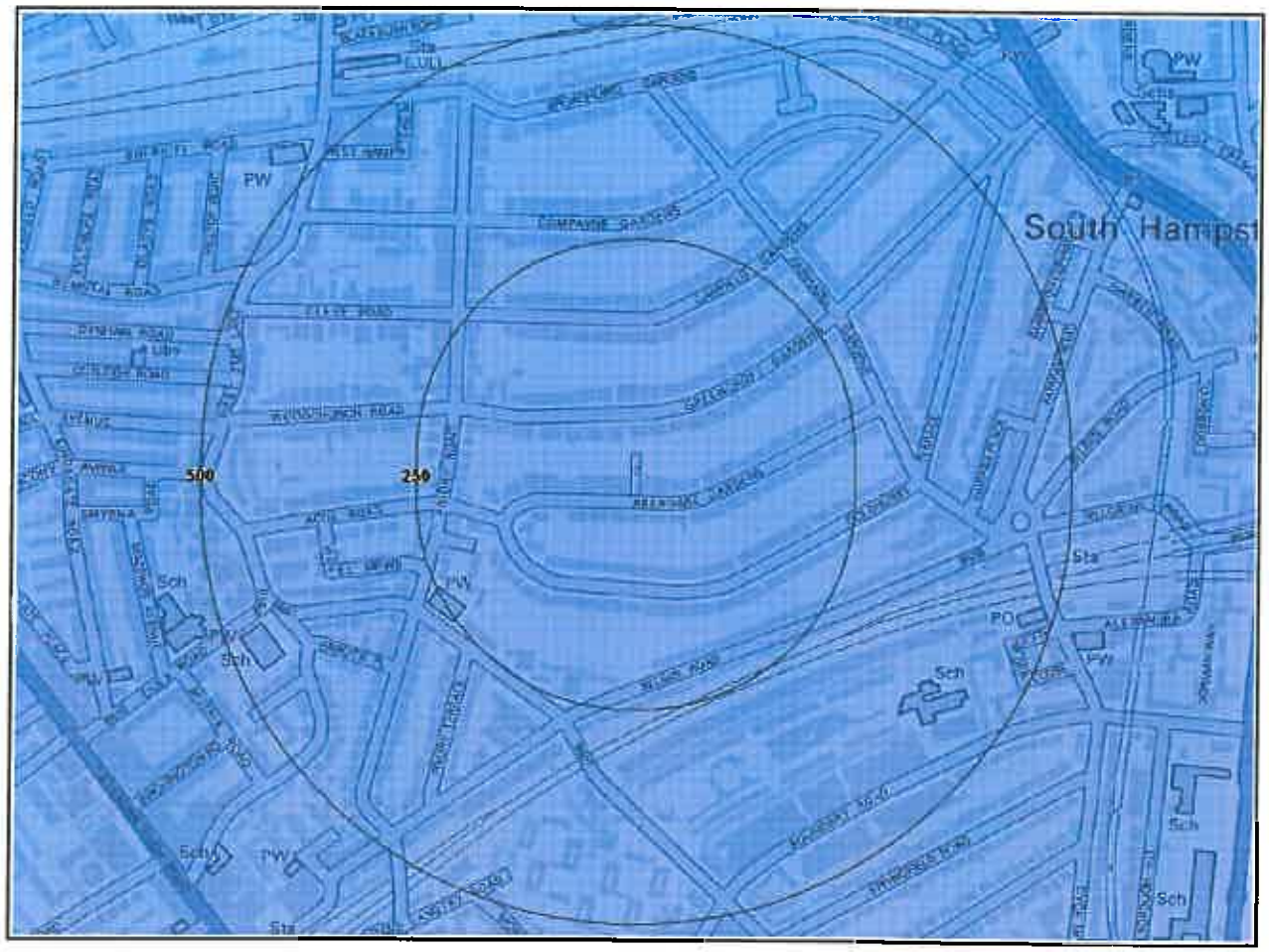
- Site Outline
- Search Buffers (m): 250, 500
- Principal Aquifer
- Secondary (A) Aquifer - Permeable Layers
- Secondary (B) Aquifer - Lower Permeability Layers
- Secondary Aquifer - Undifferentiated Layers
- Unproductive
- Unknown (lakes and landslip)

5b. Hydrogeology - Aquifer Within Bedrock Geology and Abstraction Licenses



Aquifer Within Bedrock Geology Legend

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Site Outline

250
500
Search Buffers (m)

Principal Aquifer

Secondary (A) Aquifer - Permeable Layers

Secondary (B) Aquifer - Lower Permeability Layers

Groundwater Abstraction Licence

Secondary Aquifer - Undifferentiated Layers

Unproductive

Unknown (lakes and landslip)

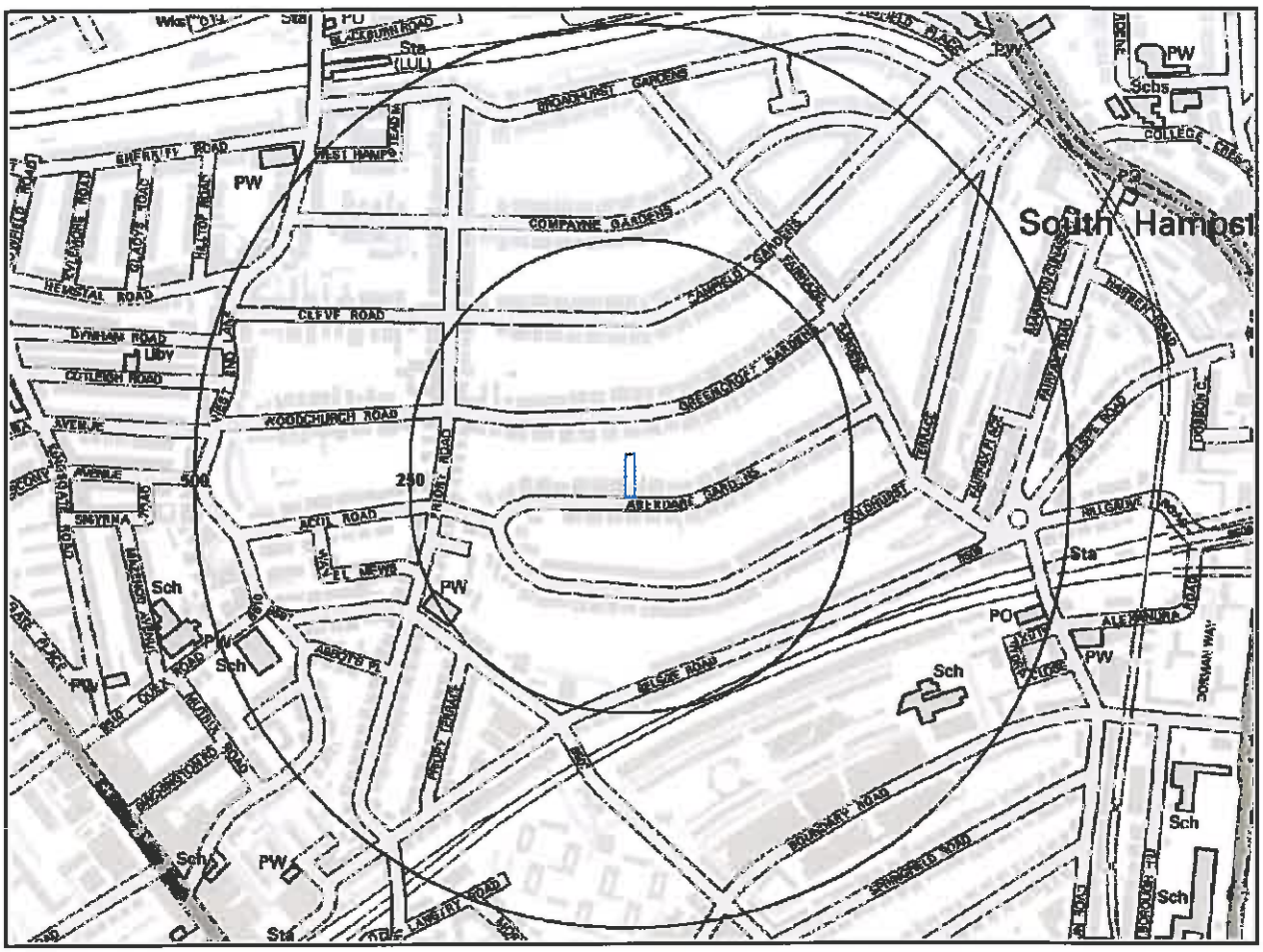
Surface Water Abstraction Licence

5c. Hydrogeology – Source Protection Zones and Potable Water Abstraction Licenses

NW N NE

W E

SW S SE



SPZ and Potable Water Abstraction Licenses
Legend

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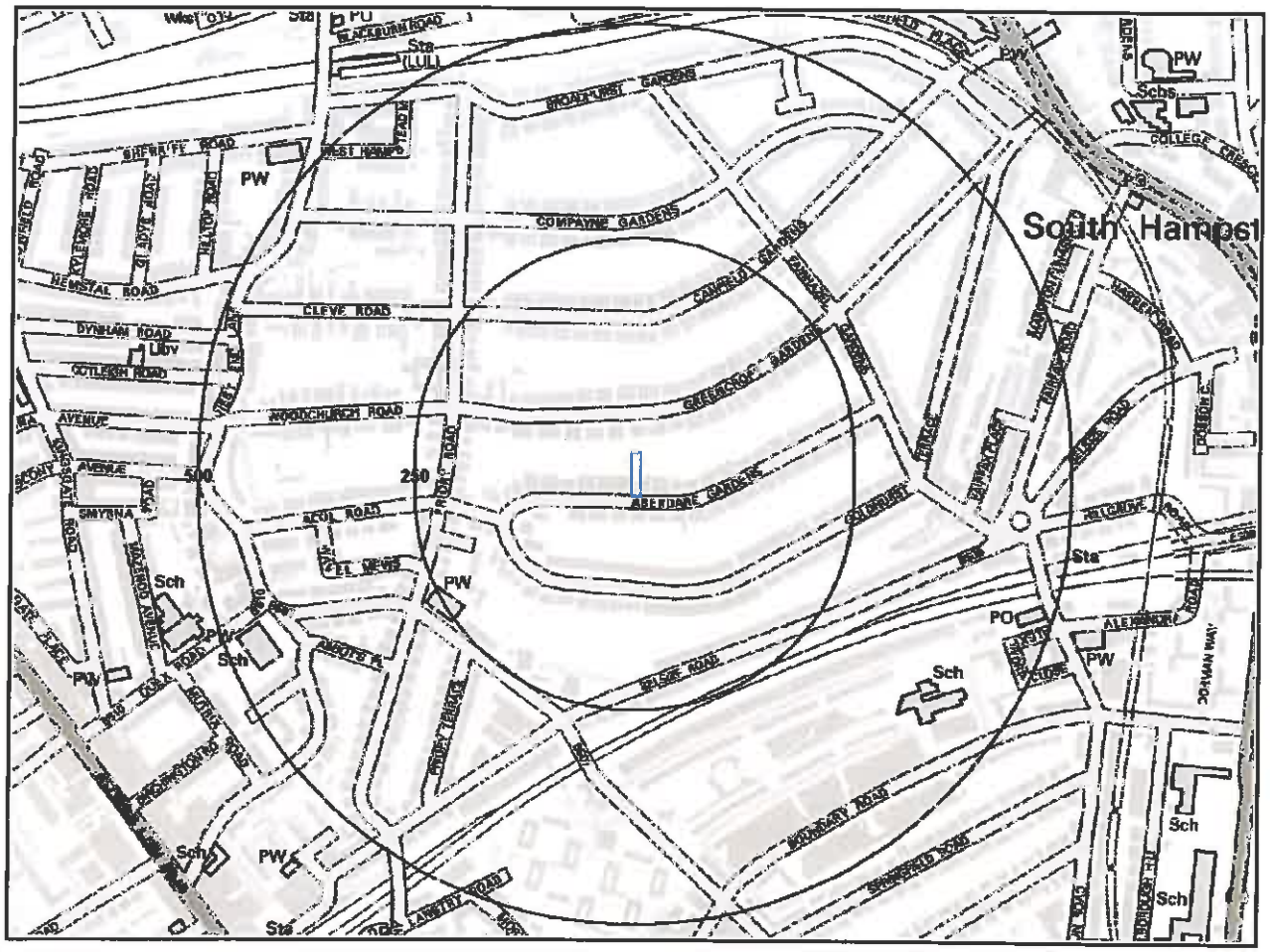
- Site Outline
- 250 / 500 Search Buffers (m)
- Source Protection Zone 1 - Inner Catchment
- Source Protection Zone 2 - Outer Catchment
- Source Protection Zone 3 - Total Catchment
- Source Protection Zone 4 - Zone of Special Interest
- Potable Water Abstraction Licence

5d. Hydrology – Detailed River Network and River Quality

NW N NE

W E

SW S SE



Hydrology Legend

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- Site Outline
- 250 / 500 — Search Buffers (m)
- Primary River
- Secondary River
- Tertiary River
- Lake/Reservoir
- Underground River (inferred)
- General Quality Assessment: Chemistry
- Canal
- Canal Tunnel
- Extended Culvert (greater than 50m)
- D/S of High Water Mark
- D/S seaward extension
- General Quality Assessment: Biology

5.Hydrogeology and Hydrology

5.1 Aquifer within Superficial Deposits

Are there records of productive strata within the superficial geology at or in proximity to the property? No

Database searched and no data found.

From 1 April 2010, the Environment Agency's Groundwater Protection Policy has been using aquifer designations consistent with the Water Framework Directive. For further details on the designation and interpretation of this information, please refer to the GroundSure Enviroinsight User Guide.

5.2 Aquifer within Bedrock Deposits

Are there records of productive strata within the bedrock geology at or in proximity to the property? Yes

From 1 April 2010, the Environment Agency's Groundwater Protection Policy has been using aquifer designations consistent with the Water Framework Directive. For further details on the designation and interpretation of this information, please refer to the GroundSure Enviroinsight User Guide.

The following aquifer records are shown on the Aquifer within Bedrock Geology Map (5b):

ID	Distance [m]	Direction	Designation	Description
2	0.0	On Site	Unproductive	These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow

5.3 Groundwater Abstraction Licences

Are there any Groundwater Abstraction Licences within 2000m of the study site? Yes

The following Abstraction Licences records are represented as points, lines and regions on the Aquifer within Bedrock Geology Map (5b):

ID	Distance	Direction	NGR	Details	
Not shown	907.0	E	526800, 184280	Licence No: 28/39/39/0219 Details: Spray Irrigation - Direct Direct Source: Thames Groundwater Point: Swiss Cottage Open Space-Borehole Data Type: Point	Annual Volume (m³): 10512 Max Daily Volume (m³): 28.8 Original Application No: WRA/N/1407 Original Start Date: 12/8/2005 Expiry Date: 31/3/2013 Issue No: 1 Version Start Date: 1/4/2008 Version End Date:
Not shown	1800.0	E		Licence No: 28/39/39/0231 Details: Potable Water Supply - Direct Direct Source: Thames Groundwater Point: Barrow Hill Pumping Station - Borehole Data Type: Point	Annual Volume (m³): 631000 Max Daily Volume (m³): 2000 Original Application No: WRA/R/1026 Original Start Date: 1/4/2007 Expiry Date: 31/3/2013 Issue No: 1 Version Start Date: 1/4/2007 Version End Date:
Not shown	1800.0	E		Licence No: 28/39/39/0202 Details: Potable Water Supply - Direct Direct Source: Thames Groundwater Point: Barrow Hill Pumping Station - Borehole Data Type: Point	Annual Volume (m³): 631000 Max Daily Volume (m³): 2000 Original Application No: WRA/2/2(24) Original Start Date: 26/9/2002 Expiry Date: 31/3/2007 Issue No: 1 Version Start Date: 26/9/2002 Version End Date:

5.4 Surface Water Abstraction Licences

Are there any Surface Water Abstraction Licences within 2000m of the study site? **No**

Database searched and no data found.

5.5 Potable Water Abstraction Licences

Are there any Potable Water Abstraction Licences within 2000m of the study site? **Yes**

The following Potable Water Abstraction Licences records are represented as points, lines and regions on the SPZ and Potable Water Abstraction Licences Map (5c):

ID	Distance	Direction	NGR	Details	
Not shown	1800.0	E	527640, 183690	Licence No: 28/39/39/0231 Details: Potable Water Supply - Direct Direct Source: Thames Groundwater Point: Barrow Hill Pumping Station - Borehole Data Type: Point	Annual Volume (m³): 631000 Max Daily Volume (m³): 2000 Original Application No: WRA/R/1026 Original Start Date: 1/4/2007 Expiry Date: 31/3/2013 Issue No: 1 Version Start Date: Version End Date:
Not shown	1800.0	E	527640, 183690	Licence No: 28/39/39/0202 Details: Potable Water Supply - Direct Direct Source: Thames Groundwater Point: Barrow Hill Pumping Station - Borehole Data Type: Point	Annual Volume (m³): 631000 Max Daily Volume (m³): 2000 Original Application No: WRA/2/2(24) Original Start Date: 26/9/2002 Expiry Date: 31/3/2007 Issue No: 1 Version Start Date: Version End Date:

5.6 Source Protection Zones

Are there any Source Protection Zones within 500m of the study site? **No**

Database searched and no data found.

5.7 River Quality

Is there any Environment Agency information on river quality within 1500m of the study site? **No**

Biological Quality:

Database searched and no data found.

Chemical Quality:

Database searched and no data found.

5.8 Detailed River Network

Are there any Detailed River Network entries within 500m of the study site? **No**

Database searched and no data found.

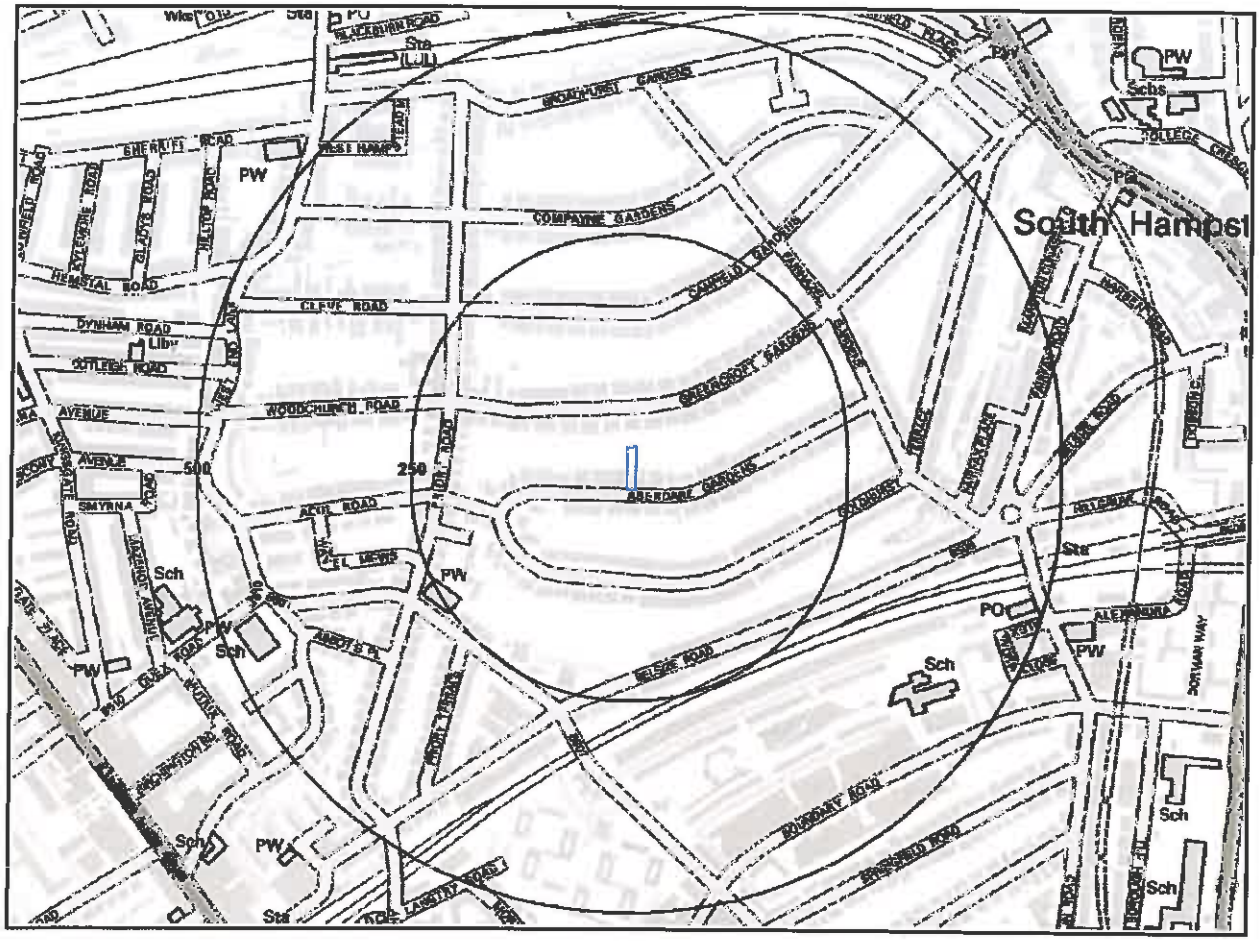
5.9 Surface Water Features

Are there any surface water features within 250m of the study site? **No**

Database searched and no data found.

6. Environment Agency Flood Map

NW N NE



W E

SW S SE

Environment Agency Flood Legend

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Site Outline

250 500 Search Buffers (m)

Zone 2 Floodplain

Zone 3 Floodplain

Flood Storage Area

Area Benefiting from Flood Defences

Flood Defences

6. Flooding

6.1 Zone 2 Flooding

Zone 2 floodplain estimates the annual probability of flooding as one in one thousand (0.1%) or greater from rivers and the sea but less than 1% from rivers or 0.5% from the sea. Alternatively, where information is available they may show the highest known flood level.

Is the site within 250m of an Environment Agency indicative Zone 2 floodplain? **No**

Database searched and no data found.

6.2 Zone 3 Flooding

Zone 3 estimates the annual probability of flooding as one in one hundred (1%) or greater from rivers and a one in two hundred (0.5%) or greater from the sea. Alternatively, where information is available they may show the highest known flood level.

Is the site within 250m of an Environment Agency indicative Zone 3 floodplain? **No**

Database searched and no data found.

6.3 Flood Defences

Are there any Flood Defences within 250m of the study site? **No**

6.4 Areas benefiting from Flood Defences

Are there any areas benefiting from Flood Defences within 250m of the study site? **No**

6.5 Areas used for Flood Storage

Are there any areas used for Flood Storage within 250m of the study site? **No**

6.6 Groundwater Flooding Susceptibility Areas

Are there any British Geological Survey groundwater flooding susceptibility flood areas within 50m of the boundary of the study site? **No**

What is the highest susceptibility to groundwater flooding in the search area based on the underlying geological conditions? **Negligible**

6.7 Groundwater Flooding Confidence Areas

What is the British Geological Survey confidence rating in this result? **Not Applicable**

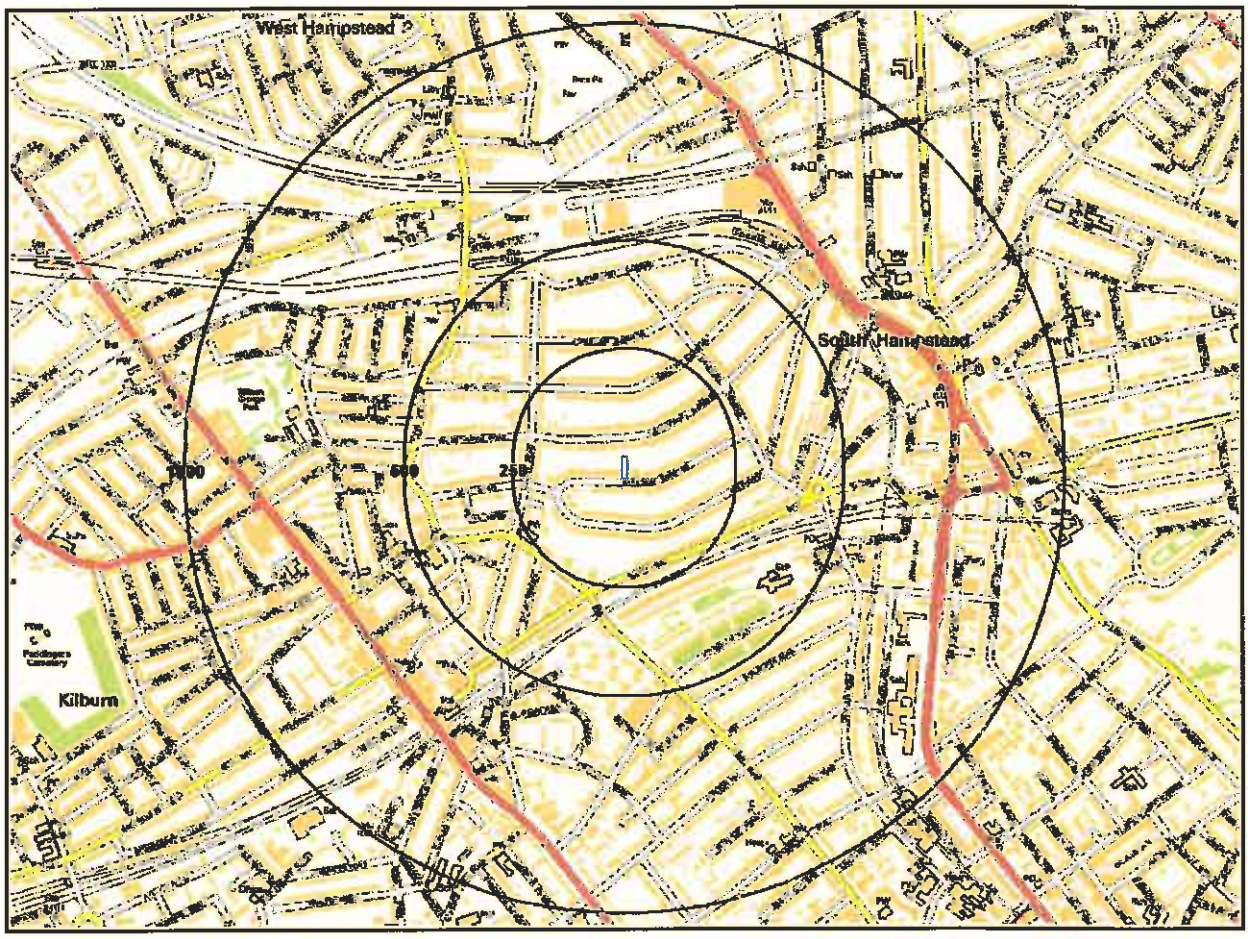
Notes:

Groundwater flooding is defined as the emergence of groundwater at the ground surface or the rising of groundwater into man-made ground under conditions where the normal range of groundwater levels is exceeded.

The **confidence rating** is on a threefold scale - Low, Moderate and High. This provides a relative indication of the BGS confidence in the accuracy of the susceptibility result for groundwater flooding. This is based on the amount and precision of the information used in the assessment. In areas with a relatively lower level of confidence the susceptibility result should be treated with more caution. In other areas with higher levels of confidence the susceptibility result can be used with more confidence.

7.Designated Environmentally Sensitive Sites Map

NW N NE



W E

SW S SE

Designated Environmentally Sensitive Sites Legend

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- Site Outline
- Areas of Outstanding Natural Beauty
- SAC
- SPA
- Nitrate Vulnerable Zones
- SSSI
- Ramsar
- Nitrate Sensitive Areas
- NNR
- LNR
- National Parks
- World Heritage Sites
- Environmentally Sensitive Areas
- Ancient Woodlands

7.Designated Environmentally Sensitive Sites

Presence of Designated Environmentally Sensitive Sites within 2000m of the study site? **No**

Records of Sites of Special Scientific Interest (SSSI) within 2000m of the study site: **0**

Database searched and no data found.

Records of National Nature Reserves (NNR) within 2000m of the study site: **0**

Database searched and no data found.

Records of Special Areas of Conservation (SAC) within 2000m of the study site: **0**

Database searched and no data found.

Records of Special Protection Areas (SPA) within 2000m of the study site: **0**

Database searched and no data found.

Records of Ramsar sites within 2000m of the study site: **0**

Database searched and no data found.

Records of Local Nature Reserves (LNR) within 2000m of the study site: **4**

The following Local Nature Reserve (LNR) records provided by Natural England/Countryside Council for Wales and Scottish Natural Heritage are represented as polygons on the Designated Environmentally Sensitive Sites Map:

ID	Distance	Direction	LNR Name	Data Source
Not shown	1597.0	SE	St John's Wood Church Grounds	Natural England
Not shown	1760.0	NW	Westbere Copse	Natural England
Not shown	1766.0	NW	Westbere Copse	Natural England
Not shown	1891.0	NE	Belsize Wood	Natural England

Records of World Heritage Sites within 2000m of the study site: **0**

Database searched and no data found.

Records of Environmentally Sensitive Areas within 2000m of the study site: **0**

Database searched and no data found.

Records of Areas of Outstanding Natural Beauty (AONB) within 2000m of the study site: 0

Database searched and no data found.

Records of National Parks (NP) within 2000m of the study site: 0

Database searched and no data found.

Records of Nitrate Sensitive Areas within 2000m of the study site: 0

Database searched and no data found.

Records of Nitrate Vulnerable Zones within 2000m of the study site: 0

Database searched and no data found.

Records of Ancient Woodland within 2000m of the study site: 0

Database searched and no data found.

8. Natural Hazards Findings

8.1 Detailed BGS GeoSure Data

BGS GeoSure Data has been searched to 50m. The data is included in tabular format. If you require further information on geology and ground stability, please obtain a GroundSure GeoInsight, available from our website. The following information has been found:

8.1.1 Shrink Swell

What is the maximum Shrink-Swell* hazard rating identified on the study site? **Moderate**

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard
Ground conditions predominantly high plasticity. Do not plant or remove trees or shrubs near to buildings without expert advice about their effect and management. For new build, consideration should be given to advice published by the National House Building Council (NHBC) and the Building Research Establishment (BRE). There is a probable increase in construction cost to reduce potential shrink-swell problems. For existing property, there is a probable increase in insurance risk during droughts or where vegetation with high moisture demands is present.

8.1.2 Landslides

What is the maximum Landslide* hazard rating identified on the study site? **Very Low**

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard
Slope instability problems are unlikely to be present. No special actions required to avoid problems due to landslides. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with landslides.

8.1.3 Soluble Rocks

What is the maximum Soluble Rocks* hazard rating identified on the study site? **Null - Negligible**

Soluble rocks are not present in the search area. No special actions required to avoid problems due to soluble rocks. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with soluble rocks.

8.1.4 Compressible Ground

What is the maximum Compressible Ground* hazard rating identified on the study site? **Negligible**

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard
No indicators for compressible deposits identified. No special actions required to avoid problems due to compressible deposits. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with compressible deposits.

8.1.5 Collapsible Rocks

What is the maximum Collapsible Rocks* hazard rating identified on the study site? **Very Low**

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard
Deposits with potential to collapse when loaded and saturated are unlikely to be present. No special ground investigation required or increased construction costs or increased financial risk due to potential problems with collapsible deposits.

8.1.6Running Sand

What is the maximum Running Sand* hazard rating identified on the study site? **Negligible**

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard
No indicators for running sand identified. No special actions required to avoid problems due to running sand. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with running sand.

* This indicates an automatically generated 50m buffer and site.

9.Mining

9.1 Coal Mining

Are there any coal mining areas within 75m of the study site? **No**

Database searched and no data found.

9.2 Shallow Mining

What is the subsidence hazard relating to shallow mining on-site*? **Negligible**

*Please note this data is searched with a 150m buffer.

9.3 Brine Affected Areas

Are there any brine affected areas within 75m of the study site? **No**

Database searched and no data found.

10.Contacts

GroundSure Helpline
Telephone: 08444 159 000
info@4c.groundsure.com

British Geological Survey (England & Wales)
Kingsley Dunham Centre
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Web: www.bgs.ac.uk
BGS Geological Hazards Reports and general geological enquiries

Environment Agency
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PO Box 544
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S60 1BY
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Web: www.environment-agency.gov.uk
Email: enquiries@environment-agency.gov.uk

Health Protection Agency
Chilton, Didcot, Oxon, OX11 0RQ
Tel: 01235 822622 www.hpa.org.uk/radiation
Radon measures and general radon information and guidance

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Tel: 0845 762 6848
DX 716176 Mansfield 5
Web: www.groundstability.com

Ordnance Survey
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Local Authority
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Report Reference: HMD-489206

GroundSure RadonCheck

Address: 29 Aberdare Gardens, South Hampstead, London, NW6 3PY

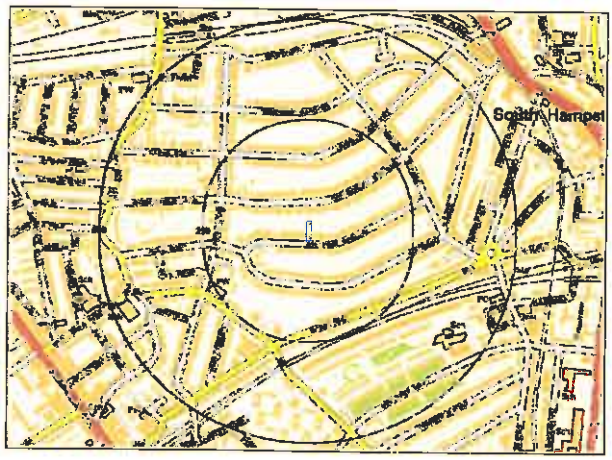
Date: Oct 8, 2012

GroundSure Reference: HMD-489208

Your Reference: C12761

Grid Reference: 525894,184158

Client: Ground Engineering Ltd



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1. Residential Radon Potential Result

1.1 Is the property in a Radon Affected Area?

The information in this section provides an answer to one of the standard legal enquiries on house purchase in England and Wales, known as *CON29 standard Enquiry of Local Authority; 3.13 Radon Gas: Location of the Property in a Radon Affected Area.*

Question: Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are above the Action Level?

Answer: The property is not in a Radon Affected Area, as less than 1% of properties are above the Action Level.

1.2 Are Radon Protective Measures required?

The information in this section will detail the level of protection required for new dwellings under as described in the latest Building Research Establishment guidance on radon protective measures for new dwellings. This may include extensions to the property.

Question: Is the property in an area where Radon Protection Measures are required for new properties or extensions to existing ones as described in publication BR211 by the Building Research Establishment?

Answer: No Radon Protective Measures are necessary.

1.3 Combined Radon Guidance

Radon is a colourless, odourless radioactive gas which is present in all areas of the United Kingdom, usually at levels that pose a negligible risk to homebuyers. However, in some areas levels of radon are much higher than in others, and in these cases it can pose a health risk. The data supplied by the Health Protection Agency (HPA) and the British Geological Survey (BGS)is not able to determine exact Radon levels, as this information can only be obtained through site-specific, in-situ testing. As less than 1% of properties in the area may be radon affected, the HPA do not consider that further action is necessary.

The responses given on the level of Radon Protective Measures required are based on a joint radon potential dataset from the Health Protection Agency (HPA) and the British Geological Survey (BGS). No Radon Protective Measures are required for new builds or extensions.

1.4 Further details on Radon

Radon is a naturally occuring radioactive gas, which enters buildings from the ground. Outdoors, it is diluted to very low levels. However, in some cases the radon level indoors can build up to high concentrations. In such cases, it does pose a serious risk to health. Exposure to high concentrations increases the risk of lung cancer. The Health Protection Agency recommends that radon levels should be reduced in homes where the annual average is at or above 200 becquerels per cubic metre (200 Bq m^{-3}). This is termed the Action Level. The Health Protection Agency defines Radon Affected Areas as those with 1% chance or more of a house having a radon concentration at or above the Action Level of 200 Bq m^{-3}.

The joint HPA-BGS digital Radon Potential Dataset used in this report provides the current definitive map of Radon Affected Areas in England and Wales.

Indoor radon levels can usually be substantially reduced at a cost comparable to many home improvements, such as replacing carpets. Details of methods of reducing radon levels are given on the Building Research Establishment Website. http://www.bre.co.uk/radon/index.html

2. Contact Details

GroundSure Helpline
Telephone: 08444 159 000
info@4c.groundsure.com

Local Authority - Camden London Borough Council. Address: Camden Town Hall, Judd Street, Camden, London, WC1H 9JE. Web: www.camden.gov.uk. Tel: 020 7278 4444

British Geological Survey Enquiries
Kingsley Dunham Centre
Keyworth, Nottingham NG12 5GG
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Web: www.bgs.ac.uk
BGS Geological Hazards Reports and general geological enquiries

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APPENDIX 4

CLASSIFICATION OF AGGRESSIVE CHEMICAL ENVIRONMENT FOR BURIED CONCRETE

TABLE C1 – AGGRESSIVE CHEMICAL ENVIRONMENT FOR CONCRETE (ACEC) CLASSIFICATION FOR NATURAL GROUND LOCATIONS[a]

Table C1 Aggressive Chemical Environment for Concrete (ACEC) classification for natural ground locations[a]

Sulfate				Groundwater		ACEC
Design Sulfate Class for location	2:1 water/soil extract[b]	Groundwater	Total potential sulfate[c]	Static water	Mobile water	Class for location
1	2 (SO_4 mg/l)	3 (SO_4 mg/l)	4 (SO_4 %)	5 (pH)	6 (pH)	7
DS-1	< 500	< 400	< 0.24	≥ 2.5		AC-1s
					> 5.5[d]	AC-1[d]
					2.5–5.5	AC-2z
DS-2	500–1500	400–1400	0.24–0.6	> 3.5		AC-1s
					> 5.5	AC-2
				2.5–3.5		AC-2s
					2.5–5.5	AC-3z
DS-3	1600–3000	1500–3000	0.7–1.2	> 3.5		AC-2s
					> 5.5	AC-3
				2.5–3.5		AC-3s
					2.5–5.5	AC-4
DS-4	3100–6000	3100–6000	1.3–2.4	> 3.5		AC-3s
					> 5.5	AC-4
				2.5–3.5		AC-4s
					2.5–5.5	AC-5
DS-5	> 6000	> 6000	> 2.4	> 3.5		AC-4s
				2.5–3.5	≥ 2.5	AC-5

Notes

a Applies to locations on sites that comprise either undisturbed ground that is in its natural state (ie is not brownfield – Table C2) or clean fill derived from such ground.

b The limits of Design Sulfate Classes based on 2:1 water/soil extracts have been lowered relative to previous Digests (Box C7).

c Applies only to locations where concrete will be exposed to sulfate ions (SO_4) which may result from the oxidation of sulfides (eg pyrite) following ground disturbance (Appendix A1 and Box C8).

d For flowing water that is potentially aggressive to concrete owing to high purity or an aggressive carbon dioxide level greater than 15 mg/l (Section C2.2.3), increase the ACEC Class to AC-2z.

Explanation of suffix symbols to ACEC Class

- Suffix 's' indicates that the water has been classified as static.
- Concrete placed in ACEC Classes that include the suffix 'z' primarily have to resist acid conditions and may be made with any of the cements or combinations listed in Table D2 on page 42.

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