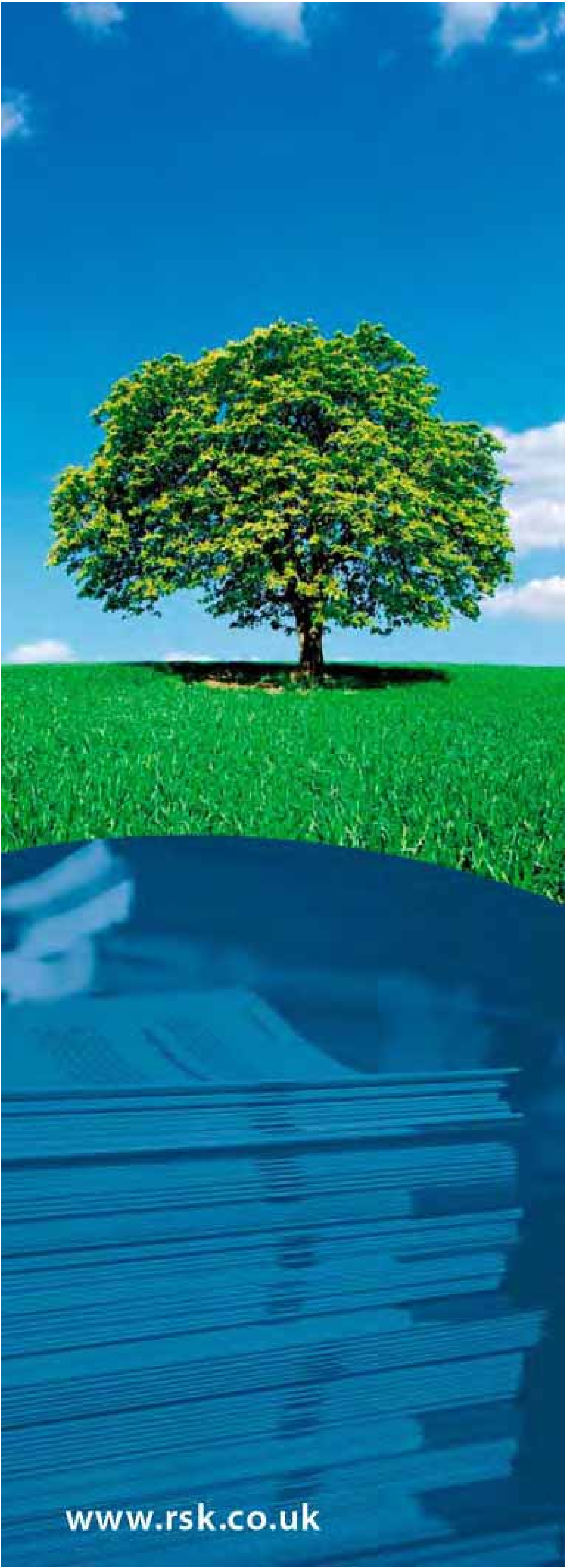

RSK GROUP PLC

GEO-ENVIRONMENTAL SITE ASSESSMENT

GONDAR GARDENS
LONDON NW6 1EW

23283-1 (00)

Linden Homes Ltd

December 2009

Safeguarding
your business
environment

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1 INTRODUCTION

RSK STATS Geoconsult Limited (RSK) was commissioned by Linden Homes Ltd to carry out a Geo-environmental Site Assessment (GSA) for the site of a Thames Water underground reservoir located on Gondar Gardens, London, NW6 1EW.

This assessment was carried out with the understanding that part of the site is to be redeveloped for a residential end-use whilst the reservoir is to be retained and converted into an underground car park.

1.1 Objectives

The objectives of this assessment are as follows:

- To enable sufficient information regarding ground conditions to be obtained from which risks to end-users and the environment can be assessed; and
- To obtain sufficient information pertaining to ground conditions to assist in the design of foundations and associated infrastructure.

1.2 Scope

The scope of the investigation and layout of this report has been designed with CLR11(1) and PPS23 in mind and guidance issued by the Environment Agency in July 2005 for land contamination reports(2). A summary of relevant legislation and government policies applicable to land development is included in Appendix B.

The risk management process comprises up to three stages of risk assessment: preliminary, generic quantitative and detailed quantitative (PRA, GQRA and DQRA). The basis for the risk assessment is a conceptual model that is produced as part of the PRA and is updated throughout the risk management process.

The scope of works for the environmental site assessment includes:

- A PRA involving the review of existing reports, utility location information, geological, hydrogeological and hydrological information, a commercially available database, historical plans, correspondence with appropriate regulatory authorities and site walkover. This information is used to construct an outline conceptual model and consider any possible pollutant linkages (where a receptor may be connected to a source by a viable pathway) that may be present and design intrusive investigation if required;
- Where required, evaluation of possible pollutant linkages by intrusive investigation and laboratory analysis. This information is used to refine the conceptual model;
- GQRA (if required) to assess possible pollutant linkages identified in the PRA and enable outline conceptual model to be refined; and
- Provide recommendations for further works, DQRA and remedial actions of ground and groundwater (if deemed applicable).

The scope of works for the geotechnical assessment includes:

- Intrusive investigation and laboratory analysis to enable soil parameters for geotechnical purposes to be ascertained; and
- Interpretation of ground conditions and geotechnical data to provide recommendations with respect to foundation, floor slabs and infrastructure design.

The results of the site investigation, *in-situ* tests and laboratory analysis pertinent to geotechnical issues are given in Section 7.

1.3 Limitations

The comments given in this report and the opinions expressed are based on the ground conditions encountered during the site work and on the results of tests made in the field and in the laboratory (waiting for the results). However, there may be conditions pertaining to the site that have not been disclosed by the investigation and which therefore could not be taken into account. In particular, groundwater levels may vary from those reported due to seasonal, or other, effects.

This report is subject to the RSK service constraints given in Appendix A.

1.4 Previous Work

RSK is unaware of any previous investigations for the site.

2 SITE DETAILS

2.1 Site Location

The site is located in Gondar Gardens, London. The site comprises a former Thames Water buried reservoir constructed circa 1890 located within a residential area of West Hampstead near Shoot Up Hill. The site is rectangular in shape and approximately 1.2ha.

It is of note that the reservoir does not extent beneath the site to the full extent to the east.

The National Grid Reference for the approximate centre of the site is 524840 185310. A site location plan is presented as Figure 1.

2.2 Site Description

The site is at an elevation of approximately 75m AOD and is generally level apart from the boundaries of the site which slope down to residential boundaries that border the site with Gondar Gardens to the west.
To the front bordering Gondar Gardens there are significant trees including an electrical sub-station. Mature trees also present in bordering gardens. A site plan is presented as Figure 3.

2.3 Future Development

Consideration is being given to partial demolition of the reservoir to the front on Gondar Gardens and the construction of three storey terraced housing with partial double basements below. The former reservoir is being considered for underground car parking. The proposed site layout is given in Figure 2.

3 PRELIMINARY RISK ASSESSMENT

The following describes the results of the review of available information for the site and the findings from the site inspection. The information together with that presented in Section 2 has been used to identify potential contaminant sources and sensitive receptors, from which an outline conceptual model has been developed.

3.1 Geology

Published records (5) for the area indicates the geology of the area to comprise the London Clay Formation.

Associated with the reservoir construction, reworked materials (London Clay) are likely to be percent.

The geological information recorded in the Envirocheck reports (4) includes the following:

- No mining, quarrying or land reclamation activities are recorded as having taken place within 2km of the site.

The National Radiological Protection Board information contained within the environmental database indicates that the percentage of homes above the action level is less than 1%. The British Geological Survey information contained within the environmental database information indicated that no radon protective measures are considered necessary for the site.

3.2 Hydrogeology

The Groundwater Vulnerability Map(6) indicates the London Clay Formation to be classified as a non-aquifer. This formation is generally regarded as containing insignificant quantities of groundwater. Groundwater flow, although imperceptible, does take place and needs to be considered in assessing risks associated with persistent pollutants. Some non-aquifers scan yield water in sufficient quantities for domestic use.

3.2.1 Groundwater Abstractions

The Source Protection Zones (SPZ) provides an indication of the potential risk of pollution. Three zones (Inner, Outer and Total Catchment) are usually defined. Information on the Environment Agency website(7) indicates the site is not situated within a groundwater SPZ.

According to the Envirocheck report, there are no abstractions within 2km the site.

3.2.2 Soil Leaching Potential

The London Clay beneath the site is classified as being of negligibly permeability.

3.3 Hydrology

An unknown surface water feature is located 464m northwest of the site.

3.3.1 Surface Water Abstractions

No surface water abstractions have been identified within 2km of the site.

3.3.2 Flooding

Information on the Environment Agency website indicates the site is not situated within a Flood Zone.

3.4 Sensitive Land Uses

The site is not located within a Nitrate vulnerable zone.

A local nature reservoir (Westbere Copse) is located 234m to the west.

A comprehensive evaluation of ecological receptors is outside the scope of this report although there was evidence on site that an ecological survey was being carried out by others.

It is understood that the site is currently designated by the local council as ‘private open space’.

3.5 Site History Review

A review of the site history has been carried out through the study of Ordnance Survey maps dating from the late 1800s onwards. The review is designed to identify potential historic sources of contamination that may have impacted soil or groundwater quality beneath the sites and to identify any potentially contaminative land uses in the area that may have impacted the site.

3.5.1 Historic Maps

A review of the historical development of the site from between 1896 and 2009 was undertaken using map extracts provided within the Landmark Envirocheck report. This information has been summarised in Table 3-1. The historical maps have been produced within this report, Appendix C.

Table 3-1: Historical Map Review

Date Scale	Site Activity	Surrounding area
1896 1:2,500	The site has been developed with a reservoir (named as Grand Junction W.W) It is also understood that the reservoir has been constructed in 1872.	Adjacent to the site, residential developments are indicated to the east and south of the site. Open lands (possible agricultural lands) are indicated to the north and west of the site boundaries. The Hampstead cemetery is located approximately 500m to the north. A clay pit is indicated approximately 600m to the northwest. A railway is located approximately 550m to the southwest.
1915 1:2,500	No significant changes. The reservoir is now referred as Metropolitan Water Board.	The western site boundary is now bordered by Gondar Gardens. The site is generally bounded by residential houses and flats. Allotment gardens are indicated approximately 370m to the northwest of the site.
1935-1936 1:2,500	Two small structures are indicated on the west of the site.	The clay pit and allotment gardens are no longer indicated.
1955 1:2,500	Some infrastructure change is indicated to the front of the reservoir.	No significant changes around the site
1962-1974 1:2,500	A sub-station is indicated in the northwest corner.	No significant changes around the site
1991-1994 1:2,500	No significant changes	No significant changes around the site
2006 1:10 000	No significant changes.	No significant changes around the site
2009 1:10 000	No significant changes.	No significant changes around the site

The historical maps have revealed the site to has been developed with a reservoir since 1896. The reservoir is for the storage of drinking water. There is no evidence of infrastructure or processes associated with water treatment. On this basis the risk of significant contamination being present is considered to be very low.

3.5.2 Database Information

Two discharge consent are identified within 1km of the site. The closed being 158m to the north of the site. This is registered to the Thames Water Utilities Ltd at Shoot Up Hill for the discharge of freshwater.

There are no records of Integrated Pollution and Prevention Controls located within a 2km radius of the site.

There are no records of Local Authority Pollution and Prevention Controls registered within 2km of the site.

There is a single record of Category 3 – minor pollution incidents to controlled waters within 1km of the site, it is located 977m north of the site relating to unknown chemicals.

There are no records of historical landfill sites within 2km of the site.

There is a single record of registered waste transfer sites within 1km, the closed being 786m to the southeast for L.B of Camden, site category.

There are no records of local authority recorded landfill sites within 2km of the site

There are no records of registered landfill sites within 2km of the site.

A single record of registered waste treatment or disposal sites scrapyard within 1km, the closed being 553m to the southeast for T H Beardon & Son Ltd, site category.

The reservoir was decommissioned circa 2000. During its operational period and following decommissioning the facility has been well managed and has remained secure with no evidence of fly tipping or material storage.

3.5.3 Trade Directories

There is ten contemporary trade records within 250m and hundred and eighty four up to 1km of the site. The closest being 58m to the west at 54 Sarre Road, London, classified as carpet, curtain & upholstery cleaners. The status of this is inactive. The second closest 80m to the north at 35 Gondar Gardens, London classified as metal products fabricated, status-active.

Three records of fuel station entries are within 1km of the site. The closest being 322m to the northeast for Fortune Green Service Station, brand-Texaco, status-obsolete.

3.6 Site Walkover

A walkover survey of the site was conducted on the 17 November 2009. The site access via Gondar Gardens. The site is occupied a former Thames Water buried reservoir. The site is generally level apart for the boundaries of the site, which slope down to residential boundaries. The front bordering Gondar Gardens and along the boundaries there are significant trees and shrubs. A sub-station is located at northwest corner.

Infrastructure associated with the reservoir is treated to the front end on the surface of reservoir and to the south.

Apart from the south, the site is bounded by residential houses.

There was evidence of an ecology survey being carried out (carpet tiles scattered on surface of reservoir).

3.6.1 Asbestos

No potential asbestos containing materials were identified during the walkover.

3.6.2 Invasive Non-Native Plants

The Environment Agency considers that the second most significant threat to biodiversity, after habitat destruction, is posed by invasive non-native species. Invasive plants can deprive native plants of nutrients, light and space, can dilute native species by cross-breeding and can alter plant populations.

Japanese Knotweed is an invasive weed that has the potential to damage asphalt surfaces and paved areas and even penetrate substructures and grow into buildings. It is difficult and costly to eradicate. It should be noted that failure to appropriately dispose of any material containing Japanese knotweed is an offence and may lead to prosecution under the Wildlife and Countryside Act 1991.

During the site walkover, Japanese knotweeds were identified at three locations along the northern boundary at the approximate locations are shown in Figure 3. It is recommended that before any site operations are carried out, the site be re-inspected for Japanese knotweed. It should be treated before works commence. Inspections for Japanese knotweed should also be made as a matter of routine.

3.7 Summary of Potential Contaminant Sources

Whilst risks to the site from previous historical land uses is considered to be very low, there are a number of potential sources of contamination associated with made ground if present.

3.7.1 Potential On-Site Sources

- Possible Made ground associated with reservoir construction.

3.7.2 Potential Off-Site Sources

- Possible Made ground (potential source of ground gases);
- Drainage system; and

3.8 Sensitive Receptors

There are a number of receptors that may be affected by potential contamination identified above. These may include:

- Future site workers;
- Future site residents;
- Uptake by vegetation; and
- Adjacent off-site residents.

3.9 Summary of Plausible Pathways

A number of plausible pathways are present that could connect the identified sources and receptors:

- Direct contact (dermal, ingestion and inhalation);
- Inhalation of gases/vapours;
- Root uptake;
- Lateral and vertical migration;
- Migration along drains and backfill around drains; and
- Permeation of plastic pipes.

3.10 Outline Conceptual Model

The information presented in Sections 2 and 3.1-3.9 has been used to compile an outline conceptual model. The identified potential contaminants and receptors have been considered with any possible pathways that may link them. The resulting pollutant linkages are considered in Table 3-2. The risk classification has been estimated in accordance with information in Appendix D.

Table 3-2: Risk Estimation for Potential Pollutant Linkages in Outline Conceptual Model

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk
Made ground, possibly containing TPH, PAH, and heavy metal contaminants	Future construction/ maintenance workers	Direct contact Inhalation (dust and vapours) Dermal contact	Low Likelihood	Minor	**Very Low.** Although there is potential for contact with soil that may be impacted during typical work activities, managing health and safety using H&S and PPE requirements should reduce risks to acceptable levels
	Future occupants	Direct contact/ ingestion (soil, via piped water supply)	Unlikely	Minor	**Very Low.** There is potential for impacted soils and groundwater on site to reach occupants.
	Neighbouring occupants/ workers	Migration and inhalation of dust or vapours via permeable shallow geology	Low likelihood	Minor	**Very Low.** It is possible that construction is planned where dust may be created that could be contaminated.
	Shallow groundwater body - made ground	Leachate migration	Low Likelihood	Minor	**Low.** Shallow groundwater could be impacted by contaminants. Vertical migration and mobilisation of contaminants may occur following infiltration.

	Surface water Unknown watercourse		Low likelihood	Minor	**Very Low.** Shallow groundwater could be impacted by contaminants if present. However no viable pathway to unknown watercourse is believed to exist.
	Plant uptake	Vegetation	Likely	Minor	**Low.** Without remedial works, impacted soils and shallow groundwater could inhibit plant growth
Hazardous ground gases	Construction/ maintenance workers	Migration and inhalation of soil gas via permeable shallow geology.	Likely	Medium	**Moderate.** During construction phase, workers may enter excavations (e.g. laying services) where concentrations of bulk gases may concentrate
	Future residents		Likely	Medium	**Moderate.** Dependent on gas flows, gas migration could occur. Bulk gases may be present that could migrate and be inhaled by residents either indoors or outdoors, indicating that protection measures may need to be incorporated into buildings
	Neighbouring Residents		Likely	Medium	**Moderate.** Concentrations of bulk gases may exist and dependent on gas flows, off-site migration is possible

3.11 Preliminary Risk Assessment Conclusions and Recommendations

The review of information and the construction of the outline conceptual site model highlight potential pollutant linkages. In order to investigate any unacceptable risk presented by these, an intrusive investigation has been carried out. This is detailed in Section 4 of this report.

4 ENVIRONMENTAL SITE INVESTIGATION

RSK carried out an intrusive investigation work between the 17th November 2009.

4.1 Sampling Strategy and Methodology

It was considered that the preferred method of exploration would be the use of drive-in sampler boreholes as these needed minimal access and would cause minimal disruption to the ground surface, allow geotechnical testing to be carried out and also to allow monitoring wells to be installed. This drilling method also allows the best possible sampling for environmental purposes, as potential cross contamination of the recovered soils is minimal.

A single cable percussion borehole was principally utilised to collect geotechnical information to allow foundation design, classify the sulphate class of the subsoil for buried concrete design.

4.1.1 Health and Safety Considerations

All works completed on site were undertaken in line with RSK's Safety, Health, Environmental and Quality Management System (SHEQ MS), which is accredited to ISO9001: 2000 (Quality Management System standard), ISO14001:2004 (Environmental Management System standard) and OHSAS18001:2007 (Occupational Health and Safety Management System standard).

All proposed holes were scanned and cleared by a specialist services scan sub-constructor.

Unexpected services were not encountered during works.

4.1.2 Investigation Locations

Seven probeholes, designated PH1 to PH7, were sunk by percussive means using drive-in sampling techniques. A single borehole, designated BH1 was also sunk by light cable percussion technique. Representative samples were taken from probeholes borehole and returned to the laboratory for analysis. The descriptions of the strata encountered together with comments on groundwater conditions and hole stability are given in the probehole records presented in Appendix E.

35mm diameter perforated standpipes were installed in four probeholes (PH1, PH2, PH3 PH7) to enable future monitoring of groundwater levels and the flow rates, pressures and concentrations of any gas. Installation details are given in the exploratory hole records summarised in Table 4-1.

Table 4-1: Standpipe Installation Detail ....

Location	Response Zone Depth	Targeting Stratum	Diameter
PH1	1.00m to 4.00m	London Clay	35mm
PH2	1.00m to 4.00m	London Clay	35mm
PH3	1.00m to 4.00m	London Clay	35mm
PH7	1.00m to 4.00m	London Clay	35mm

In the absence of any significant areas of concern, the exploratory hole positions were chosen to provide good coverage of the site and with respect to the proposed developments, in particular to areas of soft landscaping. With respect to geo-hazards, a probeholes were sunk to the front of the site to assess for clay desiccation associated with the existing trees. The exploratory hole locations are identified in Figure 3. A summary of the exploratory hole rationale is presented in Table 4-2.

Table 4-2: Exploratory Hole Location Rationale

Exploratory Hole Number	Location (see Figure 3)	Rationale
BH1	Front part of site	For any potential pile foundations

PH1	Front part of the site within proposed footprint areas.	Location of proposed house. Clay desiccation assessment.
PH2	Northwest corner of site	Location of proposed house and private garden. Clay desiccation assessment.
PH3	Northern part of the site	General coverage
PH4	Eastern part of the site	General coverage
PH5	South-eastern part of the site	General coverage
PH6	South of site	General coverage
PH7	Southwest corner of site	Location of proposed road

The depths of the exploratory holes, descriptions of strata encountered, comments on groundwater conditions, samples obtained and installation details are included on the exploratory hole records in Appendix E.

4.1.3 Soil Sampling

In each exploratory hole, at least one soil sample was recovered from each stratum encountered. Samples were collected and stored in accordance with the RSK quality procedures to maintain sample integrity and preservation and to minimise the chance of cross contamination. The samples were transported to the laboratory in chilled cool boxes. Laboratory Chain of Custody Forms can be provided if required.

4.1.4 Groundwater/Gas Monitoring

At the time of writing no groundwater or gas monitoring visits have been carried out.

4.2 Ground Conditions

In general, ground conditions beneath the site were consistent with those anticipated from the available geological information for the area in that the site is underlain by the London Clay.

Made Ground was found to overlie this natural deposit.

The ground conditions are summarised as follows:

Topsoil:

Topsoil was encountered within all locations apart from BH1 and PH1 to a maximum depth of 0.3mbgl. It comprises silty sandy clay with occasional fine to medium gravel and roots.

Made Ground:

Made ground was encountered to a maximum depth of 4.0mbgl and comprised silty sandy clay with fragments of brick, stone, concrete, mudstone, tarmac and roots. Remoulded London Clay was encountered within PH3 to PH5. This material is considered to be reworked London Clay associated with the reservoir construction.

London Clay

Beneath the made ground, the London Clay was encountered to a maximum depth of 20.0mbgl (BH1). The stratum generally comprises firm becoming stiff and very stiff brown mottled grey silty clay with occasional pockets of sand. Very stiff clay was encountered within the probeholes. Due to tree roots influence, the clay within PH1, PH2, PH6 and PH7 is considered to be desiccated to about 3.0mbgl.

Groundwater

At the time of site work, slight groundwater seepage was encountered at a depth of 13.0mbgl within BH1. Groundwater was not encountered within other locations

4.2.1 Observed Contamination

Contamination was not identified by visual or olfactory means within the soils encountered.

4.3 Analytical Strategy and Methodology

Soil samples were tested for the analyses listed in Table 4-3 below. The analytical schedule was based on a standard suite of potential contaminant. All analysis was undertaken by UKAS and MCERTS certified laboratories. The details of the laboratory certification are included on the certificates in Appendix F.

Table 4-3: Scheduled Soil Analysis.

Exploratory Hole No. & Sample Depth (m bgl)	Analyte	Rationale
PH1 @ 0.30m PH1 @ 0.70m PH2 @ 0.40m PH3 @ 0.50m PH6 @ 0.30m PH7 @ 0.30m	Speciated TPH, USEPA speciated PAH, arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, zinc (metals suite), pH and Asbestos screening	General suite to cover the most likely indicator chemicals based on site history and on site observations

4.4 Chemical Conditions

Soil samples were submitted to Envirolab Ltd for analysis as detailed on the laboratory chain of custody forms (a copy of which can be provided if required). Full analytical certificates for soil samples are provided in Appendix F, respectively. The results are discussed in the GQRA, Section 5.

5 GENERIC QUANTITATIVE RISK ASSESSMENT

Based upon the site history, nature of the site and encountered ground conditions, it is considered there is potentially no unacceptable risk with respect to residential development of the site. A quantitative risk assessment has therefore been carried at with respect to this.

In line with CLR11 (1), there are two stages of quantitative risk assessment, generic and detailed. The GQRA comprises the comparison of soil that is appropriate to the linkage being assessed.

The site investigation work and subsequent refinement of the conceptual model indicates that there are relevant pollutant linkages at the site, which require further consideration.

5.1 Relevant Linkages for Assessment

The linkages for assessment are presented in Table 5-1.

Table 5-1: Linkages for Generic Quantitative Risk Assessment

Relevant Pollutant Linkage	GAC
Future residents and maintenance workers (e.g. gardeners) could come into direct and/or indirect contact with contamination via areas of soft landscaping in communal space	Human health GAC for a proposed residential end use with and without private gardens since proposed end use includes residential gardens. Information relating to adopted GAC screening values is presented in Appendix G.
The integrity of drinking water pipes may be compromised via permeation, which could taint supplies.	Chemical test data obtained from the samples of drinking water have been compared to the Water Supply (Water Quality) Regulations 2001, which are protective of drinking water. Information relating to adopted GAC screening values is presented in Appendix H.

5.2 Human Health Assessment

RSK has derived GAC’s for the assessment of human health risks for a ‘residential with plant uptake’ for the new terraced houses taking account of the following pathways (as appropriate, depending on the individual characteristics of potential contaminants):

- Direct soil and dust ingestion;
- Consumption of home grown produce;
- Consumption of soil attached to home grown produce;
- Dermal contact with soil and indoor dust; and
- Inhalation of indoor and outdoor dust and soil gases.

The GAC’s for residential end-use with plant uptake are presented in Appendices G, together with the rationale behind their derivation.

5.3 Methodology and Results

The laboratory data has been assessed against Generic Assessment Criteria (GAC) and data from targeted samples compared directly to the GAC.

Data for all results were observed to be less than the GAC for a domestic end-use for soils apart from a single data. A slightly elevated benzo(a)pyrene (2.13mg/kg > 0.95mg/kg) was encountered within PH1 at 0.3mbgl. However, the PH1 is located beneath a footprint of the proposed building. Therefore, the pathway is broken and an unacceptable risk to human health may be present.

5.3.1 Permeation of Plastic Utilities

The chemical test results have been compared with the GAC presented in Appendix I for this linkage. This indicates that locally some contaminant concentrations do exceed the GAC for water supply pipe protection, particularly within the PH1 (12mg/kg at 0.3mbgl), PH3 (14mg/kg at 0.5mbgl), PH6 (11mg/kg at 0.3mbgl) and PH7 (22mg/kg 0.3mbgl) with regard to arsenic compared to GAC of 10mg/kg.

Depending on the installation proposals for any water supply pipes, contamination resistant pipes may be required. Once the completed design drawings for drinking water supply pipe are known, the potential for contamination resistant pipes can be reviewed.

It is recommended that discussions be held with the appropriate water company to determine the specification of pipe required for adoption at the site should this be required in future.

5.3.2 Ground Gas

At this time ground gas assessment has not been carried out. There is no potential contaminated made ground was encountered during the investigation and no landfill sites within 2kmm of the site. Based upon the PRA and the ground conditions encountered during the investigation, it is considered that the site is very low risk of ground gas issues. It is also considered that no gas precaution measures could be adopted out for potential ground gas although this will be confirm with the EHO. The requirement for gas monitoring will be discussed with the EHO of the local authority.

5.4 Environmental Assessment Conclusions - soils

The laboratory results indicate that the site is at very low risk from contamination. It is considered that remedial measures are not necessary therefore the site is considered suitable for the proposed end-use.

Should any visual or olfactory contamination be encountered during site development then further advice must be sought.

6 WASTE

6.1 Waste Classification

All wastes require pre-treatment prior to disposal at landfill. Pre-treatment must be a physical/thermal/chemical/biological process, including sorting, that changes the characteristics of the waste in order to reduce its volume/reduce its hazardous nature/ facilitate its handling/enhance its recovery. It is best practice to provide your waste collector (or the disposal site) with details of how the waste has been treated. Your waste collector may provide a pre-treatment confirmation form or space on the waste transfer note to detail the pre-treatment, alternatively a standard form produced by the Environment Agency may be used:

http://www.environment-agency.gov.uk/commondata/acrobat/annex1_1898741.pdf

RSK has developed a waste soils characterisation assessment tool, which follows the guidance within WM2, known as HAZWASTE. The analytical results have been run through this assessment tool for potential off-site disposal of materials in the future.

None of the samples were classified as **hazardous** waste, and would most likely be classified as **non-hazardous**. To determine if the soils could be classified as inert, Waste Assessment Criteria (WAC) testing will need to be carried out. The results of the HAZWASTE assessment have been included in Appendix I.

6.2 Waste Acceptance Criteria

All inert, stable non-reactive hazardous and hazardous wastes must be tested and found to be below the Waste Acceptance Criteria (WAC) leaching limit values for the classification of landfill they are being disposed in. Currently, no WAC is in place for non hazardous waste.

7 GEOTECHNICAL SITE ASSESSMENT

The aim of the geotechnical investigation is to ascertain ground conditions at the site and provide sufficient data regarding the soil parameters to enable the design of foundations, floor slabs and infrastructure to be carried out. This aim was achieved by:

- Exploratory holes – 7No. of probeholes and 1No. borehole;
- *In situ* tests – SPT's and hand vane shear strength tests; and
- Laboratory analysis – Moisture Content, Atterberg Limit, undrained triaxial tests, oedometer tests and BRE Suite for concrete classification.

7.1 Methodology

As outlined in Section 4, exploratory holes also were drilled for geo-environmental purposes. Information from these holes was used together with the in-situ SPT's and hand vane tests to provide geotechnical parameters. The methodology for the geotechnical intrusive investigation is presented in Sections 7.1.1 to 7.1.2.

7.1.1 Intrusive Investigation Undertaken

7.1.1.1 Probeholes

Seven probeholes, designated PH1 to PH7, were sunk by percussive means using drive-in sampling techniques. Representative samples were taken from the sampler tubes and returned to the laboratory for analysis. The descriptions of the strata encountered together with comments on groundwater conditions and hole stability are given in the probehole records presented in Appendix E.

In situ standard penetration tests were carried out to assess the relative density or consistency of the strata encountered. The values of penetration resistance (N values) are given in the probehole records.

7.1.1.2 Borehole

A single borehole, designated BH1, was sunk by light cable percussion techniques. The depth of the borehole, descriptions of the strata encountered and comments on groundwater conditions are given in the borehole records presented in Appendix E.

100mm diameter undisturbed samples were taken in the cohesive soils and representative disturbed samples were taken throughout the full depth of boring. These were returned to the laboratory for examination and testing.

Standard penetration tests were carried out at regular intervals to assess the relative density, consistency or hardness of the strata encountered. The values of penetration resistance (N values) are given in the borehole records.

7.1.2 Monitoring Installations

34mm diameter perforated standpipes were installed in four probeholes (PH1 to PH3 and PH7) to enable future monitoring of groundwater levels and the flow rates, pressures and concentrations of gas.

The standpipes were installed in the probeholes and surrounded with pea gravel and sealed at the surface with bentonite. Valves were fixed to the top of the installations, which were protected with a metal cover and sealed at the surface with concrete.

Details of the installations are given on the respective records presented in Appendix E.

7.1.3 Laboratory Analysis

The geotechnical testing has generally been carried out in accordance with the methods given in BS 1377(10)

The natural moisture contents, natural wet densities and shear strengths of 7No. 100mm diameter undisturbed samples were determined by undrained triaxial compression tests.

One-dimensional consolidation (Oedometer test) tests of 3No. were determined.

The natural moisture contents of 11No. samples and liquid and plastic limits of 4No. samples of the cohesive soils were determined.

This assessment of the potential for chemical attack on buried concrete based on current BRE guidance(11) was carried out.

The results of all the geotechnical testing are given in Appendix J.

7.2 Foundation Design

7.2.1 Residential terraced houses

It is understood that consideration is being given to partial demolition of the reservoir to the front and the construction of 3 storeys terraced housing with partial double basements. Given the nature of the proposed structure the adoption of spread type foundation is not considered to be a practical proposition, on this basis it is recommended that a piled foundation solution should be considered for the proposed structures. Continuous flight auger or continuous helical displacement piles are considered appropriate for the site.

Based on the cable percussive borehole completed to date, illustrative load carrying capacities have been calculated for a single bored pile of various lengths and diameters. The working load of the pile has been derived assuming an overall factor of safety of 2.5 and 3.0.

The results for allowable load carrying capacities are given in Table 7-1 and are based on the SPT-N values from soil conditions given in the borehole logs (Appendix E), laboratory shear strengths and the undrained shear strength profile (Appendix K). An adhesion factor (∝) of 0.60 was utilised throughout pile lengths. It has been assumed that little or no positive skin friction will be obtained from the made ground, which has been taken to be 0.5m thick.
Due to the influence of trees, the findings of the investigation indicate that relatively deep-seated desiccation is present beneath the footprint of the proposed buildings.

It is understood that the trees are to be removed prior to construction. Whilst this would allow rehydration of the ground to occur, the time scale for this would be prohibitive in terms of time scale for construction. Depending upon weather conditions, rehydration may take several years, possibly up to 10 years.

To overcome heave on piles the adoption of slip membranes may be considered or the incorporation of additional reinforcement.

Table 7-1: Illustrative Load Carrying Capacities

Depth of pile (m)	Diameter of pile (m)	Shaft Friction F_s (kN)	End bearing Q_b (kN)	Ultimate Pile Capacity (kN)	Allowable Pile Capacity (kN) FoS = 2.5	Allowable Pile Capacity (kN) FoS = 3.0
12	0.30	650	64	714	286	238
	0.35	759	87	845	338	282
	0.40	867	113	980	392	327
	0.45	975	143	1119	447	373
	0.50	1084	177	1261	504	420

13	0.30	721	80	801	320	267
	0.35	841	108	949	380	316
	0.40	961	141	1103	441	368
	0.45	1081	179	1260	504	420
	0.50	1202	221	1423	569	474
14	0.30	797	86	883	353	294
	0.35	930	117	1047	419	349
	0.40	1063	153	1216	486	405
	0.45	1196	193	1389	556	463
	0.50	1329	239	1567	627	522
15	0.30	879	92	972	389	324
	0.35	1026	126	1151	461	384
	0.40	1172	164	1336	535	445
	0.45	1319	208	1527	611	509
	0.50	1466	256	1722	689	574
16	0.30	966	98	1064	426	355
	0.35	1127	133	1261	504	420
	0.40	1289	174	1463	585	488
	0.45	1450	220	1670	668	557
	0.50	1611	272	1883	753	628
17	0.30	1059	101	1160	464	387
	0.35	1236	138	1373	549	458
	0.40	1412	180	1592	637	531
	0.45	1589	228	1816	727	605
	0.50	1765	281	2046	818	682
18	0.30	1158	104	1262	505	421
	0.35	1350	142	1492	597	497
	0.40	1543	185	1729	692	576

It should be noted that the behaviour of pile/pile groups under working loads should be determined as part of the detailed design work. The carrying capacity of piles will depend to a large extent on the method and care taken during their installation. It is therefore recommended that the advice of a specialist-piling contractor be sought as to the most suitable type of pile for the prevailing ground conditions and also as to their lengths and diameters to support the required working loads.

7.2.2 Floor Slab

Suspended floor slabs will be required where the new buildings overlap the footprints of the existing structure, area of thick made ground and previously removed/to be removed trees/shrubs, as specified in the NHBC Standards Chapter 5.2, Suspended Ground Floors: 2001(13).

7.2.3 Basement Construction

Based on the proposed construction, it is envisaged that a sheet pile wall or contiguous piles may be incorporated into planned excavations and aiding in groundwater control (if encountered). The advice of a specialist contractor should be sought on the design of proposed sheet pile walls or contiguous piles where incorporated into the development.

For the basement structure, consideration should be given to the adoption of a concrete reinforced ground bearing slab with downstand thickening of the slab beneath load bearing walls and columns with the ground and basement floors designed as structural props.

Given the anticipated depth of basement construction i.e. about 6.0m below current site levels, the formation sub-soils of the basement will generally comprise stiff silty clay. For likely loaded columns/walls, a net allowable bearing pressure of 125kN/m^2 can be assumed at this level although for heavy loads, piled foundations will be necessary.

Basement construction/heavy excavation will result in some heave of the basement sub-soils. It is recommended that any retaining wall design should consider appropriate negative skin friction or heave protection for the retaining structures and foundations and from any heave associated with the removal of trees.

7.2.4 Excavation Stability

It is considered that excavations within the shallow made ground and clay sub-soils will be relatively stable in the short term although excavations requiring manned entry, including excavations in the underlying deeper clay, will require closely boarded side support and/or support gained from the permanent piled walled for proposed basement.

It should be noted that a health and safety risk assessment must be undertaken for any excavations, which have to be entered by site operatives. In any event, excavations over 1.20m deep must be provided with side support before any entry is permitted.

7.3 Infrastructure

7.3.1 Road Construction

It is understood that a new road is proposed to assess the rear of the properties and the underground reservoir. It is anticipated that the formation soils for the road will comprises reworked London Clay. At this time, the engineering characteristics of such material are unpredictable and the CBR value of made ground does not predict overall settlements that may occur.

Due to the nature of the made ground and the proposed ground level change, it would be prudent to assume the material to be frost susceptible throughout thus a minimum pavement thickness of 450mm would be appropriate. Notwithstanding the above, it would be prudent at this stage, to allow for a CBR value of 2% for initial design purposes.

Following construction, it is recommended that the proposed formation be tested to confirm design parameters.

It is recommended that all soft, organic topsoil be removed from beneath the pavement construction. Any pockets of soft or loose material at formation level should be removed and replaced with well-compacted granular material. All formations should be compacted to make good any disturbance caused by excavation. It is recommended that the formation be not exposed for any period of time during inclement weather.

7.3.2 Gravity Retaining Walls

It is understood that the proposed new road will be constructed at various levels and consideration should be given to the adoption of reinforced concrete gravity retaining walls (RGRW). Given the anticipated formation level of the RGRW i.e. about 2-3m below current site levels, the formation sub-soils of the RGRW will generally comprise firm/stiff silty clay. Suitable soil parameters for retaining wall design are given in Table 7-2.

Table 7-2: Retaining Wall Soil Parameters

Soil type	c'	ϕ',	Allowable bearing pressure
London Clay	0	22°	100kN/m^2

7.4 Soakaway Design

Below a cover of made ground the natural soils at this site were generally found to comprise silty clay of very low permeability. In these conditions, it is considered that soakaway drainage would not be feasible and therefore consideration should be given to discharging surface water into main drainage.

7.5 Chemical Attack on Buried Concrete

The assessment of the potential for chemical attack on buried concrete is based on current BRE guidance. The desk study and site walkover indicates that, for the purposes of this assessment of the aggressive chemical environment, the site may be considered as a Brownfield development where disturbance of pyrite-bearing ground could result in additional sulphate.

Moreover, where buried concrete is placed resulting in ground disturbance this will likely be restricted within the top 1.5m, and within soil types of low potential pyrite (made ground). Based on these assumptions, any impact due to pyritic conditions can be discounted.

The recommendation therefore is that all buried concrete to be placed on site can be assessed similarly whether placed in the made ground or London Clay. Subsequently, the mean of the highest 20% of water soluble sulphate on the chemical analyses undertaken on 12No. samples has been calculated at 2.007g/l (i.e. mean of 2.10g/l, 2.00g/l and 1.92g/l). This equates to a design sulphate class of **DS–3**. Based on static ground water conditions assumed within the London Clay and the mean of the lowest 20% of the pH results (i.e. mean of 7.6, 7.9 and 8.1) calculated at 7.87, the aggressive chemical environment for concrete (ACEC) classification is indicated at **AC-2s**.

8 CONCLUSIONS AND RECOMMENDATIONS

8.1 Environmental

Based upon the PRA, site investigation and laboratory results indicate that the site is at very low risk from contamination. It is considered that no remedial measures are necessary and that the site is considered suitable for proposed residential development.

Consideration should be given to the treatment and eradication of knotweed observed at the site.

However, the following measures should be implemented:

- Consultation with the Environment Agency and Environmental Health Department of the Local Borough Council to confirm that the conclusions and recommendations of this report are acceptable;
- Should any soil be imported to site then this should be validated at source to confirm its suitability;
- Should olfactory or visually impacted contamination be encountered during site development then further advice must be sought; and
- Adoption of health and safety measures during the development works on site should be undertaken e.g. provision of cleaning facilities, dust suppression measures, when required.

8.2 Waste

RSK has developed a waste soils characterisation assessment tool, which follows the guidance within WM2, known as HAZWASTE. The available analytical results have been run through this assessment tool for potential off-site disposal of materials in the future.

None of the samples were classified as hazardous waste.

8.3 Geotechnical

Detailed comments in relation to geotechnical issues associated with the site are presented in Section 7.

The geotechnical recommendations not outlined above can be summarised as follows:

- *It is recommended that a piled foundation solution should be considered for the proposed structures taking into account any effects from desiccation etc. Continuous flight auger or continuous helical displacement piles are considered appropriate for the site.*
- *It is considered that suspended floor slabs are adopted throughout the development.*
- *Roads and pavements are initially designed on a CBR value of between 2% for clay formation. Following construction, it is recommended that the proposed formation be tested to confirm design parameters.*
- *With respect to the design of buried concrete, Design Sulphate Class of DS-3 and an Aggressive Chemical Environment classification of AC-2s were determined.*

9 REFERENCES

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2. Environment Agency. Guidance on Requirements for Land Contamination Reports. Version 1, July 2005.

3. "Geotechnical and Geo-Environmental Desk Study Report" Report Reference No 56220ISAK_DS dated October 2008. Prepared by Faber Maunsell/AECOM on behalf of Berkeley Homes (Urban Living) Ltd

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5. Geology Maps, Envirocheck Report, 1:10, 000, reference number: 29328636_1_1, dated 10 November 2009.

6. Environment Agency. Groundwater Vulnerability Map. West London, Sheet 39, 1:100,000.

7. www.environment-agency.gov.uk

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10. BS1377: Part 1:1990, Soils for civil engineering purposes, BSI, 1990

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12. NHBC Standards - Chapter 4.2, Building near Trees, National House Building Council, (Effective September 2007).

13. NHBC Standards, Revised September 1999 (Effective January 2007). "Chapter 5.2: Suspended Ground Floors."

FIGURES

Reproduced from the 2006 Ordnance Survey 1:50,000 Scale Landranger Map 176, OSGR - TQ 248 853
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Client
LINDEN HOMES LIMITED

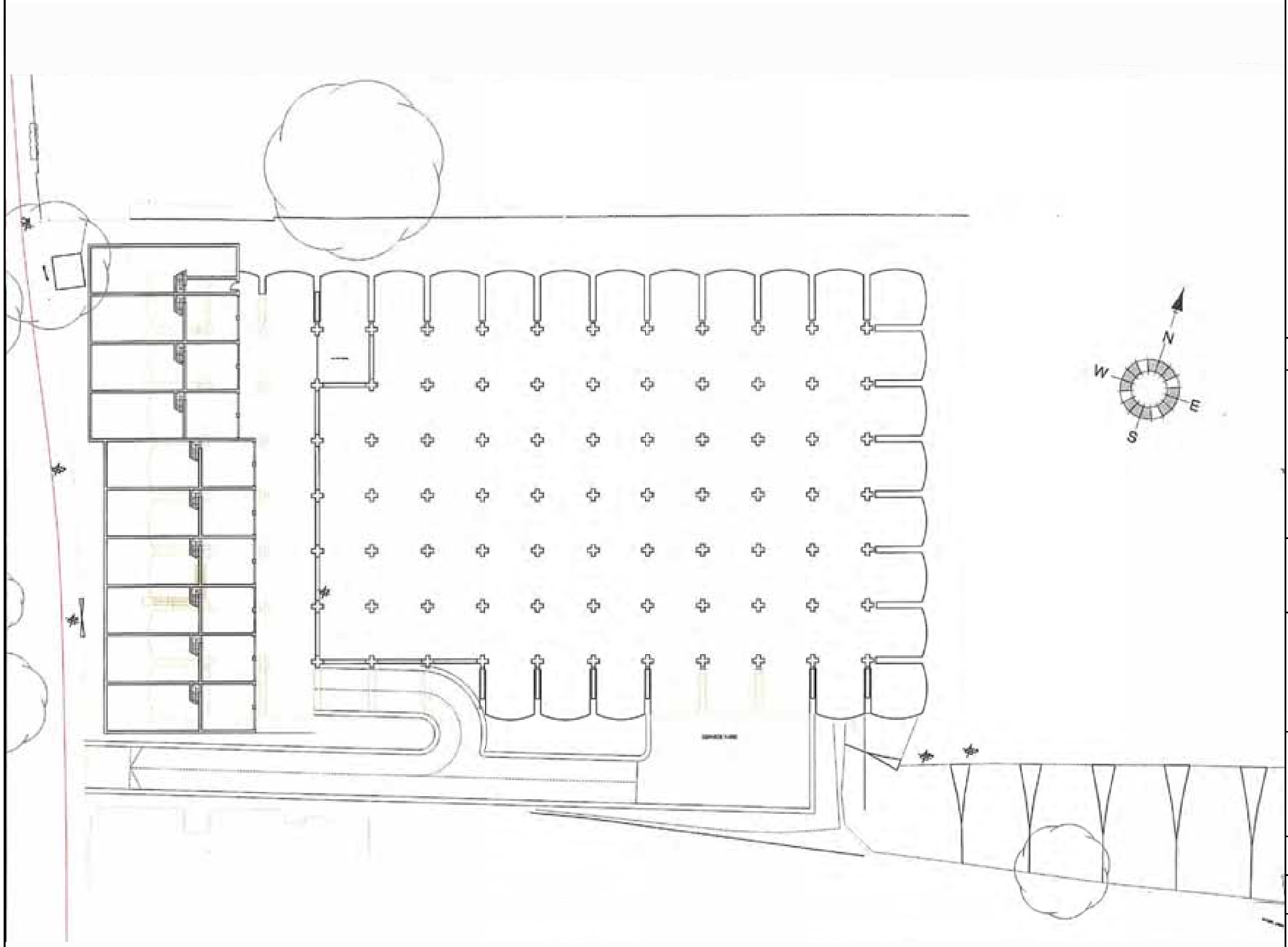
Project Title
GONDAR GARDENS,
LONDON

Drawing Title
SITE LOCATION MAP

Rev	Drawn	Date	Checked	Date	Approved	Date
00	MDW	23.11.09	NT	23.11.09	NT	23.11.09

Dimensions	Scale	Original Size
m	1:50,000	A4

Project Number	Drawing File	Drawing Number
23283	23283 - Fig 1 SLP.dwg	FIGURE 1



LEGEND

Rev.	Date	Amendment	Drawn	Chkd.	Appd.
P1	23.11.09	FIRST ISSUE	MDW	NT	NT

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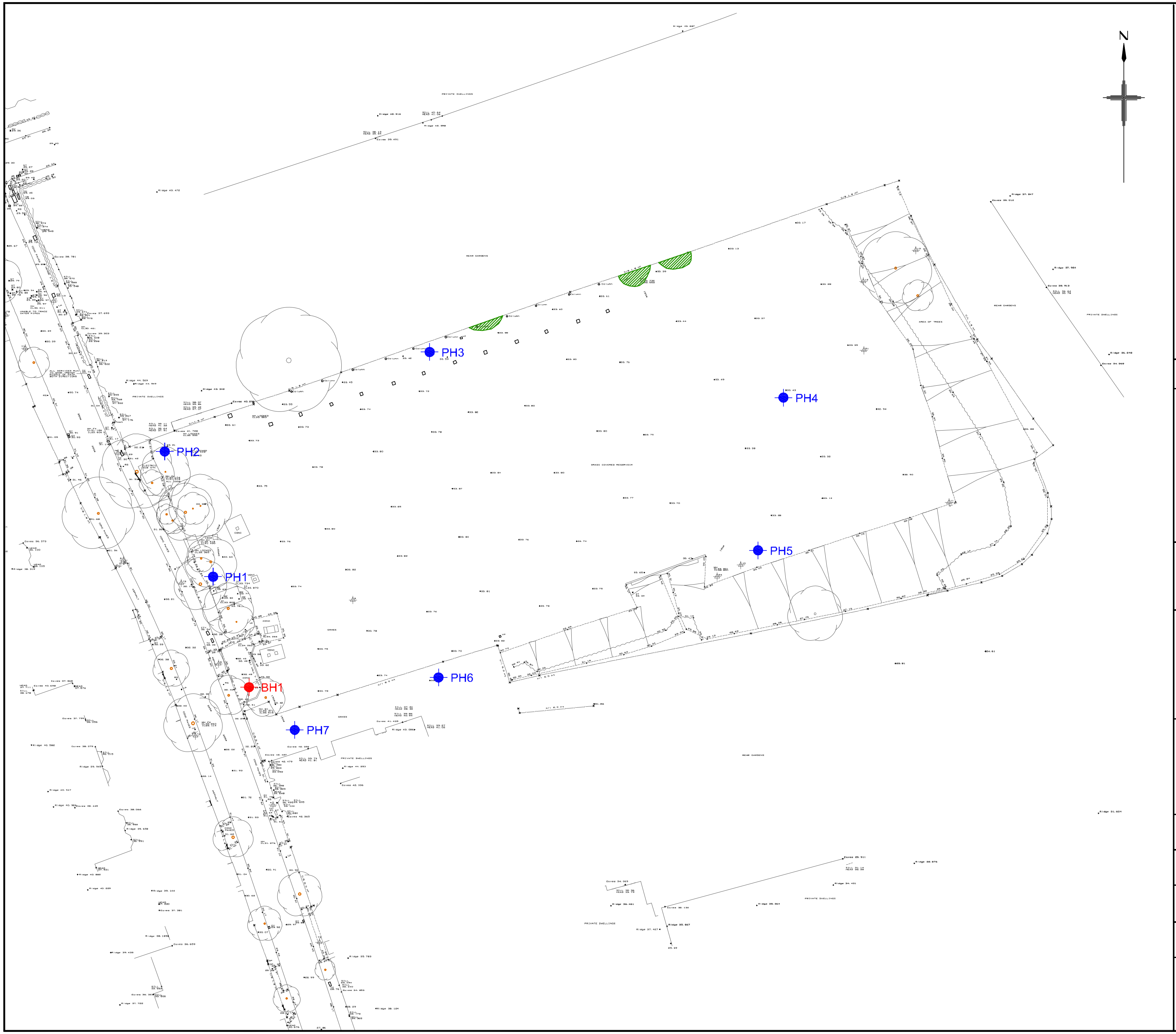
Client
LINDEN HOMES LIMITED

Project Title
GONDAR GARDENS,
LONDON

Drawing Title
PROPOSED SITE PLAN

Drawn	Date	Checked	Date	Approved	Date
MDW	23.11.09	NT	23.11.09	NT	23.11.09

Scale: NTS
Orig Size: A3
Dimensions: m
Project No.: 23283 (L01)
Drawing File: 23283 (L01).dwg
Drawing No.: FIGURE 2
Rev.: P1



LEGEND

- 🔴 Borehole Location
- 🔵 Probehole Location
- ▨ Japanese Knotweed Identified

Rev.	Date	Amendment	Drawn	Chkd.	Appd.
P1	23.11.09	FIRST ISSUE	MDW	NT	NT

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Client
LINDEN HOMES LIMITED

Project Title
GONDAR GARDENS,
LONDON

Drawing Title
SITE PLAN

Drawn	Date	Checked	Date	Approved	Date
MDW	23.11.09	NT	23.11.09	NT	23.11.09

Scale
1:750

Orig Size
A3

Dimensions
m

Project No.
23283 (L01)

Drawing File
23283 (L01).dwg

Drawing No.
FIGURE 3

Rev.
P1

Scale 1 : 750
0 10 20 30 40 50m

APPENDIX A

Service Constraints

RSK STATS GEOCONSULT LIMITED
SERVICE CONSTRAINTS

1. This report and the site investigation carried out in connection with the report (together the "Services") were compiled and carried out by RSK STATS Geoconsult Limited (RSK) for Linden Homes Ltd (Urban Living) (the "client") in accordance with the terms of a contract between RSK and the "client". The Services were performed by RSK with the skill and care ordinarily exercised by a reasonable environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.
2. Other than that expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.
3. Unless otherwise agreed the Services were performed by RSK exclusively for the purposes of the client. RSK is not aware of any interest of or reliance by any party other than the client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. **Any such party would be** well advised to seek independent advice from a competent environmental consultant and/or lawyer.
4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK 's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date hereof, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.
5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.
6. The observations and conclusions described in this report are based solely upon the Services which were provided pursuant to the agreement between the client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off the site of asbestos, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials.
7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a walk-over survey of the site together with RSK's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walk-over survey. Further RSK was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the client and RSK.
8. The phase II or intrusive environmental site investigation aspects of the Services is a limited sampling of the site at pre-determined borehole and soil vapour locations based on the operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and RSK] [based on an understanding of the available operational and historical information,] and it should not be inferred that other chemical species are not present.
9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site.

APPENDIX B

Summary of Legislation and Policy Relating to Contaminated Land

Summary of legislation and policy relating to contaminated land

Part IIA of the Environmental Protection Act (EPA) and its associated Contaminated Land Regulations 2000 (SI 2000/227), which came into force in England on 1 April 2000, are the basis for the current regulatory framework and form the statutory regime for the identification and remediation of contaminated land.

Part IIA of the EPA 1990 defines contaminated land as 'any land which appears to the Local Authority in whose area it is situated to be in such a condition by reason of substances in, on or under the land, that significant harm is being caused, or that there is significant possibility of significant harm being caused, or that pollution of controlled waters is being or is likely to be caused'. Controlled waters, defined by the Water Resources Act, are considered all groundwater, inland waters and estuaries.

The intention of the EPA 1990 Part IIA is to deal with contaminated land issues that are considered to cause significant harm, on land that is not undergoing development, (see circular 2-2000 for definitions of what is significant harm, website link - http://www.defra.gov.uk/environment/land/contaminated/circ2-2000/index.htm).

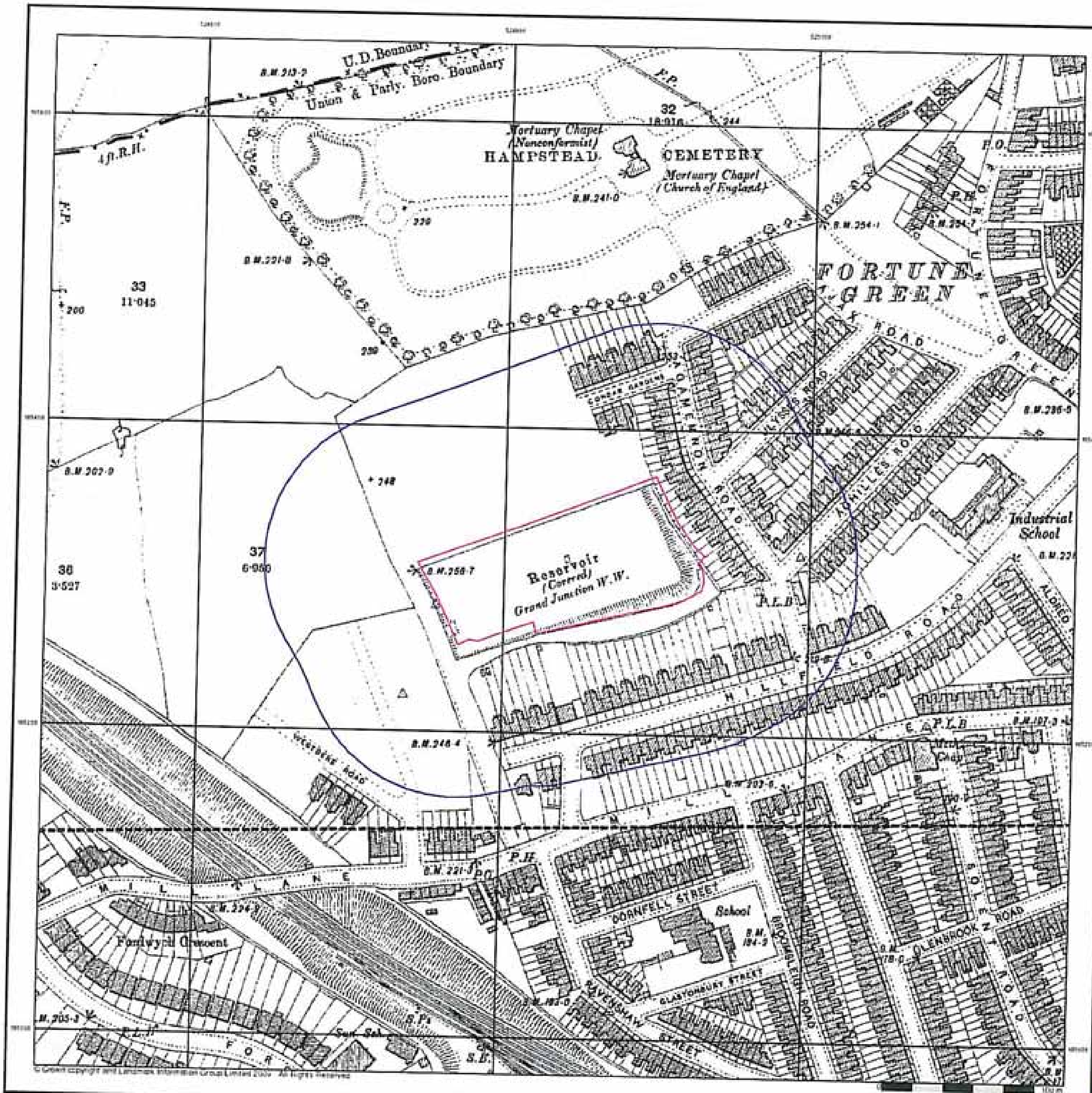
The Water Framework Directive 2000/60/EC (WFD) legislation aims to deliver long-term protection of the water environment and to improve the quality of all water bodies, including rivers, wetlands, coasts, estuaries, lakes, man-made structures and groundwater.

The Water Resources Act 1991 introduces an offence to cause or knowingly permit pollution of controlled waters. The Act provides the Environment Agency with powers to implement remediation necessary to protect controlled waters and recover all reasonable costs of doing so. The Groundwater Regulations, 1998, aim to complement EPA 1990. These regulations give the Environment Agency the power to *prevent* the discharge of List I substances and *restrict* the discharge of List II substances to groundwater.

Contaminated land is often dealt with through planning because of land redevelopment. This approach is documented in Planning Policy Statement: Planning and Pollution Control PPS23, which states that it remains the responsibility of the landowner and developer to identify land affected by contamination and carry out sufficient remediation to render the land suitable for use. The overall aim of the planning and pollution control policy is to promote the sustainable and beneficial use of land (in particular, encouraging reuse of previously developed land in preference to greenfield sites). Within this aim, polluting activities that are necessary for society and the economy should be so sited and planned, and subject to such planning conditions, that their adverse effects are minimised and contained to within acceptable limits.

APPENDIX C

Selected Historical Maps



London

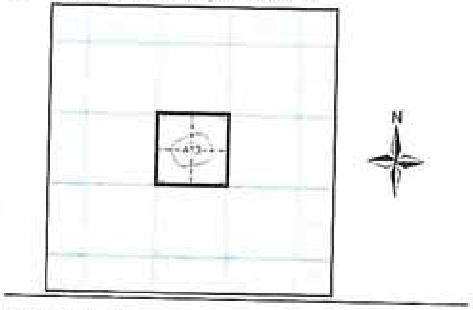
Published 1896

Source map scale - 1:2,500

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

Map Name(s) and Date(s)

Historical Map - Segment A13



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National Grid Reference:	524840, 185310
Slice:	A
Site Area (Ha):	1.2
Search Buffer (m):	100

Site Details

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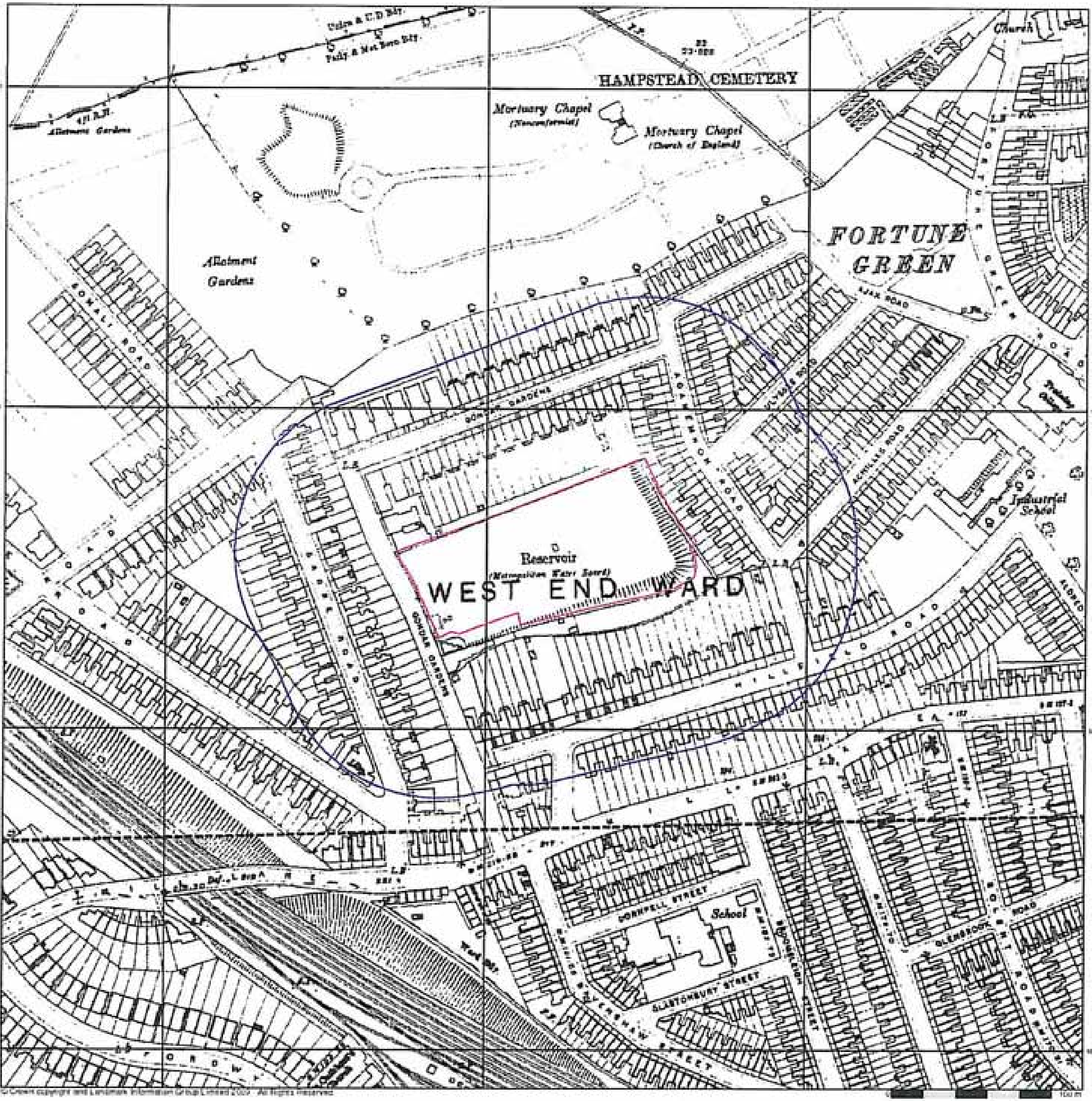
Fax:	0844 844 9951
Web:	www.envirocheck.co.uk



RSK GROUP PLC

London

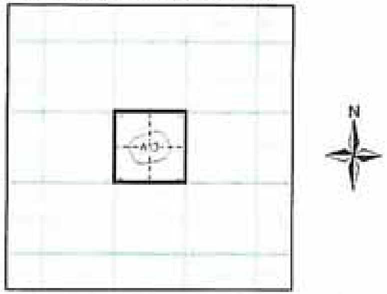
Published 1915

Source map scale - 1:2,500

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

Map Name(s) and Date(s)

Historical Map - Segment A13



Order Details

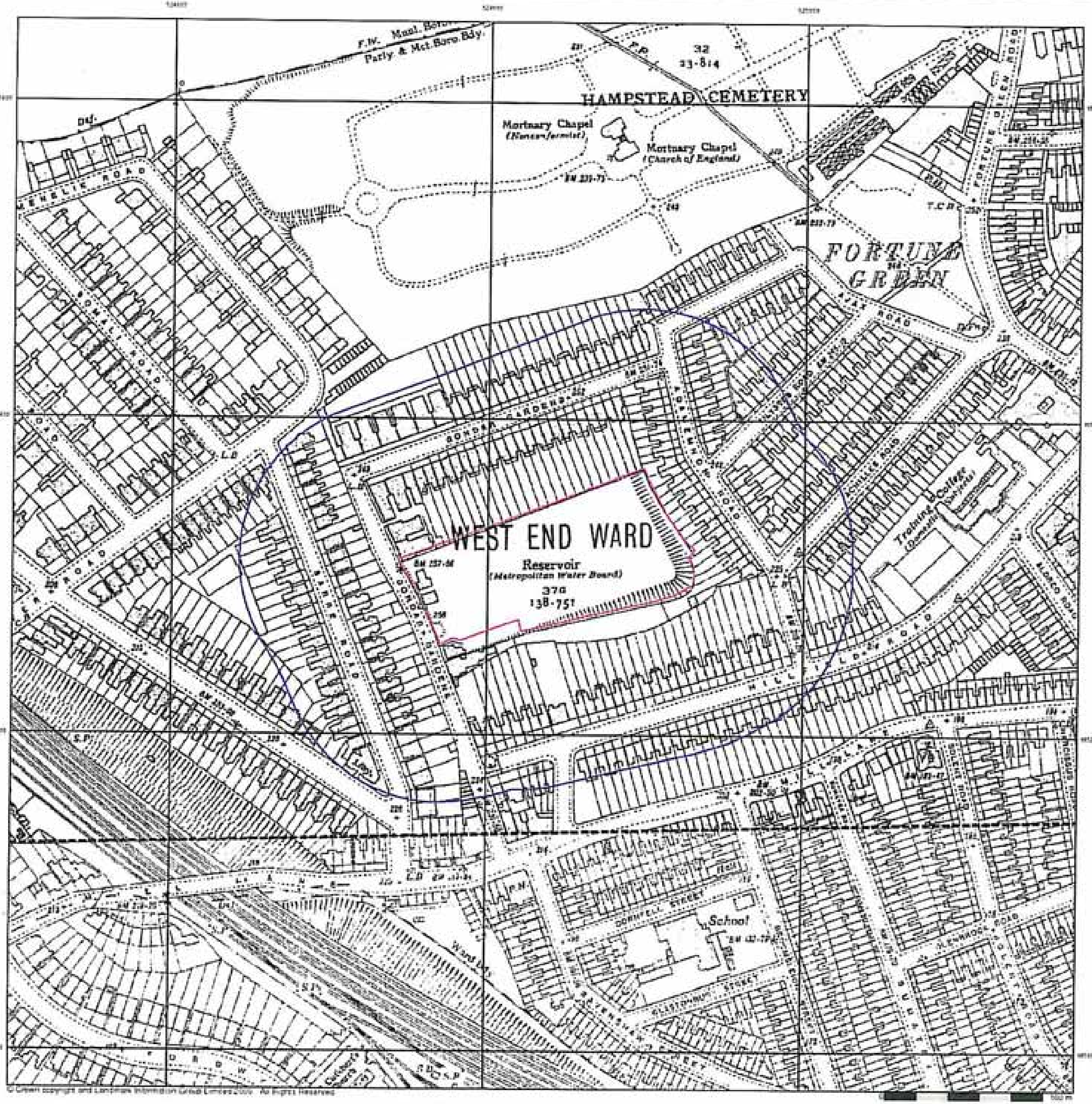
Order Number:	29328636_1_1
Customer Ref:	23283
National Grid Reference:	524840, 185310
Slice:	A
Site Area (Ha):	1.2
Search Buffer (m):	100

Site Details

1 Gondar Gardens, LONDON, NW6 1EW

Landmark

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



RSK GROUP PLC

London

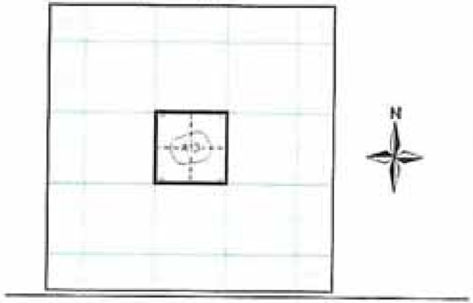
Published 1935 - 1936

Source map scale - 1:2,500

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

Map Name(s) and Date(s)

Historical Map - Segment A13



Order Details

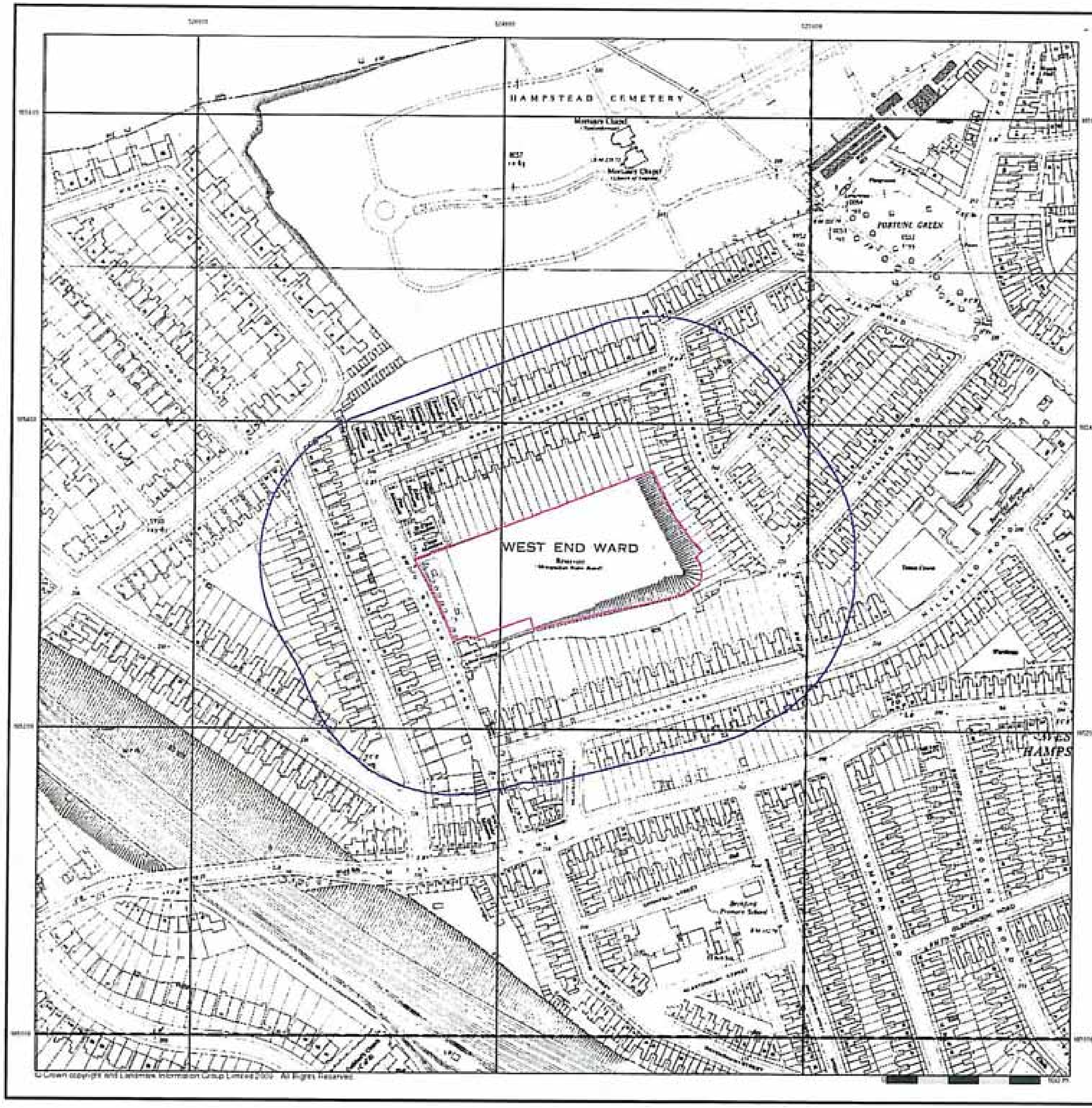
Order Number:	29328636_1_1
Customer Ref:	23283
National Grid Reference:	524840, 185310
Slice:	A
Site Area (Ha):	1.2
Search Buffer (m):	100

Site Details

1 Gondar Gardens, LONDON, NW6 1EW

Landmark

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

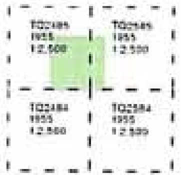


RSK GROUP PLC

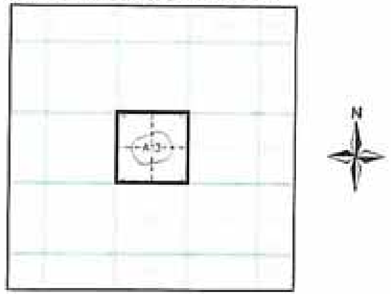
Ordnance Survey Plan
Published 1955
Source map scale - 1:2,500

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

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

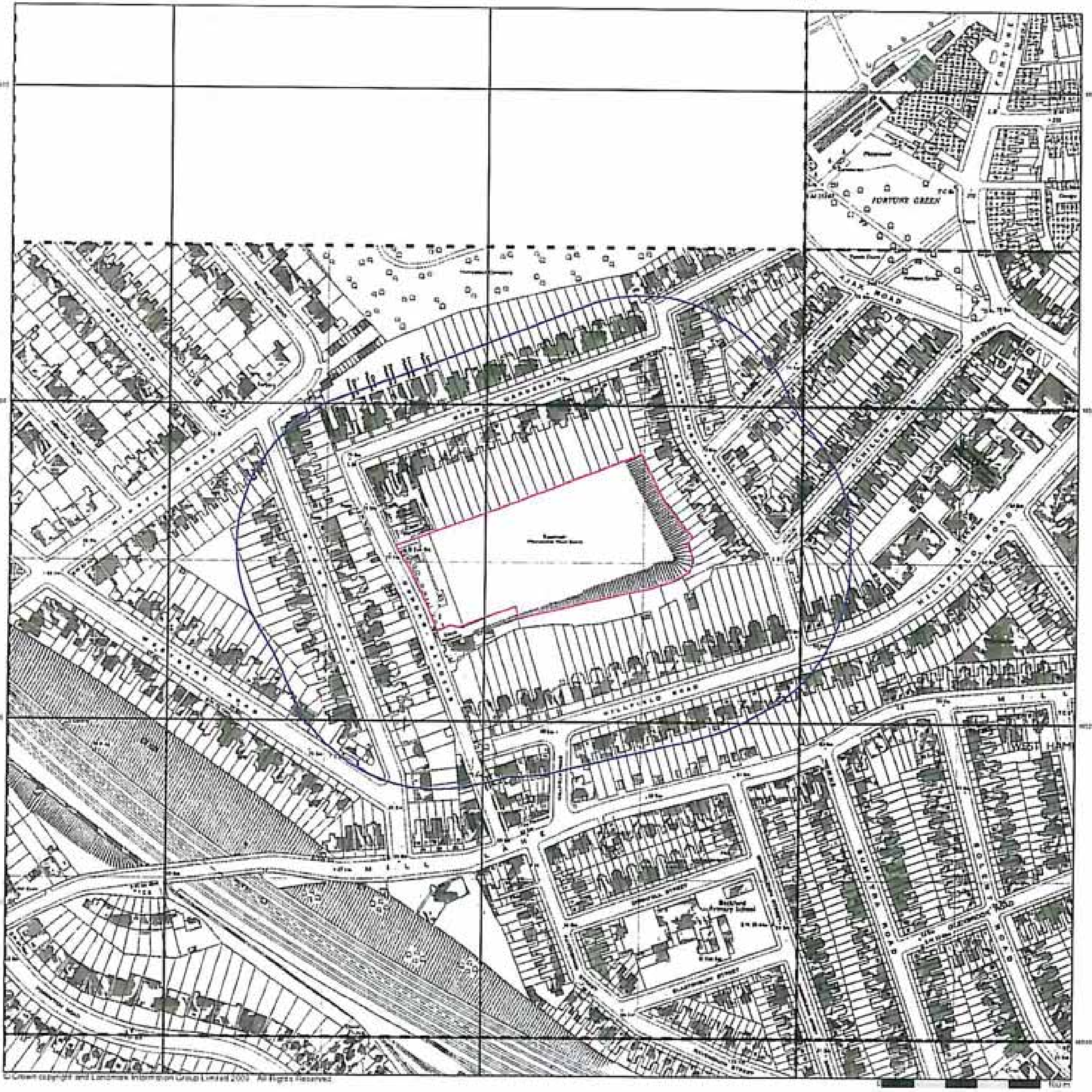
Order Number:	29328636_1_1
Customer Ref:	23283
National Grid Reference:	524840, 185310
Slice:	A
Site Area (Ha):	1.2
Search Buffer (m):	100

Site Details

1 Gondar Gardens, LONDON, NW6 1EW

Landmark

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

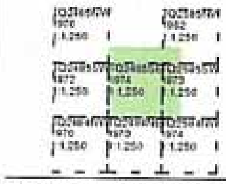


RSK GROUP PLC

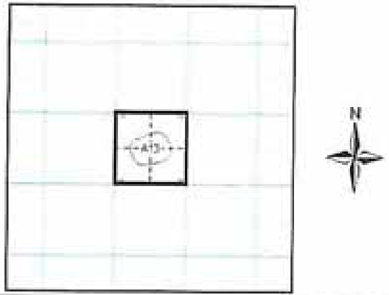
Ordnance Survey Plan
Published 1962 - 1974
Source map scale - 1:1,250

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

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

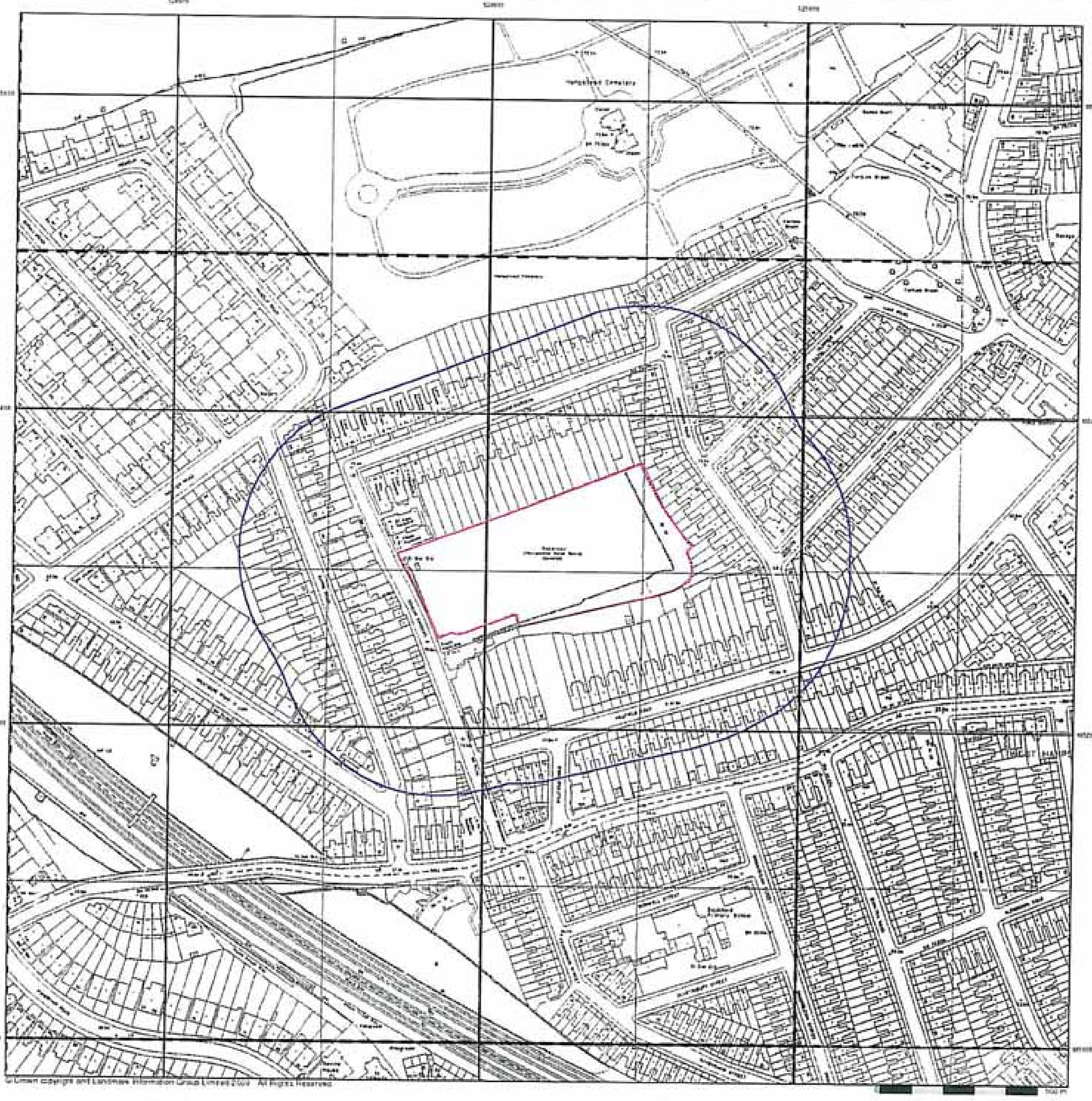
Order Number:	29328636_1_1
Customer Ref:	23283
National Grid Reference:	524840, 185310
Slice:	A
Site Area (Ha):	1.2
Search Buffer (m):	100

Site Details

1 Gondar Gardens, LONDON, NW6 1EW

Landmark

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



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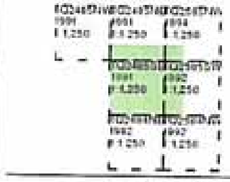
RSK

GROUP PLC

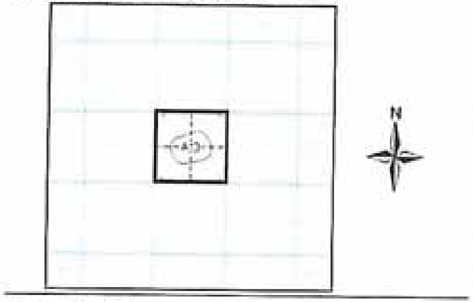
Large-Scale National Grid Data
Published 1991 - 1994
Source map scale - 1:1,250

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

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	29326636_1_1
Customer Ref:	23283
National Grid Reference:	524840, 185310
Slice:	A
Site Area (Ha):	1.2
Search Buffer (m):	100

Site Details

1 Gondar Gardens, LONDON, NW6 1EW

Landmark

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

RSK GROUP PLC

10k Raster Mapping

Published 2006

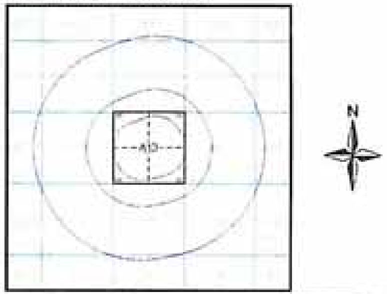
Source map scale - 1:10,000

The historical maps shown were produced from the Ordnance Survey's 1:10,000 colour raster mapping. These maps are derived from Landplan which replaced the old 1:10,000 maps originally published in 1970. The data is highly detailed showing buildings, fences and field boundaries as well as all roads, tracks and paths. Road names are also included together with the relevant road number and classification. Boundary information depiction includes county, unitary authority, district, civil parish and constituency.

Map Name(s) and Date(s)

TQ28NW 2006 1:10,000	TQ28NE 2006 1:10,000
TQ28SW 2006 1:10,000	TQ28SE 2006 1:10,000

Historical Map - Slice A



Order Details

Order Number:	29328636_1_1
Customer Ref:	23283
National Grid Reference:	524840, 185310
Slice:	A
Site Area (Ha):	1.2
Search Buffer (m):	1000

Site Details

1 Gondar Gardens, LONDON, NW6 1EW

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Tel:	0844 844 9952
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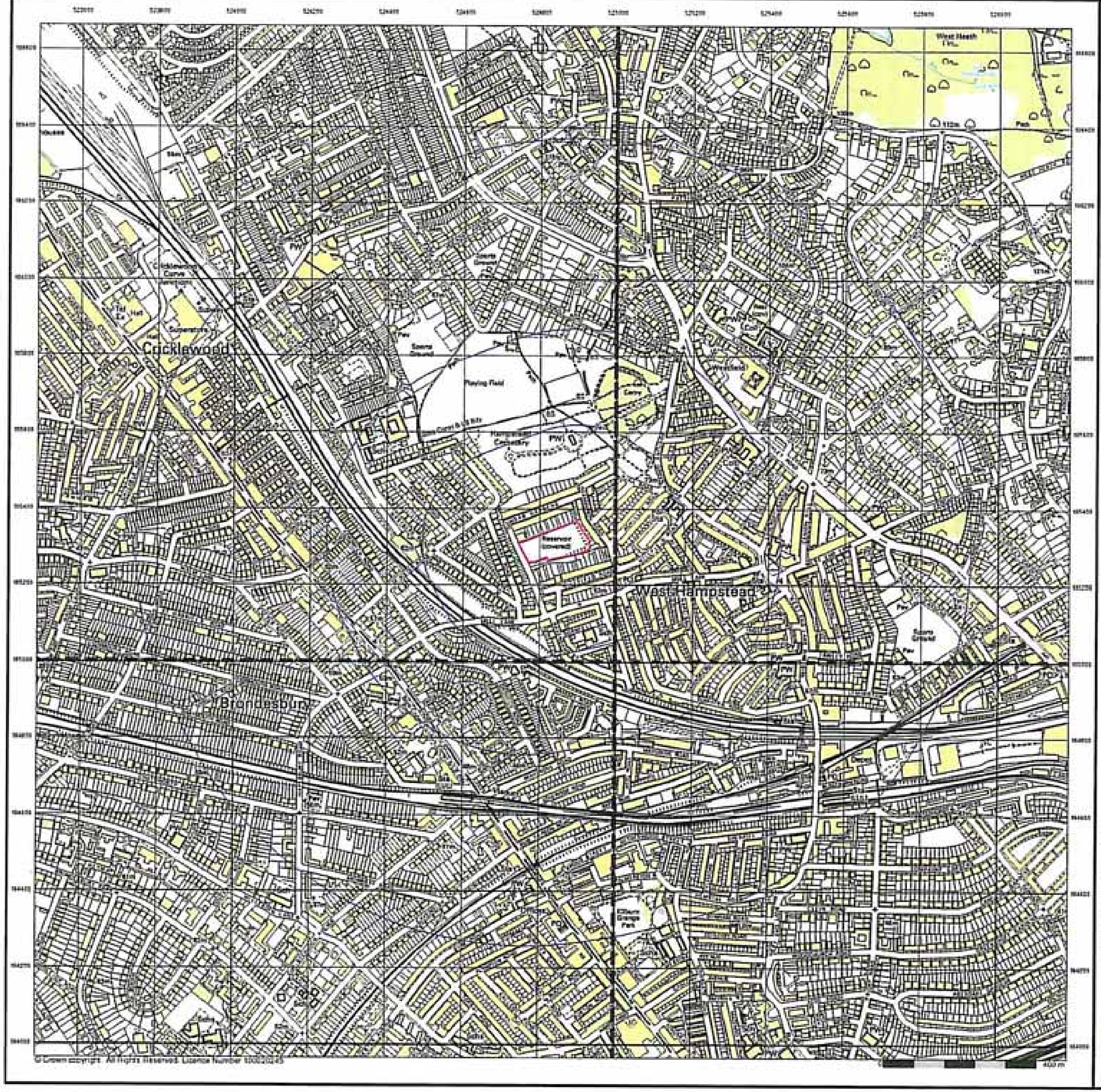


RSK GROUP PLC

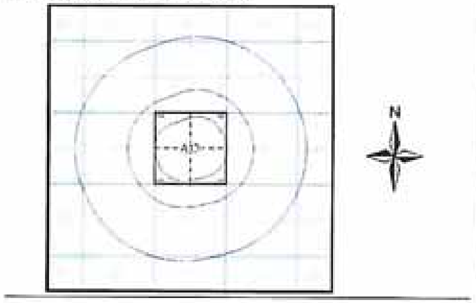
10k Raster Mapping
Published 2009
Source map scale - 1:10,000

The historical maps shown were produced from the Ordnance Survey's 1:10,000 colour raster mapping. These maps are derived from Landplan which replaced the old 1:10,000 maps originally published in 1970. The data is highly detailed showing buildings, fences and field boundaries as well as all roads, tracks and paths. Road names are also included together with the relevant road number and classification. Boundary information depiction includes county, unitary authority, district, civil parish and constituency.

Map Name(s) and Date(s)

TQ28NW 2009 1:10,000	TQ28NE 2009 1:10,000
TQ28SW 2009 1:10,000	TQ28SE 2009 1:10,000

Historical Map - Slice A



Order Details

Order Number:	29328636_1_1
Customer Ref:	23283
National Grid Reference:	524840, 185310
Slice:	A
Site Area (Ha):	1.2
Search Buffer (m):	1000

Site Details

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APPENDIX D

Methodology of Risk Assessment

Risk Assessment
Methodology

CLR11 outlines the framework to be followed for risk assessment in the UK. The framework is designed to be consistent with UK legislation and policies including planning. Under CLR11, three stages of risk assessment exist: Preliminary, Generic Quantitative and Detailed Quantitative. An outline Conceptual Model should be formed at the preliminary risk assessment stage that collates all the existing information pertaining to a site in text, tabular or diagrammatic form. The outline conceptual model identifies potentially complete (termed possible) pollutant linkages (source–pathway–receptor) and is used as the basis for design of the site investigation. The outline Conceptual Model is updated as further information becomes available, for example as a result of the site investigation.

Production of a Conceptual Model requires an assessment of risk to be made. Risk is a combination of the likelihood of an event occurring and the magnitude of its consequences. Therefore, both the likelihood and the consequences of an event must be taken into account when assessing risk. RSK has adopted guidance provided in CIRIA C552 for use in the production of conceptual models.

The likelihood of an event can be classified on a four-point system using the following terms and definitions based on CIRIA C552:

- Highly likely: the event 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: it is probable that an event will occur or circumstances are such that the event is not inevitable, but possible in the short term and likely over the long term;
- Low likelihood: circumstances are possible under which an event could occur, but it is not certain even in the long term that an event would occur and it is less likely in the short term; and
- Unlikely: circumstances are such that it is improbable the event would occur even in the long term.

The severity can be classified using a similar system also based on CIRIA C552. The terms and definitions relating to severity are:

- Severe: short term (acute) risk to human health likely to result in ‘significant harm’ as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution of sensitive water resources. Catastrophic damage to buildings or property. Short-term risk to an ecosystem or organism forming part of that ecosystem (note definition of ecosystem in ‘Draft Circular on Contaminated Land’, DETR 2000);
- Medium: chronic damage to human health (‘significant harm’ as defined in ‘Draft Circular on Contaminated Land’, DETR 2000), pollution of sensitive water resources, significant change in an ecosystem or organism forming part of that ecosystem (note definition of ecosystem in ‘Draft Circular on Contaminated Land’, DETR 2000);

- Mild: pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services ('significant harm' as defined in 'Draft Circular on Contaminated Land', DETR 2000). Damage to sensitive buildings, structures or the environment; and
- Minor: harm, not necessarily significant, but that could result in financial loss or expenditure to resolve. Non-permanent human health effects easily prevented by use of personal protective clothing. Easily repairable damage to buildings, structures and services.

Once the likelihood of an event occurring and its severity have been classified, a risk category can be assigned the table below.

		Consequences			
		Severe	**Medium**	**Mild**	**Minor**
Probability	**Highly likely**	Very high	High	Moderate	Moderate/Low
	Likely	High	Moderate	Moderate/Low	Low
	Low likelihood	Moderate	Moderate/Low	Low	Very Low
	Unlikely	Moderate/Low	Low	Very Low	Very Low

Definitions of these risk categories are as follows together with an assessment of the further work that might be required:

- Very high: there is a high probability that severe harm could occur or there is evidence that severe harm is currently happening. This risk, if realised, could result in substantial liability and urgent investigation and remediation are likely to be required;
- High: harm is likely to occur. Realisation of the risk is likely to present a substantial liability and urgent investigation is required and remedial works may be necessary in the short term and are likely over the long term;
- Moderate: it is possible that harm could arise, but it is unlikely that the harm would be severe and it is more likely that the harm would be relatively mild. Investigation is normally required to clarify the risk and determine the liability. Some remedial works may be required in the longer term;
- Low: it is possible that harm could occur, but it is likely that if realised this harm would at worst normally be mild; and
- Very Low: there is a low possibility that harm could occur and if realised the harm is unlikely to be severe.

APPENDIX E

Exploratory Hole Records

Client: LINDEN HOMES LTD
Site: GONDAR GARDENS, LONDON
Project No: 23283

RSK GROUP PLC

Record of : BH1
Sheet 1 of 1
Scale, 1:**

Boring Method: Cable Percussive (Shell and Auger)
Date: 17/11/2009 - 17/11/2009
Driller: MB Drilling
Logged By: MB

Ground Level: -
Top of Casing Elevation (m): -

Samples Depth	Tests (m) and Field Records
0.10 D 001	
0.40 D 002	
.70 D 003	
1.30-1.60 U 001	
1.60 D 004	
3.00 D 005	3.00m, SPT N=11 (1,1,2,2,3,4)
4.50-4.80 U 002	
4.80 D 006	
6.00 D 007	6.00m, SPT N=20 (3,3,4,5,5,6)
7.50-7.90 U 003	
7.90 D 008	
8.80 D 009	
9.00 D 010	9.00m, SPT N=20 (3,3,4,5,6,5)
10.50-10.80 U 004	
10.80 D 011	
12.00 D 012	12.0m, SPT N=22 (4,4,4,5,7,6)
	GW - 13.00m -
13.50-13.90 U 005	
13.90 D 013	
15.00 D 014	15.0m, SPT N=23 (3,4,5,5,6,7)
16.50-16.80 U 006	
16.80 D 015	
18.00 D 016	18.0m, SPT N=32 (4,5,6,9,8,9)
19.50-19.90 U 007	
19.90 D 017	

Level (m)	Depth / (Thk) (m)	Description
	0.35	MADE GROUND (Reinforced concrete)
	0.50	MADE GROUND (brown silty sandy clay with fine to coarse gravel, stone and fragments of concrete and brick)
	(8.30) 8.80	Firm becoming stiff brown occasional mottled grey silty CLAY with occasional fine to medium gravel. Occasional pockets of sand.
	(11.20) 20.00	Stiff grey silty CLAY with occasional fine gravel. Occasional pockets of sand.
		End of Borehole at 20.00 m

General Remarks:
Groundwater seepage was slightly encountered at 13.0mbgl.

Water Strikes		Chiselling			Borehole and Casing Details			
					Borehole		Casing	
Strike ▽	Level ▼	From: (m)	To: (m)	Time: (hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)
13.00	-							

Client: LINDEN HOMES LTD
Site: GONDAR GARDENS, LONDON
Project No: 23283

RSK GROUP PLC

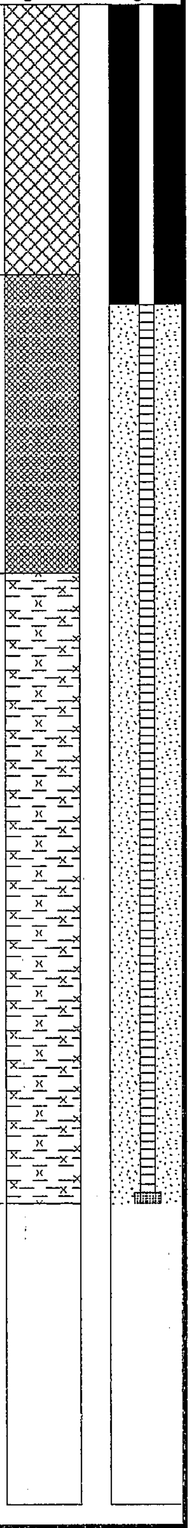
Record of : PH1

Sheet 1 of 1
Scale, 1:25

Boring Method: Competitor Rig
Date: 17/11/2009 - 17/11/2009
Driller: MB Drilling
Logged By: NT

Ground Level: -
Top of Casing Elevation (m): -

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description
			0.0	MADE GROUND (brown grey silty sandy clay with occasional fine to coarse gravel and fragments of stone, brick concrete and roots)
.30 D 001				
			(0.90)	
0.70 D 002				
			0.90	MADE GROUND (remolded stiff to very stiff brown silty clay. Occasional roots and fragments of bricks between 1.5 and 1.7mbgl). Possible desiccation.
	1.00m, CPT N=18 (2,3,3,4,4,7)		1.0	
.20 D 003				
			(1.00)	
			1.90	Stiff becoming very stiff brown occasional mottled grey silty CLAY with occasional fine to medium gravel. Occasional roots. Occasional pockets of sand. Possible desiccation.
	2.00m, CPT N=24 (3,3,4,5,7,8)		2.0	
2.20 D 004				
2.90-3.00 D 005				
	3.00m, CPT N=31 (4,4,6,7,8,10)		(2.10) 3.0	
	4.00m, CPT N=28 (4,4,5,7,7,9)		4.00 4.0	End of Borehole at 4.00 m
			5.0	



General Remarks:
Groundwater was not encountered. Hand vane at 1.0m and 2.0m is greater than 240kPa.

Water Strikes		Chiselling			Borehole and Casing Details			
					Borehole		Casing	
Strike ▽	Level ▼	From: (m)	To: (m)	Time: (hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)
No Groundwater Encountered								

Client: LINDEN HOMES LTD
Site: GONDAR GARDENS, LONDON
Project No: 23283

RSK GROUP PLC

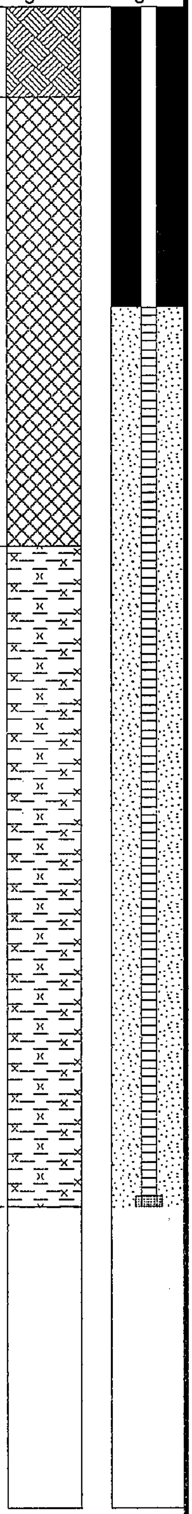
Boring Method: Competitor Rig
Date: 17/11/2009 - 17/11/2009
Driller: MB Drilling
Logged By: NT

Ground Level: -
Top of Casing Elevation (m): -

Record of : PH2

Sheet 1 of 1
Scale, 1:25

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description
			0.0	TOPSOIL (grass over grey silty sandy clay with occasional fine to medium gravel, stone and roots)
0.40 D 001			0.30	MADE GROUND (remolded stiff to very stiff brown silty clay. Occasional roots and fragments of bricks, concrete, stone and mudstone)
.00 D 002	1.00m, CPT N=15 (2,3,3,4,4,4)		1.0 (1.50)	
			1.80	Stiff becoming very stiff brown occasional mottled grey silty CLAY with occasional fine to medium gravel. Occasional roots up to 3.0mbgl. Occasional pockets of sand.
.00 D 003	2.00m, CPT N=14 (2,3,4,2,3,5)		2.0	
			(2.20)	
.00 D 004	3.00m, CPT N=20 (2,3,3,4,6,7)		3.0	
	4.00m, CPT N=18 (3,4,4,4,4,6)		4.00 4.0	End of Borehole at 4.00 m
			5.0	



eneral Remarks:
roundwater was not encountered.

Water Strikes		Chiselling			Borehole and Casing Details			
					Borehole		Casing	
Strike ▽	Level ▼	From: (m)	To: (m)	Time: (hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)
No Groundwater Encountered								

Client: LINDEN HOMES LTD
Site: GONDAR GARDENS, LONDON
Project No: 23283

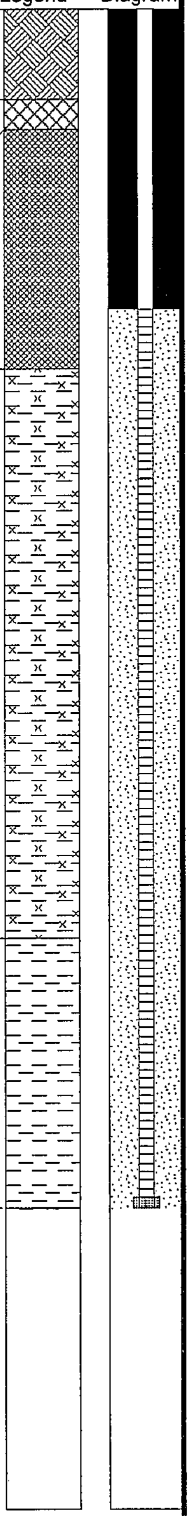
RSK GROUP PLC

Record of : PH3
Sheet 1 of 1
Scale, 1:25

Boring Method: Competitor Rig
Date: 17/11/2009 - 17/11/2009
Driller: MB Drilling
Logged By: NT

Ground Level: -
Top of Casing Elevation (m): -

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description
			0.0	TOPSOIL (grass over grey silty sandy clay with occasional fine to medium gravel and roots)
			0.30	MADE GROUND (Fine coarse gravel and stone)
			0.40	MADE GROUND (remolded stiff brown silty clay with occasional fine to medium gravel. Occasional pockets of sand.
.50 D 001				
			(0.80)	
	1.00m, CPT N=10 (2,2,2,2,3,3)		1.0	
			1.20	Stiff becoming very stiff brown occasional mottled grey silty CLAY with occasional fine to medium gravel. Occasional roots. Occasional pockets of sand (Possible remolded clay)
.70 D 002				
	2.00m, CPT N=13 (2,2,3,2,4,4)		2.0	
			(1.90)	
.60 D 003				
	3.00m, CPT N=10 (1,2,2,2,3,3)		3.0	
			3.10	Firm to stiff brown occasional mottled grey silty CLAY with occasional fine to medium gravel. Occasional pockets of sand.
			(0.90)	
.70 D 004				
	4.00m, CPT N=8 (1,1,1,2,2,3)		4.00 4.0	End of Borehole at 4.00 m
			5.0	



eneral Remarks:
roundwards was not encountered. Hand vane at 2.0m is greater than
40kPa.

Water Strikes		Chiselling			Borehole and Casing Details			
					Borehole		Casing	
Strike ▽	Level ▼	From: (m)	To: (m)	Time: (hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)
No Groundwater Encountered								

Client: LINDEN HOMES LTD
Site: GONDAR GARDENS, LONDON
Project No: 23283

RSK GROUP PLC

Record of : PH4

Sheet 1 of 1
Scale, 1:25

Boring Method: Competitor Rig
Date: 17/11/2009 - 17/11/2009
Driller: MB Drilling
Logged By: NT

Ground Level: -
Top of Casing Elevation (m): -

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram
			0.0	TOPSOIL (grass over grey brown silty sandy clay with occasional fine to medium gravel and roots)	▨	▨
			0.20	MADE GROUND (brown grey silty sandy clay with occasional fine to coarse gravel and fragments of stone, tarmac and brick)	▨	▨
.50 D 001			0.40	MADE GROUND (remolded stiff brown silty clay. Occasional pockets of sand)	▨	▨
			(0.80)			
	1.00m, CPT N=6 (1,1,1,1,2,2)		1.0			
.30 D 002			1.20	MADE GROUND (remolded Firm to stiff brown silty clay. Occasional pockets of sand. Fragments of brick between 3.5m and 3.7m)	▨	▨
	2.00m, CPT N=5 (0,1,1,1,1,2)		2.0			
.70 D 003			(2.80)			
			3.0			
3.60 D 004						
	4.00m, CPT N=5 (1,1,1,1,1,2)		4.00 4.0	End of Borehole at 4.00 m		
			5.0			

ieneral Remarks:
iroundwarter was not encountered. Hand vane at 2.0m (100kPa) and 3.0m
70kPa).

Water Strikes		Chiselling			Borehole and Casing Details			
					Borehole		Casing	
Strike ▽	Level ▼	From: (m)	To: (m)	Time: (hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)
No Groundwater Encountered								

Client: LINDEN HOMES LTD
Site: GONDAR GARDENS, LONDON
Project No: 23283

RSK GROUP PLC

Record of : PH5
Sheet 1 of 1
Scale, 1:25

Boring Method: Competitor Rig
Date: 17/11/2009 - 17/11/2009
Driller: MB Drilling
Logged By: NT

Ground Level: -
Top of Casing Elevation (m): -

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description
			0.0	
			0.20	TOPSOIL (grass over grey brown silty sandy clay with occasional fine to medium gravel and stone)
.30 D 001			(0.70)	MADE GROUND (grey brown silty sandy clay with occasional fine to coarse gravel, fragments of tramac, brick and stone)
			0.90	
	1.00m, CPT N=8 (1,1,2,2,2,2)		1.0	MADE GROUND (remolded stiff brown silty clay. Occasional pockets of sand).
			(1.20)	
.60 D 002				
	2.00m, CPT N=6 (1,1,1,2,1,2)		2.0	
			2.10	MADE GROUND (remolded firm to stiff brown silty clay. Occasional fragments of bricks and pockets of sand)
.80 D 003				
	3.00m, CPT N=5 (1,1,1,1,1,2)		(1.90) 3.0	
.50 D 004				
	4.00m, CPT N=7 (1,1,2,1,2,2)		4.004.0	End of Borehole at 4.00 m
			5.0	

eneral Remarks:
roundwater was not encountered.

Water Strikes		Chiselling			Borehole and Casing Details			
					Borehole		Casing	
Strike ▽	Level ▼	From: (m)	To: (m)	Time: (hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)
No Groundwater Encountered								

Client: LINDEN HOMES LTD
Site: GONDAR GARDENS, LONDON
Project No: 23283

RSK GROUP PLC

Record of : PH6

Sheet 1 of 1
Scale, 1:25

Boring Method: Competitor Rig
Date: 17/11/2009 - 17/11/2009
Driller: MB Drilling
Logged By: NT

Ground Level: -
Top of Casing Elevation (m): -

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description
			0.10	TOPSOIL (grass over grey brown silty sandy clay with occasional fine to medium gravel and roots)
.30 D 001				
			0.50	MADE GROUND (remolded brown silty sandy clay with occasional fine to coarse gravel)
			(0.60)	MADE GROUND (brown grey silty sandy clay with occasional fine to coarse gravel and fragments of stone, tarmac and brick and roots)
	1.00m, CPT N=12 (2,2,3,2,3,4)		1.0	
			1.10	
			(0.60)	MADE GROUND (Remolded stiff brown silty clay with occasional fine to coarse gravel and fragments of stone and roots)
			1.70	Stiff brown occasional mottled grey silty CLAY with occasional fine to medium gravel. Occasional pockets of sand.
.00 D 002	2.00m, PT N=12 (3,2,2,3,3,4)		2.0	
.70 D 003				
			(2.30)	
	3.00m, CPT N=21 (3,3,4,4,6,7)		3.0	
.80 D 004				
	4.00m, CPT N=12 (2,2,2,3,3,4)		4.00 4.0	End of Borehole at 4.00 m
			5.0	

eneral Remarks:
roundwater was not encountered.

Water Strikes		Chiselling			Borehole and Casing Details			
					Borehole		Casing	
Strike ▽	Level ▼	From: (m)	To: (m)	Time: (hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)
No Groundwater Encountered								

Client: LINDEN HOMES LTD
Site: GONDAR GARDENS, LONDON
Project No: 23283

RSK GROUP PLC

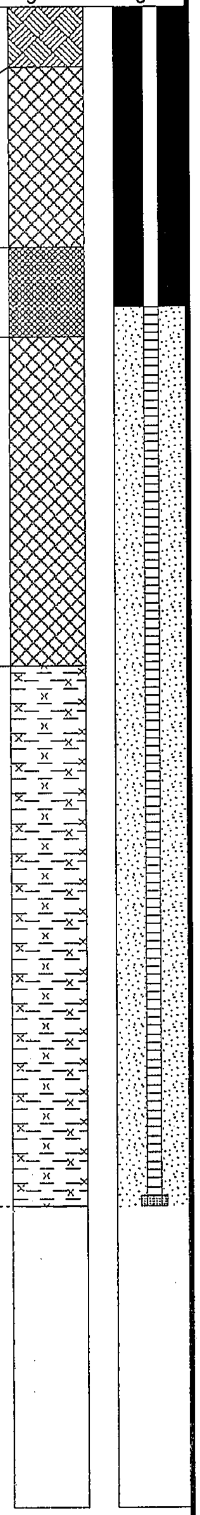
Record of : PH7

Sheet 1 of 1
Scale, 1:25

Boring Method: Competitor Rig
Date: 17/11/2009 - 17/11/2009
Driller: MB Drilling
Logged By: NT

Ground Level: -
Top of Casing Elevation (m): -

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description
			0.0	TOPSOIL (grass over grey brown silty sandy clay with occasional fine to medium gravel)
			0.20	
0.30 D 001			(0.60)	MADE GROUND (brown grey silty sandy clay with occasional fine to coarse gravel and fragments of stone, brick and roots)
			0.80	MADE GROUND (sand and gravel with stone)
	1.00m, CPT N=8 (2,2,2,2,2,2)		1.0	
			1.10	MADE GROUND (remolded stiff brown silty clay. Occasional roots, fragments of bricks and pockets of sand)
			(1.10)	
1.80 D 002				
	2.00m, CPT N=9 (2,1,2,2,2,3)		2.0	
			2.20	Stiff bown occasional mottled grey silty CLAY with occasional fine to medium gravel. Occasional roots up to 3.0mbgl. Occasional pockets of sand.
40 D 003				
	3.00m, CPT N=20 (3,3,4,4,5,7)		3.0	
			(1.80)	
.50 D 004				
	4.00m, CPT N=12 (1,2,2,3,3,4)		4.00 4.0	End of Borehole at 4.00 m
			5.0	



eneral Remarks:
roundwater was not encountered.

Water Strikes		Chiselling			Borehole and Casing Details			
					Borehole		Casing	
Strike ▽	Level ▼	From: (m)	To: (m)	Time: (hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)
No Groundwater Encountered								

APPENDIX F

Chemical Test Certificates

envirolab
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 09/01125
Issue Number: 2 **Date:** 27 November, 2009

Client:
RSK STATS Hemel Hempstead
18 Frogmore Road
Hemel Hempstead
UK
HP3 9RT

Project Manager: Naveneethan Thiruchelvam
Project Name: Gondar Gardens, London
Project Ref: 23283
Order No: Not specified
Date Samples Received: 19/11/09
Date Instructions Received: 19/11/09
Date Analysis Completed: 25/11/09

Prepared by:

M Marshall

Melanie Marshall
Laboratory Coordinator

Approved by:

G Scott

Gill Scott
Laboratory Manager

Notes - Soil samples
All results are reported as dry weight (<40℃).
Stones >10mm are removed from the sample prior to analysis and results corrected where appropriate.
Subscript A indicates analysis performed on the sample as received.
Subscript D indicates analysis performed on the dried sample.
Superscript M indicates method accredited to MCERTS.
Samples with matrix code 7 are not predominantly sand/loam/clay and are not covered by our MCERTS accreditation.

Notes - General
Superscript * indicates subcontracted analysis.
Superscript # indicates method accredited to ISO 17025.
Analytical results reflect the quality of the sample at the time of analysis only.
Method summaries are available upon request.
Opinions and interpretations expressed are outside the scope of our accreditation.
IS indicates Insufficient sample for analysis.
IS-QC indicates Insufficient sample for reanalysis following QC failure.
NDP indicates No Determination Possible.

mCERTS
THE ENVIRONMENT AGENCY MONITORING CERTIFICATION SCHEME

UKAS TESTING
1247

Envirolab Job Number: 09/01125 **Client Project Name: Gondar Gardens, London**

Client Project Ref: 23283

Lab Sample ID	09/01125/1	09/01125/2	09/01125/3	09/01125/4	09/01125/5	09/01125/6	09/01125/7	09/01125/8	Units	Method ref
Client Sample No										
Client Sample ID	PH1	PH1	PH2	PH3	PH6	PH7	PH1	BH1		
Depth to Top	0.30	0.70	0.40	0.50	0.30	0.30	2.20	3.00		
Depth To Bottom										
Date Sampled	17-Nov-09	17-Nov-09	17-Nov-09	17-Nov-09	17-Nov-09	17-Nov-09	17-Nov-09	17-Nov-09		
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Sample Matrix Code	6	6	3	6	6	6A	6	3		
Asbestos Screen$_A$	No ACM	No ACM	No ACM	No ACM	No ACM	No ACM	-	-		Visual
pH$_D^{M\#}$	7.9	8.1	8.8	8.1	7.6	8.3	8.1	8.2		A-T-031s
Sulphate (water sol 2:1)$_D^{M\#}$	0.03	0.04	0.03	0.18	0.02	<0.01	-	-	g/l	A-T-026s
Sulphate BRE (water sol 2:1)$_D^{M\#}$	-	-	-	-	-	-	0.58	1.92	g/l	A-T-026s
Sulphate (acid soluble)$_D^{M\#}$	750	460	310	340	280	560	-	-	mg/kg	A-T-028
Sulphate BRE (acid sol)$_D^{M\#}$	-	-	-	-	-	-	0.14	1.32	% w/w	A-T-028
Arsenic$_D^{M\#}$	12	10	7	14	11	22	-	-	mg/kg	A-T-024
Cadmium$_D^{M\#}$	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	mg/kg	A-T-024
Copper$_D^{M\#}$	32	22	18	55	43	49	-	-	mg/kg	A-T-024
Chromium$_D^{M\#}$	75	77	60	44	82	44	-	-	mg/kg	A-T-024
Chromium (hexavalent) Dep$_D$	<1	<1	<1	<1	<1	<1	-	-	mg/kg	A-T-040s
Lead$_D^{M\#}$	74	24	16	201	215	367	-	-	mg/kg	A-T-024
Mercury$_D$	0.47	0.25	0.25	4.20	0.36	0.64	-	-	mg/kg	A-T-024
Nickel$_D^{M\#}$	45	47	36	33	50	31	-	-	mg/kg	A-T-024
Selenium$_D^{M\#}$	2	2	2	2	2	2	-	-	mg/kg	A-T-024
Sulphur BRE (total)$_D$	-	-	-	-	-	-	0.06	0.54	% w/w	A-T-024
Zinc$_D^{M\#}$	100	82	65	118	193	194	-	-	mg/kg	A-T-024

Envirolab Job Number: 09/01125

Client Project Name: Gondar Gardens, London

Client Project Ref: 23283

Lab Sample ID	09/01125/1	09/01125/2	09/01125/3	09/01125/4	09/01125/5	09/01125/6	09/01125/7	09/01125/8	Units	Method ref
Client Sample No										
Client Sample ID	PH1	PH1	PH2	PH3	PH6	PH7	PH1	BH1		
Depth to Top	0.30	0.70	0.40	0.50	0.30	0.30	2.20	3.00		
Depth To Bottom										
Date Sampled	17-Nov-09	17-Nov-09	17-Nov-09	17-Nov-09	17-Nov-09	17-Nov-09	17-Nov-09	17-Nov-09		
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Sample Matrix Code	6	6	3	6	6	6A	6	3		
Speciated TPH										
Ali >C5-C6$_{A}^{\#}$	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-	mg/kg	A-T-022s
Ali >C6-C8$_{A}^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	mg/kg	A-T-022s
Ali >C8-C10$_{A}^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	mg/kg	A-T-022s
Ali >C10-C12$_{A}^{\#}$	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	mg/kg	A-T-023s
Ali >C12-C16$_{A}^{\#}$	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	mg/kg	A-T-023s
Ali >C16-C21$_{A}^{\#}$	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	mg/kg	A-T-023s
Ali >C21-C35$_{A}^{\#}$	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	mg/kg	A-T-023s
Total Aliphatics$_{A}^{\#}$	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	mg/kg	A-T-022+23s
Aro >C5-C7$_{A}^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	mg/kg	A-T-022s
Aro >C7-C8$_{A}^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	mg/kg	A-T-022s
Aro >C8-C9$_{A}^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	mg/kg	A-T-022s
Aro >C9-C10$_{A}^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	mg/kg	A-T-022s
Aro >C10-C12$_{A}^{\#}$	2.0	2.4	2.4	3.6	1.7	2.0	-	-	mg/kg	A-T-023s
Aro >C12-C16$_{A}^{\#}$	5.7	3.3	4.5	4.2	2.3	2.0	-	-	mg/kg	A-T-023s
Aro >C16-C21$_{A}^{\#}$	13.3	0.9	0.5	1.2	1.2	<0.1	-	-	mg/kg	A-T-023s
Aro >C21-C35$_{A}^{\#}$	8.7	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	mg/kg	A-T-023s
Total Aromatics$_{A}^{\#}$	30	6.6	7.4	9.0	5.2	3.9	-	-	mg/kg	A-T-022+23s
TPH (Ali & Aro)$_{A}^{\#}$	30	6.6	7.4	9.1	5.2	3.9	-	-	mg/kg	A-T-022+23s
BTEX - Benzene$_{A}^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	mg/kg	A-T-022s
BTEX - Toluene$_{A}^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	mg/kg	A-T-022s
BTEX - Ethyl Benzene$_{A}^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	mg/kg	A-T-022s
BTEX - m & p Xylene$_{A}^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	mg/kg	A-T-022s
BTEX - o Xylene$_{A}^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	mg/kg	A-T-022s
MTBE$_{A}^{\#}$	<0.01	<0.01	<0.01	0.01	0.01	<0.01	-	-	mg/kg	A-T-022s

Envirolab Job Number: 09/01125 **Client Project Name: Gondar Gardens, London**

Client Project Ref: 23283

Lab Sample ID	09/01125/1	09/01125/2	09/01125/3	09/01125/4	09/01125/5	09/01125/6	09/01125/7	09/01125/8	Units	Method ref
Client Sample No										
Client Sample ID	PH1	PH1	PH2	PH3	PH6	PH7	PH1	BH1		
Depth to Top	0.30	0.70	0.40	0.50	0.30	0.30	2.20	3.00		
Depth To Bottom										
Date Sampled	17-Nov-09	17-Nov-09	17-Nov-09	17-Nov-09	17-Nov-09	17-Nov-09	17-Nov-09	17-Nov-09		
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Sample Matrix Code	6	6	3	6	6	6A	6	3		
PAH 16										
Acenapthene$_A^{M\#}$	0.13	0.04	0.01	0.11	<0.01	0.08	-	-	mg/kg	A-T-019s
Acenapthylene$_A^{\#}$	0.07	<0.01	<0.01	<0.01	<0.01	0.02	-	-	mg/kg	A-T-019s
Anthracene$_A^{M\#}$	1.67	0.14	<0.01	1.19	<0.01	0.25	-	-	mg/kg	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	0.93	0.01	0.02	0.22	<0.01	0.03	-	-	mg/kg	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	2.13	0.04	0.04	0.92	<0.01	0.34	-	-	mg/kg	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	1.04	0.05	0.02	0.26	<0.01	0.09	-	-	mg/kg	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	1.47	0.05	0.04	0.40	<0.01	0.43	-	-	mg/kg	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	1.31	0.07	0.02	0.57	<0.01	0.34	-	-	mg/kg	A-T-019s
Chrysene$_A^{M\#}$	4.16	0.12	0.05	1.80	<0.01	0.73	-	-	mg/kg	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	0.06	0.01	0.06	0.06	<0.01	0.16	-	-	mg/kg	A-T-019s
Fluoranthene$_A^{M\#}$	9.08	0.14	0.02	4.20	0.01	1.57	-	-	mg/kg	A-T-019s
Fluorene$_A^{M\#}$	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	mg/kg	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	0.53	0.08	0.07	0.06	<0.01	0.12	-	-	mg/kg	A-T-019s
Naphthalene$_A^{M\#}$	0.04	0.02	0.02	0.04	<0.01	0.07	-	-	mg/kg	A-T-019s
Phenanthrene$_A^{M\#}$	2.50	0.05	<0.01	1.80	<0.01	0.34	-	-	mg/kg	A-T-019s
Pyrene$_A^{M\#}$	8.04	0.37	0.02	3.87	<0.01	1.28	-	-	mg/kg	A-T-019s
Total PAH$_A^{\#}$	33.2	1.19	0.41	15.5	0.01	5.85	-	-	mg/kg	A-T-019s

Envirolab Job Number: 09/01125 **Client Project Name: Gondar Gardens, London**

Client Project Ref: 23283

Lab Sample ID	09/01125/9	09/01125/10	09/01125/11	09/01125/12					Units	Method ref
Client Sample No										
Client Sample ID	BH1	BH1	BH1	BH1						
Depth to Top	6.00	9.00	15.00	19.90						
Depth To Bottom										
Date Sampled	17-Nov-09	17-Nov-09	17-Nov-09	17-Nov-09						
Sample Type	Soil	Soil	Soil	Soil						
Sample Matrix Code	3	3	3	3						
pH$_D^{M\#}$	8.3	8.7	8.9	9.1						A-T-031s
Sulphate BRE (water sol 2:1)$_D^{M\#}$	2.00	2.10	0.97	0.41					g/l	A-T-026s
Sulphate BRE (acid sol)$_D^{M\#}$	0.40	0.69	0.15	0.11					% w/w	A-T-028
Sulphur BRE (total)$_D$	0.12	0.71	0.42	1.41					% w/w	A-T-024

APPENDIX G

Generic Assessment Criteria for Human Health
With gardens

Generic Assessment Criteria for Human Health
Residential Scenario – Private Gardens

The human health generic assessment criteria (GAC) have been developed during a period of regulatory review and updating of the Contaminated Land Exposure Assessment (CLEA) project. Hence, the Environment Agency (EA) is in the process of publishing updated reports relating to the CLEA project and the GAC presented in this document may change to reflect these updates. This issue was prepared following the publication of soil guideline value reports and associated publications(1) for mercury, selenium, benzene, toluene, ethylbenzene and xylene in March 2009 plus arsenic and nickel in May 2009. Where available, the published soil guideline values (SGV)(1) have been used as GAC.

1. Model Selection

Soil assessment criteria (SAC) were calculated for compounds where SGV have not been published using CLEA v1.04. Groundwater assessment criteria (GrAC) protective of human health via the inhalation pathway were derived using the RBCA 1.3b model. RSK has updated the inputs within RBCA to reflect the UK guidance(2-5). The SAC and GrAC collectively are termed GAC.

2. Conceptual Model

In accordance with EA Science Report SC050221/SR3(3), the residential with private garden scenario considers risks to a female child between the ages of 0 and 6 years old. In accordance with Box 3.1, SR3(3), the pathways considered for production of the SAC in the residential with gardens scenario are:

- Direct soil and dust ingestion;
- Consumption of homegrown produce;
- Consumption of soil attached to homegrown produce;
- Dermal contact with soil and indoor dust, and
- Inhalation of indoor and outdoor dust and vapours.

Figure 1 is a conceptual model illustrating these linkages.

The pathway considered in production of the GrAC is the volatilisation of compounds from groundwater and subsequent vapour inhalation by residents whilst indoors. Figure 2 illustrates this linkage. Although the outdoor air inhalation pathway is also valid, this contributes little to the overall risks owing to the dilution in outdoor air.

Within RBCA, the solubility limit of the determinant restricts the extent of volatilisation, which in turn drives the indoor air inhalation pathway. Whilst the same restriction is not built into the CLEA model, the model output cells are flagged red where the soil saturation limit has been exceeded. In accordance with the SGV report for xylene(1), where the soil saturation or solubility limit has been exceeded the GAC has been set at this limit. It should be noted this is a highly conservative assumption. Unless free-phase product is present, concentrations of the chemical are unlikely to be present at sufficient concentration to result in an exceedance of the health criteria value (HCV).

3. Input Selection

Chemical data was obtained from EA Report SC050021/SR7(5) and the health criteria values (HCV) from the UK TOX reports (published 2002 and 2009) where available.

For total petroleum hydrocarbons (TPH), HCV and chemical specific parameters were taken from the TPH Criteria Working Group (TPHCWG). Until further information is available regarding whether the TPH fractions should be considered cumulatively and/or additional data becomes available regarding background exposure, RSK has taken the conservative view that 50% exposure to TPH fractions is derived from background. Thus, the mean daily intake has been set at 50% of the toxicological data. Aromatic hydrocarbons C_5-C_8 were not modelled since benzene and toluene are being modelled separately. The aromatic C_8-C_9 hydrocarbon fraction comprises ethylbenzene, xylene and styrene. Since ethylbenzene and xylene are being modelled separately, the physical, chemical and toxicological data for this band has been taken from styrene. Owing to the lack of UK-specific data, default information in the RBCA model was used to evaluate methyl tertiary butyl ether (MTBE). No published UK data was available for 1,2,4- and 1,3,5-trimethylbenzene, so information was obtained from the US EPA. Toxicity reports were generated by RSK in line with guidance in CLR9(7) for 14 of the 16 USEPA polycyclic aromatic hydrocarbons (PAH). RSK notes that CLR9(7) has been withdrawn and these toxicity reports may need to be updated using additional references included within SR2(2). However, the data in these documents is considered to remain valid since it broadly follows the approach outlined in SR2. Therefore, the HCV from these reports was used with the chemical data obtained from SR7(5), where available.

RBCA uses toxicity data for the inhalation pathway in different units to the CLEA model and cannot consider separately the mean daily intake (MDI), occupancy periods or breathing rates. Therefore, the HCV was amended to take account of:

- Amendments to the MDI using Table 3.4 of SR2(2);
- A child weighing 13.3kg (average of 0-6 year old female in accordance with Table 4.6 of SR3(3)) and breathing 11.85m^3 (average daily inhalation rate for a 0-6yr old female in accordance with Table 4.14 of SR3(3); and
- The 50% rule (for petroleum hydrocarbons, trimethylbenzenes and MTBE)(2) where MDI data is not currently available but background exposure is considered important in the overall exposure.

Physical Parameters

For the residential with private gardens scenario, the CLEA default building is a small two-storey terrace house with concrete ground bearing slab. The house is assumed to have a 100m^2 private garden consisting of lawn, flowerbeds and incorporating a 20m^2 plot for growing fruit and vegetables consumed by the residents. SR3(3) notes this residential building type to be the most conservative in terms of protection from vapour intrusion. The building parameters are outlined in Table 5.

The parameters for a sandy loam soil type were used in line with SR3(3). This includes a value of 6% for the percentage soil organic matter (SOM) within the soil. In RSK's experience, this is rather high for many sites. To avoid undertaking site specific risk assessments for this parameter, RSK has produced an additional set of SAC for an SOM of 1%.

For the GrAC, the depth to groundwater was taken as 2.5m based on RSK's experience of assessing the volatilisation pathway from groundwater.

4. GAC

The SAC were produced using the input parameters in Tables 1 to 5 and the GrAC using input parameters in Table 6. The final selected GAC are presented by pathway in Table 7 and the combined GAC in Table 8.

Figure 1
Conceptual Model for CLEA Residential Scenario – Private Gardens

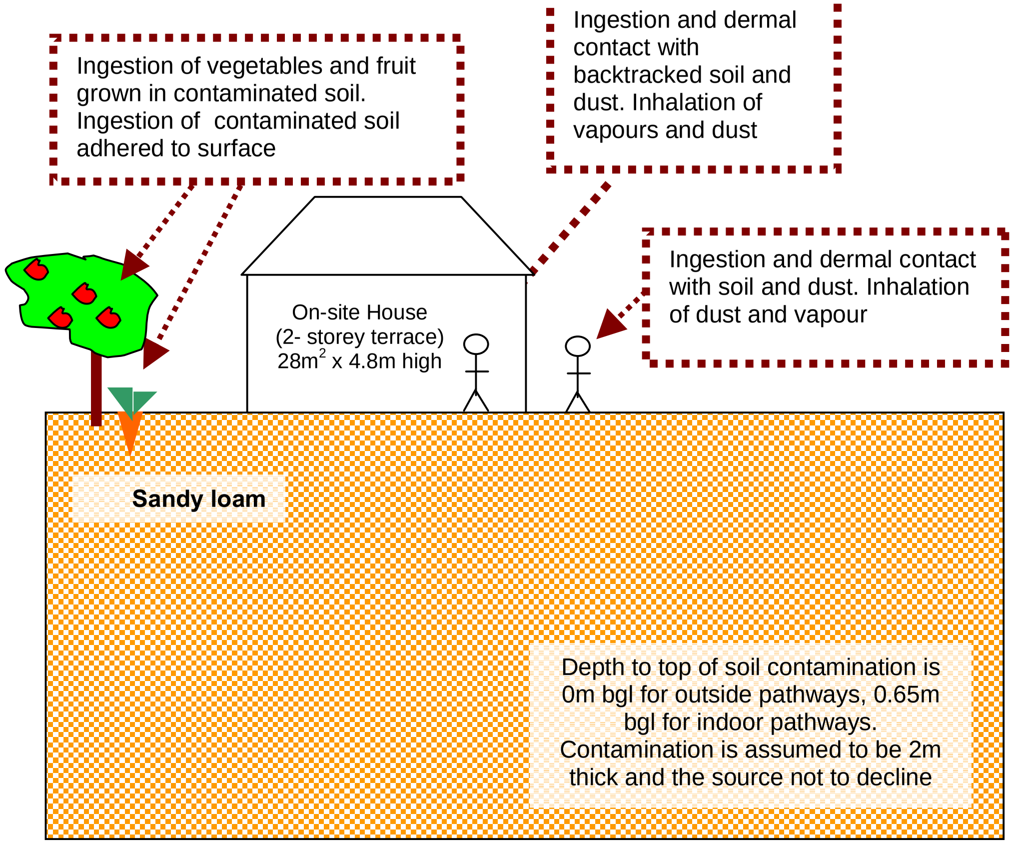


Table 1
Exposure Assessment Parameters for Residential Scenario - Private Gardens – Inputs for RBCA Model

Parameter	Value	Justification
Land use	Residential with homegrown produce	Chosen land use
Receptor	Female child age 1 to 6	Key generic assumption given in Box 3.1, SR3
Building	Small terraced house	Key generic assumption given in Box 3.1, report SC050021/SR3. Two storey small terraced house chosen as it is the most conservative residential building type in terms of protection from vapor intrusion (Section 3.4.6, SR3)
Soil type	Sandy Loam	Most common UK soil type (Section 4.3.1, From Table 3.1, SR3)
Start AC (age class)	1	Range of age classes corresponding to key generic assumption that the critical receptor is a young female child aged zero to six. From Box 3.1, report SC050021/SR3.
End AC (age class)	6	
SOM (%)	(i) 6	Representative of sandy loamy soil according to EA Guidance note dated January 2009 entitled 'Changes We Have Made to the CLEA Framework Documents'
	(ii) 1	To provide SAC for sites where SOM <6% as often observed by RSK
pH	7	Model default

Table 2
Residential with Private Gardens –Homegrown Produce Data for CLEA Model

	Consumption Rate (g FW kg^{-1} BW day^{-1}) by Age Class						**Dry Weight Conversion Factor**	**Homegrown Fraction (average)**	**Homegrown Fraction (high end)**	**Soil loading factor**	**Preparation correction factor**
Name	1	2	3	4	5	6	g DW g^{-1} FW	-	-	g g^{-1} DW	-
Green vegetables	7.12	6.85	6.85	6.85	3.74	3.74	0.096	0.05	0.33	1.00E-03	2.00E-01
Root vegetables	10.69	3.30	3.30	3.30	1.77	1.77	0.103	0.06	0.4	1.00E-03	1.00E+00
Tuber vegetables	16.03	5.46	5.46	5.46	3.38	3.38	0.21	0.02	0.13	1.00E-03	1.00E+00
Herbaceous fruit	1.83	3.96	3.96	3.96	1.85	1.85	0.058	0.06	0.4	1.00E-03	6.00E-01
Shrub fruit	2.23	0.54	0.54	0.54	0.16	0.16	0.166	0.09	0.6	1.00E-03	6.00E-01
Tree fruit	3.82	11.96	11.96	11.96	4.26	4.26	0.157	0.04	0.27	1.00E-03	6.00E-01
Justification	Table 4.17, SR3						Table 6.3, SR3	Table 4.19, SR3		Table 6.3, SR3	

Table 3
Residential with Private Gardens – Land Use Data for CLEA Model

Parameter	Unit	Age Class					
		1	2	3	4	5	6
EF (soil and dust ingestion)	day yr^{-1}	180	365	365	365	365	365
EF (consumption of homegrown produce)	day yr^{-1}	180	365	365	365	365	365
EF (skin contact, indoor)	day yr^{-1}	180	365	365	365	365	365
EF (skin contact, outdoor)	day yr^{-1}	180	365	365	365	365	365
EF (inhalation of dust and vapour, indoor)	day yr^{-1}	365	365	365	365	365	365
EF (inhalation of dust and vapour, outdoor)	day yr^{-1}	365	365	365	365	365	365
Justification		Table 3.1, SR3					
Occupancy period (indoor)	hr day^{-1}	23	23	23	23	19	19
Occupancy period (outdoor)	hr day^{-1}	1	1	1	1	1	1
Justification		Table 3.2, SR3					
Soil to skin adherence factor (indoor)	mg cm^{-2} day^{-1}	6.00E-02	6.00E-02	6.00E-02	6.00E-02	6.00E-02	6.00E-02
Soil to skin adherence factor (outdoor)	mg cm^{-2} day^{-1}	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Justification		Table 8.1, SR3					
Soil and dust ingestion rate	g day^{-1}	1.00E-01	1.00E-01	1.00E-01	1.00E-01	1.00E-01	1.00E-01
Justification		Table 6.2, SR3					

Table 4
Residential with Private Gardens – Receptor Data for CLEA Model

Parameter	Unit	Age Class						Justification
		1	2	3	4	5	6	
Body weight	kg	5.6	9.8	12.7	15.1	16.9	19.7	Table 4.6, SR3
Body height	m	0.7	0.8	0.9	0.9	1	1.1	
Inhalation rate	m^{3} day^{-1}	8.5	13.3	12.7	12.2	12.2	12.2	Table 4.14, SR3
Max exposed skin fraction (indoor)	m^{2} m^{-2}	0.32	0.33	0.32	0.35	0.35	0.33	Table 4.8, SR3
Max exposed skin fraction (outdoor)	m^{2} m^{-2}	0.26	0.26	0.25	0.28	0.28	0.26	

Table 5
Residential with Private Gardens – Soil and Building Inputs for CLEA Model

Parameter	Unit	Value	Justification
SOIL PROPERTIES for sandy loam			
Porosity, total	$cm^3\ cm^{-3}$	0.53	Default soil type is sandy loam, section 4.3.1, SR3. Parameters for sandy loam from Table 4.4, SR3
Porosity, air filled	$cm^3\ cm^{-3}$	0.20	
Porosity, water filled	$cm^3\ cm^{-3}$	0.33	
Residual soil water content	$cm^3\ cm^{-3}$	0.12	
Saturated hydraulic conductivity	$cm\ s^{-1}$	3.56E-03	
van Genuchten shape parameter (*m*)	-	3.20E-01	
Bulk density	$g\ cm^{-3}$	1.21	
Threshold value of wind speed at 10m	$m\ s^{-1}$	7.20	Default value taken from Section 9.2.2, SR3
Empirical function (F_x) for dust model	-	1.22	Value taken from Section 9.2.2, SR3
Ambient soil temperature	K	283	Annual average soil temperature representative of UK surface soils. Section 4.3.1, SR3
AIR DISPERSION MODEL			
Mean annual wind speed (10 m)	$m\ s^{-1}$	5.00	Default value taken from Section 9.2.2, SR3
Air dispersion factor at height of 0.8 m	$g\ m^{-2}\ s^{-1}$ per $kg\ m^{-3}$	2400	Values for a 0.01 ha site, appropriate to a residential land use in Newcastle (most representative city for UK). (from Table 9.1, SR3) Assumed child of 6 is not tall enough to reach 1.6m
Air dispersion factor at height of 1.6 m	$g\ m^{-2}\ s^{-1}$ per $kg\ m^{-3}$	0	
Fraction of site with hard or vegetative cover	$m^2\ m^{-2}$	0.75	Section 3.2.6, SR3 based on residential land use
BUILDING PROPERTIES for small terrace house with ground-bearing floor slab			
Building footprint	m^2	28	From Table 3.3 and 4.21, SR3
Living space air exchange rate	hr^{-1}	0.50	
Living space height (above ground)	m	4.8	
Living space height (below ground)	m	0.0	Assumed no basement
Pressure difference (soil to enclosed space)	Pa	3.1	From Table 3.3, SR3
Foundation thickness	m	0.15	
Floor crack area	cm^2	423	
Dust loading factor	$\mu g\ m^{-3}$	50	Default value for a residential site taken from Section 9.3, SR3
VAPOUR MODEL			
Default soil gas ingress rate	$cm^3\ s^{-1}$	25	Generic flow rate, Section 10.3, SR3
Depth to top of source (beneath building)	cm	50	Section 3.2.6, SR3 states source is 50cm below building or 65cm below ground surface
Depth to top of source (no building)	cm	0	Section 10.2, SR3 assumes impact from 0-1m for outdoor inhalation pathway
Thickness of contaminant layer	cm	200	Model default for indoor air, Section 4.9, SR4
Time average period for surface emissions	years	6	Time period of a 0 to 6 year old, Box 3.5, SR3
User-defined effective air permeability	cm^2	3.05E-08	Calculated for sandy loam using equations in Appendix 1, SR3

Figure 2
GrAC Conceptual Model for RBCA Residential with Gardens Scenario

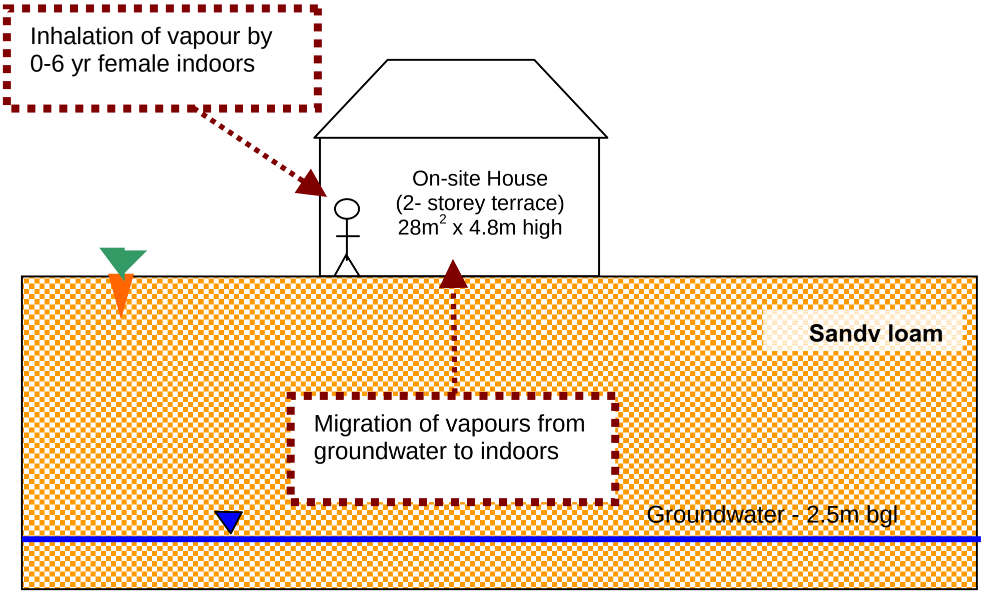


Table 6
Residential with Private Gardens RBCA Inputs

Parameter	Unit	Value	Justification
RECEPTOR			
Averaging time	Years	6	From Box 3.1, SR3
Receptor weight	kg	13.3	Average of CLEA 0-6 year old female data, Table 4.6, SR3
Exposure duration	Years	6	From Box 3.1, report , SR3
Exposure frequency	Days/yr	350	Weighted using occupancy period of 23 hours per day for 365 days of the year
SOIL TYPE – SANDY LOAM			
Total porosity	-	0.53	CLEA value for sandy loam. Parameters for sandy loam from Table 4.4, SR3
Volumetric water content	-	0.33	
Volumetric air content	-	0.20	
Dry bulk density	g cm^{-3}	1.21	
Vertical hydraulic conductivity	cm s^{-1}	3.56E-3	CLEA value for saturated conductivity of sandy loam, Table 4.4, SR3
Vapour permeability	m^2	3.05E-12	Calculated for sandy loam using equations in Appendix 1, SR3
Capillary zone thickness	m	0.1	Professional judgement
Fraction organic carbon	%	(i) 0.0348	Representative of sandy loam according to EA Guidance note dated January 2009 entitled Changes We Have Made to the CLEA Framework Documents
		(ii) 0.0058	To provide SAC for site's where SOM < 6% as often observed by RSK
BUILDING			
Building volume/area ratio	m	4.8	Table 3.3, SR3
Foundation area	m^2	28	
Foundation perimeter	m	22	Calculated assuming building measures 7m x 4m to give 28m^2 foundation area
Building air exchange rate	d^{-1}	12	Table 3.3, SR3
Depth to bottom of foundation slab	m	0.15	
Foundation thickness	m	0.15	
Foundation crack fraction	-	0.0151	Calculated from floor crack area of 423 cm^2 and building footprint of 28m^2 in Table 4.21, SR3
Volumetric water content of cracks	-	0.33	Assumed equal to underlying soil type in assumption that cracks become filled with soil over time. Parameters for sandy loam from Table 4.4, SR3
Volumetric air content of cracks	-	0.2	
Indoor/outdoor differential pressure	Pa	3.1	From Table 3.3, SR3

REFERENCES

1) Environment Agency, 31 March 2009 and May 2009. Science Report SC050021 / benzene SGV, toluene SGV, ethylbenzene SGV, xylene SGV, mercury SGV, selenium SGV, nickel SGV and arsenic SGV. Supplementary information for the derivation of SGV for: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel and arsenic. Contaminants in soil: updated collation of toxicological data and intake values for humans: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel and arsenic.

2) Environment Agency, January 2009. Science Report SC050021/SR2 Human Health Toxicological Assessment of Contaminants in Soil.

3) Environment Agency, January 2009. Science Report SC050021/SR3 Updated Technical Background to the CLEA Model.

4) Environment Agency, January 2009. Science Report SC050021/SR4 CLEA Software (Version 1.04) Handbook.

5) Environment Agency. 2008. Science Report SC050021/SR7. Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values.

6) Environment Agency and DEFRA. Contaminants in Soil: Collation of Toxicological Data and Intake Values for Humans. Numbers 1–12, 14, 16–25.

7) Environment Agency. March 2002. CLR 9. Contaminants in soil: Collation of Toxicological Data and Intake Values for Humans.

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITH PRIVATE GARDENS

Table 7

Human Health Generic Assessment Criteria by Pathway for Residential Scenario - Private Gardens

Compound		GrAC (mg/l)	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
			Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Metals										
Arsenic	(b,c)	-	3.24E+01	8.50E+01	2.35E+01	NR	3.24E+01	8.50E+01	2.35E+01	NR
Cadmium		-	6.21E+01	4.25E+01	2.93E+01	NR	6.21E+01	4.25E+01	2.93E+01	NR
Chromium (hexavalent)		-	2.78E+02	4.25E+01	3.76E+01	NR	2.78E+02	4.25E+01	3.76E+01	NR
Copper		-	8.96E+03	6.08E+03	4.74E+03	NR	8.96E+03	6.08E+03	4.74E+03	NR
Lead	(a)	-	4.50E+02	-	-	NR	4.50E+02	-	-	NR
Elemental Mercury (Hg^0)	(b,d)	9.40E-03	-	1.70E-01	-	4.31E+00	-	1.02E+00	-	2.58E+01
Inorganic Mercury (Hg^{2+})	(b)	-	1.81E+02	2.55E+03	1.69E+02	NR	1.81E+02	2.55E+03	1.69E+02	NR
Methyl Mercury (Hg^{4+})	(b)	2.00E+01	1.39E+01	1.59E+01	7.40E+00	7.33E+01	1.39E+01	6.53E+01	1.14E+01	3.04E+02
Nickel	(b,d)	-	5.31E+02	1.27E+02	1.19E+02	NR	5.31E+02	1.27E+02	1.19E+02	NR
Selenium	(b,c)	-	3.51E+02	-	-	NR	3.51E+02	-	-	NR
Zinc	(c)	-	2.53E+04	-	-	NR	2.53E+04	-	-	NR
Cyanide		-	2.66E+01	3.97E+00	3.68E+00	NR	2.66E+01	3.97E+00	3.68E+00	NR
Volatile Organic Compounds										
Benzene	(b)	2.60E+01	1.12E-01	2.69E-01	7.92E-02	1.22E+03	4.89E-01	1.04E+00	3.32E-01	4.71E+03
Toluene	(b)	1.90E+03	1.47E+02	6.26E+02	1.19E+02	8.69E+02	7.59E+02	3.14E+03	6.11E+02	4.36E+03
Ethylbenzene	(b)	2.60E+02	1.06E+02	1.70E+02	6.52E+01	5.18E+02	5.70E+02	9.32E+02	3.54E+02	2.84E+03
Xylene - m	(b)	8.40E+01	2.02E+02	5.56E+01	4.36E+01	6.25E+02	1.09E+03	3.07E+02	2.40E+02	3.46E+03
Xylene - o		1.00E+02	1.85E+02	5.98E+01	4.52E+01	4.78E+02	9.96E+02	3.27E+02	2.46E+02	2.62E+03
Xylene - p		8.70E+01	1.91E+02	5.34E+01	4.17E+01	5.76E+02	1.02E+03	2.94E+02	2.28E+02	3.17E+03
Total xylene		8.40E+01	2.02E+02	5.56E+01	4.36E+01	6.25E+02	1.09E+03	3.07E+02	2.40E+02	3.46E+03
Methyl t-Butyl ether		2.20E+03	1.75E+00	1.84E+02	1.75E+00	1.66E+04	7.41E+00	3.70E+02	7.37E+00	3.34E+04
Trichloroethene		1.80E+00	2.83E+00	1.10E-01	1.06E-01	1.54E+03	1.40E+01	5.11E-01	4.93E-01	7.14E+03
Tetrachloroethene		3.60E+00	1.06E+01	1.60E+00	1.39E+00	4.24E+02	5.55E+01	8.21E+00	7.15E+00	2.18E+03
1,1,1-Trichloroethane		2.60E+01	3.20E+02	6.33E+00	6.21E+00	1.43E+03	1.55E+03	2.84E+01	2.79E+01	6.39E+03
1,1,1,2Tetrachloroethane		1.40E+01	5.19E+00	1.08E+00	8.93E-01	2.60E+03	2.78E+01	5.83E+00	4.82E+00	1.40E+04
1,1,2,2-Tetrachloroethane		1.40E+01	2.70E+00	2.76E+00	1.37E+00	2.67E+03	1.30E+01	1.24E+01	6.34E+00	1.20E+04
Carbon Tetrachloride		5.50E-02	1.05E+00	1.81E-02	1.79E-02	1.52E+03	5.44E+00	8.99E-02	8.92E-02	7.54E+03
1,2-Dichloroethane		3.00E-01	3.06E-02	6.46E-03	5.34E-03	3.41E+03	1.05E-01	1.60E-02	1.39E-02	8.43E+03
Vinyl Chloride		1.90E-02	3.69E-03	5.43E-04	4.73E-04	1.36E+03	1.21E-02	1.07E-03	9.86E-04	2.69E+03
1,2,4-Trimethylbenzene		7.50E-02	3.39E+01	7.42E-01	7.38E-01	1.03E+02	1.87E+02	4.19E+00	4.17E+00	5.85E+02
1,3,5-Trimethylbenzene		4.70E-02	1.45E+01	4.60E-01	4.56E-01	9.47E+01	7.94E+01	2.59E+00	2.56E+00	5.33E+02
Semi-Volatile Organic Compounds										
Acenaphthene		3.20E+00	2.05E+02	7.34E+00	7.08E+00	1.32E+02	7.49E+02	4.32E+01	4.09E+01	7.89E+02
Acenaphthylene		4.20E+00	1.23E+01	5.45E-01	5.22E-01	3.89E+02	5.32E+01	3.21E+00	3.03E+00	2.31E+03
Anthracene		2.10E-02	4.26E+04	1.39E+03	1.34E+03	3.60E+00	5.15E+04	7.40E+03	6.47E+03	2.16E+01
Benzo(a)anthracene		3.80E-03	1.42E+01	8.09E+00	5.16E+00	1.71E+00	1.57E+01	2.05E+01	8.90E+00	1.03E+01
Benzo(b)fluoranthene		2.00E-03	1.47E+01	2.50E+01	9.25E+00	1.22E+00	1.58E+01	2.87E+01	1.02E+01	7.29E+00
Benzo(g,h,i)perylene		2.60E-04	2.35E+03	5.38E+04	2.25E+03	1.87E-02	2.40E+03	5.63E+04	2.30E+03	1.12E-01
Benzo(k)fluoranthene		8.00E-04	1.50E+01	2.66E+01	9.60E+00	6.87E-01	1.59E+01	2.91E+01	1.03E+01	4.12E+00
Chrysene		2.00E-03	1.37E+02	1.95E+02	8.03E+01	4.40E-01	1.55E+02	2.72E+02	9.90E+01	2.64E+00
Dibenzo(a,h)anthracene		6.00E-04	1.53E+00	2.37E+00	9.28E-01	3.93E-03	1.59E+00	2.85E+00	1.02E+00	2.36E-02
Fluoranthene		2.30E-01	1.12E+02	1.51E+01	1.33E+01	1.89E+01	1.50E+02	7.18E+01	4.85E+01	1.13E+02
Fluorene		1.90E+00	2.35E+03	8.85E+01	8.53E+01	1.53E+02	6.86E+03	5.23E+02	4.86E+02	9.13E+02
Indeno(1,2,3-cd)pyrene		2.00E-04	1.45E+01	2.43E+01	9.08E+00	6.14E-02	1.58E+01	2.86E+01	1.02E+01	3.68E-01
Phenanthrene		5.30E-01	2.39E+03	1.17E+03	7.85E+02	7.06E+01	3.03E+03	6.33E+03	2.05E+03	4.23E+02
Pyrene		1.30E-01	1.08E+03	1.44E+02	1.27E+02	2.20E+00	1.49E+03	6.93E+02	4.73E+02	1.32E+01
Benzo(a)pyrene		3.80E-03	1.49E+00	2.62E+00	9.49E-01	9.11E-01	1.58E+00	2.90E+00	1.02E+00	5.46E+00
Naphthalene		1.90E+01	2.68E+01	1.64E+00	1.54E+00	7.64E+01	1.43E+02	9.27E+00	8.71E+00	4.32E+02
Phenol	(c)	-	4.40E+02	-	-	4.16E+04	1.98E+03	-	-	1.74E+05

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITH PRIVATE GARDENS

Table 7
Human Health Generic Assessment Criteria by Pathway for Residential Scenario - Private Gardens

Compound		GrAC (mg/l)	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
			Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Total Petroleum Hydrocarbons										
Aliphatic hydrocarbons EC_5-EC_6		1.00E+01	8.97E+03	2.47E+01	2.47E+01	3.69E+02	4.31E+04	8.04E+01	8.03E+01	1.20E+03
Aliphatic hydrocarbons $>EC_6$-EC_8		5.40E+00	1.52E+04	5.11E+01	5.10E+01	1.69E+02	6.62E+04	2.39E+02	2.39E+02	7.93E+02
Aliphatic hydrocarbons $>EC_8$-EC_{10}		2.30E-01	3.14E+03	1.11E+01	1.11E+01	8.46E+01	4.12E+03	6.29E+01	6.27E+01	4.79E+02
Aliphatic hydrocarbons $>EC_{10}$-EC_{12}		3.40E-02	3.99E+03	5.36E+01	5.35E+01	5.02E+01	4.34E+03	3.18E+02	3.12E+02	2.98E+02
Aliphatic hydrocarbons $>EC_{12}$-EC_{16}		7.60E-04	4.39E+03	2.48E+02	2.45E+02	2.22E+01	4.41E+03	1.49E+03	1.34E+03	1.33E+02
Aliphatic hydrocarbons $>EC_{16}$-EC_{21}	(c)	-	8.84E+04	-	-	9.15E+00	8.84E+04	-	-	5.49E+01
Aliphatic hydrocarbons $>EC_{21}$-EC_{35}	(c)	-	8.84E+04	-	-	6.45E+00	8.84E+04	-	-	3.87E+01
Aromatic hydrocarbons $>EC_8$-EC_9		6.50E+01	1.66E+02	2.65E+02	1.33E+02	6.20E+02	8.50E+02	1.54E+03	7.02E+02	3.61E+03
Aromatic hydrocarbons $>EC_9$-EC_{10}		7.40E+00	5.53E+01	1.77E+01	1.60E+01	6.20E+02	2.83E+02	1.03E+02	9.17E+01	3.61E+03
Aromatic hydrocarbons $>EC_{10}$-EC_{12}		2.50E+01	8.04E+01	9.74E+01	5.84E+01	3.72E+02	3.90E+02	5.74E+02	3.04E+02	2.19E+03
Aromatic hydrocarbons $>EC_{12}$-EC_{16}		5.80E+00	1.40E+02	5.05E+02	1.29E+02	1.70E+02	6.01E+02	3.00E+03	5.67E+02	1.01E+03
Aromatic hydrocarbons $>EC_{16}$-EC_{21}	(c)	-	8.84E+04	-	-	5.99E+01	8.84E+04	-	-	3.59E+02
Aromatic hydrocarbons $>EC_{21}$-EC_{35}	(c)	-	1.11E+03	-	-	4.82E+00	1.29E+03	-	-	2.89E+01

Notes:

-' Generic assessment criteria not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data.

EC - equivalent carbon. GrAC - groundwater assessment criteria. SAC - soil assessment criteria.

The CLEA model output is colour coded depending upon whether the soil saturation limit has been exceeded.

🟥	Calculated SAC exceeds soil saturation limit and may significantly effect the interpretation of any exceedances since the contribution of the indoor and outdoor vapour pathway to total exposure is >10%. This shading has also been used for the RBCA output where the theoretical solubility limit has been exceeded. SAC/GrAC is set at soil saturation/solubility limit.
🟨	Calculated SAC exceeds soil saturation limit but will not effect the SSV significantly since the contribution of the indoor and outdoor vapour pathway to total exposure is <10%.
🟩	Calculated SAC does not exceed the soil saturation limit.

For consistency where the theoretical solubility limit within RBCA has been exceeded in production of the GrAC, these cellls have also been hatched red.

The SAC for organic compounds are dependant upon soil organic matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58. 1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, polycyclic aromatic hydrocarbons, MTBE, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway, section 10.1.1, SR3

(a) GAC taken as former Soil Guideline Value owing to uncertainty regarding toxicological approach to be adopted by the Environment Agency.

(b) GAC taken from the Environment Agency SGV reports published March and May 2009.

(c) SAC for selenium, zinc, phenol, aliphatic and aromatic hydrocarbons >EC16 does not include inhalation pathway owing to absence of toxicity data. SAC for arsenic is only based on oral contribution (rather than combined) owing to the relative small contribution from inhalation in accordance with the SGV report.

(d) SAC for elemental mercury and nickel is based on the inhalation pathway only owing to an absence of toxicity for elemental mercury andr in accordance with the SGV report for nickel.

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITH PRIVATE GARDENS

RSK GROUP PLC

Table 8
Human Health Generic Assessment Criteria for Residential Scenario - Private Gardens

Compound	GrAC for Groundwater (mg/l)	SAC for Soil SOM 1% (mg/kg)	SAC for Soil SOM 6% (mg/kg)
Metals			
Arsenic	-	32	32
Cadmium	-	29	29
Chromium (hexavalent)	-	38	38
Copper	-	4,700	4,700
Lead	-	450	450
Elemental Mercury (Hg^0)	0.009	0.17	1.0
Inorganic Mercury (Hg^{2+})	-	170	170
Methyl Mercury (Hg^{4+})	20	7.4	11
Nickel	-	130	130
Selenium	-	350	350
Zinc	-	25,000	25,000
Cyanide	-	3.7	3.7
Volatile Organic Compounds			
Benzene	26	0.08	0.33
Toluene	1,900	120	610
Ethylbenzene	260	65	350
Xylene - m	84	44	240
Xylene - o	100	45	250
Xylene - p	87	42	230
Total xylene	84	44	240
Methyl t-Butyl ether	2,200	1.8	7.4
Trichloroethene	1.8	0.11	0.49
Tetrachloroethene	3.6	1.4	7.2
1,1,1-Trichloroethane	26	6.2	28
1,1,1,2Tetrachloroethane	14	0.89	4.8
1,1,2,2-Tetrachloroethane	14	1.4	6.3
Carbon Tetrachloride	0.06	0.02	0.09
1,2-Dichloroethane	0.3	0.005	0.01
Vinyl Chloride	0.02	0.0005	0.001
1,2,4-Trimethylbenzene	0.08	0.74	4.2
1,3,5-Trimethylbenzene	0.05	0.46	2.6
Semi-Volatile Organic Compounds			
Acenaphthene	3.2	7.1	41
Acenaphthylene	4.2	0.52	3.0
Anthracene	0.02	1,300	6,500
Benzo(a)anthracene	0.004	5.2	8.9
Benzo(b)fluoranthene	0.002	9.3	10
Benzo(g,h,i)perylene	0.0003	2,300	2,300
Benzo(k)fluoranthene	0.0008	9.6	10
Chrysene	0.002	80	99
Dibenzo(a,h)anthracene	0.0006	0.93	1.0
Fluoranthene	0.23	13	49
Fluorene	1.9	85	490
Indeno(1,2,3-cd)pyrene	0.0002	9.1	10
Phenanthrene	0.53	790	2,100
Pyrene	0.13	130	470
Benzo(a)pyrene	0.004	0.95	1.0
Naphthalene	19	1.5	8.7
Phenol	-	440	2,000
Total Petroleum Hydrocarbons			
Aliphatic hydrocarbons EC_5-EC_6	10	25	80
Aliphatic hydrocarbons >EC_6-EC_8	5.4	51	240
Aliphatic hydrocarbons >EC_8-EC_{10}	0.23	11	63
Aliphatic hydrocarbons >EC_{10}-EC_{12}	0.03	50	300
Aliphatic hydrocarbons >EC_{12}-EC_{16}	0.0008	22	130
Aliphatic hydrocarbons >EC_{16}-EC_{21}	-	88,000	88,000
Aliphatic hydrocarbons >EC_{21}-EC_{35}	-	88,000	88,000
Aromatic hydrocarbons >EC_8-EC_9	65	130	700
Aromatic hydrocarbons >EC_9-EC_{10}	7.4	16	92
Aromatic hydrocarbons >EC_{10}-EC_{12}	25	58	300
Aromatic hydrocarbons >EC_{12}-EC_{16}	5.8	130	570
Aromatic hydrocarbons >EC_{16}-EC_{21}	-	88,000	88,000
Aromatic hydrocarbons >EC_{21}-EC_{35}	-	1,100	1,300

Notes:

-' Generic assessment criteria not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data.

EC - equivalent carbon. GrAC - groundwater assessment criteria. SAC - soil assessment criteria.

The SAC for organic compounds are dependent on Soil Organic Matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58. 1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, polycyclic aromatic hydrocarbons, MTBE, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway, section 10.1.1, SR3.

SAC for aliphatic C10-C12 and C12-C16 is taken as soil saturation limit in accordance with CLEA. For consistency with CLEA, the GrAC for aliphatic and aromatic C12-C16 hydrocarbons and all PAH (acenaphthylene) has been set as the theoretical solubility limit.

▨	Calculated SAC exceeds soil saturation limit (SSL), thus SSL taken as SAC in line with recently published SGV. For consistency where the GrAC exceeds the solubility limit, GrAC has been set at the solubility limit. These are highly conservative since concentrations of the chemical are very unlikely to be at sufficient concentration to result in an exceedance of the health criteria value at the point of exposure (i.e. indoor air) provided free-phase product is absent.

APPENDIX H

Generic Assessment Criteria for Phytotoxic Effects, Pipelines and Controlled Waters

GENERIC ASSESSMENT CRITERIA FOR PHYTOTOXIC EFFECTS, PIPELINES AND CONTROLLED WATERS

This appendix presents the generic assessment criteria (GAC) that RSK considers are suitable for assessing risks to:

- Vegetation via the uptake of phytotoxic determinants through plant roots;
- Water supply pipes constructed using conventional pipe materials, i.e. polyethylene; and
- Controlled waters.

The GAC for each of these receptors is discussed in turn.

PHYTOTOXIC DETERMINANTS TO FACILITATE HEALTHY PLANT GROWTH

Copper and zinc can inhibit plant growth but are not normally hazardous to human health. The GAC for this pollutant linkage have been taken from Department of the Environment Publication, Code of Practice for Agricultural Use of Sewage Sludge, 1996. The GAC for the phytotoxic determinants are presented in Table A1. The table also includes nickel since this is also phytotoxic determinant and the Soil Guideline Value (SGV which is protective of human health) for a commercial (5000mg/kg) or residential without plant uptake (75mg/kg) is greater than the GAC to protect plant growth in acidic soil. Therefore, the SGV may not be suitably protective of the phytotoxic effects pathway.

Table A1: Generic Assessment Criteria for Phytotoxic Determinants

Determinant	Generic Assessment Criteria (mg/kg)			
	pH 5.0 < 5.5	pH 5.5 < 6.0	pH 6.0 < 7.0	pH >7.0
Zinc	200	200	200	300
Copper	80	100	135	200
Nickel	50	60	75	110

WATER SUPPLY PIPES

Risks to water supply pipes have been assessed in accordance with the Water Regulations Advisory Scheme Information and Guidance Note 9-04-03, dated October 2002 and the flow chart included as Figure A1 in this appendix.

The regulations include a requirement to use only suitable materials when laying water pipes and laying water pipes without protection is not permitted at contaminated sites. The water supplier has a statutory duty to enforce the regulations. Therefore, this assessment is a guide, the results of which should be checked with the water supplier.

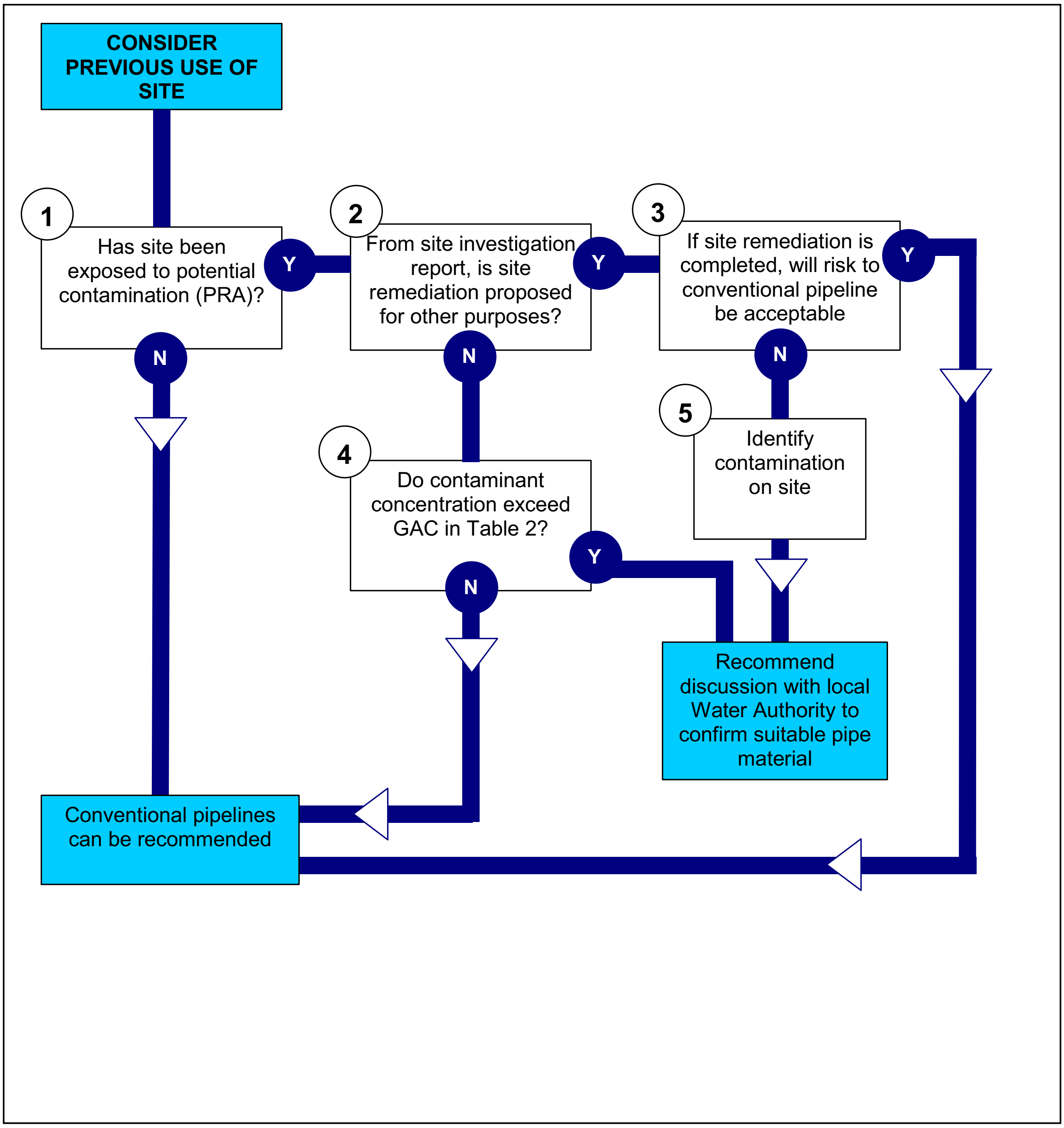
Since water supply pipes are typically laid at a minimum depth of 750mm below finished ground levels, sample results from depths between 0.5m and 1.5m below finished level are generally considered suitable for assessing risks to water supply. Samples outside these depths can be used providing the strata is the same as that in which water supply pipes are likely to be located. The GAC for this linkage are recorded in Table A2 and are based on recommendations of the ‘Foundation for Water Research Guidance Note, FR0448: Laying Potable Water Pipelines in Contaminated Ground, 1994’. Owing to the number of caveats and lack of research into contaminants that could affect water supply, the water industry has undertaken research on a project entitled ‘Pipe Materials Selection and Specification for use in Contaminated Land’. This document will be used to update the GAC for this pathway once available.

Table A2: Generic Assessment Criteria for Water Supply Pipes

CONTAMINANT	GAC (mg/kg dried soil)
Corrosion	
Sulphate (SO_4)	2000
Sulphur (S)	5000
Sulphide	250
pH	Less than pH5 Greater than pH8
Toxic Substances	
Antimony(Sb)	10
Arsenic (As)	10*
Cadmium(Cd)	3
Chromium (hexavalent) (Cr)	25
Chromium (total) (Cr)	600
Cyanide (free) (CN)	25*
Cyanide (complexed) (CN)	250*
Lead (Pb)	500
Mercury (Hg)	1
Selenium(Se)	3
Thiocyanate (SCN)	50
Organic Contaminants	
Coal Tar	50
Cyclohexane extractable	50
Phenol	5
Polycyclic Aromatic Hydrocarbons	50
Toluene extractable	50
Petroleum Hydrocarbons	50
Notes: * denotes ‘it is not recommended that water pipes should be laid in sites where these substances are identified or suspected’.	

FIGURE A1

FLOW CHART FOR WATER SUPPLY PIPELINE ASSESSMENT ADOPTED FROM GUIDANCE NOTE 9-04-03



CONTROLLED WATERS

The GAC for controlled waters are presented in Table A3. In line with the Environment Agency's Remedial Targets Methodology dated December 2006, the GAC for controlled waters are termed 'target concentrations'.

The target concentration can be derived by several means with consideration to:

- Whether the substance is classified as List I or List II substance by the EU under the Groundwater Directive 80/68/EEC;
- Background concentrations in the aquifer; and
- Published guidance such as Environmental Quality Standards that are protective of ecology or The Water Supply (Water Quality) Regulations 2001 that are protective of drinking water.

A list of target concentrations considered suitable to assess risks to major aquifers and minor aquifers are presented in Table A3. Those for a major aquifer are taken from the UK Water Supply (Water Quality) Standards where possible owing to the possibility of a drinking water supply being within an influencing distance from the site or the possibility of one being installed. The target concentrations for a minor aquifer are generally taken as the freshwater Environmental Quality Standards where available owing to groundwater in minor aquifers commonly providing baseflow to surface watercourses.

Table A3: Target Concentrations for Controlled Waters

Determinant	Target Concentrations (mg/l)	
	Major Aquifer/Source Protection Zone	Minor Aquifer/Surface Watercourse
Metals		
Arsenic	0.01(1)	0.05(7)
Cadmium	0.005(1)	0.005(7)
Chromium (total)	0.05(1)	0.005, 0.01, 0.02, 0.02, 0.05, 0.05(8)
Copper	2.0(1)	0.001, 0.006, 0.01, 0.01, 0.01 0.028(8)
Lead	0.025(1)	0.004, 0.01, 0.01, 0.02, 0.02, 0.02(8)
Mercury	0.001(1)	0.001(7)
Selenium	0.01(1)	0.01(1,12)
Nickel	0.02(1)	0.05, 0.1, 0.15, 0.15, 0.2, 0.2(8)
Zinc	5(2)	0.008, 0.05, 0.075, 0.075, 0.075, 0.125(8)

Chlorinated Solvents		
Trichloroethene	0.01(1)	0.01(7)
Tetrachloroethene		0.01(7)
1,1,1-Trichloroethane	0.0001(3)	0.1(7)
1,1,2-Trichloroethane	0.0001(3)	0.4(7)
Carbon Tetrachloride	0.003(1)	0.012(7)
1,2-Dichloroethane	0.003(1)	0.01(7)
Vinyl Chloride	0.0005(1)	0.0005(1,12)
Trihalomethanes	0.1(4)	0.1(4,12)
Chloroform (one of the trihalomethanes included above)	-	0.012(7)
Polycyclic Aromatic Hydrocarbons		
Acenaphthene	0.0058(9,13)	0.0058(9)
Acenaphthylene	0.0058(9,13)	0.0058(9)
Anthracene	0.000012(9,13)	0.000012(9)
Benzo(a)anthracene	0.000018(9,13)	0.000018(9)
Benzo(b)fluoranthene	0.0001(1)	0.000014(9)
Benzo(k)fluoranthene		0.000014(9)
Benzo(g,h,i)perylene		0.00002(9)
Indeno(1,2,3-cd)pyrene		No data(9)
Chrysene	0.00001(9,13)	0.00001(9)
Dibenzo(a,h)anthracene	0.00001(9,13)	0.00001(9)
Fluoranthene	0.00001(9,13)	0.00001(9)
Fluorene	0.0021(9,13)	0.0021(9)
Phenanthrene	0.003(9,13)	0.003(9)
Pyrene	0.00004(9,13)	0.00004(9)
Benzo(a)pyrene	0.00001(1)	0.000015(9)
Naphthalene	0.01(9,13)	0.01(7)
Petroleum Hydrocarbons		
Total Petroleum Hydrocarbons	0.01(2)	0.01(2,10)
Benzene	0.001(1)	0.03(7)
Toluene	0.004(3)	0.05(7)
Ethylbenzene	0.02(8,13)	0.02(8)
Xylene	0.003(3)	0.03(7)
Methyl t-Butyl ether	0.015(6)	0.015(6,12)
Pesticides and Herbicides		
Aldrin	0.00003(1)	0.00001(7)
Dieldrin	0.00003(1)	0.00003(1,12)
Heptachlor	0.00003(1)	0.00003(1,12)
Heptachlor epoxide	0.00003(1)	0.00003(1,12)
Other pesticides	0.0001(1)	0.0001(1,12)
Total pesticides	0.0005(1)	0.0005(1,12)

Endrin	0.000005(7,13)	0.000005(7)
Total DDT	0.000025(7,13)	0.000025(7)
Azinphos - methyl	0.00001(7,13)	0.00001(7)
Cyfluthrin	0.000001(7,13)	0.000001(7)
Demeton	0.0005(7,13)	0.0005(7)
Dichlorvos	0.000001(7,13)	0.000001(7)
Dimethoate	0.001(7,13)	0.001(7)
Endosulphan	0.000003(7,13)	0.000003(7)
Fenitrothion	0.000001(7,13)	0.000001(7)
Flucofuron	0.001(7,13)	0.001(7)
Malathion	0.00001(7,13)	0.00001(7)
Mevinphos	0.00002(7,13)	0.00002(7)
Omethoate	0.00001(7,13)	0.00001(7)
PCSDs	0.00005(7,13)	0.00005(7)
Permethrin	0.00001(7,13)	0.00001(7)
Sulcofuron	0.025(7,13)	0.025(7)
Triazaphos	0.000005(7,13)	0.000005(7)
Atrazine & Simazine	0.002(7,13)	0.002(7)
Bentazone	0.5(7,13)	0.5(7)
Linuron	0.002(7,13)	0.002(7)
Mecoprop	0.02(7,13)	0.02(7)
Trifluralin	0.0001(7,13)	0.0001(7)
Miscellaneous		
Cyanide	0.05(1)	0.05(1,12)
Phenol	0.0005(2)	0.03(7)
Sodium	200(1)	170(7)
Chloride	250(1)	250(7)
Ammonium (as NH_{4+})	0.5(1)	0.5(1,12)
Ammonia (NH_3 as N)	0.015(7,13)	0.015(7)
Sulphate	250(1)	400(7)
Iron	0.20(1)	1(7)
Manganese	0.05(1)	0.05(1,12)
Aluminium	0.2(1)	0.2(1,12)
Nitrate (as NO_3)	50(1)	50(1,12)
Nitrite (as NO_2)	0.5(1)	0.5(1,12)

Notes

1. Statutory Instrument 2000 No 3184. The Water Supply (Water Quality) Regulations.
2. Statutory Instrument 1989 No 1147. The Water Supply (Water Quality) Regulations, 1989.
3. Environment Agency. Minimum Reporting Values listed in Appendix 7 of Hydrogeological Risk Assessments for Landfills and the Derivation of Groundwater Control and Trigger Levels. LFTGN01. Note target concentration for xylenes is 0.003mg/l each for o-xylene and m/p xylene.
4. Statutory Instrument 1989 No 3184. The Water Supply (Water Quality) Regulations, 2000 – sum of chloroform, bromoform, dibromochloromethane and bromodichloromethane.
5. Target concentration for Major Aquifer receptor taken as equal to target concentration for Minor Aquifer owing to absence of published guidance for PAH compounds other than those which are carcinogenic.
6. Environment Agency MTBE Guidance.
7. Freshwater Environmental Quality Standards.
8. Freshwater Environmental Quality Standards for all fish life (including game) and dependent upon hardness range. Hardness ranges are: 0-50mg/l $CaCO_3$, 50-100 mg/l $CaCO_3$, 100-150 mg/l $CaCO_3$, 150-200 mg/l $CaCO_3$, 200-250 mg/l $CaCO_3$ and >250 mg/l $CaCO_3$. The target concentrations included in Table 3 are listed in order of increasing calcium carbonate concentrations.
9. Polycyclic Aromatic Hydrocarbons (PAH): Priorities for Environmental Quality Standard Development, WRc Plc, R&D Technical Report P45. 2002. Where Predicted No-Effect Concentration is below the laboratory method detection limit (LMDL) for chrysene, dibenzo(ah)anthracene and fluoranthene, the target concentration has been set at the LMDL of 0.00001mg/l.
10. Owing to hydrocarbons being List I substances, 0.01mg/l (DWS) should be used in the first instance against the total of the hydrocarbon bands. However, if the hydrocarbon concentrations measured in groundwater exceed this value, an alternative value of 0.05mg/l could be used providing it is justified based on the type of aquifer and distance to secondary receptors such as a stream. The value is taken as the lowest concentration in Statutory Instrument 1996 No. 3001 titled The Surface Waters (Abstraction for Drinking Water) (Classification) Regulations, 1996.
11. Value for ethylbenzene taken from R&D Technical Report P2-115/TR4 – Proposed Environmental Quality Standards for Ethylbenzene in Water.
12. Where a published target concentration considered suitable for use with a minor aquifer could not be found for certain substances such as selenium, the target concentration used for the major aquifer has been adopted.
13. Where a published target concentration considered suitable for use with a major aquifer could not be found for certain substances such as ethylbenzene, the target concentration used for the minor aquifer has been adopted.

‘-’ A target concentration for chloroform for a major aquifer is absent since it is one of the trihalomethane compounds. See note 4 above.

APPENDIX I

HAZWASTE Assessment Results

As cmpds (AsS), Cd (CdO), CrVI cmpds ($FeCrO_4$), Cu (Cu_2O), Inorg Hg cmpds (HgO), Pb cmpds ($PbSO_4$), Ni ($NiCO_3$), Se cmpds (SeS) and Zn as ZnO. Also Ba ($BaCO_3$), Be cmpds ($BeSO_4$), Co (CoO), Mn (MnO_2) and Mo (MoO_3)

HASWASTE. Envirolab's Contaminated Land Soil Hazardous Waste Assessment Tool.

Envirolab. Units 7&8 Sandpits Business Park, Mottram Road, Hyde, Cheshire SK14 3AR.
Dr Iain Haslock. BSc, PhD, CChem, MRSC.

envirolab

Site Code and Name

P/WS/BH epth (m) nvirolab reference		PH1 0.30	PH1 0.70	PH2 0.40	PH3 0.50	PH6 0.30	PH7 0.30								
		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Arsenic		12	10	7	14	11	22								
hromium		0.1	0.1	0.1	0.1	0.1	0.1								
opper		32	22	18	55	43	49								
ead		74	24	16	201	215	367								
Nickel		45	47	36	33	50	31								
Zinc		100	82	65	118	193	194								
admium		0.5	0.5	0.5	0.5	0.5	0.5								
ercury		0.47	0.25	0.25	4.20	0.36	0.64								
elenium		2	2	2	2	2	2								
arium															
Beryllium															
Cobalt															
anganese															
olybdenum															
otal USEPA 16 PAHs															
Naphthalene		0.04	0.02	0.02	0.04	<0.01	0.07								
Acenaphthylene		0.07	0.01	0.01	0.01	0.01	0.02								
Acenaphthene		0.13	0.04	0.01	0.11	0.01	0.08								
luorene		0.02	0.01	0.01	0.01	0.01	0.01								
henanthrene		2.50	0.05	0.01	1.80	0.01	0.34								
nthracene		1.67	0.14	0.01	1.19	0.01	0.25								
Fluoranthene		9.08	0.14	0.02	4.20	0.01	1.57								
Pyrene		8.04	0.37	0.02	3.87	0.01	1.28								
enzo(a)anthracene		0.93	0.01	0.02	0.22	0.01	0.03								
hrysene		4.16	0.12	0.05	1.80	0.01	0.73								
enzo(b)fluoranthene		1.04	0.05	0.02	0.26	0.01	0.09								
enzo(k)fluoranthene		1.31	0.07	0.02	0.57	0.01	0.34								
Benzo(a)pyrene		2.13	0.04	0.04	0.92	0.01	0.34								
Indeno(123cd)pyrene		0.53	0.08	0.07	0.06	0.01	0.12								
ibenzo(ah)anthracene		0.06	0.01	0.06	0.06	0.01	0.16								
enzo(ghi)perylene		1.47	0.05	0.04	0.40	0.01	0.43								
enzo(j)fluoranthene															
Benzene		0.01	0.01	0.01	0.01	0.01	0.01								
Toluene		0.01	0.01	0.01	0.01	0.01	0.01								
Ethylbenzene		0.01	0.01	0.01	0.01	0.01	0.01								
ylenes		0.01	0.01	0.01	0.01	0.01	0.01								
rimethylbenzenes		0.01	0.01	0.01	0.01	0.01	0.01								
hlorobenzene															
1,2-Dichlorobenzene															
1,3-Dichlorobenzene															
,4-Dichlorobenzene															
,2,4-Trichlorobenzene															
-Chlorotoluene															
-Chlorotoluene															
Oil in Waste Carcinogenic H7															
Total TPH	>1,000mg/kg														
etrol or (C6-C10)	>1,000mg/kg														
iesel or (C10-C25)	>10,000mg/kg														
ube Oil or (C25+)	>1,000mg/kg														
8 IARC H7 Carcinogenic PAHs marker test (applicable to LRD only)	>1%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Kerosene															
erosene															
reosote															
reosote															
pH Corrosive H8 (Irritant H4)															
pH (soil)	<2 H8 >11.5	7.9	8.1	8.8	8.1	7.6	8.3								
H (leachate)	<2 H8 >11.5														
lkali Reserve (gNaOH/100g)															
H4 Alkali Reserve test	>13	7.9	8.1	8.8	8.1	7.6	8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H8 Alkali Reserve test	>14.5	7.9	8.1	8.8	8.1	7.6	8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Produces Toxic Gases H12															
Total Sulphide	>1,400mg/kg														
ree Cyanide	>1,200mg/kg														
CBs Total															
henols Total															
Phenol															
Cresols															
ylenols															
-Naphthol															
esourcinol															
Asbestos Screen (enter Y or N)	H7>0.1%; H5>3%; H6>25%														
azard Codes	Thresholds	%	%	%	%	%	%	%	%	%	%	%	%	%	%
rritant H4	>10%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Irritant H4	>20%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Harmful H5	>25%	0.024	0.015	0.012	0.042	#VALUE!	0.065	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
oxic H6 (Harmful H5)	>0.1%H5<7%; H6>7%	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
oxic H6 (Harmful H5)	>3%H5<25%; H6>25%	0.002	0.002	0.001	0.002	0.002	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Carcinogenic H7	>0.1%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Carcinogenic H7	>1%	0.009	0.009	0.007	0.007	0.010	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
orrosive H8 (Irritant H4)	>5%H4<10%; H8>10%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
oxic for Reproduction H10	>0.5%	0.011	0.004	0.002	0.029	0.031	0.054	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
oxic for Reproduction H10	>5%	0.011	0.004	0.002	0.029	0.031	0.054	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mutagenic H11	>0.1%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mutagenic H11	>1%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ecotoxic H14	>1.0	0.141	0.104	0.081	0.202	#VALUE!	0.302	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Consider other individual contaminants on a case by case basis.

Table 3.2 of Annex VI of the CLP Regulation.

APPENDIX J

Geotechnical Testing Results Certificates

UKAS
TESTING
No 2652

STRUCTURAL
SOILS LTD

SITE INVESTIGATION

SOIL, ROCK &
MATERIAL TESTING

GEOTECHNICAL
CONSULTANCY

CONTAMINATED
LAND ASSESSMENT

Nava
RSK STATS Geoconsult Limited
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

25th November 2009

TESTING REPORT

YOUR REF: 23283

SITE: GONDAR GARDENS, LONDON

CERTIFICATE NUMBER: 580876

DATE SAMPLES RECEIVED: 18th November 2009
DATE TESTING COMMENCED: 18th November 2009

DATE OF SAMPLE DISPOSAL: 25th December 2009

INSTRUCTIONS: Please carry out Moisture Content, Atterberg Limit, Quick Un-drained Triaxial and Oedometer tests on the samples provided.

Dear Nava,

I have pleasure in enclosing the test report for the above project that you submitted to us for testing.

Yours sincerely

Paul Kent
Laboratory Manager

Enc.

18 FROGMORE ROAD
HEMEL HEMPSTEAD
HERTS
HP3 9RT
TEL: 01442 416660
FAX: 01442 437550
hemel@soils.co.uk
www.soils.co.uk

HEAD OFFICE:
Bristol

BRANCH OFFICE:
Castleford
West Yorkshire

Borehole	Depth (m)	Moisture Content (%)	Sample Description
BH1 / 1	1.30-1.60	29	Bright brown mottled brown sandy CLAY becoming less sandy with depth.
BH1 / 2	4.50-4.80	32	Brown CLAY with occasional gypsum.
BH1 / 3	7.50-7.90	31	Brown CLAY with occasional gypsum.
BH1 / 4	10.50-10.80	25	Very dark brown CLAY with occasional pockets of black silt and gypsum.
BH1 / 5	13.50-13.90	28	Very dark brown CLAY.
BH1 / 6	16.50-16.80	27	Very dark grey CLAY.
BH1 / 7	19.50-19.90	27	Very dark grey CLAY.
BH1 / 4	1.60	33	Brown CLAY with pockets of yellowish brown silty fine sand and some gypsum.
PH1 / 5	2.90-3.00	20	Brown mottled grey CLAY with occasional pockets of silty fine sand.
PH2 / 3	2.00	24	Brown CLAY with some small pockets of silty fine sand and traces of gypsum.

Moisture contents tested in accordance with BS 1377: Part 2: 1990: Clause 3

Key to Gravel Sizes:			
	fine	-	2 to 6mm
	medium	-	6 to 20mm
	coarse	-	20 to 60mm

SUMMARY OF SAMPLE DESCRIPTIONS AND MOISTURE CONTENT

RSK STATS GEOCONSULT LIMITED
GONDAR GARDENS, LONDON 23283

UKAS TESTING
2652

Borehole	Depth (m)	Moisture Content (%)	Sample Description
PH7 / 3	2.40	25	Brown mottled grey CLAY with occasional pockets of silty fine sand.

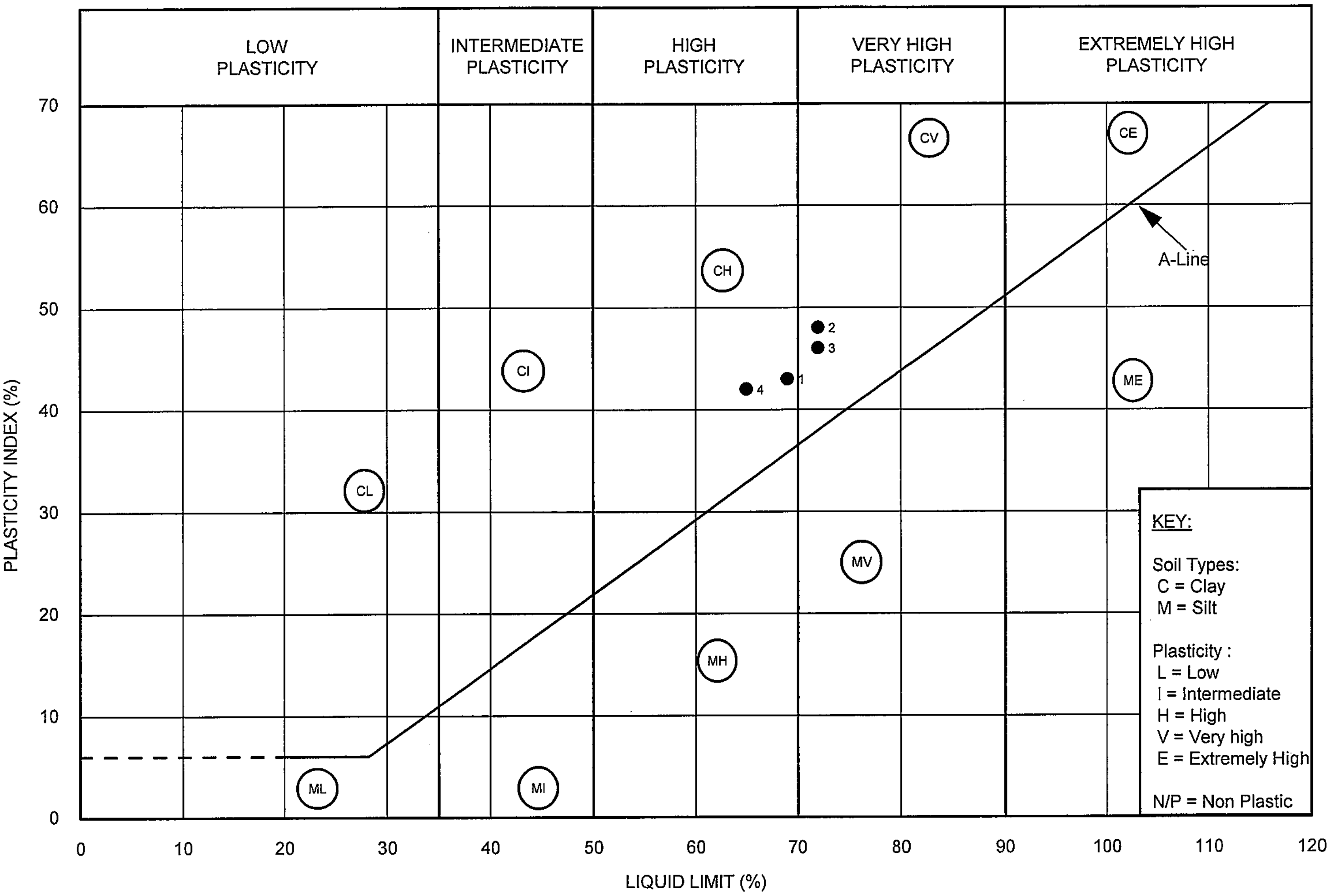
Moisture contents tested in accordance with BS 1377: Part 2: 1990: Clause 3

Key to Gravel Sizes:	fine	-	2 to 6mm
	medium	-	6 to 20mm
	coarse	-	20 to 60mm

SUMMARY OF SAMPLE DESCRIPTIONS AND MOISTURE CONTENT

Template Issue: 4 Drawn by: SC Date: 25/11/2009

Filename: 580876 / 02_SD.XLS

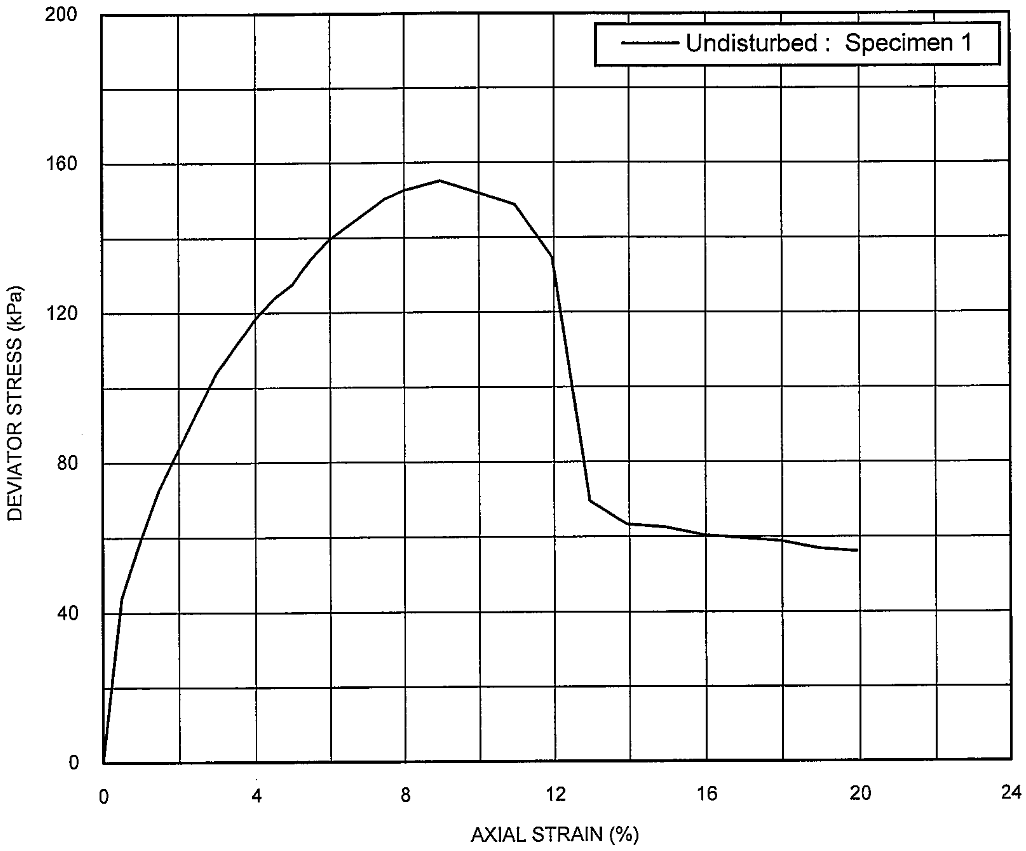


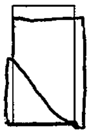
Plot Number	Borehole	Sample	Depth (m)	BS Test Method*	Preparation Method †	% Passing 425 micron Sieve	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)
1	BH1	4	1.60	4.4/5.3/5.4	4.2.3	100	69	26	43
2	PH1	5	2.90-3.00	4.4/5.3/5.4	4.2.3	100	72	24	48
3	PH2	3	2.00	4.4/5.3/5.4	4.2.3	100	72	26	46
4	PH7	3	2.40	4.4/5.3/5.4	4.2.3	100	65	23	42

*Tested in accordance with the following clauses of BS 1377:Part 2:1990:
4.3 - Cone Penetrometer Method
4.4 - One point Cone Penetrometer Method
4.5 - Casagrande Method
4.6 - One point Casagrande Method
5.3 - Plastic Limit Method
5.4 - Plasticity Index

†Tested in accordance with the following clauses of BS 1377:Part 2:1990:
4.2.3 - Natural Soil
4.2.4 - Sieved Specimen

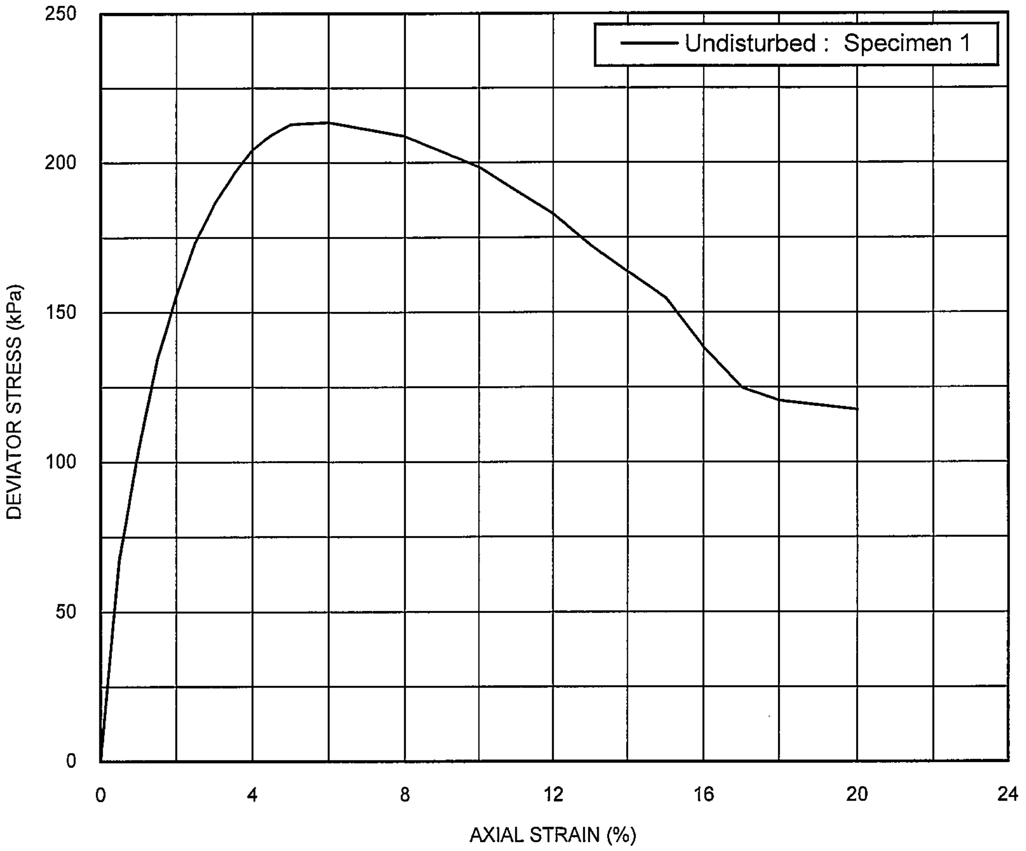
ATTERBERG LIMITS TEST RESULTS

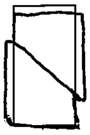


Initial Conditions	Units	Specimen 1
Sample length	mm	202.8
Sample diameter	mm	102.7
Membrane thickness	mm	0.24
Rate of strain	%/min	2.0
Bulk density	Mg/m^3	1.98
Dry density	Mg/m^3	1.56
Moisture content	%	27
Failure Conditions		
Cell pressure	kPa	26
Membrane correction	kPa	0.5
Corrected deviator stress	kPa	155
Strain at failure	%	9.0
Undrained shear strength	kPa	78
Sample Details		Failure shape 
Borehole	: BH1	
Sample	: 1	
Depth (m)	: 1.30	

Tested in accordance with BS 1377: Part 7: 1990: Clause 8

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST



Initial Conditions	Units	Specimen 1
Sample length	mm	210.0
Sample diameter	mm	102.4
Membrane thickness	mm	0.24
Rate of strain	%/min	2.0
Bulk density	Mg/m^3	1.96
Dry density	Mg/m^3	1.49
Moisture content	%	31
Failure Conditions		
Cell pressure	kPa	90
Membrane correction	kPa	0.4
Corrected deviator stress	kPa	214
Strain at failure	%	6.0
Undrained shear strength	kPa	107
Sample Details		Failure shape
Borehole	: BH1	
Sample	: 2	
Depth (m)	: 4.50	

Tested in accordance with BS 1377: Part 7: 1990: Clause 8

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST

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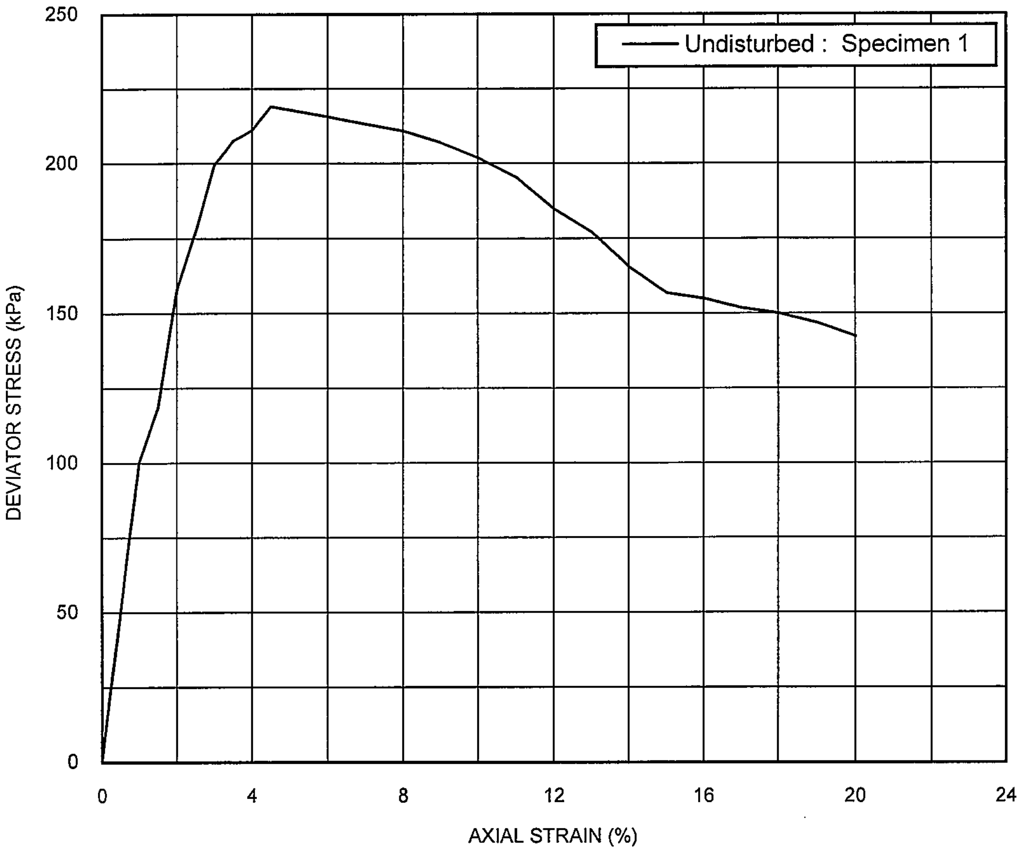
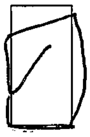
GONDAR GARDENS, LONDON 23283

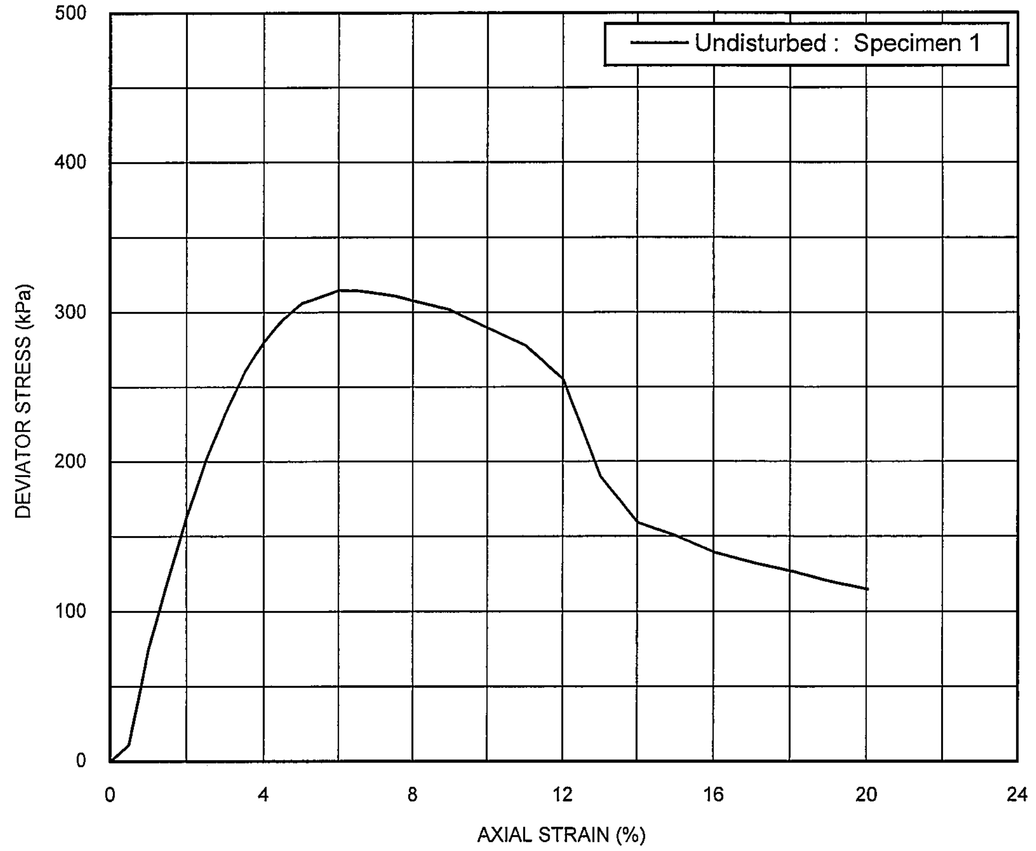
2652

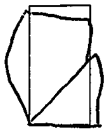


Initial Conditions	Units	Specimen 1
Sample length	mm	209.8
Sample diameter	mm	102.7
Membrane thickness	mm	0.24
Rate of strain	%/min	2.0
Bulk density	Mg/m^3	1.95
Dry density	Mg/m^3	1.48
Moisture content	%	32
Failure Conditions		
Cell pressure	kPa	150
Membrane correction	kPa	0.3
Corrected deviator stress	kPa	219
Strain at failure	%	4.5
Undrained shear strength	kPa	110
Sample Details Borehole Sample Depth (m)	 : BH1 : 3 : 7.50	Failure shape 

Tested in accordance with BS 1377: Part 7: 1990: Clause 8

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST

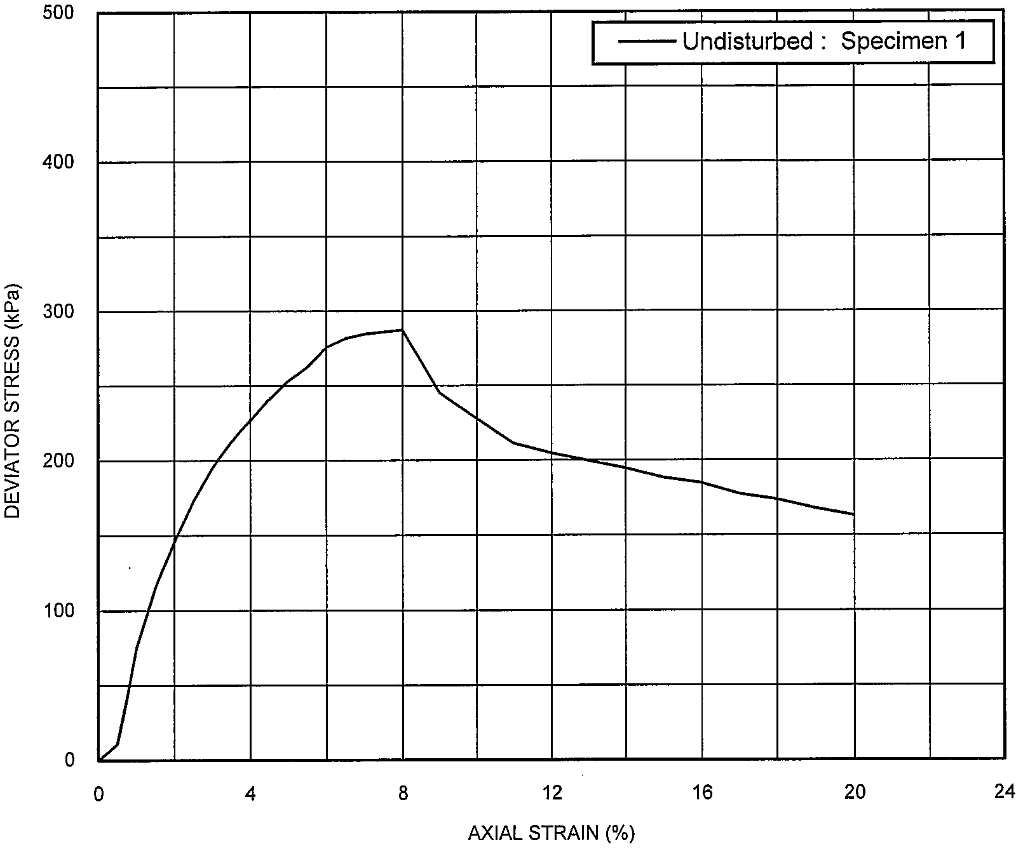


Initial Conditions	Units	Specimen 1
Sample length	mm	209.6
Sample diameter	mm	102.5
Membrane thickness	mm	0.24
Rate of strain	%/min	2.0
Bulk density	Mg/m^3	2.01
Dry density	Mg/m^3	1.59
Moisture content	%	26
Failure Conditions		
Cell pressure	kPa	210
Membrane correction	kPa	0.4
Corrected deviator stress	kPa	314
Strain at failure	%	6.0
Undrained shear strength	kPa	157
Sample Details Borehole Sample Depth (m)	: BH1 : 4 : 10.50	Failure shape 

Tested in accordance with BS 1377: Part 7: 1990: Clause 8

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST

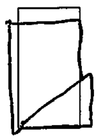
UKAS TESTING
2652



Initial Conditions	Units	Specimen 1
Sample length	mm	210.2
Sample diameter	mm	102.6
Membrane thickness	mm	0.24
Rate of strain	%/min	2.0
Bulk density	Mg/m^3	1.98
Dry density	Mg/m^3	1.55
Moisture content	%	28
Failure Conditions		
Cell pressure	kPa	270
Membrane correction	kPa	0.5
Corrected deviator stress	kPa	287
Strain at failure	%	8.0
Undrained shear strength	kPa	144

Sample Details
Borehole : BH1
Sample : 5
Depth (m) : 13.50

Failure shape



Tested in accordance with BS 1377: Part 7: 1990: Clause 8

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST

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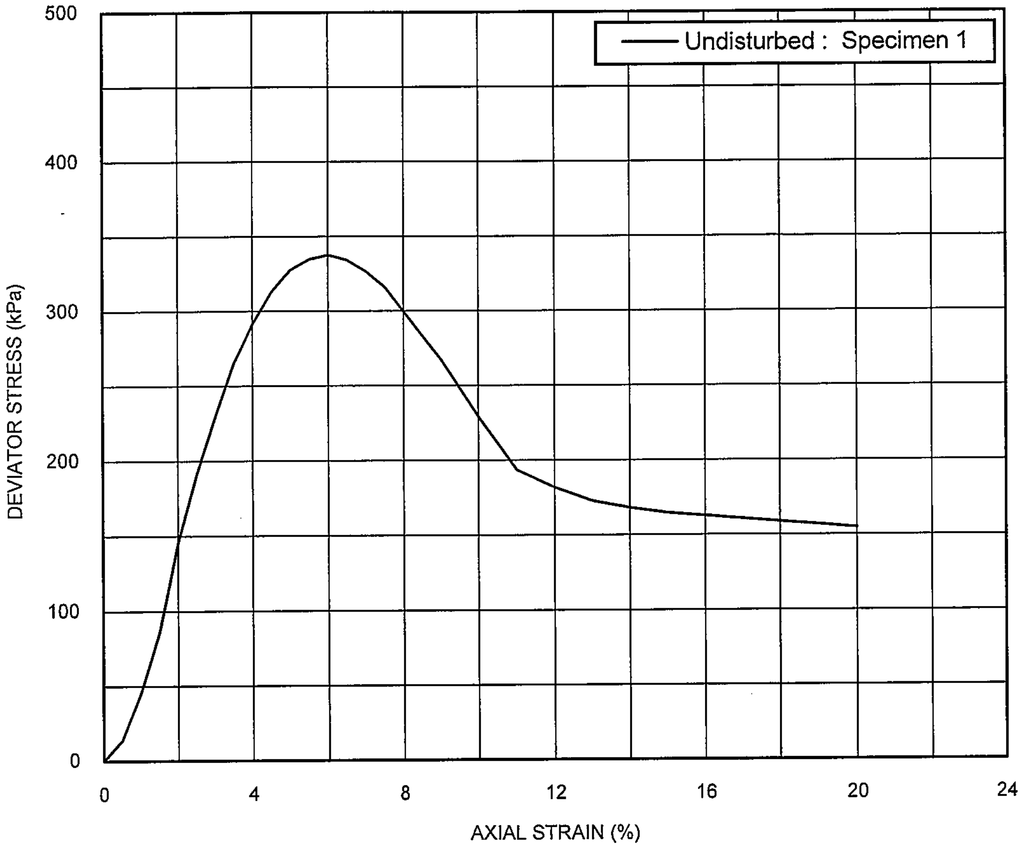
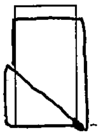
GONDAR GARDENS, LONDON 23283

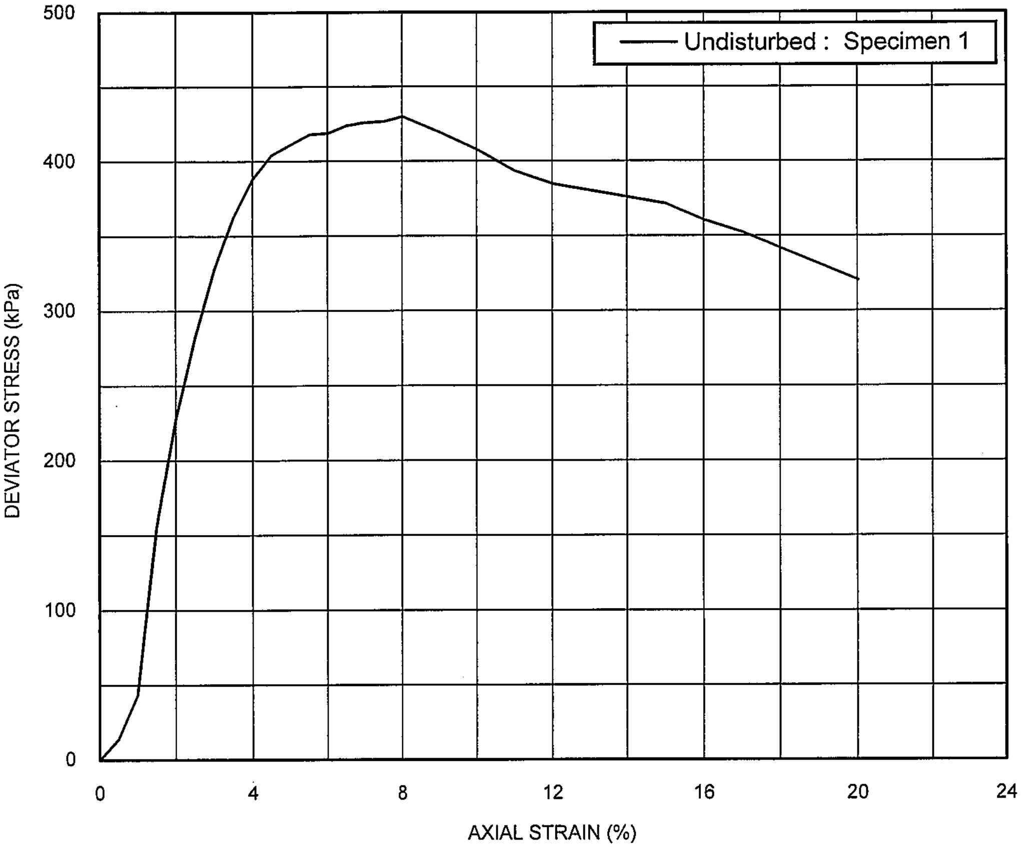
UKAS
TESTING
2652

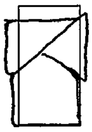


Initial Conditions	Units	Specimen 1
Sample length	mm	209.9
Sample diameter	mm	102.7
Membrane thickness	mm	0.24
Rate of strain	%/min	2.0
Bulk density	Mg/m^3	1.98
Dry density	Mg/m^3	1.56
Moisture content	%	27
Failure Conditions		
Cell pressure	kPa	330
Membrane correction	kPa	0.4
Corrected deviator stress	kPa	337
Strain at failure	%	6.0
Undrained shear strength	kPa	169
Sample Details		Failure shape 
Borehole	: BH1	
Sample	: 6	
Depth (m)	: 16.50	

Tested in accordance with BS 1377: Part 7: 1990: Clause 8

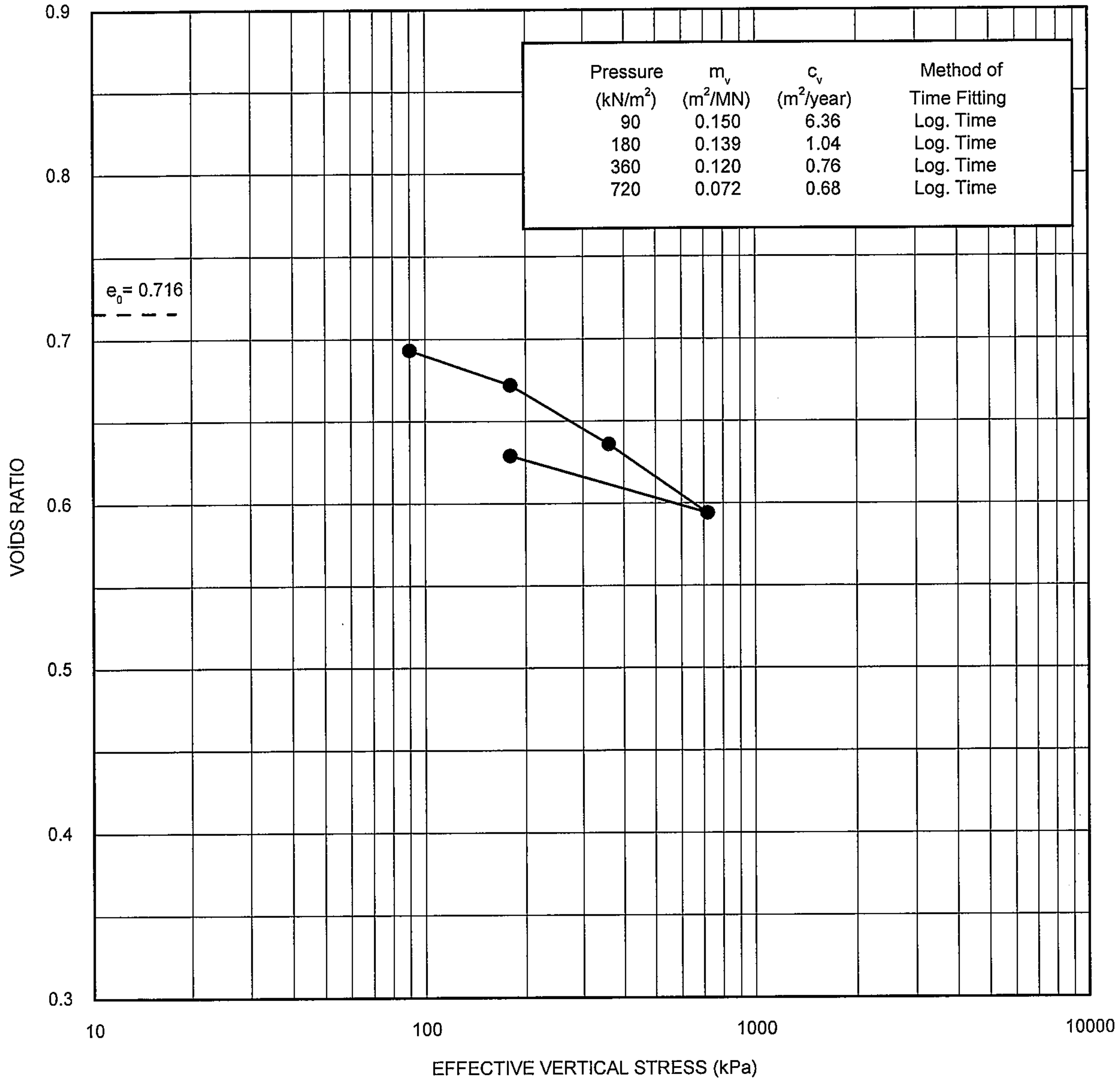
UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST



Initial Conditions	Units	Specimen 1
Sample length	mm	209.7
Sample diameter	mm	102.9
Membrane thickness	mm	0.24
Rate of strain	%/min	2.0
Bulk density	Mg/m^3	2.01
Dry density	Mg/m^3	1.58
Moisture content	%	27
Failure Conditions		
Cell pressure	kPa	390
Membrane correction	kPa	0.5
Corrected deviator stress	kPa	430
Strain at failure	%	8.0
Undrained shear strength	kPa	215
Sample Details		Failure shape 
Borehole	: BH1	
Sample	: 7	
Depth (m)	: 19.50	

Tested in accordance with BS 1377: Part 7: 1990: Clause 8

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST



Pressure (kN/m^2)	m_v (m^2/MN)	c_v (m^2/year)	Method of Time Fitting
90	0.150	6.36	Log. Time
180	0.139	1.04	Log. Time
360	0.120	0.76	Log. Time
720	0.072	0.68	Log. Time

Initial Conditions

Specimen height	: 20.0 mm	Bulk density	: 2.00 Mg/m^3
Specimen diameter	: 75.0 mm	Dry density	: 1.57 Mg/m^3
Degree of saturation	: 100 %	Moisture content	: 27 %
Particle density	: 2.70 Mg/m^3 (Assumed)	Lab. temperature	: 21 °C
Specimen condition	: Undisturbed	Swelling pressure	: NA kPa

Borehole : BH1

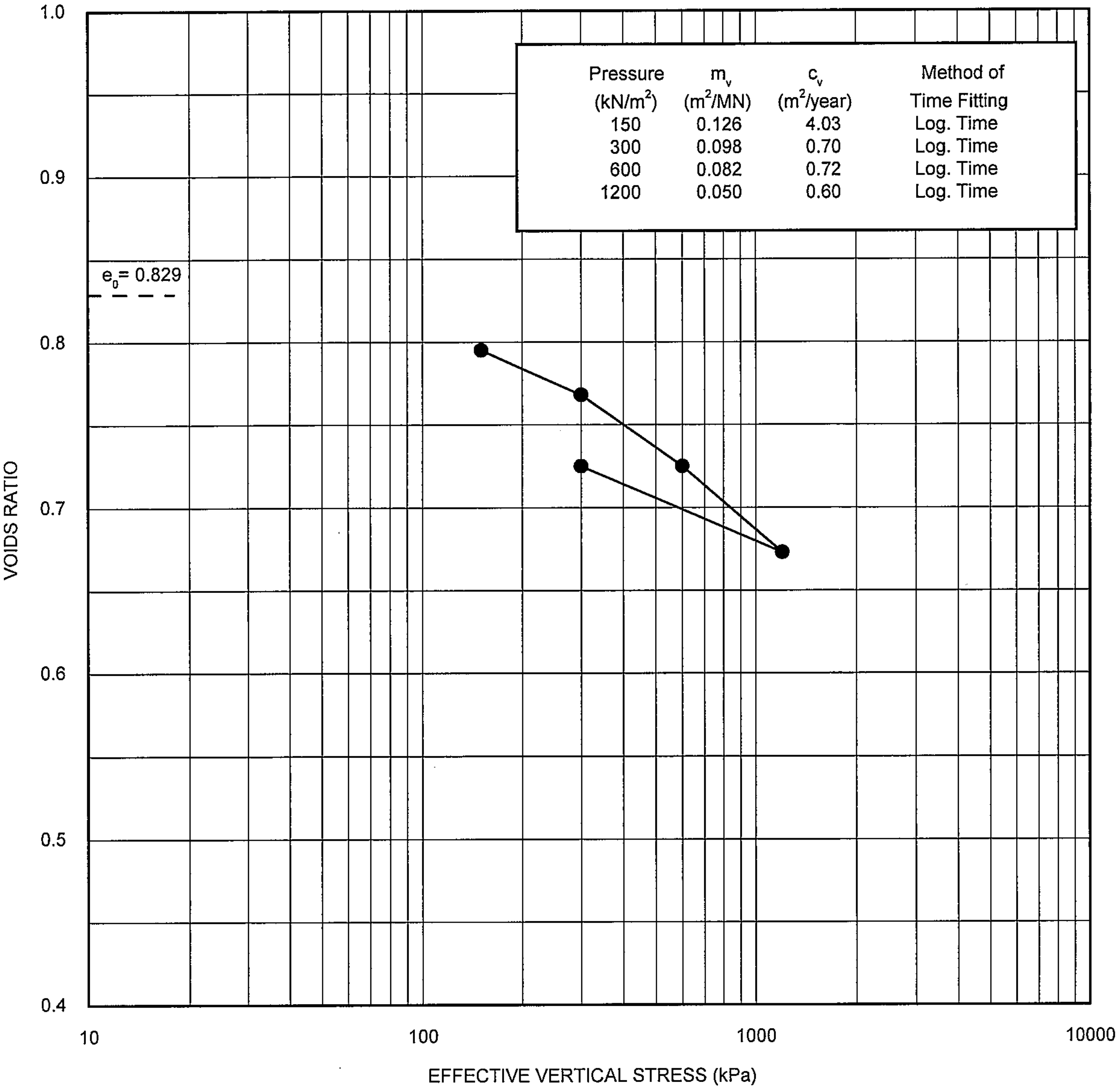
Sample : U2

Depth (m): 4.50-4.80

Specimen Depth (m): 4.70

Tested in accordance with BS1377: Part 5: 1990: Clause 3

ONE - DIMENSIONAL CONSOLIDATION TEST (OEDOMETER)



Pressure (kN/m^2)	m_v (m^2/MN)	c_v (m^2/year)	Method of Time Fitting
150	0.126	4.03	Log. Time
300	0.098	0.70	Log. Time
600	0.082	0.72	Log. Time
1200	0.050	0.60	Log. Time

Initial Conditions

Specimen height	: 19.0 mm	Bulk density	: 1.93 Mg/m^3
Specimen diameter	: 75.0 mm	Dry density	: 1.48 Mg/m^3
Degree of saturation	: 100 %	Moisture content	: 31 %
Particle density	: 2.70 Mg/m^3 (Assumed)	Lab. temperature	: 21 °C
Specimen condition	: Undisturbed	Swelling pressure	: NA kPa

Borehole : BH1

Sample : U3

Depth (m): 7.50-7.90

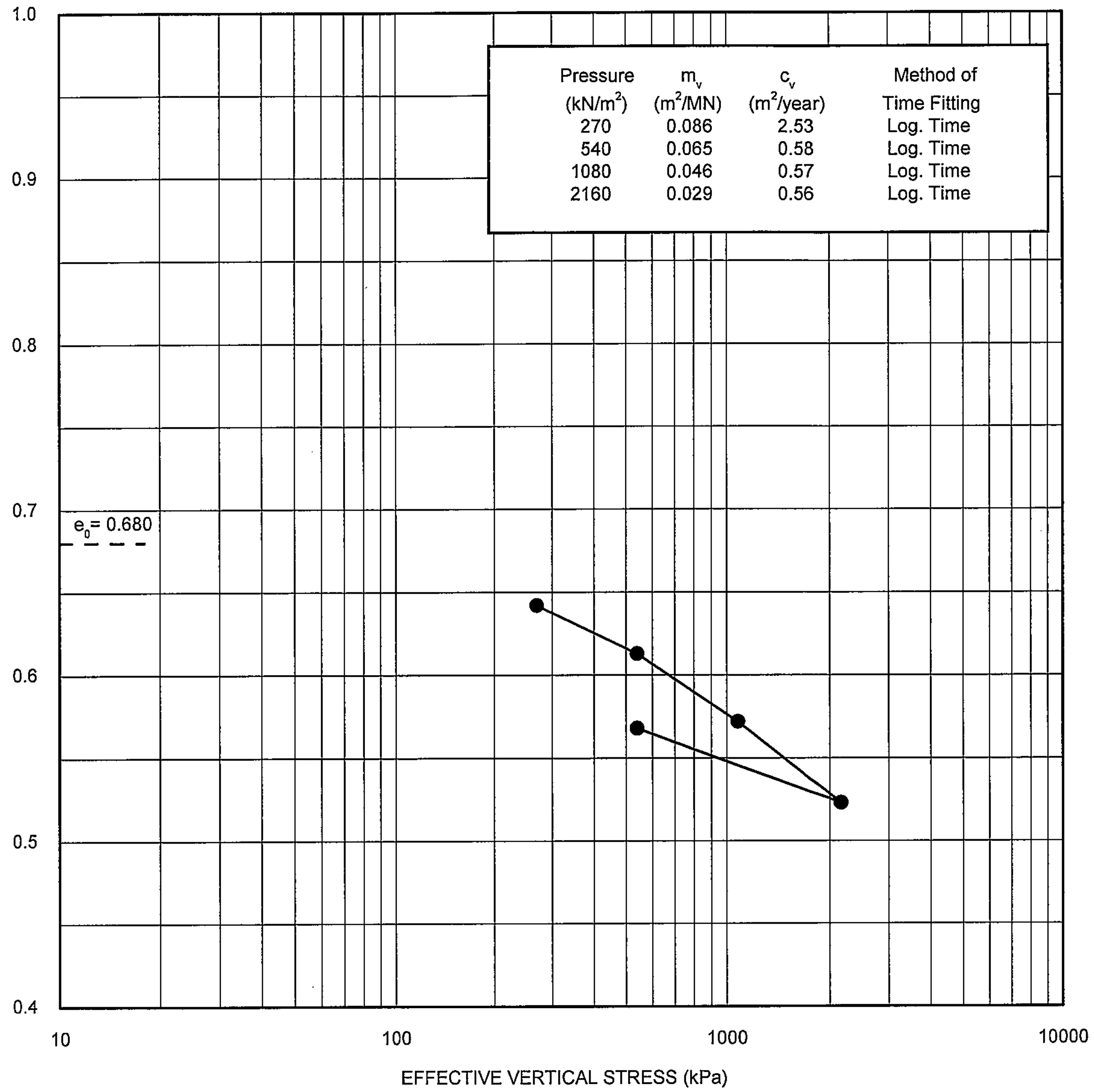
Specimen Depth (m): 7.80

Tested in accordance with BS1377: Part 5: 1990: Clause 3

ONE - DIMENSIONAL CONSOLIDATION TEST (OEDOMETER)

RSK STATS GEOCONSULT LIMITED
GONDAR GARDENS, LONDON 23283

Filename: 580876 \ COMPRESS \ BH1_U5_OD.OPJ



Pressure (kN/m^2)	m_v (m^2/MN)	c_v (m^2/year)	Method of Time Fitting
270	0.086	2.53	Log. Time
540	0.065	0.58	Log. Time
1080	0.046	0.57	Log. Time
2160	0.029	0.56	Log. Time

Initial Conditions

Specimen height	: 20.0 mm	Bulk density	: 2.02 Mg/m^3
Specimen diameter	: 75.0 mm	Dry density	: 1.61 Mg/m^3
Degree of saturation	: 100 %	Moisture content	: 26 %
Particle density	: 2.70 Mg/m^3 (Assumed)	Lab. temperature	: 21 °C
Specimen condition	: Undisturbed	Swelling pressure	: NA kPa

Borehole :	BH1
Sample :	U5
Depth (m):	13.50-13.90
Specimen Depth (m):	13.80

Tested in accordance with BS1377: Part 5: 1990: Clause 3

ONE - DIMENSIONAL
CONSOLIDATION TEST (OEDOMETER)

APPENDIX K

Shear Strength/Depth Profile

RSK GROUP PLC	Site Gondar Gardens, London	**Shear Strength - Depth Profile**	
		Client: Linden Homes Ltd	Job Number 23283