Planning Application Submission – February 2014

Land Contamination and Ground Investigation Report

Consultant: Listers Geotechnical

Latchmere House – Scheme 1

Berkeley Homes (Central London) Ltd

Berkeley
Designed for life

LISTERS

Geotechnical Consultants

DRAFT

Ministry of Justice

Ground Investigation

HMP Latchmere House
Church Road
Ham Common
RICHMOND
TW10 5HH

Report No: 12.07.020
September 2012

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EXECUTIVE SUMMARY

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Project Engineer:-	**Murray Bateman** –Director		
Date	September 2012	**Project Reference**	12-07-020
Client	Ministry of Justice		
Contact	Jones Lang LaSalle	**Client Reference**	
Site Location	HMP Latchmere House, Ham, Surrey. TW10 5HH		
OS Grid Reference	518510, 171310		
Development Proposals	Residential development – plans not put forward at the time of the investigation		
Published Geology	Kempston Park Gravel over London Clay		
Topography	Flat-lying		
Vegetation	No significant vegetation		
Existing Buildings	Disused prison with exercise yard, cell block, chapel, hospital, vistors centre, work area etcup until 1914-1918		
Site History	Large residential house and garden to First World War; then hospital for "shell-shocked" officers; then an interrogation camp for MI5 during WW II and prison after the war.		
Hydrology	No nearby significant water features		
Hydrogeology	Underlying Kempton Park Gravel are a Secondary A Aquifer, not within a SPZ		
Geotechnical Hazards	None		
Ground Conditions Encountered	Made Ground to a maximum of 1.00m bgl overlying medium dense to very dense granular sand, gravelly sands and sandy gravels.		
Groundwater Encountered	Approximately 3.00m bgl		
Ground Contamination	Nothing significant but contingency should be allowed for, for isolated pockets encountered during construction.		
Groundwater Contamination	Risk considered to be very low		
Site Remediation Required	None specifically		
Soil Gases	None		
Foundations	Strips or Pads		
Allowable Bearing Pressure/Safe Bearing Capacity	175 to 200 kN/m^2		
Floor Slabs	Ground bearing		
Waste Soil Classification	INERT		
Soakaways	Will be successful		
Roads & Hard Standing Design	CBR 20%		
Chemical Attack On Buried Concrete	Design Sulphate Class DS –1 ACEC Class AC-3z		

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APPENDICES

GROUND INVESTIGATION REPORT

INTRODUCTION

A ground investigation has been undertaken at HMP Latchmere House, Church Road, Ham Common, Richmond, TW10 5HH. A Site Location Plan is provided in Appendix A. The Ordnance Survey National Grid reference for the centre of the site is 518510, 171310.

This report describes the work carried out by Listers Geotechnical Consultants, the ground conditions encountered and discusses their implications with regard to the proposed development.

Instructions to undertake the investigation were received from the employer's agent, Jones Lang LaSalle, in their budget acceptance form, dated 3rd August 2012.

This report has been prepared for the sole use of the client and their professional advisors. This report shall not be relied upon by third parties without the express written authority of Listers Geotechnical Consultants. If an unauthorised third party comes into possession of this report they must not rely on it and the authors owe them no duty of care and skill.

SCOPE OF THE INVESTIGATION

The scope of the investigation was to undertake a desk study and walkover survey, provide an assessment of the geotechnical engineering properties of the ground and the extent of any soil contamination on the site. A contaminated land risk assessment was undertaken based on the Contaminated Land Exposure Assessment (CLEA) and Environment Agency R&D P20 guidelines.

This investigation has been undertaken in order to determine any potential liabilities associated with the purchase of the site, to enable unconditional bid for the land from potential buyers. The report can be assigned to the eventual purchasers of the land.

PROPOSALS

Clear proposals for development of the land were not available at the time of writing the report, although it was envisaged that the site would be attractive to residential developers.

SITE INFORMATION AND WALKOVER SURVEY

A walkover survey of the site and its immediate surrounds was undertaken on the 23rd July 2012. A selection of site photographs is provided in Appendix A along with the site plans.

The site is located to the north of Kingston upon Thames adjacent to Richmond Deer Park in a mainly residential area. It is bound to the south and west by houses and gardens and to the northeast by parkland.

It is an approximately rectangular parcel of land with maximum dimensions of 250m from southwest to northeast and 100 metres from southeast to northwest. The site is entered from the north via Church Road, where you pull into a large tarmaced area in front of the old Latchmere House, a large three storey brick built Victorian mansion house, with tarmac car parking to the rear. The main ex-detention centre lays to the south of the old house and is surrounded by a large steel fence. This is entered from the north with a guard house to the immediate west of the entrance; this is a single storey brick building with tarmac surround. To the rear of the building was an area that appeared to have housed an above storage tank of some kind, there being a concrete base and disconnected pipes running out of the wall adjacent. This area was targeted during the intrusive investigation.

To the south of the guard house was a works area, which was a collection of huts and an old two storey brick building, that housed a large number of workshops and storerooms surrounded by a tarmaced area. The was a hazardous chemicals storeroom (that can be seen in the photographs), a carpenters shops, an electronics room and other storerooms. The chemical store and carpenters shop were targeted during the intrusive investigation.

To the east of the works area were the Chaplains' office, reception and infirmary. These consisted of a variety of one and two storey brick built buildings, that were locked at the time of the investigation. To the north of the hospital building was an old boiler house, with pipes leading south towards the hospital building.

To the south of the hospital building was a two storey brick built cell block, which was also locked at the time of the investigation. To the southeast of the hospital block was the market garden area with strawberry patch, aviary, and vegetable patch. At the time of the investigation the area was overgrown with grass.

The kitchen block was to the south of the garden area and was a modern single storey brick built block with corrugated roof. To the southwest of this block was a large above ground storage fuel tank (AST) that fed an emergency generator. The fuel tank was bunded, and there was no leakage visible, with pipes travelling partially above ground and partially below to the generator, 15 metres to the south.

A light assembly workshop was located to the east of that, which was again a modern single storey block built building, which had been used for the assembly of plastic buckets.

The gymnasium was located to the southwest of the light assembly workshop and the main parade ground to the south. The parade ground was an open area of tarmac, which had become overgrown with weeds along joints and the gym was an old building that was once a swimming pool, but now had wooden flooring and weightlifting equipment. To the south and west of the parade ground were two areas that had been the bases for above ground fuel storage tanks (AST). To the south the Hazchem warning sign was still in place indicating flammable liquid (most likely diesel), see photographs in the Appendices.

To the east of the parade ground was the Chapel and Education block, both brick built structures with no potential pollution sources and running along the southern boundary was cell block 'B', another two storey brick built detention unit.

There were a number of potential point pollution sources revealed during the walkover survey, as described above. These were all targeted during the investigation, however, there were no significant indicates of pollution (oil staining on floors etc) and over all the whole site area seemed to have been in good order, if overgrown, due to lack of recent usage.

GEOLOGY

Published Geology

Reference to the British Geological Survey 1:50,000 scale map and other published geological information on the area indicates that the site is underlain by Kempston Park Gravel of Quaternary age overlying London Clay Formation strata of Eocene age at depth.

The Kempston Park Gravel is a River Terrace Gravel Deposit, which means they are ancient floodplain deposits of the River Thames when it was at a higher level, before erosion occurred. As such, it will consist of sands and sand and gravel with rare sandy clay lenses.

The London Clay Formation is an ancient sea floor deposits and as such consists of blue grey mudstones, which weather to a stiff chocolate brown clay with orange silt partings, near surface. These deposits underlay the majority of London to a considerable thickness.

DESK STUDY AND BACKGROUND INFORMATION

GENERAL

A desk study review of the site and its history has been undertaken to establish the former land usage and the potential for any historically derived sources of chemical contamination. A copy of the desk study information is presented in Appendix C of this report.

It should be noted that the information provided in the desk study is obtained from independent third party sources. It is provided in good faith, but no guarantee can be provided as to its accuracy. The Client should make independent enquiries on information provided in the desk study information that may impact on the proposed development. The desk study information is not necessarily exhaustive and further information relevant to the site may be available from other sources.

The desk study comprises a review of the following consultations and information sources:-

1. Environment Agency (EA)
2. Natural England
3. National Geoscience Information Service
4. Centre for Ecology & Hydrology
5. British Geological Survey (BGS)
6. Contemporary Trade Directories
7. Historical Ordnance Survey maps

Information from the above referenced sources has been utilised to develop a conceptual model of the site for use in the geotechnical appraisal and source-pathway-receptor risk assessment.

HISTORY OF THE SITE

The history of the site has been established by reviewing the historical Ordnance Survey maps and aerial imagery of the area, collected as part of the desk study information. This has established the following:-

The first map of 1871 shows that the large Victorian House, marked ‘Latchmere House’, had been built by this time. It is believed to have belonged to the Tollemache family, Earls of Dysart. It does not appear as large at this time, being extended by 1897. The area of the prison appears to be gardens at this time, with localised wooded and grassed areas. There is an old gravel pit 100m to the east of the site.

As stated the house was extended before 1897, but it is not until the map of 1913 that building are constructed to the south.

Access to the internet indicate that during WW I Latchmere house and it's estate was used as a convalescence hospital for British Army officers returning with mental problems, such as "shell shock". It can be seen in this map that there were a number of buildings built along the northwest boundary (one appearing to be the gymnasium or swimming pool at that time). Other buildings are also seen to the northwest of the main house. The majority of the grounds remain open wooded and grassed areas.

The buildings remain unchanged until between 1920 and 1933 when the hospital wing and cell block 'A' area can be seen attached to the main house. Again after research, it can be seen that the house and land were used during WW II by MI5 as an interrogation camp for enemy spies and sympathizers.

Immediately after the war (1948) the house and land was handed to Her Majesty's Prison Service and was initially used as a young offenders institute, then a remand centre, deportees prison and latterly as a rehabilitation centre for prisoners about to finish their sentence. The prison finally closed in 2011. Reference to the historical maps was not very instructive, as the development has been blocked out, but reference to a underground water services plan provided by the client shows the make up of the prison circa 1970 with oil storage tanks adjacent to the kitchen, gymnasium and cell block 'B', as discussed during the walkover survey.

Surrounding the site development does not encroach with 250m until the map of 1938, when residential roads are built around the whole southern area of the site. There is a sand and gravel ballast pit 150m to the east of the site in the map of 1933, but this is infilled between 1940 and 1948 and covered with housing. There is no significant amount of development after WW II, just infill residential development.

HYDROLOGY

The nearest significant surface watercourse is the River Thames that flows towards the north, approximately 750m to the southwest of the site. In this area the River Thames has been designated as River Quality B.

The River Quality scale is a grading system established by the Environment Agency and is based on dissolved oxygen, biological oxygen demand and ammonia content of the river. Grade A is classified as being very good, whilst Grade F is classified as being bad.

There are no current surface water abstraction licenses located within 1000m of the site.

HYDROGEOLOGY

Information obtained from the Environment Agency indicates that the site is located on a Secondary A Superficial Aquifer, the Kempston Park Formation and Non-Productive Bedrock.

The aquifer designation data is based on geological mapping provided by the British Geological Survey. The maps are divided into two different types of aquifer designation:

- **Superficial (Drift)** - permeable unconsolidated (loose) deposits. For example, sands and gravels.
- **Bedrock** - solid permeable formations e.g. sandstone, chalk and limestone.

For each type there are Principal, Secondary A, Secondary B and Unproductive Strata, each with a decreasing rank of importance.

There are no current groundwater abstraction licenses located within 1000m of the site.

According to information provided by the Environment Agency the site is outside of any Source Protection Zones (SPZ). An SPZ is a protection zone placed around a well or borehole that supplies groundwater of potable quality. An SPZ is divided into three zones defined as follows.

There have been no substantiated pollution incidents to controlled waters within 250m of the site.

LANDFILL, WASTE TREATMENT AND INDUSTRIAL USAGE SITES

Reference to records from the BGS, the Environment Agency and the Local Authority indicates that there are no waste transfer, waste treatment or waste management facilities within 1000m of the site area. However, there is one historical landfill disposal sites within 900m of the site. However, this is to the southwest and across the River Thames. There was also the sand and ballast to the immediate east of the site that is now covered with residential housing. This is not indicated at all, and there is not record to it having been backfilled at all.

There have been no applications for Integrated Pollution Control Licenses or Integrated Pollution Prevention and Control (IPPC) licenses within 2000m of the site.

There are seven past or present trade directory entries that have been found within 250m of the site, these are all listed in Appendix C. These include domestic appliance servicing, cleaning services, dry cleaners and office equipment distributers.

RADON GAS

Reference to information obtained from the National Geoscience Information Service indicates that the site lies within an area where <1% of homes exceed the action level of 200Bq/m^3 for radon gas. The BGS recommends that no radon protection measures are necessary in the construction of new dwellings or extensions.

RISK OF GASEOUS CONTAMINATION

We have provisionally assessed the risk of ground gas impacting the site, by reference to guidance given in the paper "A pragmatic approach to ground gas risk assessment for the 21st Century" Card and Wilson, 2011. This is a follow up paper to the CIRIA Report 665 and is compatible with that document.

- No credible sources or pathways for landfill gas migration from an off site landfill have been identified, although the old sand and gravel pit 100m to the east of the site is a slight risk.
- The site has not been a registered landfill
- The Made Ground is not expected to be 5m deep or an average of 3m in thickness.
- The site is not located on a carbonate rich rock that can produce carbon dioxide.
- Radon protection measures are not recommended/required for this site.
- Table 2 in the Card and Wilson 2011 paper has been referenced and the site does not lie on a potential naturally organic soil or a humic or degradable Made Ground soil, as defined in this table.

As such, it is considered that gas monitoring is not required at this site. However as we have installed groundwater monitoring standpipes at the site and as a precaution these have been monitored for ground gasses twice over a period of four weeks during groundwater monitoring. The results are reported later in this report.

CONCEPTUAL MODEL

A preliminary qualitative risk assessment has been carried out using the source-pathway-receptor principle. As such, potential sources of contamination and potential receptors have been assessed using the Contaminated Land Exposure Assessment (CLEA) Guidelines. The fact that a pathway must exist between a potential source of contamination and a potential receptor for there to be a risk, has been taken into account.

The results of the desk study and walkover indicate that the following potential sources of ground contamination are present at or in close proximity to the site:

1. Made Ground is possibly present at the site associated with historical development.
2. Above ground storage pits and boiler houses across the site, where hydrocarbons could have leaked into the ground.
3. The very slight possibility of migrating soil gases from the old sand and gravel pit to the east of the site.

The following most sensitive receptors have been identified at the site:

Human Health

1. End users of the site (residents)
2. Surrounding residents
3. Construction workers

Environmental

1. Controlled Waters - the Kempston Park Formation- Secondary A aquifer beneath the site.

It is considered that a number of potential pathways exist between these potential sources and the above identified receptors.

For the human receptors these include:

1. Direct soil ingestion in areas of exposed soil.
2. Ingestion of soil attached to homegrown fruit and vegetables.
3. Ingestion of fruit and vegetables with contamination uptake.
4. Inhalation of indoor and outdoor vapours and dust.
5. Dermal contact with contaminated soil.
6. Inhalation of soil gases or vapours migrating through permeable strata into the building.

For the environmental receptors the pathways include:

1. Migration of contaminants through the unsaturated zone.
2. Migration of contaminants through the groundwater.
3. Migration of soil gases through permeable strata.

EXPLORATION AND TESTING

GENERAL

A total of eighteen continuous tube sample boreholes were put down on the site between the 23rd and 25th July 2012. The logs are provided in Appendix A.

SAMPLING STRATEGY

The positions of the exploratory holes were selected by Listers Geotechnical Consultants to provide a wide coverage of information on the site area. As the desk study and walkover survey had identified a number of potential pollution sources at the site several of the exploratory holes were targeted on these sources. These included:

Target	Exploratory Hole
Work area Chemical Store	CT 15
Work Area Carpenter Shop	CT 14
Guardhouse AST	CT 18
Kitchen AST	CT 10
Parade Ground AST's	CT's 4 and 5

The other exploratory holes were positioned to create a semi regular pattern across the site, in order to provide a spread of information.

The position of all exploratory holes undertaken at the site as part of this investigation can be seen on the Exploratory Hole Location Plan included in Appendix A. The results of the laboratory testing are provided in Appendix B.

METHODOLOGY

The continuous tube sample boreholes, CT 1 to CT 18, were put down using an Archway Competitor Dart rig to a maximum depth of 6.0m. Boreholes were advanced using a plastic lined steel tube sampling system, driven into the ground by a top drive percussive hammer. A near continuous 87mm – 67mm diameter core sample was recovered of the sampled materials for future examination and sub-sampling.

Following the sampling, Super-Heavy dynamic probing, DP 1 to DP 6, was carried out adjacent to the position of boreholes CT4 (DP 1), CT5 (DP2), CT 12 (DP 3), CT 15 (DP 4), CT 16 (DP 5) and CT 18 (DP 6). This entailed the 63.5 kg weight of the sampler rig falling a set distance of 0.75m and forcing a

set of rods with a cone at the end into the ground. The cone used had an apex angle of 90° and a diameter of 50.5mm, giving an area of 20cm^2. The number of blows taken to achieve each 100mm penetration was recorded and given as the N_{100} value. This N_{100} value gives a reading of in-situ density in the underlying soils.

On completion of the boring, boreholes CT 4, 5 and 15 were utilised for the installation of a 50mm diameter slotted uPVC standpipe from the base of the borehole up to within 1.0m below existing ground level. From 1.0m depth up to ground level a plain pipe was added. The slotted section of the standpipe was surrounded with pea gravel, while expansive bentonite clay was added around the plain pipe and below the slotted section to seal the borehole. The standpipe was finished with a stopcock cover, which was then concreted flush with ground level.

Engineering and Geoenvironmental conclusions given in this report are based on data obtained from these sources but it should be noted that variations, which affect these conclusions, may occur between and beyond the test locations. Also water levels may vary with time.

GROUND CONDITIONS

The site and laboratory test work revealed that the general succession of strata can be represented by Made Ground or Topsoil overlying Kempston Park Gravel. It may be summarised as follows:

Made Ground - encountered from ground level down to depths ranging from 0.25m bgl to 1.10m bgl. It consisted of tarmac, concrete, dense brick and concrete sandy gravel but mainly of dark brown sandy Topsoil. The average depth across the site was approximately 0.50m bgl.

Kempston Park Gravel - encountered at every location from beneath the Made Ground and to the full depth of the investigation at a maximum of 6.00m bgl. It consisted of a variety of granular strata including loose to medium dense sand, medium dense to very dense gravelly sands and very dense sand and gravels.

Full laboratory sieve analyses on the granular soil horizons revealed these to be a variety of sands, gravelly sands and sands and gravels.

The results of the Super /Heavy dynamic probing indicated that the Kempston Park Gravel was medium dense to very dense with a general increase in density with depth.

Sulphate and pH Tests

Soluble sulphate tests carried out on samples recovered from the exploratory holes recorded values ranging from 0.04g/l to 0.21g/l, in conjunction with pH values ranging from 5.0 to 7.2.

GROUNDWATER

Groundwater was encountered during the fieldwork in five of the deeper boreholes at depths ranging from 3.00m bgl to 3.50m bgl.

Long term monitoring undertaken in the standpipes installed in CT's 4, 5 and 15 revealed standing groundwater level ranging from 3.12m bgl to 3.28m bgl.

OBSERVED SOIL CONTAMINATION

There was no visual or olfactory evidence of contamination during the fieldwork.

PERMEABILITY TESTING

Permeability testing was undertaken in CT's 4, 5 and 15 on the 3rd August 2012. Results are provided in Appendix A.

The results of the permeability testing indicate that the Secondary A Kempston Park Gravel Aquifer beneath the site has a permeability in the order of $1*10^{-3}$m/s to $5*10^{-4}$m/s. Considered to be very good soil permeability.

GROUND GAS

Ground gas monitoring carried out as a part of this investigation has revealed oxygen levels of between 19.3% and 20.4% by volume, carbon dioxide levels of between 0% and 1.4% by volume, and methane levels below detection.

Flow rates ranged between 0l/hr and 0.1l/hr. These low flow rates are indicative of the soils encountered which did not include any significant thicknesses of Made Ground, or have any significant quantities of organic matter or materials which can decay.

The results are provided in Appendix A.

GROUND CONTAMINATION ASSESSMENT

SOIL TESTING

Fourteen samples collected on site during this investigation were tested for a range of contaminants. The suite of testing carried out on the samples was decided upon following consultation of R&D CLR Publications, published as part of the Contaminated Land Exposure Assessment (CLEA), a joint venture between the Department for Environment, Food and Rural Affairs (DEFRA) and the Environment Agency.

The test suite included a range of:-

- Metals and inorganic substances
- Speciated Polyaromatic Hydrocarbons (PAH)
- Total Petroleum Hydrocarbons (TPH), with eight band split

The soil samples were tested to obtain 'Total' values within the soil.

The results of the tests from this investigation are included in Appendix B.

RISK ASSESSMENT GUIDELINES – HUMAN HEALTH

The human health risk assessment has been undertaken using the guidance provided in the Environment Agency's publication CLR11, Model Procedures for the Management of Contaminated Land, published in September 2004. Human health assessment criteria used are based upon the proposed final land use of the site, in this case the guidelines for 'Residential with plant uptake' have been used.

Soil Guideline Values

Currently in the UK, no statutory limits for the presence of contaminants in soils or groundwater exist. Therefore, the results of the soil samples tested are compared primarily to the new Soil Guideline Values (SGVs) published from March 2009 where available, or the old SGV for lead, by DEFRA and the EA.

The new SGVs are baseline ground contamination standards calculated using the new CLEA software described below. They are based upon a sandy loam soil type with 6% soil organic matter.

Generic Assessment Criteria (GAC)

As well as the SGVs, the set of GACs produced by Land Quality Management (LQM) and the Chartered Institute of Environmental Health (CIEH) in 2009 using the CLEA software, are used as a screening tool.

The new CLEA software 1.06 version was released in October 2009 and is a deterministic exposure model with altered exposure data to the original model. The model allows the creation of a generic assessment criteria database with which to screen laboratory testing results. These GACs are conservative and based upon common assumptions.

RISK ASSESSMENT GUIDELINES – GROUNDWATER

The procedures set out in Environment Agency's Remedial Targets Methodology *Hydrogeological risk assessment for contaminated land* (2006), have been followed.

RESULTS OF TOTAL SOIL TESTS

Of all the contaminants tested two recorded values higher than their relevant environmental standard value for human health in just one of the samples tested.

Where this has occurred, statistical analyses using the methodology set out in the CL:AIRE Document "Guidance on Comparing Soil Contamination Data with a Critical Concentration", have been undertaken on the laboratory test results in order to establish a 'true mean concentration (μ)' within the planning scenario for each determinant over the whole site area.

These analyses establish whether the data is normally distributed as well as taking into account possible erroneously high values and determine whether contamination 'outliers' features are present on the site. Once this has been established the 'upper confidence limit of 95% on μ' are subsequently compared with the relevant environmental standard value, or 'Critical Concentration (C_c)'.

The results of the analyses are described below and presented in Appendix D of this report.

Lead

Of the fourteen samples tested, the values obtained ranged from <5.0mg/kg to 630mg/kg.

The statistical analysis showed that there was one outlier in CT 6. However, there was no reason for this outlier and so it was not removed

The data were non-normally distributed and the Chebychev test was undertaken on these results and a 95% upper confidence limit of 333mg/kg was established for the site.

The relevant old approach SGV for arsenic has been set at 450mg/kg.

Benzo(a)pyrene

Of the fourteen samples tested, the values obtained ranged from <0.1mg/kg to 3.8mg/kg.

There was one outlier recorded. The outlier of 3.8mg/kg was identified at 0.50m bgl depth, in CT 15 in the work area of the site, adjacent to the dangerous chemical store. This may have been the reason for therefore the outlier was excluded.

The remainder of the data were log-normally distributed and the one-sample t-test was undertaken on these results and a 95% upper confidence limit of 0.5mg/kg was established for the site.

Using the LQM/CIEH literature, the GAC for benzo(a)pyrene for this site is 0.84mg/kg, with direct soil ingestion being the pathway of concern.

HUMAN HEALTH RISK ASSESSMENT

The following qualitative risk assessment has been carried out using the source-pathway-receptor principle. As such, potential sources of contamination have been assessed using the CLEA Guidelines. The fact that a pathway must exist between a potential source and potential receptor for there to be a risk, has been taken into account. The potential human receptors evaluated for their individual risk are:-

- End users of the site (residents).
- Surrounding residents.
- Construction workers.

GENERAL

The desk study has revealed that the site area was a residential house and gardens until the outbreak of WW I, when it changed to being a hospital for British Army Officers with "shell shock". During the Second World War it become an internment and interrogation camp for MI5. After the war it was handed over to HM Prison Service and was used as a prison of one sort or another until it was closed in 2011. As such, there are not specific significant pollution sources on the site, other than those indicated in the walkover survey.

The walkover survey indicated that there was a specific works area where several chemical stores and work shops were located. From the scale of these it is considered unlikely that any significant contamination will be found in this area, however, an elevated level of benzo(a)pyrene was encountered in CT 15, which was adjacent to the chemical store. This may be due to contamination in the ground at that location, or may have just been elevated levels with the hardcore beneath the tarmac in that location.

All other areas targeted during the investigation as potential sources of contamination did not reveal any elevated hydrocarbons or other contaminants; these included above ground storage tanks (AST's) and the carpenters workshop.

No significant contamination was encountered during this intrusive investigation, and the desk study did not reveal any reason to believe that contamination would be present or would be found. Of course, it is possible that during the development stage that isolated pockets of contamination may be encountered elsewhere on the site that have not be investigation, but this is considered unlikely. A small contingency should be allowed for digging and removing isolated pockets of contamination or importing clean soil into areas of isolated rear garden, although undoubtedly this would be clarified

once the eventual developer of the site finalising proposed plans and undertakes their own specific site investigation, based on their own development plans.

GROUNDWATER RISK ASSESSMENT

The following risk assessment has, again, been carried out using the source-pathway-receptor principle. The procedures set out in the Environment Agency's Remedial Targets Methodology *Hydrogeological risk assessment for contaminated land* (2006), have been followed. The potential environmental receptor considered during this risk assessment was:-

- Controlled Waters – the Secondary A aquifer beneath the site.

GENERAL

Based on the desk study and results of the intrusive investigation and chemical testing it is considered that the risk of groundwater pollution to the above recognised Controlled Water receptor is very low.

As such, no specific further work is considered necessary at the site with regard to risk to Controlled Waters. This should be agreed with the local Environment Agency, as they will be consultees on any planning permission that is applied for.

GEOTECHNICAL ENGINEERING CONCLUSIONS

GROUND CONDITIONS

Made Ground was encountered from ground level to depths ranging from 0.25m bgl to 1.10m bgl. It consisted of tarmac, concrete, dense brick and concrete sandy gravel but mainly of dark brown sandy Topsoil. The average depth across the site was approximately 0.50m bgl.

Kempston Park Gravel was encountered at every location from beneath the Made Ground and to the full depth of the investigation, a maximum of 6.00m bgl. It consisted of a variety of granular strata including loose to medium dense sand, medium dense to very dense gravelly sands and very dense sand and gravels.

Groundwater was encountered during the fieldwork in five of the deeper boreholes at depths ranging from 3.00m bgl to 3.50m bgl.

Long term monitoring undertaken in the standpipes installed in CT's 4, 5 and 15 revealed standing groundwater level ranging from 3.12m bgl to 3.28m bgl.

There was no visual or olfactory evidence of contamination during the fieldwork.

SITE EXCAVATION

Conventional hydraulic plant should be satisfactory for excavating foundation and service trenches within the Kempton Park Gravel.

In line with recent HSE guidelines, all excavations requiring personnel access should be adequately supported to avoid the risk of collapse. Excavations within the Kempton Park Gravel are likely to be unstable.

Groundwater is expected at a depth of 3.00m bgl, and dewatering should be allowed for if excavations are to extend that deep.

FOUNDATION SOLUTIONS

Shallow Foundations

Conventional pad and strip/trench fill foundations should be suitable placed at 0.90m below ground level and not less than 0.20m below the top of the Kempton Park Gravel. Maximum net bearing pressures of 200kN/m^2 may be used for pads up to 2m square and 175kN/m^2 for strip/trench fill foundations up to 1.0m wide.

Settlement under these maximum loadings and sizes should be less than 25mm and should be virtually complete in after the loads are fully mobilised.

GROUND FLOOR SLABS

Provided all the Topsoil and Made Ground is stripped off, ground bearing floor slabs could be constructed placed on a layer of well compacted granular fill.

GAS PROTECTION

The risk of ground gases impacting the site was assessed by reference to the paper "A pragmatic approach to ground gas risk assessment for the 21st Century" Card and Wilson, 2011. This is a follow up paper to the CIRIA Report 665 and is compatible with that document.

The results of the gas monitoring have revealed that no significant carbon dioxide or methane gas is being produced in the ground. Therefore, for this residential building it is considered that no gas protection is necessary with regard to methane or carbon dioxide gas.

The BGS advises that no radon gas protection measures are necessary.

CLASSIFICATION OF WASTE MATERIAL

The excavations on site from foundation and services trenches will produce a considerable amount of surplus soil. Under current waste management legislation this soil is classified as waste and needs disposing of at a licensed facility. However, some of the soil may be able to be re-used on-site as described in the RE-USE OF MATERIAL ON SITE section below.

If it is decided that the soil should be taken off-site as waste and disposed of, the implementation of the Landfill Directive means that the waste soil requires classification prior to leaving site.

European Waste Catalogue Determination

Using the 'Total' soil contamination test results from this investigation in conjunction with the HazWasteOnline spreadsheets, all of the soil has been classified as **non-hazardous** waste.

A summary of the results of the assessment are provided in the Appendices. The full details of the assessment are available upon request.

With regard to the European Waste Catalogue Code 17 05 04 'Stone and soils from uncontaminated sites' should be classified as **inert**. As such the Kempton Park Gravel from this site should be classified as such.

Waste Acceptance Criteria (WAC) Testing Results

To further classify the Made Ground soil for landfill disposal, Waste Acceptance Criteria (WAC) testing has been carried out a representative sample collected from site. The results show that this soil **passes** the **inert** waste criteria.

Waste Classification

From the results of the HazWasteOnline spreadsheets and the WAC testing, currently, all the waste soil on this site is classified as inert and should be disposed at an **INERT** landfill site

Analytical results relevant to the materials being disposed of should be provided to the landfill operators or waste management contractors to confirm whether it meets their license agreements and to confirm tipping costs.

Site Waste Management Plan

Currently, in England, you must have a site waste management plan (SWMP) for all new construction projects worth more than £300,000.

The level of detail that your SWMP should contain depends on the estimated build cost, excluding VAT.

For projects estimated at over £500,000 (excluding VAT) the SWMP should contain details of the:

- types of waste removed from the site
- identity of the person who removed the waste and their waste carrier registration number
- a description of the waste
- site that the waste was taken to
- environmental permit or exemption held by the site where the material is taken.

At the end of the project, you must review the plan and record the reasons for any differences between the plan and what actually happened.

RE-USE OF MATERIAL ON SITE

Currently, if surplus soil is ‘fit for re-use’ on the site, exemptions can be sought from the Environment Agency to allow this activity.

A recent voluntary code of practice published by CL:AIRE, in conjunction with the EA, (the Definition of Waste: Development Industry Code of Practice, Version 2) endorses the re-use of surplus soil on and off the site of origin without the need for exemptions from the EA, dependent on whether it is “fit for

purpose". It also supports the use of "Hub and Cluster" sites (to enable surplus soil to be used on agreed sites in the local vicinity, dependent on the soil being 'fit for purpose').

Based upon the human health and groundwater risk assessments, the soils on this site are currently considered to be suitable to be re-used on site for landscaping purposes, dependent on the agreement of the Local Authority.

SUBSURFACE CONCRETE

With respect to BRE Special Digest 1 'Concrete in Aggressive Ground' (2005), chemical tests on selected soil samples have recorded soluble sulphate concentrations ranging from 0.04g/l to 0.21g/l. The pH values ranged from 5.0 to 7.2.

This would correspond to a Design Sulphate Class of **DS-1**.

In terms of BRE Special Digest 1, the former/current land use on the site means that it should be considered as natural ground.

The groundwater beneath the site should be considered as mobile.

The chemical test results should be assessed in accord with BRE Special Digest 1 and appropriate action taken for any new sub-surface concrete requirements. Reference to this document indicates that these results correspond to **AC-3z** class (ACEC) 'Aggressive Chemical Environment for Concrete' in the ground.

ACCESS ROADS AND PARKING

The structural design of a road or hard standing is based on the strength of the subgrade, which is assessed on the California Bearing Ratio, **CBR**, scale. Past experience has indicated that the measurement of the in-situ CBR value tends to give unreliable results because of the influence of the moisture content of the materials. In practice, the correlation given in Transport and Road Research Laboratory, Report LR1132, is usually more appropriate than direct determination of the CBR.

On the basis of laboratory classification tests it is recommended that for formation prepared in the Kempton Park Gravel, a subgrade CBR value of 20% be adopted for design purposes. Any areas of soft or deleterious material should be excavated and replaced with a properly compacted granular fill.

SOAKAWAYS

Permeability testing was undertaken in CT's 4, 5 and 15 on the 3rd August 2012. Results are provided in Appendix A.

The results of the permeability testing indicate that the Secondary A Kempston Park Gravel Aquifer beneath the site has permeability in the order of $1*10^{-3}$m/s to $5*10^{-4}$m/s. Considered to be very good soil permeability. As such, it is considered that soakaways would be a very effective methods of disposing of surface water run-off from this site.

REFERENCES

1. Building Research Establishment (BRE) BR 211, Radon: guidance on protective measures for new buildings. 2007.
2. Environment Agency, 'The Model Procedures for the Management of Land Contamination', CLR 11, 2004
3. Transport and Road Research Laboratory, Report 1132, 'The Structural Design of Bituminous Roads'. 1984.
4. Health and Safety Executive (HSE), "Protection of Workers and the General Public during Development of Contaminated Land" HS(G) 66. HMSO London 1991.
5. Environment Agency, Remedial Target Methodology, Hydrogeological Risk Assessment for Contaminated Land, 2006
6. Site Investigations, Code of Practice, BS5930:1999+A2 2010
7. Soils for Civil Engineering Purposes, BS1377, 1990
8. Investigation of Potentially Contaminated Sites – Code of Practice, BS10175, 2011
9. Concrete in Aggressive Ground, BRE Special Digest 1, 2005

LISTERS 12-07-020

Prepared By: -

Signed.....
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Checked By: -

Signed.....
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B.Sc, M.Sc, Ph.D, M.C.S.M, FGS, C.Geol, C.Sci

For and on behalf of Listers Geotechnical Consultants

APPENDIX 'A'

Site Work, Plans and Photographs

Site Location

Scale: 1:50,000

Crown Copyright

Date September 2012	**SITE LOCATION MAP**	Report No. 12.07.020

Key

= Window Sampler Borehole, July 2012

LATCHMERE CLOSE

boundary stone

boundary stone

security fence

security fence

garages

WORKS AREA

gate lodge and visits block

gymnasium [old swimming pool]

LIGHT ASSEMBLY WORKSHOP

A.O. STORE

STORKMAN OFFICE

C.E.S.

'A' BLOCK CELLS administration block/ hospital over GOVERNOR'S OFFICE & STEWARDS OFFICE

hospital cells

INNER HALL

gas meter

OIL STORAGE TANK

recreation room

bins

parade ground

'B' BLOCK CELLS

boiler house

oil storage tank

garden st. store

kitchen dining room

EDUCATION BLOCK

INTERDENOMINATIONAL CHAPEL C/E & R/C.

stone wall

CT 1

CT 2

CT 3

CT 4

CT 5

CT 6

CT 7

CT 8

CT 9

CT 10

CT 11

CT 12

CT 13

CT 14

CT 15

CT 16

CT 17

CT 18

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Exploratory Hole Location Plan

Site: Latchmere House, Ham, Surrey. TW10 5HH

Date: August 2012 | **Job No.:** 12.07.020

Scale: NTS

The Old House

The rear of the works area

Date:- Sept 2012	**Site Photographs**	**Job No. :- 12-07-020**

Inside the danger chemicals stores in the works area

The route leading down the western side of the site.

Date:- Sept 2012	**Site Photographs**	**Job No. :- 12-07-020**

A potential above ground tank to the rear of the guard house

An old boiler house adjacent to the site entrance

Date:- Sept 2012	**Site Photographs**	**Job No. :- 12-07-020**

The garden area

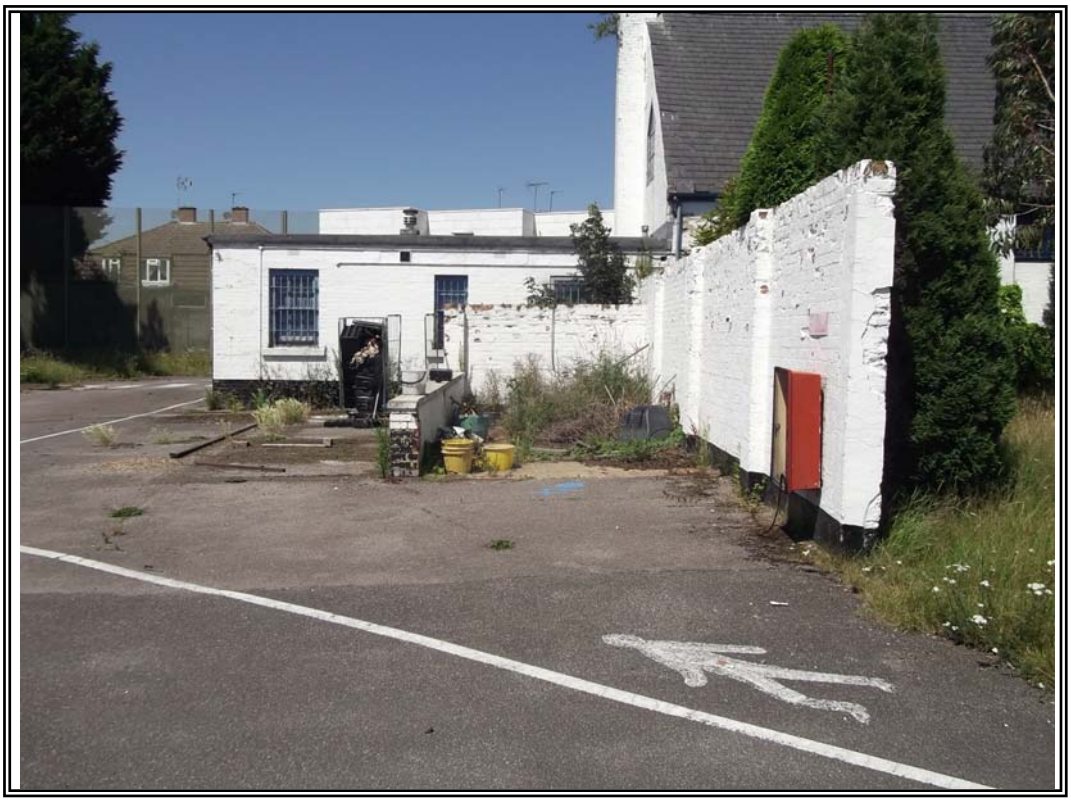
Above ground fuel tank for the emergency generator

Date:- Sept 2012	**Site Photographs**	**Job No. :- 12-07-020**

The emergency generator

The main hard standing area

Date:- Sept 2012	**Site Photographs**	**Job No. :- 12-07-020**



An area where an above ground storage tank once stood in the main hard standing area

The eastern boundary fence

Date:- Sept 2012	**Site Photographs**	**Job No. :- 12-07-020**

Hazardous chemical store and AST in main hard standing area.

Southern boundary

Date:- Sept 2012	**Site Photographs**	**Job No. :- 12-07-020**

Light Assembly Workshop

Inside the light assembly workshop

Date:- Sept 2012	**Site Photographs**	**Job No. :- 12-07-020**

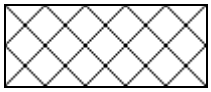
Northern end of the light assembly workshop

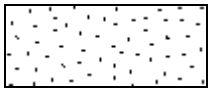
Gymnasium and access route.

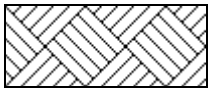
Date:- Sept 2012	**Site Photographs**	**Job No. :- 12-07-020**

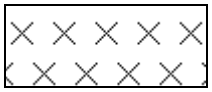
1.0 SOIL/ROCK SYMBOLS

1.1 Soils

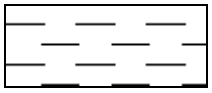

Made Ground

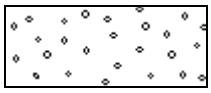

Sand

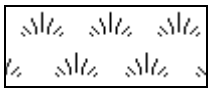

Topsoil


Silt

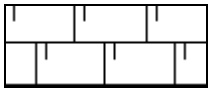

Boulders and Cobbles

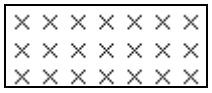

Clay

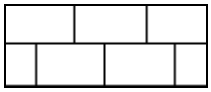

Gravel

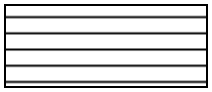

Peat

1.2 Rocks, Sedimentary

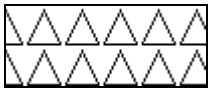

Chalk


Siltstone

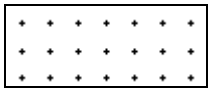

Limestone


Mudstone


Conglomerate


Breccia


Coal


Sandstone

SOIL/ROCK SYMBOLS

LOCATION: Latchmere House, Church Road, Ham Common, Richmond, Surrey

BOREHOLE NO. CT1

Date of Boring: 23/07/2012

Description of Strata	Strata Change			Samples		PP	Water Level
	Legend	Depth -m		Depth -m	Type	kPa (Cu)	-m
		Scale	Strata				
MADE GROUND Loose dark brown sandy gravelly TOPSOIL. Gravel is fine to medium angular of ash		0.0	0.50	0.10	D		
KEMPTON PARK GRAVEL Medium dense brown fine SAND		1.0	(1.10)	0.50 1.00	D D		
KEMPTON PARK GRAVEL Dense becoming very dense brown gravelly fine SAND. Gravel is fine to medium angular and subangular of flint		2.0	1.60 (0.80)	1.60 2.00	D D		Dry
Base of borehole at 2.40 m			2.40	2.40	D		
		3.0					
		4.0					
		5.0					
		6.0					

Borehole Diameter: 87mm

NGR: 518420, 171210

Instrumentation: Backfilled with arisings

Remarks:
1. Method of boring: continuous tube sampler

- ▽ Water Strike
- ▼ Water (Standing Level)
- W Water Sample
- B Bulk Sample
- D Small Disturbed Sample
- U Undisturbed Sample (No. of blows shown in brackets)
- * Extrapolated Value

Date	BOREHOLE LOG	Report No: 12.07.020
August 2012		Client Ref:

LOCATION: Latchmere House, Church Road, Ham Common, Richmond, Surrey

BOREHOLE NO. CT2

Date of Boring: 23/07/2012

Description of Strata	Strata Change: Legend	Strata Change: Depth -m Scale	Strata Change: Depth -m Strata	Samples: Depth -m	Samples: Type	PP kPa (Cu)	Water Level -m
MADE GROUND Loose dark brown sandy TOPSOIL.		0.0		0.10	D		
			0.50	0.50	D		
MADE GROUND Loose brown and dark brown slightly gravelly fine SAND. Gravel is medium angular of brick			0.90	0.90	D		
		1.0	(0.60)				
KEMPTON PARK GRAVEL Medium dense brown slightly gravelly fine SAND. Gravel is fine to medium angular of flint			1.50	1.50	D		
KEMPTON PARK GRAVEL Dense / very dense brown gravelly fine SAND. Gravel is fine to medium angular and subangular of flint		2.0		2.00	D		Dry
			(1.50)				
				2.50	D		
Base of borehole at 3.00 m		3.0	3.00	3.00	D		
		4.0					
		5.0					
		6.0					

Borehole Diameter: 87mm

NGR: 518450, 171166

Instrumentation: Backfilled with arisings

Remarks:
1. Method of boring: continuous tube sampler

- ▽ Water Strike
- ▼ Water (Standing Level)
- W Water Sample
- B Bulk Sample
- D Small Disturbed Sample
- U Undisturbed Sample (No. of blows shown in brackets)
- * Extrapolated Value

Date	BOREHOLE LOG	Report No: 12.07.020
August 2012		Client Ref:

LOCATION: Latchmere House, Church Road, Ham Common, Richmond, Surrey

BOREHOLE NO. CT3

Date of Boring: 23/07/2012

Description of Strata	Strata Change: Legend	Strata Change: Depth -m Scale	Strata Change: Depth -m Strata	Samples: Depth -m	Samples: Type	PP kPa (Cu)	Water Level -m
MADE GROUND Loose dark brown sandy TOPSOIL.		0.0	(0.60)	0.15	D		
			0.60	0.60	D		
SAND Loose becoming medium dense brown fine SAND.		1.0	(1.00)	1.00	D		
			1.60	1.60	D		
KEMPTON PARK GRAVEL Firm brown silty CLAY with roots			1.75	1.75	D		
KEMPTON PARK GRAVEL Dense brown gravelly fine SAND. Gravel is fine to medium angular and subangular of flint		2.0	(1.25)	2.00	D		Dry
				2.50	D		
Base of borehole at 3.00 m		3.0	3.00	3.00	D		
		4.0					
		5.0					
		6.0					

Borehole Diameter: 87mm

NGR: 518442, 171259

Instrumentation: Backfilled with arisings

Remarks:
1. Method of boring: continuous tube sampler

- ▽ Water Strike
- ▼ Water (Standing Level)
- W Water Sample
- B Bulk Sample
- D Small Disturbed Sample
- U Undisturbed Sample

(No. of blows shown in brackets)

- * Extrapolated Value

Date	BOREHOLE LOG	Report No: 12.07.020
August 2012		Client Ref:

LOCATION: Latchmere House, Church Road, Ham Common, Richmond, Surrey

BOREHOLE NO. CT4

Date of Boring: 23/07/2012

Description of Strata	Strata Change: Legend	Strata Change: Depth -m Scale	Strata Change: Depth -m Strata	Samples: Depth -m	Samples: Type	PP kPa (Cu)	Water Level -m
MADE GROUND Tarmac		0.0	0.05 0.12	0.12	D		
MADE GROUND Concrete			0.40	0.40	D		
MADE GROUND Loose dark brown medium SAND AND GRAVEL with brick cobbles. Gravel is fine to medium angular		1.0	0.90 (0.60)	0.90	D		
MADE GROUND Loose brown and dark brown gravelly fine SAND. Gravel is fine to medium angular with ash and brick			1.50 (0.60)	1.50	D		
KEMPTON PARK GRAVEL Loose brown slightly gravelly fine SAND. Gravel is fine to medium angular of flint Dense brown gravelly fine to medium SAND		2.0	2.10	2.10	D		
KEMPTON PARK GRAVEL				2.50	D		
KEMPTON PARK GRAVEL Medium dense becoming dense brown slightly gravelly fine SAND. Gravel is medium angular and subangular of flint		3.0	(1.90)	3.00	D		▽
				3.50	D		
KEMPTON PARK GRAVEL Dense brown fine to medium SAND AND GRAVEL. Gravel is fine to medium angular and subangular of flint		4.0	4.00 (1.00)	4.00	D		
Base of borehole at 5.00 m		5.0	5.00	5.00	D		
		6.0					

Borehole Diameter: 87mm

NGR: 518448, 171224

Instrumentation: 50mm diameter gas standpipe installed 4.00m to 1.00m, slotted pipe and gravel filter, 1.00m to GL, plain pipe, bentonite and steel cover

Remarks:

1. Method of boring: continuous tube sampler

▽ Water Strike

▼ Water (Standing Level)

W Water Sample

B Bulk Sample

D Small Disturbed Sample

U Undisturbed Sample

(No. of blows shown in brackets)

* Extrapolated Value

Date	BOREHOLE LOG	Report No: 12.07.020
August 2012		Client Ref:

LOCATION: Latchmere House, Church Road, Ham Common, Richmond, Surrey

BOREHOLE NO. CT5

Date of Boring: 23/07/2012

Description of Strata	Strata Change: Legend	Strata Change: Depth -m Scale	Strata Change: Depth -m Strata	Samples: Depth -m	Samples: Type	PP kPa (Cu)	Water Level -m
MADE GROUND Loose dark brown sandy gravelly TOPSOIL with brick and concrete cobbles. Gravel is fine to medium angular		0.0	(0.70)	0.10	D		
MADE GROUND Loose dark brown slightly gravelly fine SAND. Gravel is medium angular			0.70	0.70	D		
KEMPTON PARK GRAVEL Loose brown slightly gravelly fine SAND. Gravel is fine to medium angular of flint		1.0	1.10	1.10	D		
			1.50	1.50	D		
KEMPTON PARK GRAVEL Very dense brown fine to medium SAND AND GRAVEL. Gravel is fine to medium angular and subangular of flint		2.0	(1.50)	2.00	D		
				2.50	D		
KEMPTON PARK GRAVEL Very dense brown gravelly fine to medium SAND. Gravel is fine to medium angular and subangular of flint		3.0	3.00	3.00	D		▽ ▼
				3.50	D		
		4.0	(2.00)	4.00	D		
Base of borehole at 5.00 m		5.0	5.00	5.00	D		
		6.0					

Borehole Diameter: 87mm

NGR: 518468, 171189

Instrumentation: 50mm diameter gas standpipe installed 4.00m to 1.00m, slotted pipe and gravel filter, 1.00m to GL, plain pipe, bentonite and steel cover

Remarks:
1. Method of boring: continuous tube sampler
2. Borehole collapsed in to 4.0m
3. Very little penetration

▽ Water Strike
▼ Water (Standing Level)
W Water Sample
B Bulk Sample
D Small Disturbed Sample
U Undisturbed Sample
(No. of blows shown in brackets)
* Extrapolated Value

Date	BOREHOLE LOG	Report No: 12.07.020
August 2012		Client Ref:

LOCATION: Latchmere House, Church Road, Ham Common, Richmond, Surrey

BOREHOLE NO. CT6

Date of Boring: 23/07/2012

Description of Strata	Strata Change			Samples		PP	Water Level
	Legend	Depth -m		Depth -m	Type	kPa (Cu)	-m
		Scale	Strata				
MADE GROUND Loose dark brown sandy TOPSOIL.		0.0	(0.60)	0.10	D		
MADE GROUND Loose orange brown fine SAND.			0.60	0.60	D		
MADE GROUND Loose dark brown gravelly fine SAND. Gravel is medium angular and subangular with occasional brick		1.0	0.90	0.90	D		
KEMPTON PARK GRAVEL Dense brown fine SAND AND GRAVEL. Gravel is fine to medium angular of flint			1.40	1.40	D		
		2.0	(1.10)	2.00	D		Dry
KEMPTON PARK GRAVEL Medium dense brown slightly gravelly fine SAND. Gravel is medium angular of flint			2.50	2.50	D		
Base of borehole at 3.00 m		3.0	3.00	3.00	D		
		4.0					
		5.0					
		6.0					

Borehole Diameter: 87mm

NGR: 518492, 171177

Instrumentation: Backfilled with arisings

Remarks:
1. Method of boring: continuous tube sampler

- ▽ Water Strike
- ▼ Water (Standing Level)
- W Water Sample
- B Bulk Sample
- D Small Disturbed Sample
- U Undisturbed Sample (No. of blows shown in brackets)
- * Extrapolated Value

Date	BOREHOLE LOG	Report No: 12.07.020
August 2012		Client Ref:

LOCATION: Latchmere House, Church Road, Ham Common, Richmond, Surrey

BOREHOLE NO. CT7

Date of Boring: 24/07/2012

Description of Strata	Strata Change			Samples		PP	Water Level
	Legend	Depth -m		Depth -m	Type	kPa (Cu)	-m
		Scale	Strata				
MADE GROUND Loose dark brown sandy TOPSOIL.		0.0		0.10	D		
			0.50	0.50	D		
KEMPTON PARK GRAVEL Loose brown slightly gravelly fine SAND. Gravel is fine to medium angular of flint			(0.60)				
		1.0	1.10	1.10	D		
KEMPTON PARK GRAVEL Very dense brown fine SAND AND GRAVEL with occasional roots (2mm diameter to 1.30m). Gravel is fine to medium angular and subangular of flint			(1.00)	1.50	D		
		2.0	2.10	2.10	D		Dry
Base of borehole at 2.10 m							
		3.0					
		4.0					
		5.0					
		6.0					

Borehole Diameter: 87mm

NGR: 518525, 171211

Instrumentation: Backfilled with arisings

Remarks:
1. Method of boring: continuous tube sampler
2. No penetration past 2.10m bgl

▽ Water Strike
▼ Water (Standing Level)
W Water Sample
B Bulk Sample
D Small Disturbed Sample
U Undisturbed Sample
(No. of blows shown in brackets)
* Extrapolated Value

Date	BOREHOLE LOG	Report No: 12.07.020
August 2012		Client Ref:

LOCATION: Latchmere House, Church Road, Ham Common, Richmond, Surrey

BOREHOLE NO. CT8

Date of Boring: 23/07/2012

Description of Strata	Strata Change: Legend	Strata Change: Depth -m Scale	Strata Change: Depth -m Strata	Samples: Depth -m	Samples: Type	PP kPa (Cu)	Water Level -m
MADE GROUND Loose dark brown sandy TOPSOIL.		0.0		0.10	D		
			0.50	0.50	D		
KEMPTON PARK GRAVEL Loose brown slightly gravelly fine SAND. Gravel is fine to medium angular of flint			(0.60)				
		1.0	1.10	1.10	D		
KEMPTON PARK GRAVEL Medium dense brown fine to medium SAND AND GRAVEL. Gravel is fine to medium angular and subangular of flint				1.50	D		
		2.0	(1.90)	2.00	D		Dry
				2.50	D		
Base of borehole at 3.00 m		3.0	3.00	3.00	D		
		4.0					
		5.0					
		6.0					

Borehole Diameter: 87mm

NGR: 518496, 171222

Instrumentation: Backfilled with arisings

Remarks:
1. Method of boring: continuous tube sampler

- ▽ Water Strike
- ▼ Water (Standing Level)
- W Water Sample
- B Bulk Sample
- D Small Disturbed Sample
- U Undisturbed Sample (No. of blows shown in brackets)
- * Extrapolated Value

Date	BOREHOLE LOG	Report No: 12.07.020
August 2012		Client Ref:

LOCATION: Latchmere House, Church Road, Ham Common, Richmond, Surrey

BOREHOLE NO. CT9

Date of Boring: 23/07/2012

Description of Strata	Strata Change			Samples		PP	Water Level
	Legend	Depth -m		Depth -m	Type	kPa (Cu)	-m
		Scale	Strata				
MADE GROUND Tarmac		0.0	0.10 0.20	0.20	D		
MADE GROUND Reinforced concrete			0.50	0.50	D		
MADE GROUND Loose dark brown medium SAND AND GRAVEL with occasional concrete cobbles. Gravel is fine to medium angular and subangular		1.0	(1.10)	1.00	D		
KEMPTON PARK GRAVEL Loose / medium dense brown slightly gravelly fine SAND. Gravel is fine to medium angular and subangular of flint			1.60	1.60	D		
KEMPTON PARK GRAVEL Dense brown fine to medium SAND AND GRAVEL. Gravel is fine to medium angular and subangular of flint		2.0	2.00	2.00	D		Dry
			(1.00)	2.50	D		
KEMPTON PARK GRAVEL Medium dense brown slightly gravelly fine SAND. Gravel is fine to medium angular of flint		3.0	3.00	3.00	D		
Base of borehole at 3.00 m		4.0					
		5.0					
		6.0					

Borehole Diameter: 87mm

NGR: 518475, 171233

Instrumentation: Backfilled with arisings

Remarks:
1. Method of boring: continuous tube sampler

- ▽ Water Strike
- ▼ Water (Standing Level)
- W Water Sample
- B Bulk Sample
- D Small Disturbed Sample
- U Undisturbed Sample
  (No. of blows shown in brackets)
- * Extrapolated Value

Date	BOREHOLE LOG	Report No: 12.07.020
August 2012		Client Ref:

LOCATION: Latchmere House, Church Road, Ham Common, Richmond, Surrey

BOREHOLE NO. CT10

Date of Boring: 23/07/2012

Description of Strata	Strata Change			Samples		PP	Water Level
	Legend	Depth -m		Depth -m	Type	kPa (Cu)	-m
		Scale	Strata				
MADE GROUND Tarmac		0.0	0.13	0.13	D		
MADE GROUND Loose dark brown SAND AND GRAVEL. Gravel is fine to coarse angular with brick			0.40	0.40	D		
			(0.70)				
MADE GROUND Loose brown and dark brown slightly gravelly fine SAND with brick and concrete cobbles. Gravel is fine to medium angular and subangular (services in trial pit at 0.25m and 0.90m depth)		1.0	1.10	1.10	D		
			(0.60)				
KEMPTON PARK GRAVEL Loose / medium dense brown slightly gravelly fine SAND. Gravel is medium angular			1.70	1.70	D		
		2.0		2.00	D		Dry
			(1.30)				
KEMPTON PARK GRAVEL Medium dense brown gravelly fine SAND. Gravel is fine to medium angular and subangular of flint				2.50	D		
Base of borehole at 3.00 m		3.0	3.00	3.00	D		
		4.0					
		5.0					
		6.0					

Borehole Diameter: 87mm

NGR: 518496, 171264

Instrumentation: Backfilled with arisings

Remarks:
1. Method of boring: continuous tube sampler

- ▽ Water Strike
- ▼ Water (Standing Level)
- W Water Sample
- B Bulk Sample
- D Small Disturbed Sample
- U Undisturbed Sample

(No. of blows shown in brackets)

- * Extrapolated Value

Date	BOREHOLE LOG	Report No: 12.07.020
August 2012		Client Ref:

LOCATION: Latchmere House, Church Road, Ham Common, Richmond, Surrey

BOREHOLE NO. CT11

Date of Boring: 23/07/2012

Description of Strata	Strata Change			Samples		PP	Water Level
	Legend	Depth -m		Depth -m	Type	kPa (Cu)	-m
		Scale	Strata				
MADE GROUND Loose dark brown sandy TOPSOIL.		0.0		0.10	D		
			0.50	0.50	D		
KEMPTON PARK GRAVEL Loose becoming medium dense brown fine SAND with occasional roots (3mm diameter to 1.10m)		1.0		1.00	D		
			(1.50)				
				1.50	D		
KEMPTON PARK GRAVEL Dense brown gravelly fine SAND. Gravel is fine to medium angular of flint		2.0	2.00	2.00	D		Dry
			(1.00)	2.50	D		
Base of borehole at 3.00 m		3.0	3.00	3.00	D		
		4.0					
		5.0					
		6.0					

Borehole Diameter: 87mm

NGR: 518469, 171286

Instrumentation: Backfilled with arisings

Remarks:
1. Method of boring: continuous tube sampler

- ▽ Water Strike
- ▼ Water (Standing Level)
- W Water Sample
- B Bulk Sample
- D Small Disturbed Sample
- U Undisturbed Sample (No. of blows shown in brackets)
- * Extrapolated Value

Date	BOREHOLE LOG	Report No: 12.07.020
August 2012		Client Ref:

LOCATION: Latchmere House, Church Road, Ham Common, Richmond, Surrey

BOREHOLE NO. CT12

Date of Boring: 24/07/2012

Description of Strata	Strata Change			Samples		PP	Water Level
	Legend	Depth -m		Depth -m	Type	kPa (Cu)	-m
		Scale	Strata				
MADE GROUND Loose dark brown sandy TOPSOIL		0.0		0.10	D		
			0.40	0.40	D		
MADE GROUND Loose brown and dark brown gravelly fine SAND. Gravel is fine to medium angular and subangular							
			0.90	0.90	D		
KEMPTON PARK GRAVEL Loose brown slightly gravelly fine SAND. Gravel is fine to medium angular and subangular of flint		1.0	(0.60)				
			1.50	1.50	D		
KEMPTON PARK GRAVEL Dense becoming medium dense brown gravelly fine SAND. Gravel is fine to medium angular and subangular of flint		2.0		2.00	D		
				2.50	D		
			(2.50)				
		3.0		3.00	D		▽
				3.50	D		
KEMPTON PARK GRAVEL Medium dense brown slightly gravelly fine to medium SAND. Gravel is fine to medium angular of flint		4.0	4.00	4.00	D		
			(1.00)				
Base of borehole at 5.00 m		5.0	5.00	5.00	D		
		6.0					

Borehole Diameter: 87mm

NGR: 518533, 171267

Instrumentation: Backfilled with arisings

Remarks:
1. Method of boring: continuous tube sampler
2. Borehole collapsed to 3.1m

▽ Water Strike
▼ Water (Standing Level)
W Water Sample
B Bulk Sample
D Small Disturbed Sample
U Undisturbed Sample
(No. of blows shown in brackets)
* Extrapolated Value

Date	BOREHOLE LOG	Report No: 12.07.020
August 2012		Client Ref:

LOCATION: Latchmere House, Church Road, Ham Common, Richmond, Surrey

BOREHOLE NO. CT13

Date of Boring: 25/07/2012

Description of Strata	Strata Change			Samples		PP	Water Level
	Legend	Depth -m		Depth -m	Type	kPa (Cu)	-m
		Scale	Strata				
MADE GROUND Loose dark brown sandy TOPSOIL		0.0		0.10	D		
			0.40	0.40	D		
KEMPTON PARK GRAVEL Loose becoming medium dense brown fine SAND with roots (2mm diameter to 1.30m)		1.0	(1.10)	1.00	D		
			1.50	1.50	D		
KEMPTON PARK GRAVEL Dense brown gravelly fine SAND. Gravel is fine to medium angular of flint			(0.60)				Dry
		2.0	2.10	2.10	D		
KEMPTON PARK GRAVEL Dense brown fine SAND AND GRAVEL. Gravel is fine to medium angular and subangular of flint			(0.90)	2.50	D		
Base of borehole at 3.00 m		3.0	3.00	3.00	D		
		4.0					
		5.0					
		6.0					

Borehole Diameter: 87mm

NGR: 518515, 171310

Instrumentation: Backfilled with arisings

Remarks:
1. Method of boring: continuous tube sampler

- ▽ Water Strike
- ▼ Water (Standing Level)
- W Water Sample
- B Bulk Sample
- D Small Disturbed Sample
- U Undisturbed Sample

(No. of blows shown in brackets)

- * Extrapolated Value

Date	BOREHOLE LOG	Report No: 12.07.020
August 2012		Client Ref:

LOCATION: Latchmere House, Church Road, Ham Common, Richmond, Surrey

BOREHOLE NO. CT14

Date of Boring: 25/07/2012

Description of Strata	Strata Change: Legend	Strata Change: Depth -m Scale	Strata Change: Depth -m Strata	Samples: Depth -m	Samples: Type	PP kPa (Cu)	Water Level -m
MADE GROUND Dense dark brown medium SAND AND GRAVEL with cobbles. Gravel is fine to coarse angular		0.0		0.05	D		
			0.25	0.25	D		
MADE GROUND Loose brown and dark brown gravelly fine to medium SAND. Gravel is fine to medium angular with brick			0.60	0.60	D		
		1.0		1.00	D		
KEMPTON PARK GRAVEL Loose becoming medium dense brown fine SAND.			(1.40)	1.50	D		
KEMPTON PARK GRAVEL Dense brown gravelly fine SAND. Gravel is fine to medium angular and subangular of flint		2.0	2.00	2.00	D		Dry
			(1.00)	2.50	D		
Base of borehole at 3.00 m		3.0	3.00	3.00	D		
		4.0					
		5.0					
		6.0					

Borehole Diameter: 87mm

NGR: 518487, 171321

Instrumentation: Backfilled with arisings

Remarks:
1. Method of boring: continuous tube sampler

- ▽ Water Strike
- ▼ Water (Standing Level)
- W Water Sample
- B Bulk Sample
- D Small Disturbed Sample
- U Undisturbed Sample
  (No. of blows shown in brackets)
- * Extrapolated Value

Date	BOREHOLE LOG	Report No: 12.07.020
August 2012		Client Ref:

LOCATION: Latchmere House, Church Road, Ham Common, Richmond, Surrey

BOREHOLE NO. CT15

Date of Boring: 25/07/2012

Description of Strata	Strata Change: Legend	Strata Change: Depth -m Scale	Strata Change: Depth -m Strata	Samples: Depth -m	Samples: Type	PP kPa (Cu)	Water Level -m
MADE GROUND Tarmac		0.0	0.07	0.07	D		
			0.25	0.25	D		
MADE GROUND Dense dark brown medium SAND AND GRAVEL with cobbles. Gravel is fine to coarse angular flint and brick				0.50	D		
			(1.25)				
		1.0		1.00	D		
KEMPTON PARK GRAVEL Loose becoming medium dense brown fine SAND.							
			1.50	1.50	D		
KEMPTON PARK GRAVEL Dense brown gravelly fine SAND. Gravel is fine to medium angular of flint							
		2.0		2.00	D		
				2.50	D		
		3.0		3.00	D		▼
				3.50	D		▽
			(4.50)				
		4.0		4.00	D		
		5.0		5.00	D		
				5.50	D		
Base of borehole at 6.00 m		6.0	6.00	6.00	D		

Borehole Diameter: 87mm

NGR: 518508, 171337

Instrumentation: 50mm diameter gas standpipe installed 4.00m to 1.00m, slotted pipe and gravel filter, 1.00m to GL, plain pipe, bentonite and steel cover

Remarks:
1. Method of boring: continuous tube sampler
2. Borehole collapsed in to 4.0m

▽ Water Strike
▼ Water (Standing Level)
W Water Sample
B Bulk Sample
D Small Disturbed Sample
U Undisturbed Sample
(No. of blows shown in brackets)
* Extrapolated Value

Date	BOREHOLE LOG	Report No: 12.07.020
August 2012		Client Ref:

LOCATION: Latchmere House, Church Road, Ham Common, Richmond, Surrey

BOREHOLE NO. CT16

Date of Boring: 25/07/2012

Description of Strata	Strata Change			Samples		PP	Water Level
	Legend	Depth -m		Depth -m	Type	kPa (Cu)	-m
		Scale	Strata				
MADE GROUND Loose dark brown sandy TOPSOIL		0.0		0.10	D		
			0.50	0.50	D		
KEMPTON PARK GRAVEL Loose brown slightly gravelly fine SAND. Gravel is medium angular of flint		1.0	(1.10)	1.00	D		
			1.60	1.60	D		
KEMPTON PARK GRAVEL Dense becoming medium dense brown gravelly fine SAND. Gravel is fine to coarse angular and subangular of flint		2.0		2.00	D		
				2.50	D		
			(2.40)				▼
		3.0		3.00	D		
				3.50	D		
KEMPTON PARK GRAVEL Medium dense brown slightly gravelly fine to medium SAND. Gravel is fine to medium angular of flint		4.0	4.00	4.00	D		
			(1.00)				
Base of borehole at 5.00 m		5.0	5.00	5.00	D		
		6.0					

Borehole Diameter: 87mm

NGR: 518564, 171303

Instrumentation: Backfilled with arisings

Remarks:
1. Method of boring: continuous tube sampler
2. Borehole collapsed in to 2.9m

▽ Water Strike
▼ Water (Standing Level)
W Water Sample
B Bulk Sample
D Small Disturbed Sample
U Undisturbed Sample
(No. of blows shown in brackets)
* Extrapolated Value

Date	BOREHOLE LOG	Report No: 12.07.020
August 2012		Client Ref:

LOCATION: Latchmere House, Church Road, Ham Common, Richmond, Surrey

BOREHOLE NO. CT17

Date of Boring: 25/07/2012

Description of Strata	Strata Change: Legend	Strata Change: Depth -m Scale	Strata Change: Depth -m Strata	Samples: Depth -m	Samples: Type	PP kPa (Cu)	Water Level -m
MADE GROUND Tarmac		0.0	0.10	0.10	D		
			0.30	0.30	D		
MADE GROUND Medium dense black fine to medium SAND AND GRAVEL with cobbles. Gravel is fine to medium angular with brick and ash			(0.60)				
		1.0	0.90	0.90	D		
MADE GROUND Loose brown fine SAND with brick cobbles			(0.60)				
KEMPTON PARK GRAVEL Loose / medium dense brown fine SAND.			1.50	1.50	D		
KEMPTON PARK GRAVEL Very dense brown gravelly fine SAND. Gravel is fine to medium angular of flint		2.0	(1.30)	2.00	D		Dry
				2.50	D		
Base of borehole at 2.80 m			2.80	2.80	D		
		3.0					
		4.0					
		5.0					
		6.0					

Borehole Diameter: 87mm

NGR: 518550, 171343

Instrumentation: Backfilled with arisings

Remarks:
1. Method of boring: continuous tube sampler
2. No penetration pastm 2.80m bgl

- ▽ Water Strike
- ▼ Water (Standing Level)
- W Water Sample
- B Bulk Sample
- D Small Disturbed Sample
- U Undisturbed Sample (No. of blows shown in brackets)
- * Extrapolated Value

Date	BOREHOLE LOG	Report No: 12.07.020
August 2012		Client Ref:

LOCATION: Latchmere House, Church Road, Ham Common, Richmond, Surrey

BOREHOLE NO. CT18

Date of Boring: 25/07/2012

Description of Strata	Strata Change			Samples		PP	Water Level
	Legend	Depth -m		Depth -m	Type	kPa (Cu)	-m
		Scale	Strata				
MADE GROUND Tarmac		0.0	0.10	0.10	D		
MADE GROUND Medium dense dark brown gravelly fine to medium SAND with brick cobbles. Gravel is fine to medium angular with brick and ash			0.40 (0.60)	0.40	D		
KEMPTON PARK GRAVEL Loose brown fine SAND		1.0	1.00	1.00	D		
KEMPTON PARK GRAVEL Loose becoming medium dense brown slightly gravelly fine SAND. Gravel is fine to medium angular of flint			(0.90) 1.90	1.50 1.90	D D		Dry
KEMPTON PARK GRAVEL Very dense brown fine SAND AND GRAVEL. Gravel is fine to medium angular and subangular of flint		2.0	(0.70) 2.60	2.60	D		
Base of borehole at 2.60 m		3.0 4.0 5.0 6.0					

Borehole Diameter: 87mm

NGR: 518538, 171368

Instrumentation: Backfilled with arisings

Remarks:
1. Method of boring: continuous tube sampler
2. No penetration past 2.60m bgl

- ▽ Water Strike
- ▼ Water (Standing Level)
- W Water Sample
- B Bulk Sample
- D Small Disturbed Sample
- U Undisturbed Sample (No. of blows shown in brackets)
- * Extrapolated Value

Date	BOREHOLE LOG	Report No: 12.07.020
August 2012		Client Ref:

DPH and SHDP DYNAMIC PROBING

This is a simple test consisting of driving a rod with an oversize point at its base into the ground. A uniform, regular, hammer blow is used. The blow count is recorded for every 100mm of driving (N_{100}) and the results presented as a plot of blow count against depth.

Outside the UK this type of testing has been used extensively in a wide range of formats (ie. various hammer weights, hammer drops, point sizes, etc.) for many years. Since 1985 Dynamic Probing has become widely accepted in this country and the first British Standard for this test was published in 1990.

The standard equipment is a petrol powered unit using a 50kg hammer dropping through 0.50m 32mm diameter rods and a 15cm^2 area cone. This is the Heavy Dynamic Probe (DPH) and the equipment has been selected for general use as giving a good compromise between sensitivity in loose materials and penetration rates in denser materials. A sacrificial cone is used for each probing. A damper is used between the hammer and anvil.

The Super Heavy Dynamic Probe (DPSH) is a heavier version, using a 63.5kg hammer dropping through 0.75m, 32mm diameter rods and a 20cm^2 area cone.

The hammer operation is automated and driving is carried out as a continuous operation from ground level without a borehole. The test therefore not only provides a continuous record for the full depth penetration but also avoids many of the problems associated with poor operator technique when carrying out SPTs in boreholes.

Dynamic Probing provides an excellent method for locating boundaries between strata of differing density and driving resistance as well as comparative assessments of a single strata across a site. Comparisons between Dynamic probing results, SPT values and other soil parameters are given in DIN4094. Information on UK practice and correlation data in UK soils was published at the ICE Conference on Penetration Testing in 1988.

The complete machine weights 140kg stands 2.5m high and measures 750mm wide x 850mm deep when erected. For movement between positions the mast is lowered and the machine wheeled on an integral axle. Probing can be carried out within 300mm of a vertical wall.

References:

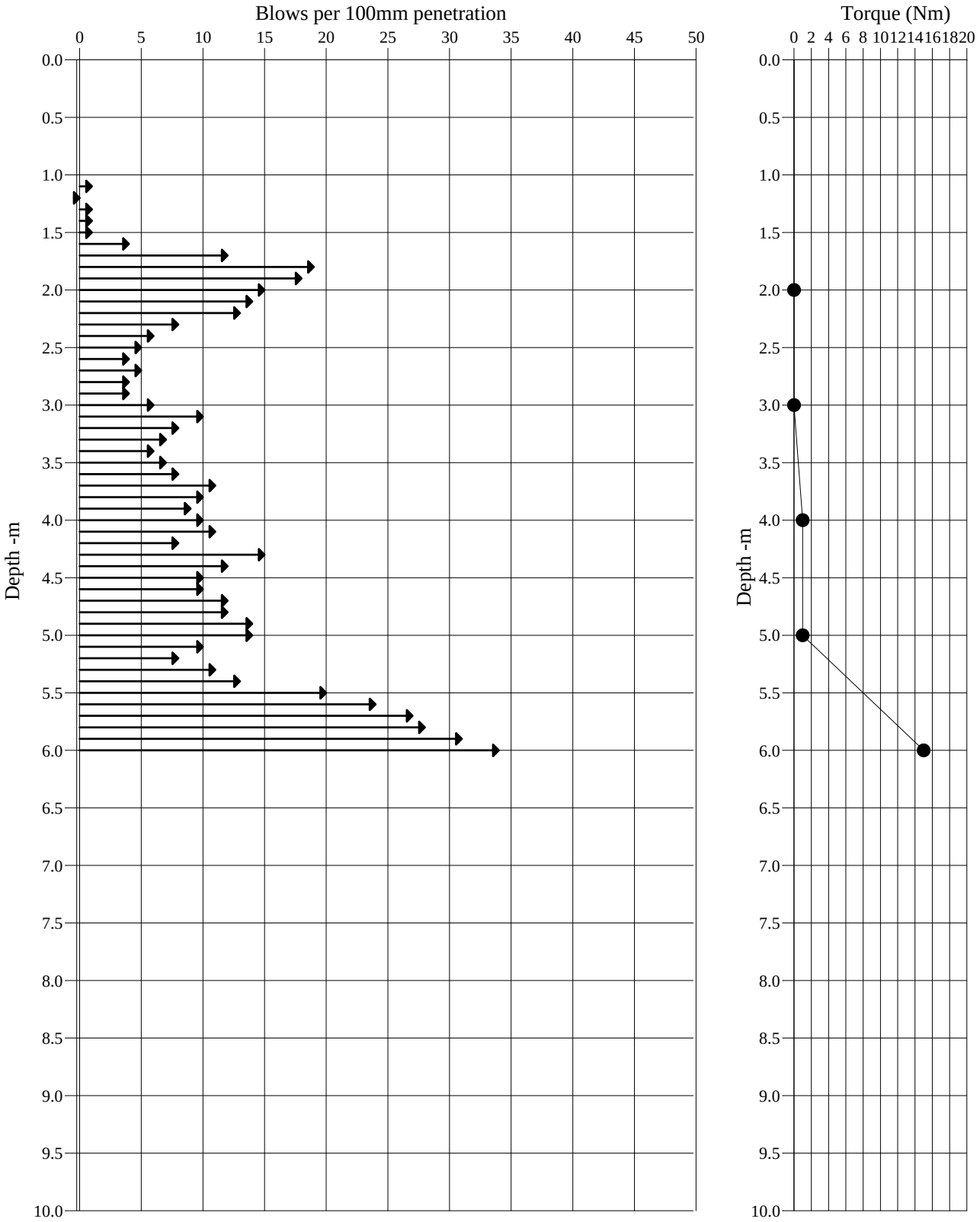
1. Subsoil; exploration by penetration tests -DIN4094. December 1990 (Standard and supplement)
2. Soils for civil engineering purposes. In-situ tests. - BS1377 Part 9 1990
3. Penetration testing in the UK. (Proceedings of the geotechnology conference organised by the Institution of Civil Engineers and held in Birmingham 6-8 July 1988)
4. Code of Practice for Site Investigations – BS5930 1999 Section 4

DPH and SHDP DYNAMIC PROBING

Site: Latchmere House, Church Road, Ham Common, Richmond, Surrey

Probe No: DP1 (CT4)

Date Probed: 26/07/2012

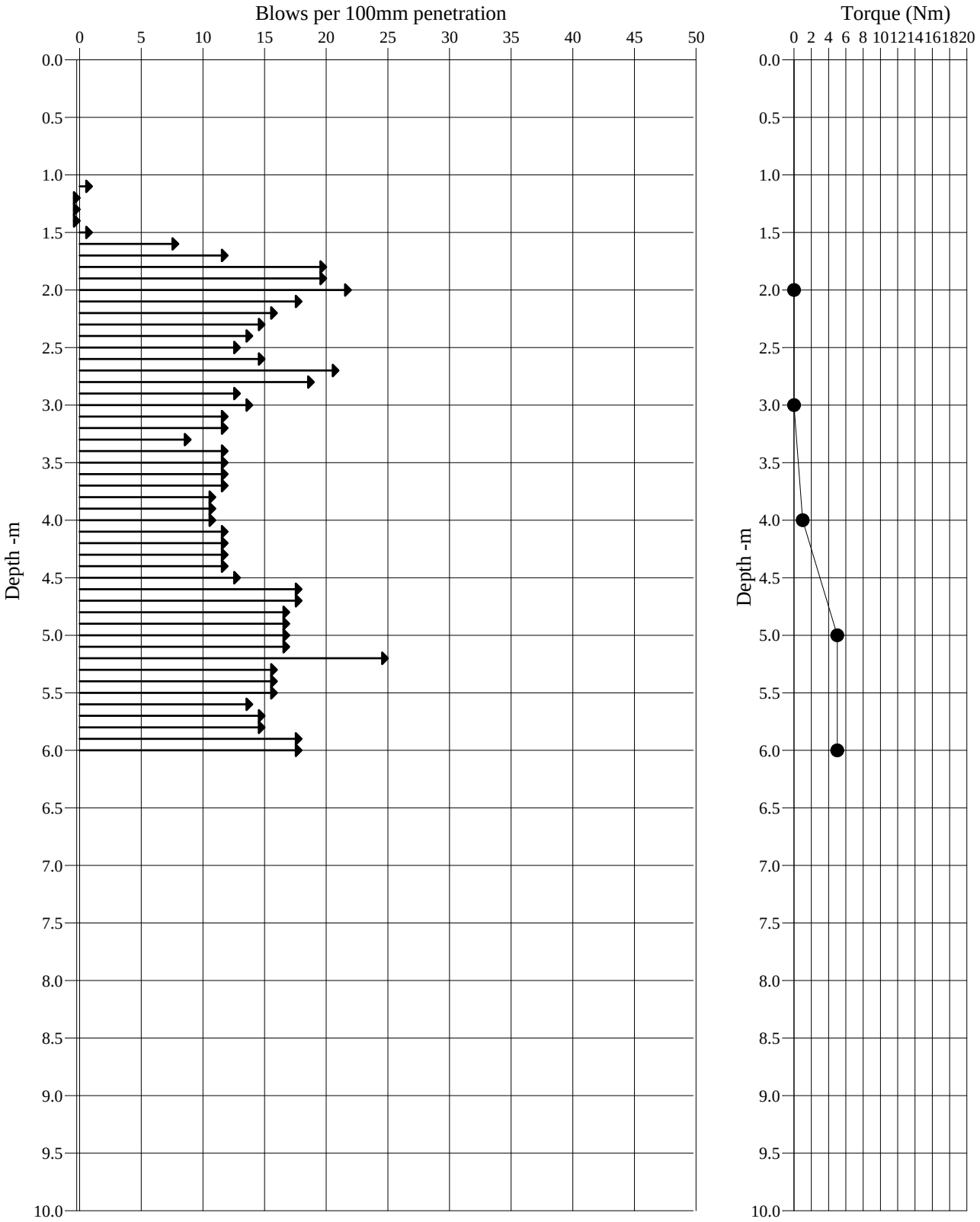


Date	PENETRATION PROBE / TORQUE	Lab. Ref. 12.07.020
August 2012		Client Ref.

Site: Latchmere House, Church Road, Ham Common, Richmond, Surrey

Probe No: DP2 (CT5)

Date Probed: 26/07/2012

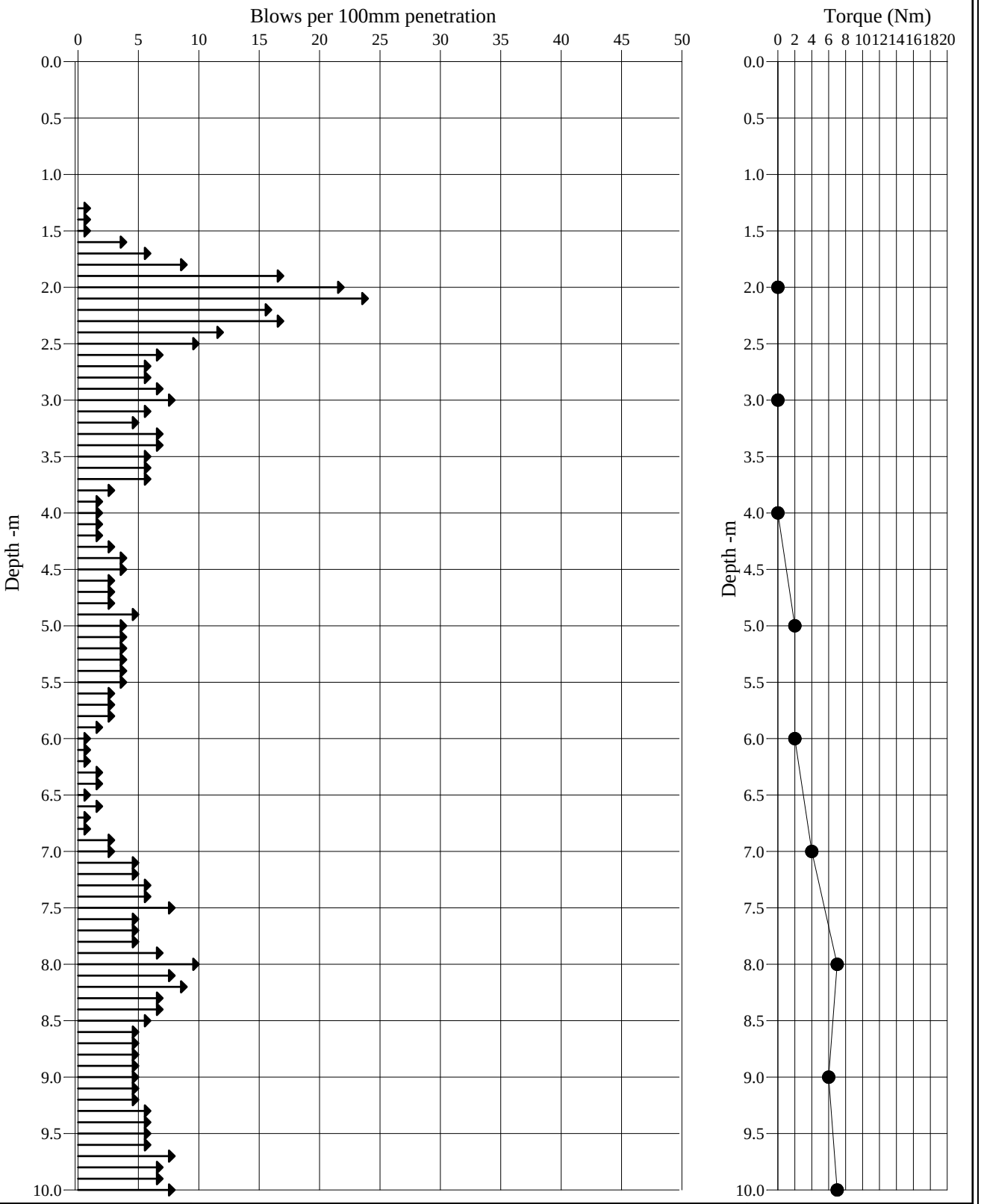


Date	PENETRATION PROBE / TORQUE	Lab. Ref. 12.07.020
August 2012		Client Ref.

Site: Latchmere House, Church Road, Ham Common, Richmond, Surrey

Probe No: DP3 (CT12)

Date Probed: 26/07/2012

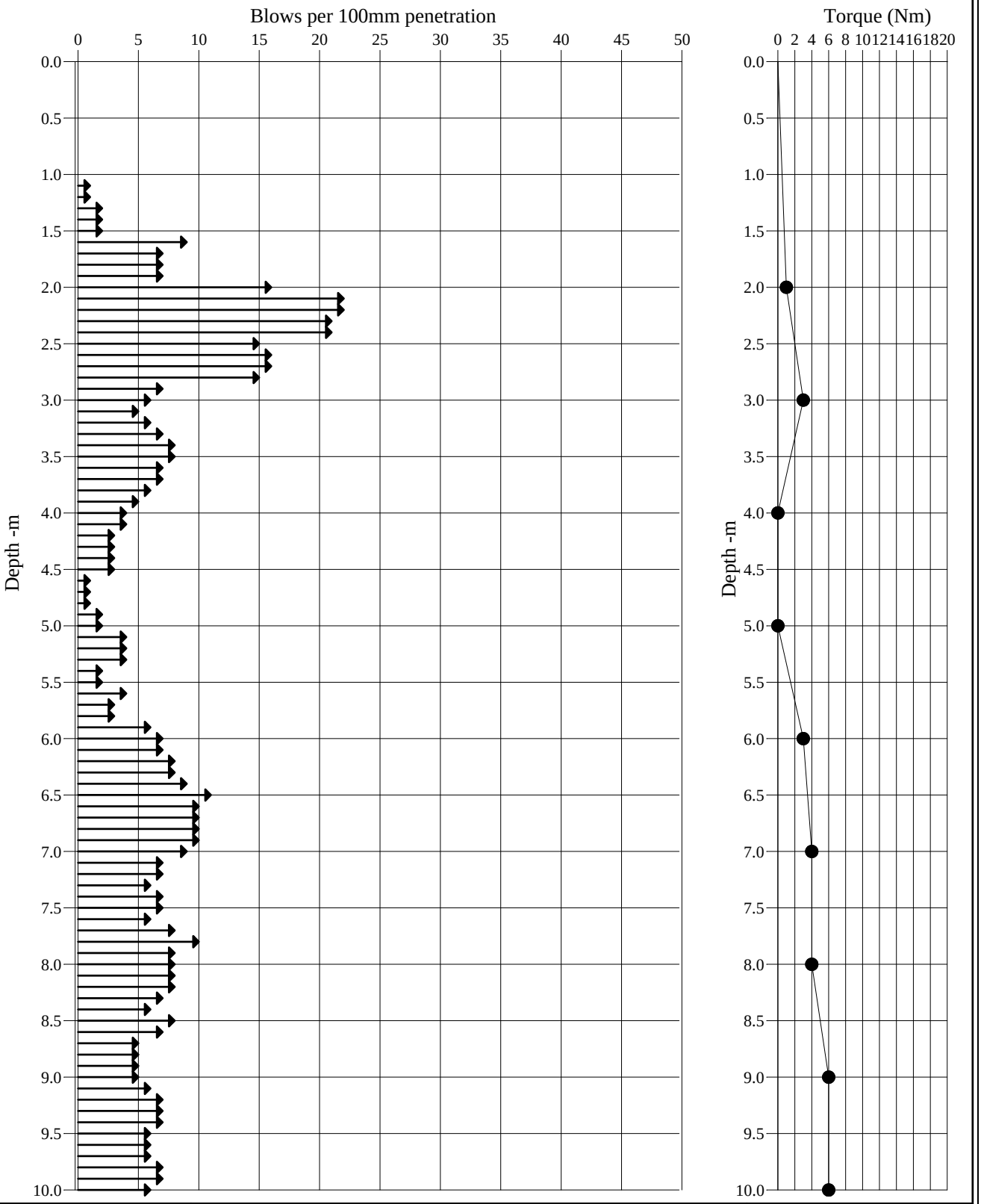


Date	PENETRATION PROBE / TORQUE	Lab. Ref. 12.07.020
August 2012		Client Ref.

Site: Latchmere House, Church Road, Ham Common, Richmond, Surrey

Probe No: DP4 (CT15)

Date Probed: 26/07/2012

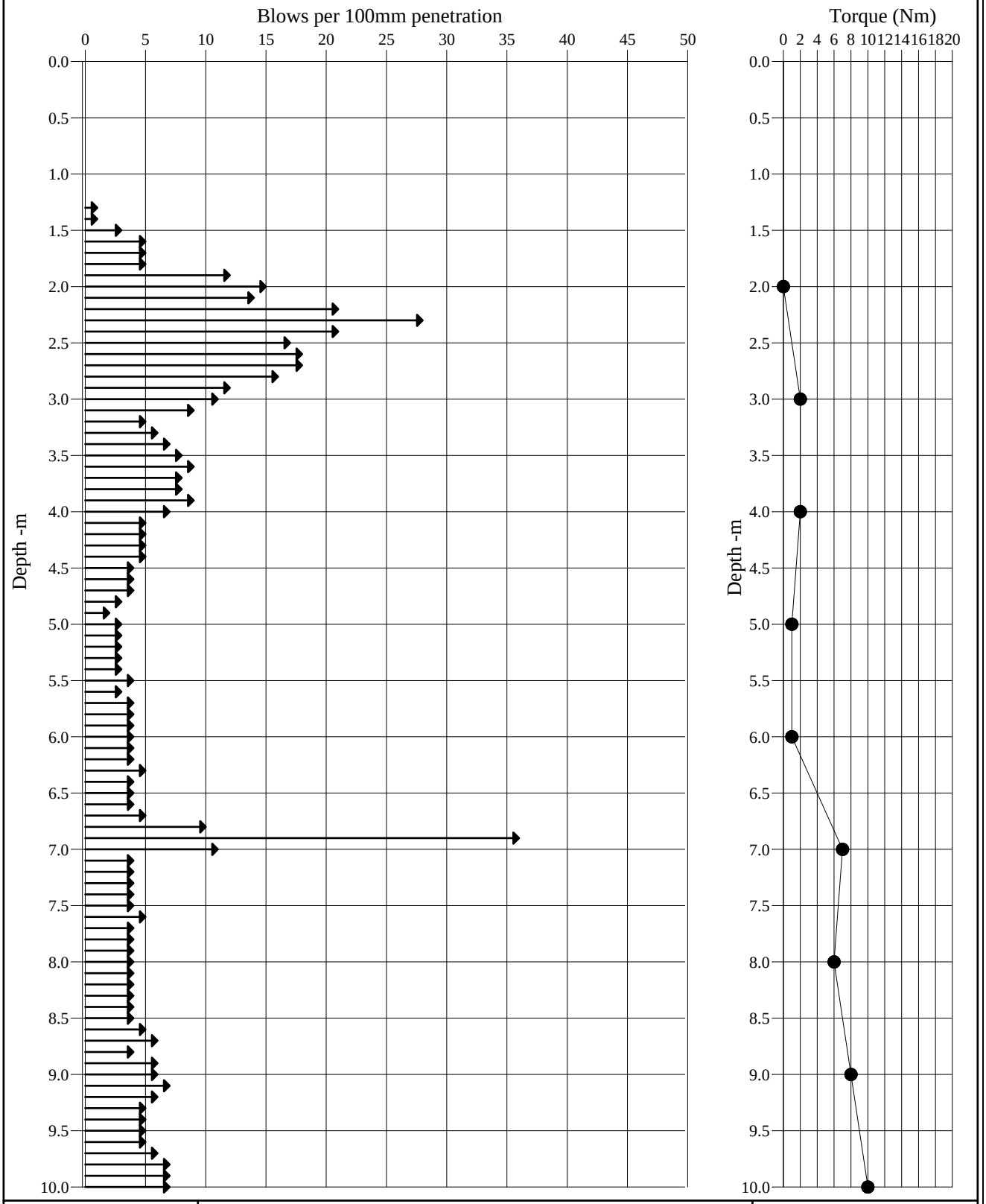


Date	PENETRATION PROBE / TORQUE	Lab. Ref. 12.07.020
August 2012		Client Ref.

Site: Latchmere House, Church Road, Ham Common, Richmond, Surrey

Probe No: DP5 (CT16)

Date Probed: 26/07/2012

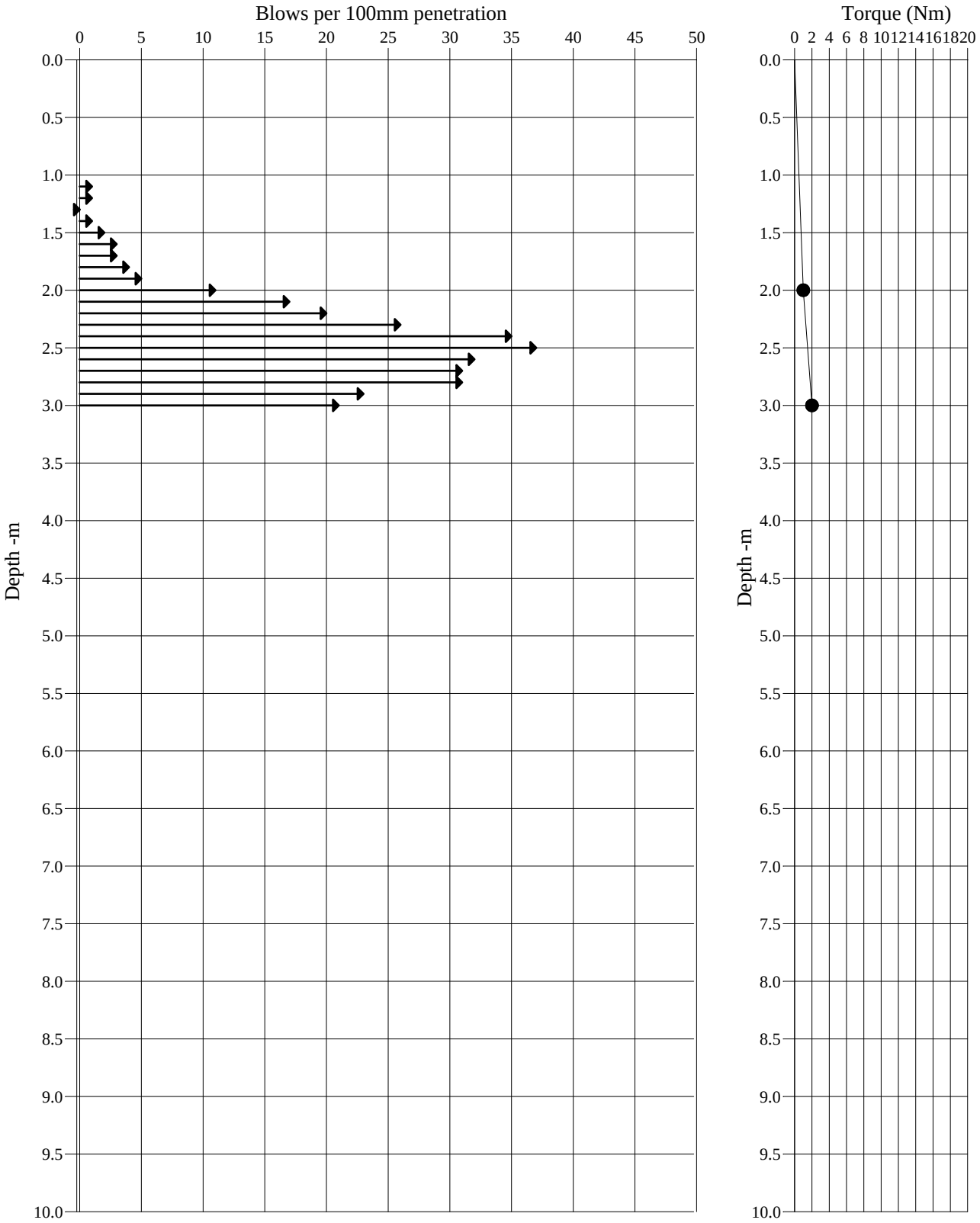


Date	PENETRATION PROBE / TORQUE	Lab. Ref. 12.07.020
August 2012		Client Ref.

Site: Latchmere House, Church Road, Ham Common, Richmond, Surrey

Probe No: DP6 (CT18)

Date Probed: 26/07/2012



Date	PENETRATION PROBE / TORQUE	Lab. Ref. 12.07.020
August 2012		Client Ref.

Permeability of soil to BS 5930:1999

For an Open Hole

Borehole Number	CT 15	
Borehole Diameter	0.08	m
Maximum initial head or depth-1	3.15	m
Area of Borehole	0.005024	m
Depth to base of hole	3.15	m

Time (s)	Depth to water (m)	Head of water (m)
0	2.08	-1.07
0.5	2.67	-0.48
1	2.82	-0.33
1.5	2.96	-0.19
2	3.08	-0.07
2.5	3.14	-0.01

Key	
	To be filled in by
MB	Engineer
07/09/2012	Calculated

Results	
Permeability (k)	
1.14E-03	**m/s**
1.26E-03	**m/s**
2.30E-03	**m/s**
Average result=	
1.57E-03	**m/s**

Permeability of soil to BS 5930:1999

For an Open Hole

Borehole Number	CT 5	
Borehole Diameter	0.08	m
Maximum initial head or depth-1	3.24	m
Area of Borehole	0.005024	m
Depth to base of hole	4	m

Time (s)	Depth to water (m)	Head of water (m)
0	1.65	-1.59
1	2.81	-0.43
1.5	2.99	-0.25
2	3.1	-0.14
3	3.17	-0.07
5	3.19	-0.05

Key	
	To be filled in by
MB	Engineer
07/09/2012	Calculated

Results	
Permeability (k)	
1.17E-03	**m/s**
8.75E-04	**m/s**
4.43E-04	**m/s**
Average result=	
8.30E-04	**m/s**

Permeability of soil to BS 5930:1999

For an Open Hole

Borehole Number	CT 4	
Borehole Diameter	0.08	m
Maximum initial head or depth-1	3.12	m
Area of Borehole	0.005024	m
Depth to base of hole	4	m

Time (s)	Depth to water (m)	Head of water (m)
0	1.86	-1.26
1	2.69	-0.43
1.5	2.85	-0.27
2	2.93	-0.19
3	2.98	-0.14
5	3.01	-0.11

Key	
	To be filled in by
MB	Engineer
07/09/2012	Calculated

Results	
Permeability (k)	
9.39E-04	**m/s**
5.57E-04	**m/s**
2.55E-04	**m/s**
Average result=	
5.83E-04	**m/s**

Geotechnical Consultants

Date of Sampling: 03/08/2012				Weather Condition Sunny				
Atmospheric Pressure:								
Test Location	Time (hh.mm)	Methane CH4(%)	Carbon Dioxide CO_2(%)	Oxygen O2(%)	LEL (%)	Atmospheric Presure (mBar)	Flow (l/h)	Water Level (m bgl)
BH4	09.30	0.0	1.4	19.4	0.0	1011	0.1	3.12
BH5	09.43	0.0	1.2	19.3	0.0	1011	0.0	3.22
BH15	09.15	0.0	0.4	20.3	0.0	1011	0.0	0.0

Date of Sampling: 17/08/2012				Weather Condition Cloudy				
Atmospheric Pressure:								
Test Location	Time (hh.mm)	Methane CH4(%)	Carbon Dioxide CO_2(%)	Oxygen O2(%)	LEL (%)	Atmospheric Presure (mBar)	Flow (l/h)	Water Level (m bgl)
BH4	09.55	0.0	0.4	20.3	0.0	1011	0.0	3.28
BH5	09.57	0.0	1.1	19.3	0.0	1011	0.0	0.0
BH15	09.51	0.0	0.0	20.4	0.0	1011	0.0	0.0

Gas measurements taken using a portable Gas Data LMS xi gas monitor

Date	GAS MONITORING RESULTS	Report No.
August 2012		12.07.020

APPENDIX 'B'

Laboratory Test Work