# Sewer Flooding
## History Enquiry

Thames Water Property Searches
12
Vastern Road
Reading
RG1 8DB

**Search address supplied** Flat 1
Otto Schiff House
14
Netherhall Gardens
London
NW3 5TQ

**Your reference** 0041 Netherhall Gardens

**Our reference** SFH_SFH_Standard_2012_2163866

**Search date** **2 February 2012**

Thames Water Utilities Ltd

Property Searches
PO Box 3189
Slough SL1 4WW

DX 151280 Slough 13

T 0118 925 1504
F 0118 923 6655/57
E searches@thameswater.co.uk
I www.thameswater-propertysearches.co.uk

# Sewer Flooding
## History Enquiry

**Search address supplied:** Flat 1, Otto Schiff House, 14, Netherhall Gardens, London NW3 5TQ

**This search is recommended to check for any sewer flooding in a specific address or area**

TWUL, trading as Property Searches, are responsible in respect of the following:-

(i) any negligent or incorrect entry in the records searched;

(ii) any negligent or incorrect interpretation of the records searched;

(iii) and any negligent or incorrect recording of that interpretation in the search report

(iv) compensation payments

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# Sewer Flooding
## History Enquiry

### History of Sewer Flooding

**Is the requested address or area at risk of flooding due to overloaded public sewers?**

The flooding records held by Thames Water indicate that there have been no incidents of flooding in the requested area as a result of surcharging public sewers.

Although Thames Water does not have records of public sewer flooding within the vicinity, please be aware that property owners are not legally obliged to report this flooding to Thames Water. In addition flooding from private sewers, watercourses and highways drains are not the responsibility of Thames Water, and such incidents may not be noted in our records. We therefore strongly advise you to contact the current owners and occupiers of the premises and inquire about sewer flooding.

For your guidance:

- A sewer is "overloaded" when the flow from a storm is unable to pass through it due to a permanent problem (e.g. flat gradient, small diameter). Flooding as a result of temporary problems such as blockages, siltation, collapses and equipment or operational failures are excluded.
- "Internal flooding" from public sewers is defined as flooding, which enters a building or passes below a suspended floor. For reporting purposes, buildings are restricted to those normally occupied and used for residential, public, commercial, business or industrial purposes.
- "At Risk" properties are those that the water company is required to include in the Regulatory Register that is presented annually to the Director General of Water Services. These are defined as properties that have suffered, or are likely to suffer, internal flooding from public foul, combined or surface water sewers due to overloading of the sewerage system more frequently than the relevant reference period (either once or twice in ten years) as determined by the Company's reporting procedure.
- Flooding as a result of storm events proven to be exceptional and beyond the reference period of one in ten years are not included on the At Risk Register.
- Properties may be at risk of flooding but not included on the Register where flooding incidents have not been reported to the Company.
- Public Sewers are defined as those for which the Company holds statutory responsibility under the Water Industry Act 1991.
- It should be noted that flooding can occur from private sewers and drains which are not the responsibility of the Company. This report excludes flooding from private sewers and drains and the Company makes no comment upon this matter.
- For further information please contact Thames Water on Tel: 0845 9200 800 or website www.thameswater.co.uk

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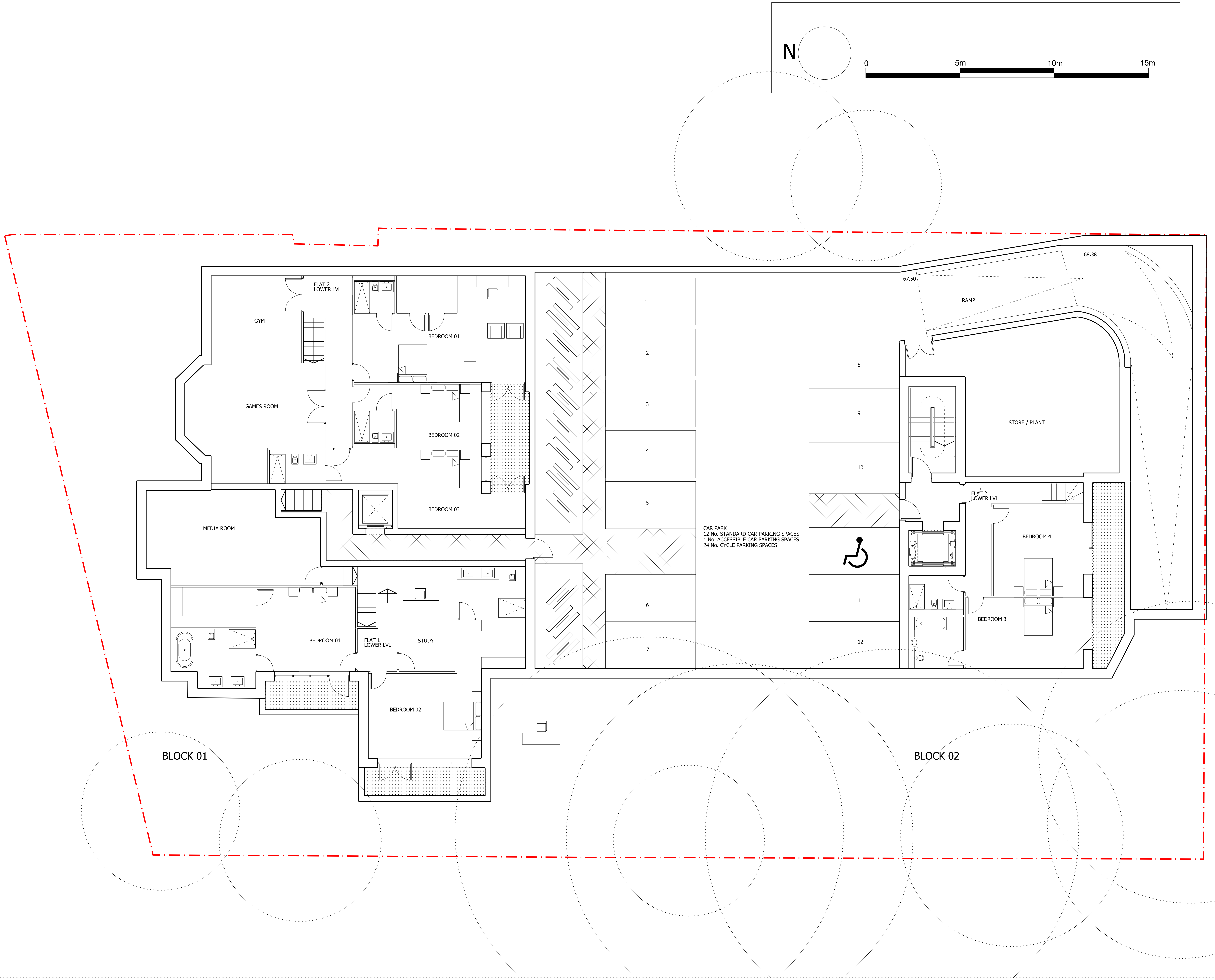
I www.thameswater-propertysearches.co.uk

Registered in England and Wales
No. 2366661, Registered office
Clearwater Court, Vastern Road
Reading RG1 8DB

# Appendix H




NOTES:

DO NOT SCALE FROM THIS DRAWING.
ALL DIMENSIONS TO BE CHECKED ON SITE.
ALL OMISSIONS AND DISCREPANCIES TO BE REPORTED TO THE ARCHITECT IMMEDIATELY.



NOTE:
DOTTED CIRCLES REPRESENT THE ROOT PROTECTION AREAS OF THE EXISTING TREES ON SITE.

| Revision description | Date | Check | Rev |
| --- | --- | --- | --- |

Squire and Partners

77 Wicklow Street London WC1X 9JY
T: 020 7278 5555 F: 020 7239 0495

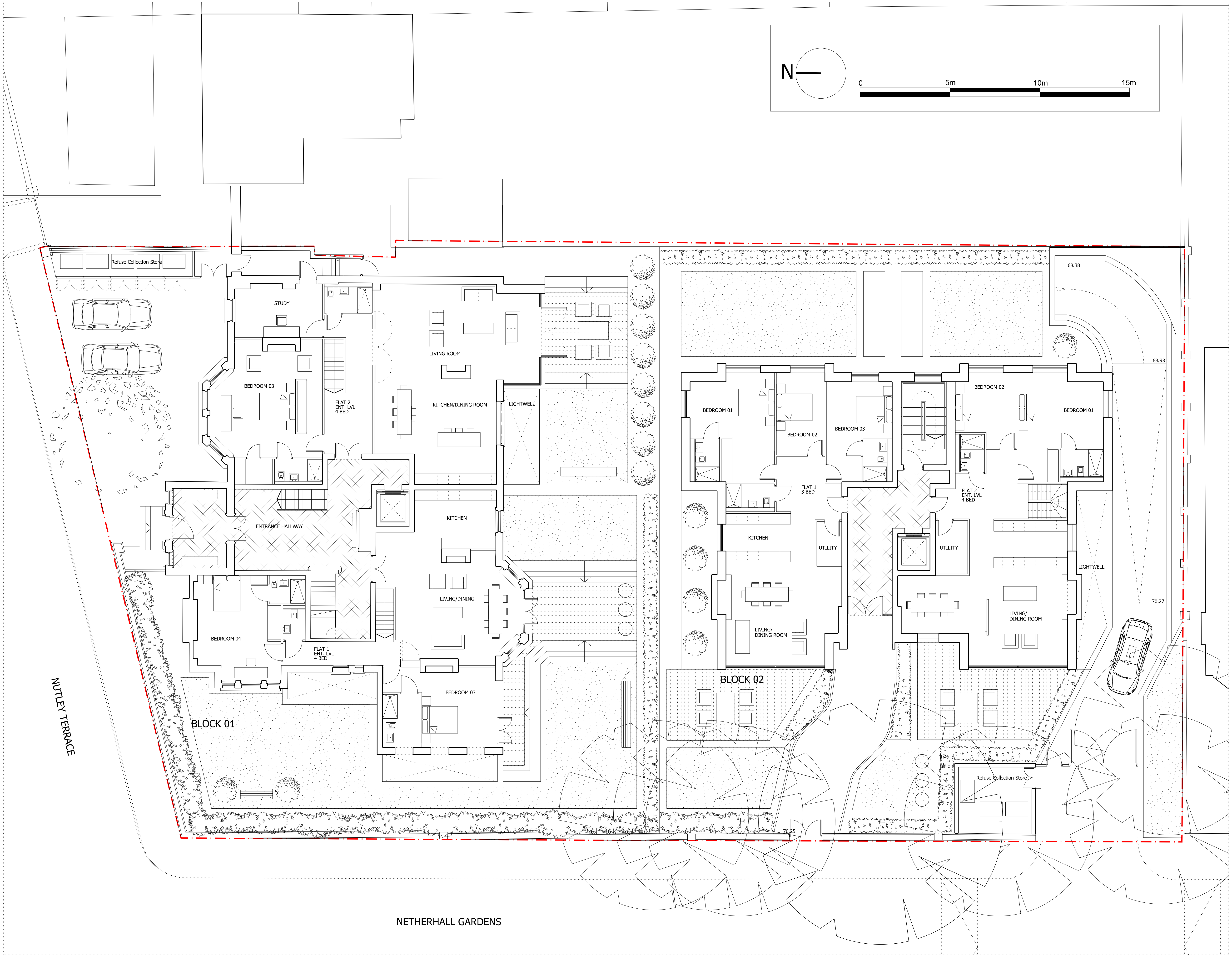
info@squireandpartners.com
www.squireandpartners.com

Project
14 Netherhall Gardens
London
NW3

Drawing
Lower Ground Floor Plan
As Proposed

| Drawn | Date | Scale |
| --- | --- | --- |
| FP | 27/01/2012 | 1: 100@A1<br>1: 200@A3 |

| Job number | Drawing number | Revision |
| --- | --- | --- |
| 11011 | P_LG_G200_001 | - |

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| Revision description | Date | Check | Rev |
|---|---|---|---|

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www.squireandpartners.com

Project
14 Netherhall Gardens
London
NW3

Drawing
Ground Floor Plan
As Proposed

| Drawn | Date | Scale |
|---|---|---|
| FP | 27/01/2012 | 1: 100@A1<br>1: 200@A3 |
| **Job number** | **Drawing number** | **Revision** |
| 11011 | P_00_G200_001 | - |


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| Revision description | Date | Check | Rev |
| --- | --- | --- | --- |

Squire and Partners

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www.squireandpartners.com

Project
14 Netherhall Gardens
London
NW3

Drawing
First Floor Plan
As Proposed

| Drawn | Date | Scale |
| --- | --- | --- |
| FP | 27/01/2012 | 1: 100@A1<br>1: 200@A3 |

| Job number | Drawing number | Revision |
| --- | --- | --- |
| 11011 | P_01_G200_001 | - |


NOTES:

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| Revision description | Date | Check | Rev |
|---|---|---|---|

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www.squireandpartners.com

Project
14 Netherhall Gardens
London
NW3

Drawing
Second Floor Plan
As Proposed

| Drawn | Date | Scale |
|---|---|---|
| FP | 27/01/2012 | 1: 100@A1<br>1: 200@A3 |

| Job number | Drawing number | Revision |
|---|---|---|
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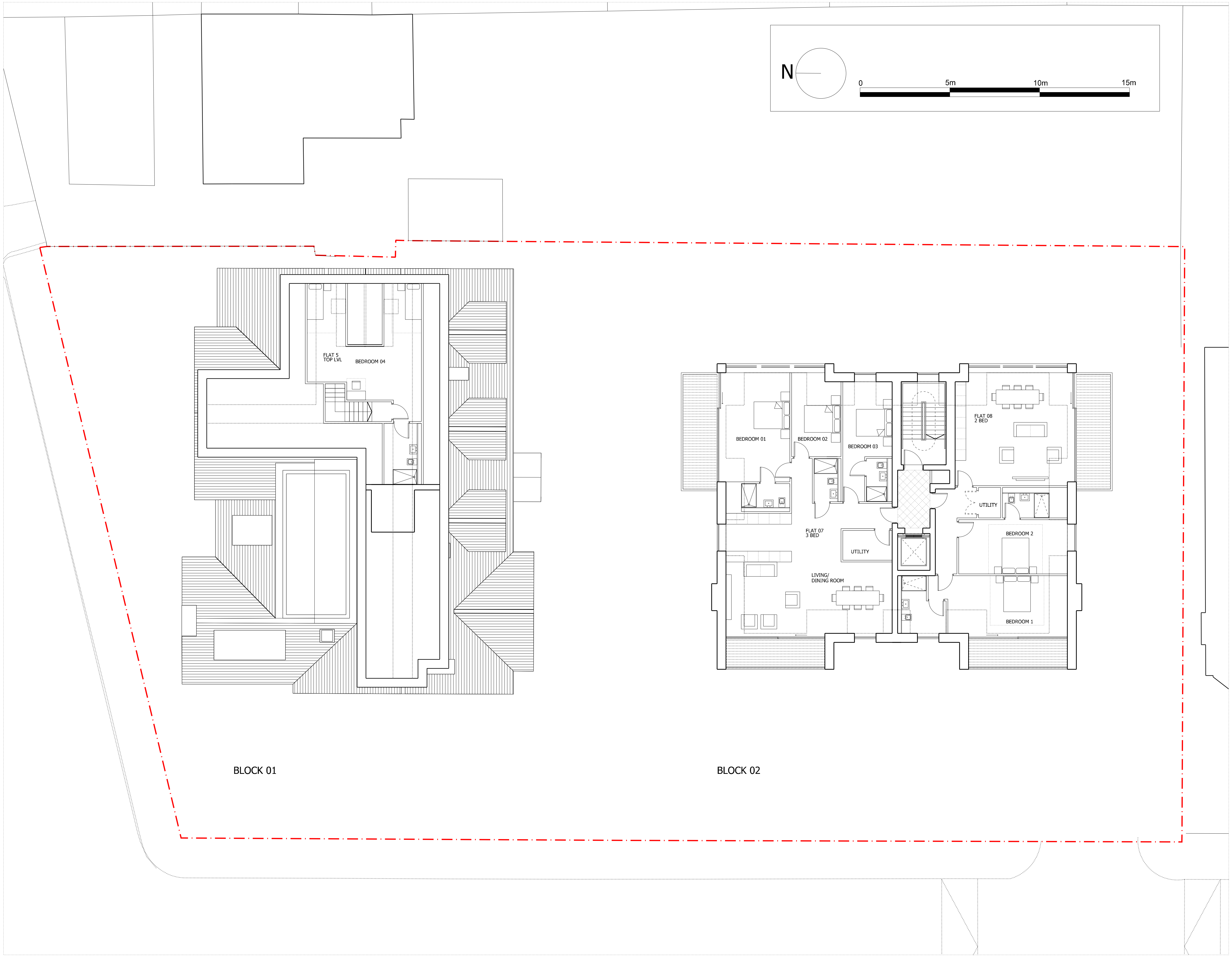


NOTES:

DO NOT SCALE FROM THIS DRAWING.
ALL DIMENSIONS TO BE CHECKED ON SITE.
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| Revision description | Date | Check | Rev |
| --- | --- | --- | --- |

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Project
14 Netherhall Gardens
London
NW3

Drawing
Third Floor Plan
As Proposed

| Drawn | Date | Scale |
| --- | --- | --- |
| FP | 27/01/2012 | 1: 100@A1<br>1: 200@A3 |

| Job number | Drawing number | Revision |
| --- | --- | --- |
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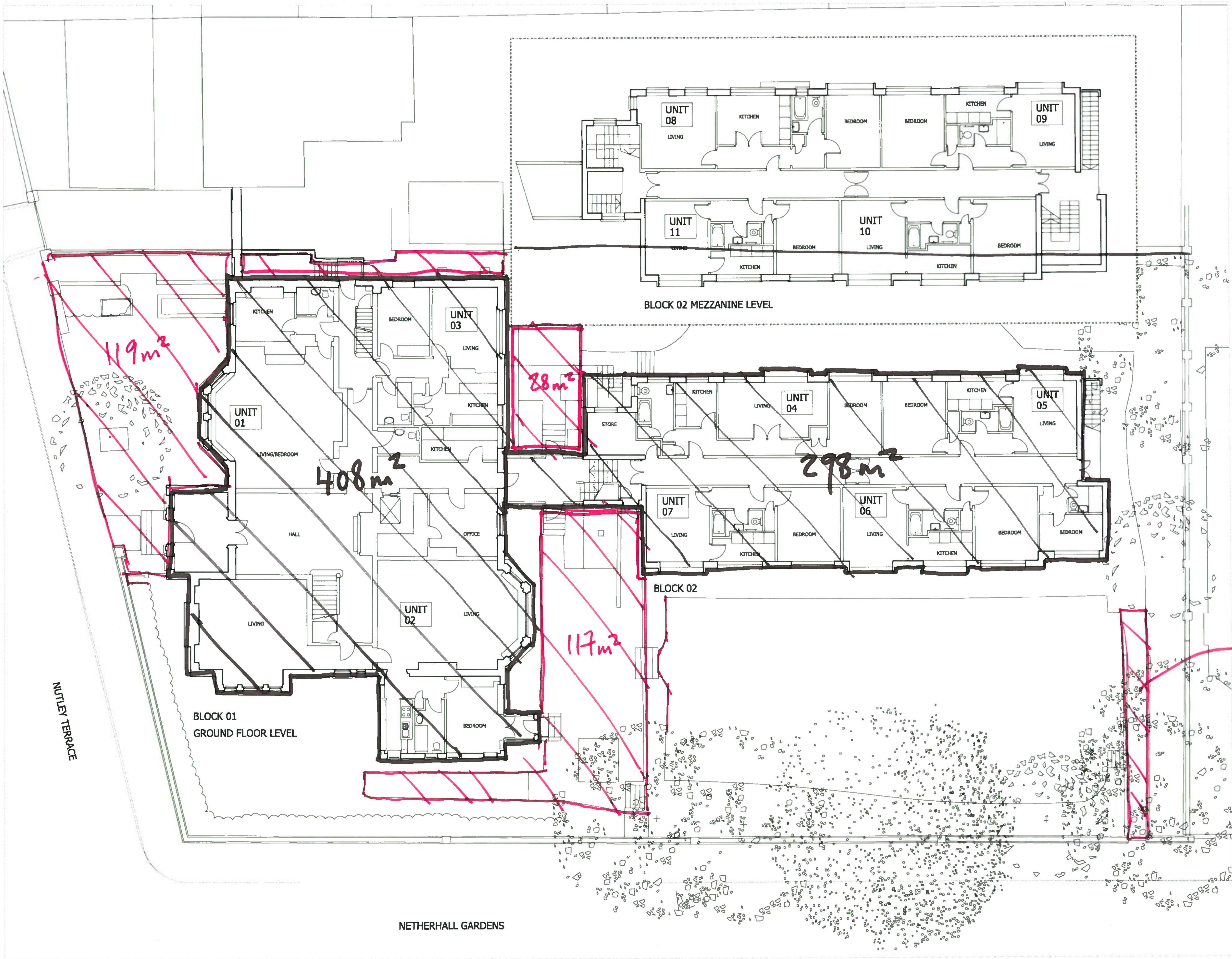




PLOT = 1904 m²

BUILDING = 408
+ 298
706 m²

HD. LANDSCAPING =
119
117
28
+ 12
276 m²

GREEN SPACE :
1904 - 706 - 276 = 922 m²

| Revision description | Date | Check | Rev |
|---|---|---|---|

Squire and Partners

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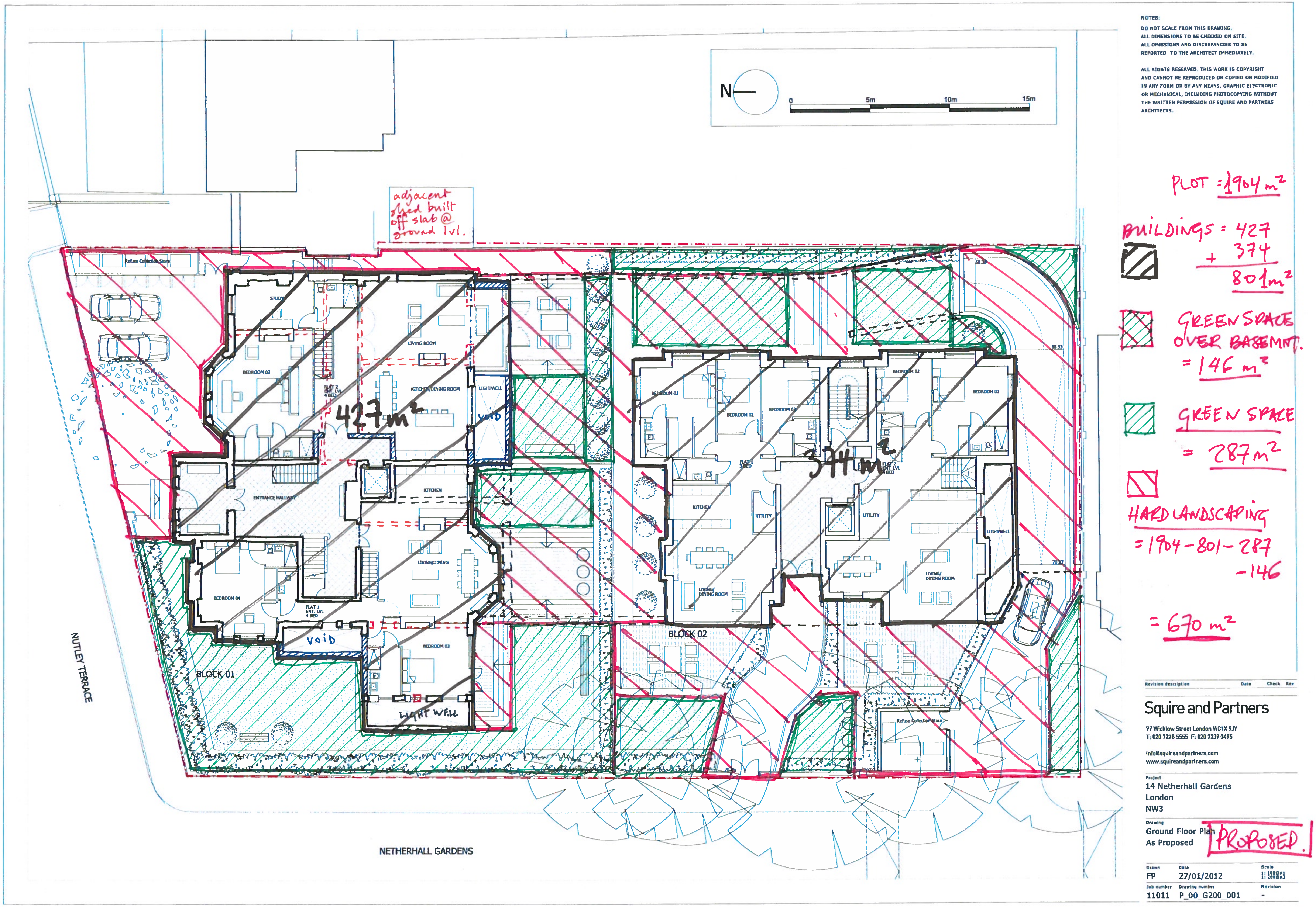
Project
14 Netherhall Gardens
London
NW3

Drawing
Ground Floor and Mezzanine Plans
As Existing

EXISTING

| Drawn | Date | Scale |
|---|---|---|
| FP | 04/10/2011 | 1: 100@A1<br>1: 200@A3 |

| Job number | Drawing number | Revision |
|---|---|---|
| 11011 | XP_00_G200_001 | - |

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| Revision description | Date | Check | Rev |
|---|---|---|---|

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www.squireandpartners.com

Project
14 Netherhall Gardens
London
NW3

Drawing
Ground Floor Plan
As Proposed

PROPOSED.

| Drawn | Date | Scale |
|---|---|---|
| FP | 27/01/2012 | 1: 100@A1<br>1: 200@A3 |
| **Job number** | **Drawing number** | **Revision** |
| 11011 | P_00_G200_001 | - |

# Appendix I

**IoH 124 Calculation of Greenfield Runoff**

| | | |
|---|---|---|
| Project: | 14 Netherhall Gardens, London, NW3 5TQ | |
| Date: | 15/02/2011 | |
| SAAR: | 653mm | Taken from FEH CD-ROM Version 3 and checked against Wallingford Procedure Volume 3 Map: Average Annual Rainfall (1941-1970) mm |
| Site area: | 50ha / 0.5km$^2$ | Always assumed to be 50ha with runoff rates adjusted pro-rata later for actual site area |
| Soil Type SPR value: | 0.47 | Wallingford soil grading taken from Wallingford Procedure Volume 3 Map: Winter rain acceptance potential and converted to SPR value using the Flood Studies Report conversion table, also checked against FEH CD-ROM Version 3 SPRHOST value |

| Wallingford soil grading | SPR value from FSR |
|---|---|
| 1 | 0.10 |
| 2 | 0.30 |
| 3 | 0.37 |
| 4 | 0.47 |
| 5 | 0.53 |

QBAR = 0.00108 x $(AREA)^{0.89}$ x $(SAAR)^{1.17}$ x $(SOIL)^{2.17}$

QBAR = 0.00108 x $0.5^{0.89}$ x $653^{1.17}$ x $0.47^{2.17}$

QBAR (50ha) = 0.223m$^3$/s

<u>Runoff as calculated from the Regional Growth Curve Factor for FSR Hydrological Region 6/7:</u>

| Region 6/7 | Growth Factor |
|---|---|
| 1 | 0.85 |
| 2 | 0.88 |
| 5 | 1.28 |
| 10 | 1.62 |
| 25 | 2.14 |
| 30 | 2.24 |
| 50 | 2.62 |
| 100 | 3.19 |

Q1 50ha = 0.189 m$^3$/s = 189.159 l/s = 3.783 l/s/ha

Q5 50ha = 0.285 m$^3$/s = 284.851 l/s = 5.697 l/s/ha

Q25 50ha = 0.476 m$^3$/s = 476.235 l/s = 9.525 l/s/ha

Q30 50ha = 0.498 m$^3$/s = 498.489 l/s = 9.970 l/s/ha

Q100 50ha = 0.710 m$^3$/s = 709.902 l/s = 14.200 l/s/ha

Runoff as factored for site

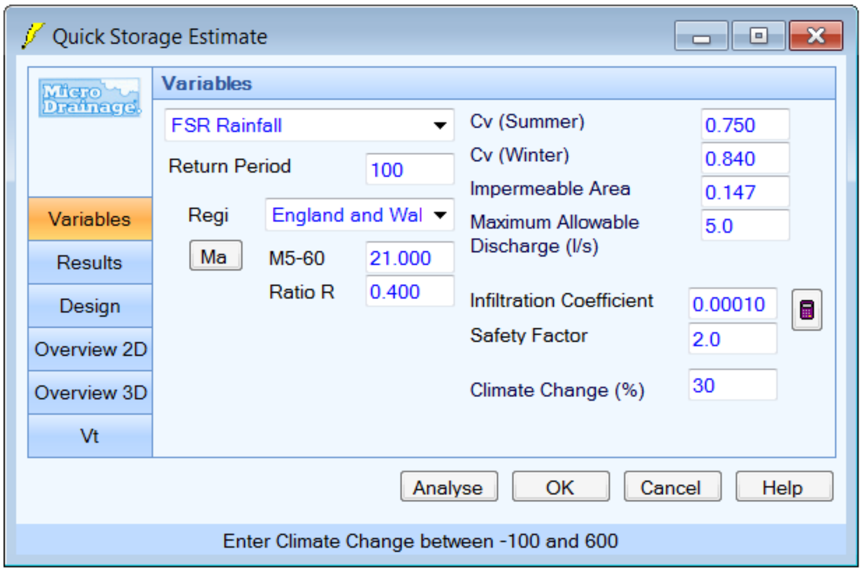
Actual site area: 0.1904ha / 1,904$m^2$

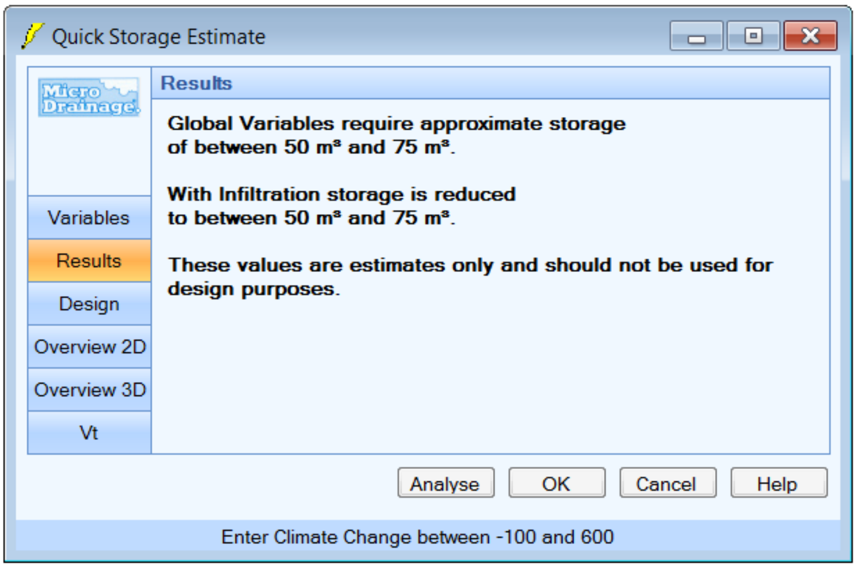
QBAR Site = 0.0008 m3/s = 0.85/s = 4.451 l/s/ha
Q1 Site = 0.0007 $m^3$/s = 0.72 l/s = 3.783 l/s/ha
Q5 Site = 0.0011 $m^3$/s = 1.08 l/s =5.697 l/s/ha
Q25 Site = 0.0018 $m^3$/s = 1.81 l/s = 9.525 l/s/ha
Q30 Site = 0.0019 $m^3$/s = 1.89 l/s = 9.970 l/s/ha
Q100 Site = 0.0027 $m^3$/s = 2.70 l/s = 14.200 l/s/ha

Note: For Greenfield sites, the critical duration is generally not relevent and the prediction of the peak rate of runoff using IoH124 does not require consideration of storm duration

Note: PPS 25 does not provide guidance on applying climate change to Greenfield runoff, only to peak rainfall intensities and river flows

# Appendix J


Quick Storage Estimate
Variables
FSR Rainfall
Return Period
100
Regi
England and Wal
Ma
M5-60
21.000
Ratio R
0.400
Cv (Summer)
0.750
Cv (Winter)
0.840
Impermeable Area
0.147
Maximum Allowable Discharge (l/s)
5.0
Infiltration Coefficient
0.00010
Safety Factor
2.0
Climate Change (%)
30
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Analyse
OK
Cancel
Help
Enter Climate Change between -100 and 600


Quick Storage Estimate
Results
Global Variables require approximate storage of between 50 m³ and 75 m³.
With Infiltration storage is reduced to between 50 m³ and 75 m³.
These values are estimates only and should not be used for design purposes.
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Analyse
OK
Cancel
Help
Enter Climate Change between -100 and 600

# Surface flow and flooding screening flowchart

The Developer should consider each of the following questions in turn, answering either “yes”, “unknown” or “no” in each instance.

Consideration should be given to both the temporary and permanent works, along with the proposed surrounding landscaping and drainage associated with a proposed basement development.

**Question 1: Is the site within the catchment of the pond chains on Hampstead Heath?**

**Question 2: As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route?**

**Question 3: Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas?**

**Question 4: Will the proposed basement result in changes to the profile of the inflows (instantaneous and long-term) of surface water being received by adjacent properties or downstream watercourses?**

**Question 5: Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?**

- **Yes** → Developer to carry forward to the scoping stage of the Basement Impact Assessment those matter/s of concern where response is "yes"
- **Unknown** → Developer to carry forward to the scoping stage of the Basement Impact Assessment those matter/s of concern where response is "unknown"
- **No** → Developer to provide statement to LB Camden giving justification for not carrying forward to the scoping stage of the Basement Impact Assessment those matter/s of concern where the response is “no”

**Question 6: Is the site in an area known to be at risk from surface water flooding, such as South Hampstead, West Hampstead, Gospel Oak and King’s Cross, or is it at risk from flooding, for example because the proposed basement is below the static water level of a nearby surface water feature?**

- **Yes** → Developer to undertake a Flood Risk Assessment in accordance with PPS25.
- **Unknown** → Developer to undertake a Flood Risk Assessment in accordance with PPS25.
- **No** → Flood Risk Assessment not required.

**Notes / sources of information**

**Question 1:** Figure 14 in the attached study (prepared using data supplied by the City of London Corporation’s hydrology consultant, Haycocks Associates) shows the catchment areas of the pond chains on Hampstead Heath

**Question 2:** This will be specific to the proposed development and will be a result of the proposed landscaping of areas above and surrounding a proposed basement. The developer should provide documentation of discussion with Thames Water to confirm that the sewers have capacity to receive any increased wastewater flows.

**Question 3:** This will be specific to the proposed development and will be a result of the chosen drainage scheme adopted for the property

**Question 4:** This will be specific to the proposed development and will be a result of the proposed landscaping and chosen drainage scheme adopted for the property. SUDS will be required to compensate any increases in peak flow.

**Question 5:** This will be specific to the proposed development and will be a result of the proposed landscaping and chosen drainage scheme adopted for the property. SUDS will be required to compensate any increases in peak flow.

**Question 6:** The principles outlined in PPS25 should be followed to ensure that flood risk is not increased.

# Subterranean (groundwater) flow screening flowchart

The Developer should consider each of the following questions in turn, answering either "yes", "unknown" or "no" in each instance.

Consideration should be given to both the temporary and permanent works, along with the proposed surrounding landscaping and drainage associated with a proposed basement development.

**Question 1a: Is the site located directly above an aquifer?**

**Question 1b: Will the proposed basement extend beneath the water table surface?**

**Question 2: Is the site within 100m of a watercourse, well (used/disused) or potential spring line?**

**Question 3: Is the site within the catchment of the pond chains on Hampstead Heath?**

**Question 4: Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?**

**Question 5: As part of the site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to the ground (e.g. via soakaways and/or SUDS)?**

**Question 6: Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to, or lower than, the mean water level in any local pond (not just the pond chains on Hampstead Heath) or spring line.**

**Yes** → Developer to carry forward to the scoping stage of the Basement Impact Assessment those matter/s of concern where response is "yes"

**Unknown** → Developer to carry forward to the scoping stage of the Basement Impact Assessment those matter/s of concern where response is "unknown"

**No** → Developer to provide statement to LB Camden giving justification for not carrying forward to the scoping stage of the Basement Impact Assessment those matter/s of concern where the response is "no"

## Notes / sources of information

**Question 1:** In LB Camden, all areas where the London Clay does not outcrop at the surface are considered to be an aquifer. This includes the River Terrace Deposits, the Claygate Member and the Bagshot Formation. The location of the geological strata can be established from British Geological Survey maps (e.g. 1:50,000 and 1:10,000 scale). Note that the boundaries are indicative and should be considered to be accurate to ±50m at best.

Additionally, the Environment Agency (EA) "Aquifer Designation Maps" can be used to identify aquifers. These can be found on the "Groundwater maps" available on the EA website (www.environment-agency.gov.uk) follow "At home & leisure" > "What's in Your Backyard" > "Interactive Maps" > "Groundwater". Knowledge of the thickness of the geological strata present and the level of the groundwater table is required. This may be known from existing information (for example nearby site investigations), however, it may not be known in the early stages of a project. Determination of the water table level may form part of the site investigation phase of a BIA.

**Question 2:** Watercourses, wells or spring lines may be identified from the following sources:

- Local knowledge and/or site walkovers
- Ordnance Survey maps (e.g. 1:25,000 or 1:10,000 scale). If features are marked (they are not always) the following symbols may be present: W; Spr; water is indicated by blue colouration. (check the key on the map being used)
- British Geological Survey maps (e.g. 1:10,000 scale, current and earlier editions). Current maps will show indicative geological strata boundaries which are where springs may form at the ground surface; of relevance are the boundary between the Bagshot Formation with the Claygate Member and the Claygate Member with the London Clay. Note that the boundaries are indicative should be considered to be accurate to ±50m. Earlier geological maps (e.g. the 1920's 1:10560 scale) maps show the location of some wells.
- Aerial photographs
- "Lost Rivers of London" by Nicolas Barton, 1962. Shows the alignment of rivers in London and their tributaries.
- The British Geological Survey (BGS) GeoIndex includes "Water Well" records. See www.bgs.ac.uk and follow "Online data" > "GeoIndex" > "Onshore GeoIndex".
- The location of older wells can be found in well inventory/catalogue publications such as "Records of London Wells" by G. Barrow and L. J. Wills (1913) and "The Water Supply of the County of London from Underground Sources" by S Buchan (1938).
- The Environment Agency (EA) "Source Protection Zone Maps" can be used to identify aquifers. These can be found on the "Groundwater maps" available on the EA website (www.environment-agency.gov.uk) follow "At home & leisure" > "What's in Your Backyard" > "Interactive Maps" > "Groundwater".
- The EA hold records of licensed groundwater abstraction boreholes. LB Camden is within the North East Area of the Thames Region. Details can be found on the EA website.
- LB Camden Environmental Health department may hold records of groundwater wells in the Borough.

Where a groundwater well or borehole is identified, it will be necessary to determine if it is extending into the Lower Aquifer (Chalk) or the Upper Aquifer (River Terrace Deposits, Bagshot Formation, Claygate Member etc). It is water wells extending into the Upper Aquifer which are of concern with regard to basement development.

**Question 3**: Figure 14 in the attached study, (prepared using data supplied by the City of London Corporation's hydrology consultant, Haycocks Associates) shows the catchment areas of the pond chains on Hampstead Heath.

**Question 4:** This will be specific to the proposed development and will be a result of the proposed landscaping of areas above and surrounding a proposed basement.

**Question 5:** This will be specific to the proposed development and will be a result of the chosen drainage scheme adopted for the property.

**Question 6:** The lowest point will be specific to the proposed development. Knowledge of local ponds may be taken from

- Local knowledge and/or site walkovers
- Ordnance Survey maps (e.g. 1:25,000 or 1:10,000 scale). If features are marked (they are not always) the following symbols may be present: W; Spr; water is indicated by blue colouration. (check the key on the map being used)
- Aerial photographs

# Slope stability screening flowchart

The Developer should consider each of the following questions in turn, answering either “yes”, “unknown” or “no” in each instance.

Consideration should be given to both the temporary and permanent works, along with the proposed surrounding landscaping and drainage associated with a proposed basement development.

**Question 1: Does the existing site include slopes, natural or manmade, greater than 7°? (approximately 1 in 8)**

**Question 2: Will the proposed re-profiling of landscaping at site change slopes at the property boundary to more than 7°? (approximately 1 in 8)**

**Question 3: Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7°? (approximately 1 in 8)**

**Question 4: Is the site within a wider hillside setting in which the general slope is greater than 7°? (approximately 1 in 8)**

**Question 5: Is the London Clay the shallowest strata at the site?**

**Question 6: Will any tree/s be felled as part of the proposed development and/or are any works proposed within any tree protection zones where trees are to be retained?** **(Note that consent is required from LB Camden to undertake work to any tree/s protected by a Tree Protection Order or to tree/s in a Conservation Area if the tree is over certain dimensions).**

**Question 7: Is there a history of seasonal shrink-swell subsidence in the local area, and/or evidence of such effects at the site?**

**Question 8: Is the site within 100m of a watercourse or a potential spring line?**

**Question 9: Is the site within an area of previously worked ground?**

**Question 10: Is the site within an aquifer? If so, will the proposed basement extend beneath the water table such that dewatering may be required during construction?**

**Question 11: Is the site within 50m of the Hampstead Heath ponds?**

**Question 12: Is the site within 5m of a highway or pedestrian right of way?**

**Question 13: Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?**

**Question 14: Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines?**

**Yes** → Developer to carry forward to the scoping stage of the Basement Impact Assessment those matter/s of concern where response is "yes"

**Unknown** → Developer to carry forward to the scoping stage of the Basement Impact Assessment those matter/s of concern where response is "unknown"

**No** → Developer to provide statement to LB Camden giving justification for not carrying forward to the scoping stage of the Basement Impact Assessment those matter/s of concern where the response is “no”

## Notes / sources of information

**Question 1, 3 & 4:** The current surface slope can be determined by a site topographical survey. Slopes may be estimated from 1:25,000 OS maps, however in many urban areas such maps will not show sufficient detail to determine surface slopes on a property-by-property scale, just overall trends. With regard to slopes associated with infrastructure, e.g. cuttings, it should be ensured that any works do not impact on critical infrastructure.

**Question 2**: This will be specific to the proposed development and will be a result of the proposed landscaping of areas above and surrounding a proposed basement.

**Question 5:** The plan footprint of the outcropping geological strata can be established from British Geological Survey maps (e.g. 1:50,000 and 1:10,000 scale). Note that the boundaries are indicative and should be considered to be accurate to ±50m at best.

**Question 6:** this is a project specific determination, subject to relevant Tree Preservation Orders etc.

**Question 7:** this can be assessed from local knowledge and on-site observations of indicative features, such as cracking, Insurance firms may also give guidance, based on post code. Soil maps can be used to identify high-risk soil types. Relevant guidance is presented in BRE Digest 298 "Low-rise building foundations: the influence of trees in clay soils" (1999); BRE Digest 240 "Low-rise buildings on shrinkable clay soils: part 1" (1993); and BRE Digest 251 "Assessment of damage in low-rise buildings" (1995).

**Question 8:** Watercourses or spring lines may be identified from the following sources:

- Local knowledge and/or site walkovers
- Ordnance Survey maps (e.g. 1:25,000 or 1:10,000 scale). If features are marked (they are not always) the following symbol may be present "Spr"; water is indicated by blue colouration. (check the key on the map being used)
- Geological maps will show indicative geological strata boundaries which are where springs may form at the ground surface; of relevance are the boundary between the Bagshot Formation with the Claygate Member and the Claygate Member with the London Clay. Note that the boundaries are indicative should be considered to be accurate to ±50m at best. British Geological Survey maps (e.g. 1:10,000 scale, current and earlier editions).
- Aerial photographs
- "Lost Rivers of London" by Nicolas Barton, 1962. Shows the alignment of rivers in London and their tributaries.

**Question 9:** Worked ground includes, for example, old pits, brickyards, cuttings etc. Information can be gained from local knowledge and/or site walkovers, and from historical Ordnance Survey maps (at 1:25,000 or 1:10,000 scale, or better) and British Geological Survey maps (at 1:10,000 scale, current and earlier editions). Earlier geological maps (e.g. the 1:10560 scale series from the 1920s) include annotated descriptions such as "old pits", "formerly dug", "brickyard" etc.

**Question 10:** In LB Camden, all areas where the London Clay does not outcrop at the surface are considered to be an aquifer. This includes the River Terrace Deposits, the Claygate Member and the Bagshot Formation. The general footprint of the geological strata can be assessed from British Geological Survey maps (e.g. 1:50,000 and 1:10,000 scale). Note that the boundaries are indicative and should be considered to be accurate to ±50m at best.

The Environment Agency (EA) Aquifer Designation Maps can be used to identify aquifers. These are available from the EA website (www.environment-agency.gov.uk), by clicking on 'At home & leisure' > 'What's in Your Backyard' > 'Interactive Maps' > 'Groundwater'.

Details are required of the thickness of the geological strata present and the level or depth of the groundwater table. This may be known from existing information (for example nearby site investigations); however, it may not be known in the early stages of a project. Determination of the water table level may form part of the site investigation phase of a BIA and may require specialist advice to answer. Depth of proposed development is project specific.

**Question 11:** From local knowledge and/or site walkovers, and from Ordnance Survey maps (e.g. 1:25,000 or 1:10,000 scale). In relation to the stability and integrity of the pond structures and dams, the guidance of a Panel Engineer should be sought. (Details of Panel Engineers can be found on the Environment Agency website: http://www.environment-agency.gov.uk/ business/sectors/64253.aspx). Duty of care needs to be undertaken during any site works in the vicinity of the ponds.

**Question 12:** From local knowledge and/or site walkovers, and from Ordnance Survey maps (e.g. 1:25,000 or 1:10,000 scale). Any works should not impact on critical infrastructure.

**Question 13:** From local knowledge and/or site walkovers. May find some details on neighbouring properties from searches of LB Council databases, e.g. planning applications and/or building control records.

**Question 14:** From local knowledge and/or site walkovers, from Ordnance Survey maps (e.g. 1:25,000 or 1:10,000 scale) and directly from those responsible for tunnels (e.g. TfL or Network Rail). Any works should not impact on critical infrastructure.

Geotechnical & Environmental Associates (GEA) is an engineer-led and client-focused independent specialist providing a complete range of geotechnical and contaminated land investigation, analytical and consultancy services to the property and construction industries**.**

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GEA Geotechnical & Environmental Associates

## Appendix E J14290 – Supplementary Ground Investigation Report

# SUPPLEMENTARY GROUND INVESTIGATION REPORT

14 Netherhall Gardens
London
NW3 5TQ

Client: Netherhall Gardens Ltd

Engineer: Fluid Structures

J14290

December 2014




GEA Geotechnical & Environmental Associates

## Document Control

| **Project title** | 14 Netherhall Gardens, London NW3 5TQ | **Project ref** | J14290 |
|---|---|---|---|
| **Report prepared by** | Hannah Dashfield BEng FGS | | |
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| **Issue No** | **Status** | **Date** | **Approved for Issue** |
|---|---|---|---|
| 1 | Final | 9 December 2014 | SB |

This report has been issued by the GEA office indicated below. Any enquiries regarding the report should be directed to the office indicated or to Steve Branch in our Herts office.

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## CONTENTS

# EXECUTIVE SUMMARY

*This executive summary contains an overview of the key findings and conclusions. No reliance should be placed on any part of the executive summary until the whole of the report has been read. Other sections of the report may contain information that puts into context the findings that are summarised in the executive summary.*

## BRIEF

This report describes the findings of a ground investigation carried out by Geotechnical and Environmental Associates Ltd (GEA), on the instructions of Fluid Structures, on behalf of Netherhall Gardens Ltd, with respect to the redevelopment of this site through refurbishment and demolition of the existing buildings, and the construction of a new four-storey building and a basement beneath the new and retained buildings. The purpose of the investigation has been to confirm the ground conditions, to assess the extent of any contamination and to provide additional information for the design of suitable foundations and retaining walls. A desk study and Basement Impact Assessment was previously undertaken by GEA (ref; J12015 report issue 3, dated April 2012) and a separate Surface Flow and Flooding Assessment was compiled by Potamos Ltd (ref. 0041/LH/02-2012/0038, dated February 2012). The site has also previously been the subject of a ground investigation by Soils Ltd and GEA was also provided with a copy of a report on measures to address recurring subsidence by vkhp-consulting (undated Report ref. AS/763610)..

## PREVIOUS DESK STUDY FINDINGS

The site and immediately surrounding area remained undeveloped until some time between 1874 and 1895, when the existing building was constructed within the northern part of the site, together with Netherhall Gardens to the west and Nutley Terrace to the north. The building within the southern part of the site was constructed at some time between 1957 and 1960 and the site has remained essentially unaltered from that time.

Network Rail's Belsize Tunnel runs along the line of Nutley Terrace immediately north of the site, at a depth of approximately 30 m and the northern part of the site is located within a 10 m exclusion zone.

## GROUND CONDITIONS

Beneath a moderate thickness of made ground, London Clay was proved to the maximum depth investigated of 20.00 m. The investigations by Soils Ltd and GEA found the made ground to extend to depths of between 0.40 m and 0.70 m, where proved, and generally comprised brown silty clay with brick, burnt coal, ash and rootlets. The London Clay comprised an upper weathered horizon extending to depths of 9.50 m and 10.00 m. Below this depth unweathered London Clay comprising stiff grey silty fissured clay with rare partings of grey fine sand and silt, was encountered and proved to the full depth of the investigation. The clay was desiccated to a maximum depth of about 4.00 m in Borehole Nos 2 to 5, located in close proximity to existing mature trees. Groundwater was not encountered during the fieldwork during either investigation but was subsequently measured within standpipes at depths of between 1.25 m and 6.65 m. Suspected soliflucted or reworked London Clay was located directly beneath the made ground in Borehole No 4 to a depth of 1.75 m, and comprised firm orange-brown mottled greenish grey silty sandy clay with rare fine to medium rounded flint gravel.

Contamination testing has revealed elevated concentrations of lead within samples of made ground.

## RECOMMENDATIONS

The formation level for the new basement will extend into the London Clay. All foundations will need to bypass any potential or desiccated clay soils. Significant groundwater inflows are not anticipated to be encountered with the basement excavation. It may be possible to form the retaining walls by underpinning of the foundations of the existing original building and eastern and southern boundary garden walls, using a traditional 'hit and miss' approach, subject to further monitoring or trial excavations. For the construction of the remainder of the basement beneath the existing proposed new building it is unlikely to be possible to adopt an open cut excavation given the size of the excavation and proximity to neighbouring structures and piles are likely to be the most appropriate solution.

Only in proposed garden areas could end users conceivably come into direct contact with the contaminated soils. It is recommended that additional sampling and testing is carried out in the proposed garden areas to determine the precautions required, once the redevelopment proposals are finalised. The identified contaminants remaining within the made ground are considered to be of low solubility and a risk to groundwater has not been identified.

Consideration will need to be given to any possible effect of the proposed development on the nearby railway tunnel.

# Part 1: INVESTIGATION REPORT

This section of the report details the objectives of the investigation, the work that has been carried out to meet these objectives and the results of the investigation. Interpretation of the findings is presented in Part 2.

## 1.0 INTRODUCTION

Geotechnical and Environmental Associates Ltd (GEA) has been commissioned by Fluid Structures, on behalf of Netherhall Gardens Ltd, to carry out a ground investigation at 14 Netherhall Gardens, London, NW3 5TQ.

The site has been the subject of a number of previous reports, for a previous client as follows:

- April 2012: Desk Study and Basement Impact Assessment. GEA (ref. J12015, report issue 3);
- February 2012: Surface Water Assessment. Potamos Consulting (ref. 0041/LH/02-2012/0038); and
- January 2011: Ground Investigation. Soils Ltd (ref. J12146/SI, dated January 2011).

The site has also previously been the subject of a report on measures to address recurring subsidence by vkhp-consulting (undated Report Ref. AS/763610), provided by Heyne Tillett Steel.

The previous reports should be referred to for information not superseded by this letter.

### 1.1 Proposed Development

Consideration is being given to the redevelopment of this site through the demolition of the 1950s building and construction of a new four-storey building at the rear of the site, together with refurbishment of the existing original three-storey buildings and construction of a new basement beneath the entire footprint of the retained building and under the majority of the site at the rear. The proposed basement will extend to a depth of about 4.00 m, but will deepened locally to roughly 6.50 m to accommodate a lift shaft.

It is understood that planning permission has been granted for the development.

This report is specific to the proposed development and the advice herein should be reviewed if the development proposals are amended.

### 1.2 Purpose of Work

The principal technical objectives of the work carried out were as follows:

- to review the previous reports;
- to determine the ground conditions and their engineering properties to greater depths than previously;

- to provide advice with respect to the design of suitable foundations and retaining walls;
- to provide an indication of the degree of soil contamination present; and
- to assess the risk that any such contamination may pose to the proposed development, its users or the wider environment.

## 1.3 Scope of Work

In order to meet the above objectives, a supplementary ground investigation was carried out which comprised, in summary, the following activities:

- two cable percussion boreholes, advanced to depths of 20.0 m, by means of a dismantlable cable percussion drilling rig;
- standard penetration tests (SPTs), carried out at regular intervals in the cable percussion boreholes, to provide additional quantitative data on the strength of the soils;
- three drive-in window sampler boreholes advanced to depths of between 3.20 m and 5.00 m;
- installation of three groundwater monitoring standpipes, to depths of 5 m and 8 m;
- two subsequent groundwater monitoring visits carried out over a period of roughly one month;
- eight hand dug trial pits excavated to expose the foundations of the existing house and retaining walls;
- laboratory testing of selected soil samples for geotechnical and contamination purposes; and
- provision of a report presenting and interpreting the above data, together with their advice and recommendations with respect to the proposed development.

## 1.4 Limitations

The conclusions and recommendations made in this report are limited to those that can be made on the basis of the investigation. The results of the work should be viewed in the context of the range of data sources consulted, the number of locations where the ground was sampled and the number of soil, gas or groundwater samples tested; no liability can be accepted for information in other data sources or conditions not revealed by the sampling or testing. Any comments made on the basis of information obtained from the client or other third parties are given in good faith on the assumption that the information is accurate; no independent validation of such information has been made by GEA.

# 2.0 THE SITE

## 2.1 Site Description

The site is located in the London Borough of Camden, approximately 200 m northeast of Finchley Road London Underground Station and 300 m southeast of Finchley Road and Frognal Rail Station. It is roughly rectangular in shape, measuring approximately 33 m east to west by 60 m north to south, and is bounded by Netherhall Gardens to the west and Nutley Terrace to the north. A three-storey building occupied by a school bounds the site to the south and a two-storey brick-built house is present to the east. The site may be additionally located by National Grid Reference 526370, 184890.

The site is occupied by a roughly square three-storey brick building in the north, which is linked by internal corridors at each floor level to a rectangular brick building in the south, which is aligned north-south. The site was unoccupied at the time of the fieldwork.

A wall screens the land to the east of the northern building from the front drive area and fills the gap between the building and the garage of the neighbouring house to the east. A paved driveway is present to the north of the building, fronting onto Nutley Terrace, and a small paved patio is located immediately south of the northern building, to the west of the linking corridor. Grassed garden areas are present to the east and west of the building, with some planted beds and numerous trees, including mature London plane trees up to 25 m, high particularly along the west of the site.

The site lies at an approximate elevation of 71 m OD and the area immediately surrounding the site slopes down towards the south and west. Netherhall Gardens slopes down gently southwards alongside the site, such that the elevation of the site reduces by approximately 2 m over a distance of 60 m at an average slope of 2°. The slope of Netherhall Gardens becomes steeper immediately south of the site such that the elevation reduces by 5 m over a distance of approximately 40 m. The site itself is essentially level, with stepped drops of approximately 0.5 m, where there is a wall in the garden and internal stairs in the linking corridor between the older and newer buildings, and a further drop of approximately 1.5 m at the southern end of the garden.

## 2.2 Previous Desk Study Findings

The previous desk study indicated that the site and immediately surrounding area remained undeveloped until some time between 1874 and 1895, when the existing building was constructed within the northern part of the site, together with Netherhall Gardens to the west and Nutley Terrace to the north. The building within the southern part of the site was constructed at some time between 1957 and 1960 and the site has remained essentially unaltered from that time.

The River Westbourne and River Tyburn historically flowed in a roughly southwards direction towards the River Thames, approximately 250 m west and 250 m east of the site respectively.

The Envirocheck report does not list any landfills within 250 m of the site and there are no contaminated land register entries or notices or pollution incidents recorded within 1 km of the site.

## 2.3 Other Information

The Geological Survey map of the area (Sheet 256) indicates that the site is underlain by the London Clay Formation from the surface. The Claygate Member overlies the London Clay roughly 125 m north of the site.

The London Clay is classified as Unproductive Strata, which refers to a stratum with low permeability that has negligible significance for water supply or river base flow, as defined by the Environment Agency (EA).

According to the vhkp report, recurring subsidence damage has been affecting the property, with subsidence damage noted at various times since at least 1976. The original building has foundations at a depth of 1.1 m below ground level. The rear addition has what has been described as a raft foundation formed at a depth of 1.4 m below ground level. In 1999, the western side of the rear wall of the main house and part of the west flank wall of the rear addition were underpinned to a maximum depth of 5 m. Underpinning to this depth was also carried out to the sun room, which had previously been underpinned in 1976/1977 to a depth of 2.6 m. The repeated damage to the building appears to occur in periods of drought conditions and vkhp attributed the recurring damage to the desiccation and shrinkage of the clay subsoil due to moisture extraction by roots of nearby large trees, possibly exacerbated by leakage from any nearby water surface pipework or underground drainage pipework.

Network Rail's Belsize Tunnel runs along the line of Nutley Terrace immediately north of the site, at a depth of approximately 30 m and the site is located within an exclusion zone.

## 2.4 Previous Site Investigation

The previous site investigation undertaken by Soils Ltd comprised two cable percussion boreholes advanced to depths of 10.00 m and confirmed the expected ground conditions in that, beneath a nominal thickness of made ground, London Clay was encountered and proved to the full depth of the investigation. The made ground comprised dark brown sandy clay with occasional to abundant brick fragments and was encountered to depths of 0.45 m and 0.65 m. The London Clay comprised firm to stiff dark brown to grey occasionally fissured silty clay with occasional partings of fine sand and scattered traces of selenite. Roots were observed to a maximum depth of 3.00 m in the boreholes.

Groundwater was not encountered during the ground investigation. A single groundwater monitoring standpipe was installed to a depth of 10.0 m in one of the boreholes, although no subsequent monitoring is known to have been carried out.

# 3.0 EXPLORATORY WORK

Access was limited by the presence of the original building and 1960s extension, along with the 10 m exclusion zone for the Network Rail tunnel located just to the north of the site. Therefore in order to meet the objectives described in Section 1.2 as far as possible within the access constraints, two cable percussion boreholes were drilled in the rear garden to depths of 20.00 m using a dismantlable drilling rig. In addition, three drive-in window sampler boreholes were drilled to depths of between 3.20 m and 5.00 m to provide additional coverage of the site.

Groundwater monitoring standpipes were installed to depths of 5.00 m and 8.00 m in three boreholes and have been monitored on two occasions to date, over a period of roughly one month.
A total of eight hand dug trial pits was excavated to expose the foundations of the existing house and retaining walls.

A selection of the disturbed and undisturbed samples recovered from the boreholes and trial pits were submitted to a soil mechanics laboratory for a programme of geotechnical testing and an analytical laboratory for a programme of contamination testing.

All of the above work was carried out under the supervision of a geotechnical engineer from GEA.

The borehole and trial pit records and results of the laboratory testing are appended, together with a site plan indicating the exploratory positions. The Ordnance Datum (OD) levels on the borehole records have been interpolated from spot heights shown on a site survey drawing by Michael Gallie and Partners (Ref 7905/02, dated August 2011), which was provided by the consulting engineers.

### 3.1 Sampling Strategy

The scope of the works was specified by the consulting engineers, with input from GEA. The trial pit positions were specified by the consulting engineers, whilst the borehole were positioned on site by GEA in accessible locations, which provided adequate coverage of the site, whilst avoiding areas of buried services.

Laboratory geotechnical classification and strength tests were undertaken on samples of the natural soil.

Six samples of the made ground were subjected to analysis for a range of common industrial contaminants and contamination indicative parameters. For this investigation the analytical suite for the soil included a range of metals, speciation of total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAH), total cyanide and monohydric phenols. The soil samples were selected to provide a general view of the chemical conditions of the soils that are likely to be involved in a human exposure or groundwater pathway and to provide advice in respect of re-use or for waste disposal classification.

The contamination analyses were carried out at an MCERTs accredited laboratory with the majority of the testing suite accredited to MCERTS standards. Details of the MCERTs accreditation and test methods are included in the Appendix together with the analytical results.

## 4.0 GROUND CONDITIONS

The investigation has confirmed the expected ground conditions in that, beneath a a moderate thickness of made ground, the London Clay Formation was encountered and proved to the full depth investigated of 20.00 m.

### 4.1 Made Ground

The made ground extended to depths of between 0.40 m and 0.70 m and generally comprised brown silty clay with roots and rootlets. With the exception of notable fragments of extraneous material, such as ash, brick and coal fragments, no visual or olfactory evidence of significant contamination was observed within these soils, although six samples of the made ground have been analysed for a range of contaminants as a precautionary measure and the results are summarised in Section 4.4.

The previous Soils Ltd investigation encountered made ground to depths of 0.45 m and 0.65 m which generally comprised dark brown sandy clay with occasional to abundant brick fragments.

## 4.2 London Clay

The London Clay comprised an upper weathered zone of firm becoming stiff brown mottled grey silty fissured clay with occasional partings of orange-brown fine sand and silt, carbonaceous material and rare selenite crystals, which extended to depths of between 9.50 m and 10.00 m. Below this depth stiff grey silty fissured clay with rare partings of grey fine sand and silt, was encountered and proved to the maximum depth investigated of 20.00 m.

The extent of the weathered London Clay was not proved in Borehole Nos 1 to 3, which extended to the maximum depth of the boreholes at these locations of between 3.20 m and 5.00 m. The strength of the clay limited the depth achieved with the hand held window sampling equipment.

In Borehole No 4 directly beneath the made ground, firm orange-brown mottled greenish grey silty sandy clay with rare fine to medium rounded flint gravel was encountered which extended to a depth of 1.75 m. This material was sandier than would be expected for London Clay and could represent a soliflucted material derived in part from the overlying Claygate Member to the north of the site.

Claystones were encountered at depths of 18.50 m and 3.00 m in Borehole Nos 4 and 5 respectively.

Roots and rootlets were noted to extend to depths of between 1.30 m and 2.75 m in Borehole Nos 2 to 5. The London Clay was noted to be ‘stiff’ at shallow depths within close proximity to existing trees. Pocket penetrometer readings and laboratory testing have confirmed the presence of desiccation within the vicinity of existing trees to a maximum depth of about 4.00 m.

The results from the laboratory undrained triaxial compression tests generally indicate the clay to be of medium strength becoming high strength to very high strength with undrained shear strengths generally increasing with depth. However the results of the triaxial results from Borehole No 5 at depths of 2.00 m and 4.00 m indicate very high strengths, reflecting the presence of desiccated clay soils.  Laboratory plasticity index test results indicate the clay to be of high volume change potential.

The previous Soils Ltd investigation encountered London Clay proved to the maximum depth investigated of 10.00 m and comprised firm to stiff dark brown to grey occasionally fissured silty clay with occasional partings of fine sand and scattered traces of selenite. Roots were observed to a maximum depth of 3.0 m in the boreholes.

## 4.3 Groundwater

Groundwater was not encountered during drilling of any of the boreholes, including the previous two 10 m deep boreholes drilled by Soils Ltd.  The table below shows the depths at which water was measured in the installed standpipes on each of the monitoring visits:

| Borehole No | Standpipe depth in m [Level m OD] | Depth to groundwater m [Level m OD] | |
|---|---|---|---|
| | | 10/11/2014 | 20/11/2014 |
| 1 | 4.00 (67.54) | 2.22 (69.32) | 1.85 (69.69) |
| 4 | 8.00 (63.17) | 2.60 (68.57) | 2.13 (69.04) |
| 5 | 8.00 (62.93) | 6.65 (64.28) | 1.25 (69.68) |

## 4.4 Soil Contamination

The table below sets out the values measured within six samples of made ground analysed. All concentrations are in mg/kg unless otherwise stated.

| Determinant | Maximum concentration recorded (mg/kg) | Minimum concentration recorded (mg/kg) | Number of samples below detection limit | Normalised upper bound $US_{95}$ |
|---|---|---|---|---|
| Arsenic | 24 | 11 | ALL | 22.2 |
| Cadmium | 0.87 | <0.10 | ALL | 0.6 |
| Chromium | 37 | 28 | ALL | 34.5 |
| Copper | 96 | 16 | ALL | 71.2 |
| Mercury | 1.9 | <0.10 | ALL | 1.2 |
| Nickel | 41 | 13 | ALL | 32.8 |
| Lead | **1000** | 100 | ONE | **817.1** |
| Selenium | <0.20 | <0.20 | ALL | 0.2 |
| Zinc | 490 | 48 | ALL | 341.2 |
| Total Cyanide | 0.50 | <0.50 | ALL | 0.5 |
| Total Phenols | <0.30 | <0.30 | ALL | 0.3 |
| Total Sulphate | 2600 | 240 | ALL | 1794.4 |
| Chloride | 0.025 | <0.010 | ALL | 0.02 |
| Sulphide | <0.50 | <0.50 | ALL | 0.5 |
| TPH C5-C35 | 37 | <10 | ALL | 23.6 |
| Naphthalene | 0.20 | <0.10 | ALL | 0.2 |
| Benzo(a)pyrene | 1.2 | <0.10 | ALL | 1.00 |
| Total PAH | 14 | <2.0 | ALL | 13.7 |
| Total Organic Carbon % | 7.2 | 0.55 | - | 4.7 |
| pH | 8.1 | 6.5 | - | - |

*Note:* The use of the normalised upper bound for 95$^{th}$ percentile confidence aims to remove some of the uncertainty associated with calculation of an arithmetic sample mean of a relatively small number of samples. The US95 value is the upper bound of the range within which it can be stated with 95% confidence that the true mean concentration of the data set will fall.
Figure in **bold** indicates concentration in excess of risk-based soil guideline values, as discussed in Part 2 of this report

### 4.4.1 Generic Quantitative Risk Assessment

The use of a risk-based approach has been adopted to provide an initial screening of the test results to assess the need for subsequent site-specific risk assessments. To this end the table below indicates those contaminants of concern that have values in excess of a generic human health risk based guideline values which are either that of the CLEA[1] Soil Guideline Value where available, or is a Generic Screening Value calculated using the CLEA UK Version 1.06[2] software assuming a residential end use, or is based on the DEFRA Category 4 Screening values[3]. The key generic assumptions for this end use are as follows:

- that groundwater will not be a critical risk receptor;
- that the critical receptor for human health will be young female children aged zero to six years old;
- that the exposure duration will be six years;
- that the critical exposure pathways will be direct soil and indoor dust ingestion, skin contact with soils and indoor dust, and inhalation of indoor and outdoor dust and vapours; and
- that the building type equates to a two-storey small terraced house.

It is considered that these assumptions are acceptable for this generic assessment of this site. The tables of generic screening values derived by GEA and an explanation of how each value has been derived are included in the Appendix.

Where contaminant concentrations are measured at concentrations below the generic screening value it is considered that they pose an acceptable level of risk and thus further consideration of these contaminant concentrations is not required. However, where concentrations are measured in excess of these generic screening values there is considered to be a potential that they could pose an unacceptable risk and thus further action will be required which could include;

- additional testing to zone the extent of the contaminated material and thus reduce the uncertainty with regard to its potential risk;
- site specific risk assessment to refine the assessment criteria and allow an assessment to be made as to whether the concentration present would pose an unacceptable risk at this site; or
- soil remediation or risk management to mitigate the risk posed by the contaminant to a degree that it poses an acceptable risk.

Elevated concentrations of lead were measured within five of the six samples of made ground tested above the respective generic risk-based guideline values with concentrations ranging between 270 mg/kg to 1000 mg/kg. These concentrations could thus pose a potentially unacceptable risk to human health through direct contact, accidental ingestion or inhalation of soil or soil derived dust.

1 *Updated Technical Background to the CLEA Model (Science Report SC050021/SR3) Jan 2009* and Soil Guideline Value reports for specific contaminants; all DEFRA and Environment Agency.
2 Contaminated Land Exposure Assessment (CL|EA) Software Version 1.06 Environment Agency 2009
3 CL:AIRE (2013) *Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination* Final Project Report SP1010 and DEFRA (2014) *Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination* Policy Companion Document SP1010

Total Organic Carbon (TOC) was also slightly elevated above 6% at a single location at 7.2%. However TOC is not considered to represent a risk in itself but can be indicative of methangoenic potential but is likely to be the result of a root inclusion, it is not considered to present a risk at this site.

The concentrations of total sulphate measured in a single sample of made ground tested exceeded the trigger value of 2400 mg/kg. Additional testing for water soluble sulphate was automatically carried out, with concentrations of between 0.031 g/l.

The significance of these results is considered further in Part 2 of the report.

### 4.5 Existing Foundations

Trial Pit Nos 1 and 2 were excavated along the southern boundary garden wall and found the existing foundations to bear at depths of 1.70 m and 1.40 m on ‘stiff’ London Clay, suspected desiccated soils.

Trial Pit No 3 indicates that the original existing building is founded at depths of 1.10 m on ‘stiff’ London Clay, which was probably desiccated.

Trial Pit No 4 excavated against the single storey part of the original building was founded at a depth of 0.60 m on firm orange-brown mottled grey silty clay.

Trial Pit No 5 was excavated against the eastern boundary of the site, against the neighbouring outbuilding which appears to be on a concrete base, founded at a depth of 0.05 m below ground level.

Trial Pit No 6 was excavated against the eastern elevation of the existing original building. The extent of the footing was not proved at this location which was found to extend to a depth of at least 0.80 m.

Trial Pit Nos 7 and 8 were excavated from basement level in the original building and Trial Pit No 7 found the western and southern elevation footing to be bearing on what appeared to be made ground at a depth of 0.51 m, whilst in Trial Pit No 8 the eastern elevation foundation was bearing on firm London Clay at a depth of 0.27 m.

Copies of the trial pit records are included in the Appendix.

# Part 2: DESIGN BASIS REPORT

This section of the report provides an interpretation of the findings detailed in Part 1, in the form of a ground model, and then provides advice and recommendations with respect to foundation options and contamination issues.

## 5.0 INTRODUCTION

The proposed redevelopment of the site includes the demolition of the southern building, to be replaced by construction of a new four-storey building, together with the construction of a basement beneath the footprint of the retained and new buildings. On the basis of the information provided, the formation level of the new basement is anticipated to be roughly 4.00 m below existing ground level with a deepened section to 6.50 m for a lift shaft and formation level will, therefore be in the London Clay.

## 6.0 GROUND MODEL

The previous desk study has revealed that the site has not had a potentially contaminative history, having apparently been occupied by the existing residential property for the entirety of its developed history and on the basis of the fieldwork, the ground conditions at this site can be characterised as follows.

- Beneath a moderate thickness of made ground, London Clay was proved to the maximum depth investigated of 20.00 m;
- the investigation by Soils Ltd and GEA found the made ground to extend to depths of between 0.40 m and 0.70 m, where proved and generally comprises brown silty clay with brick, burnt coal, ash and rootlets;
- suspected soliflucted or reworked London Clay was located directly beneath the made ground in Borehole No 4 to a depth of 1.75 m, and comprises firm orange-brown mottled greenish grey silty sandy clay with rare fine to medium rounded flint gravel;
- the London Clay comprises an upper weathered horizon extending to depths of 9.50 m and 10.00 m;
- below this depth unweathered London Clay comprising stiff grey silty fissured clay with rare partings of grey fine sand and silt, was encountered and proved to the full depth of the investigation;
- the clay was desiccated in Borehole Nos 2 to 5, located in close proximity to existing mature trees, and extended to a maximum depth of about 4.00 m;
- groundwater was not encountered during the fieldwork during either investigation but was subsequently measured within the standpipes at depths of between 1.25 m and 6.65 m;
- the chemical analyses revealed elevated concentrations of lead within some samples of made ground; and
- a Network Rail tunnel passes immediately adjacent to the northern boundary of the site.

# 7.0 ADVICE AND RECOMMENDATIONS

Formation level for the proposed 4.00 m and 6.50 m deep basements are likely to be within the London Clay. Significant groundwater inflows are not anticipated in the basement excavations.

Consideration may need to be given to the close proximity of the tunnel to the north and liaison with Network Rail will be required with respect to the effect of the new buildings on the tunnel.

## 7.1 Basement Excavation

The formation level of the new basement is anticipated to be roughly 4.00 m below existing ground level with a locally deepened section extending to a depth of 6.50 m for a lift shaft. Formation level for the basements is expected to be within the weathered firm or stiff London Clay.

Monitoring of the standpipes has recorded water at depths of between 1.25 m and 6.65 m. It is not clear to what extent the water levels in the pipes are indicative of perched groundwater within the made ground, or if there is a more general water level in the London Clay. The permeability of the London Clay is likely to be very low, with horizontal permeability ranging between 1 x $10^{-10}$ m/s and 1 x $10^{-8}$ m/s with an even lower vertical permeability. Groundwater may be present within the London Clay as discrete pockets of water rather than in continuous layers. Each individual pocket may therefore be of relatively low volume and individual inflows may cease once the pocket is emptied. In any case, inflows could conceivably occur from perched water tables, particularly in the vicinity of existing foundations.

On this basis inflows may not be significant and could be adequately dealt with through sump pumping. However, as the basement excavation will cover a much larger area than that covered by the investigation, it is possible that larger pockets or inter-connected layers of groundwater could be encountered. It would therefore be prudent for the chosen contractor to have a contingency plan in place to deal with more significant or prolonged inflows as a precautionary measure. Continued monitoring of the standpipes is an essential requirement. It would also be prudent, once access is available, to carry out a number of trial excavations, to depths as close to the full basement depth as possible to confirm the rate of any groundwater inflows.

The design of basement support in the temporary and permanent conditions needs to take account of the need to maintain the stability of the excavation, the existing slope, the surrounding structures, namely the neighbouring properties to the east and south, and to protect against groundwater inflows.

It may be possible to form the retaining walls by underpinning of the foundations of the existing original building and eastern and southern boundary garden walls, using a traditional ‘hit and miss’ approach, subject to further monitoring or trial excavations. Careful workmanship will be required to ensure that movement of the surrounding structures does not arise during underpinning of the existing foundations, but this method will have the benefit of minimising the plant required and maximising usable space in the new basement. The contractor should however have a contingency in place to deal with any groundwater inflows.
For the construction of the remainder of the basement beneath the existing proposed new building it is unlikely to be possible to adopt an open cut excavation given the size of the excavation and proximity to neighbouring structures. The noise and vibrations associated with the installation of sheet piles may be unacceptable given the close proximity of the tunnel and

the neighbouring houses, unless a “silent” installation method is adopted; the use of water jetting to assist with installation should however be carefully considered, as it may induce ground movements in nearby structures if not properly controlled.

A bored pile wall would have the advantage of being incorporated into the permanent works and will be able to provide support for structural loads. On the basis of the monitoring to date, it should be possible to adopt a contiguous bored pile wall, with the use of localised grouting and / or pumping if necessary in order to deal with groundwater inflows.

The ground movements associated with the basement excavation will depend on the method of excavation and support and the overall stiffness of the basement structure in the temporary condition. Thus, a suitable amount of propping will be required to provide the necessary rigidity. In this respect the timing of the provision of support to the wall will have an important effect on movements.

### 7.1.1 Slope Stability

The screening assessment carried out as part of the previous BIA has identified the site to be within a wider hillside setting in which the general slope is greater than 7° and the site includes slopes greater than 7°, where two level changes occur, although the overall slope of the site is under 7°. The level changes are already supported by retaining structures and the existing slopes show no sign of instability. It is understood that the proposed development will not introduce any new slopes or involve any steepening of the existing slope. Additionally, the proposed development, which will include the construction of new retaining walls as part of the basement structure, will provide additional support to that already in place and further assessment is not deemed necessary at this stage.

It is recommended that there should not be any unsupported excavations and that the basement retaining walls are suitably designed to maintain the stability of the existing slope, as discussed below. Consideration could be given to the use of ground anchors in association with retaining walls, in order to add further stability to the slope and reduce the requirement for internal propping on this relatively small site.

### 7.1.2 Basement Retaining Walls

The following parameters are suggested for the design of the permanent basement retaining walls.

| Stratum | Bulk Density ($kg/m^3$) | Effective Cohesion ($c'$ – $kN/m^2$) | Effective Friction Angle ($\Phi'$ – degrees) |
|---|---|---|---|
| Made Ground | 1700 | Zero | 20 |
| London Clay | 1950 | Zero | 25 |

Groundwater has been measured at depths of between 1.25 m and 6.65 m and further monitoring should be continued in order to establish a design water level. On this basis, groundwater inflows may be encountered in the 4.00 m and 6.50 m deep basements but are unlikely to be significant given the relatively low permeability of the London Clay. Further monitoring should be undertaken as detailed in Section 7.1, along with trial excavations. Reference should be made to BS8102:2009[4] with regard to requirements for waterproofing and design with respect to groundwater pressures.

The retaining walls will need to be designed to take account of the overall stability of the slope and this will need to be considered in more detail once the layout has been finalised.

4 BS8102 (2009) *Code of practice for protection of below ground structures against water from the ground*

### 7.1.3 Basement Heave

The existing basement is located beneath part of the existing original building and will be lowered to increase head height, which will result in a net unloading of about 35 kN/m². The basement will also be extended beneath the entire footprint of the existing building and proposed new building to depths of 4.00 m and 6.50 m and will result in a variable unloading of 80 kN/m² and 130 kN/m² respectively.

The proposed excavations will result in elastic heave and long term swelling of the underlying London Clay. The effects of the longer term swelling movement will be mitigated to some extent by the load applied by the new foundations and the continued presence of the existing building.

Consideration will need to be given to the effects of differential movement that will occur through lowering of the existing basement and beneath the remainder of the original building and proposed new buildings. Consideration may need to be given to the requirement for tension piles.

An analysis of the heave movements should be undertaken, once the proposals have been finalised.

## 7.2 Spread Foundations

The excavation to form the basement level will result in a formation level in the London Clay at depths of 4.00 m and 6.50 m below existing ground level. Desiccated clay soils were noted to extend to a maximum depth of about 4.00 m at the exploratory locations investigated, within the vicinity of existing mature trees.

Subsidence is known to have been an on-going problem at the site noted at various times since at least 1976. The repeated damage to the building appears to occur in periods of drought conditions. vkhp attributed the recurring damage to desiccation and shrinkage of the clay of the subsoil due to moisture extraction by roots of nearby large trees, possibly exacerbated by leakage from any nearby water surface pipework or underground drainage pipework.

All existing and new foundations should bypass any or potentially desiccated clay soils. It should be possible to adopt moderate width pad or strip foundations bearing in the firm or stiff clay, designed to apply a net allowable bearing pressure of 150 kN/m$^2$ below the proposed basement floor, at depths of 4.00 m and 6.50 m. This value incorporates an adequate factor of safety against bearing capacity failure and should ensure that settlement remains within normal tolerable limits.

Foundations must be extended to sufficient depth to be below the zone affected by volume changes to the clay, taking into account the presence of trees at the site and in accordance with NHBC guidelines. Foundation excavations should be checked by a suitably qualified engineer to confirm they are below the depth of desiccation.

## 7.3 Piled Foundations

For the ground conditions at this site, driven or bored piles could be adopted. Driven piles would have the advantage of minimising the spoil that is generated, but the effects of noise and vibrations on neighbouring sites are unlikely to be acceptable. Some form of bored pile may therefore be more appropriate. A conventional rotary augered pile may be appropriate but consideration will need to be given to the possible instability and water ingress within any silty or sandy zones within the London Clay. The use of bored piles installed using continuous flight auger (cfa) techniques may therefore be the most appropriate.

The following table of ultimate coefficients may be used for the preliminary design of bored piles, based on the measured SPT and cohesion / depth graph in the appendix.

| | | |
|---|---|---|
| ***Ultimate Skin Friction*** | | ***kN/m²*** |
| Made Ground / desiccated clay soils | GL to 4.0 m | Ignore |
| London Clay (α =0.5) | 4.0 m to 20.0 m | Increasing linearly from 35 to 80 |
| ***Ultimate End Bearing*** | | ***kN/m²*** |
| London Clay | 12.0 m to 20.0 m | Increasing linearly from 1035 to 1485 |

In the absence of pile tests, guidance from the (LDSA) suggests that a factor of safety of 2.6 should be applied to the above coefficients in the computation of safe theoretical working loads. On this basis it has been estimated that a 450 mm diameter pile, 15.0 m long pile, extending a depth of 11.0 m below existing ground level should provide a safe working load of about 380 kN.

The above example is not intended to constitute any form of recommendation with regard to pile size or type, but merely serve to illustrate the use of the above coefficients. Specialist piling contractors should be consulted with regard to the design of an appropriate piling scheme and their attention should be drawn to the possible presence of groundwater inflows from within sand or silt partings within the London Clay.

In the design of piled foundations the effect of potential future shrinkage and swelling of the clay should be taken into account. In designing for compressive loads it should be assumed that further desiccation, and hence shrinkage of the clay, could continue where trees are to remain. Pile shaft adhesion within the theoretical maximum future desiccated thickness should therefore be ignored.

Heave of the clay soils could also occur due to future swelling as a result of trees being removed. This would exert a tensile uplift force on the piles, unless piles are effectively isolated from the surrounding soil by means of a slip layer or sleeve around the pile shaft.

## 7.4 Shallow Excavations

On the basis of the borehole findings and trial pits, it is considered that shallow excavations for foundations and services that extend through the made ground or clay should remain generally stable in the short term, although some instability may occur. However, should deeper excavations be considered or if excavations are to remain open for prolonged periods it is recommended that provision be made for battered side slopes or lateral support. Where personnel are required to enter excavations, a risk assessment should be carried out and temporary lateral support or battering of the excavation sides considered in order to comply with normal safety requirements.

The investigation has indicated that groundwater inflows might be encountered from within the made ground, particularly within the vicinity of existing foundations. Some form of groundwater control is likely to be required and inflows should be suitably controlled by sump pumping, although this should be confirmed by additional investigations, ideally in the form of trial excavations to the full depth of the proposed basement.

## 7.5 Effect of Sulphates

Chemical analyses on a single sample of the made ground and two samples of London Clay have revealed generally low concentrations of soluble sulphate, corresponding to Class DS-1 and DS-3 of BRE Special Digest 1 Part C (2005). The measured pH value of the samples show that a ACEC class of AC-1s and ACEC AC-3 of Table C2 would be appropriate for the site. This assumes a static water condition at the site. The guidelines contained in the above digest should be followed in the design of foundation concrete.

## 7.6 Site Specific Risk Assessment

The desk study has not indicated the site to have had a potentially contaminative history, having been occupied by the existing house for it entire developed history. However, the chemical analysis has revealed elevated concentrations of lead in excess of the generic risk-based screening values for a residential end-use with plant uptake.

Elevated concentrations of lead were measured within five of the six samples of made ground tested above the respective generic risk-based guideline values with concentrations ranging between 270 mg/kg to 1000 mg/kg. These concentrations could thus pose a potentially unacceptable risk to human health through direct contact, accidental ingestion or inhalation of soil or soil derived dust.

The likely source of the lead contamination is fragments of burnt coal and ash noted within the made ground. The metal compounds within the made ground are considered likely to be of low solubility and a risk to groundwater and adjacent sites has not been identified. The concentrations could however pose a potentially unacceptable risk to human health through direct contact, accidental ingestion or inhalation of soil or soil derived dust.

### 7.6.1 End Users

End users will be effectively isolated from direct contact with the identified contaminants by the building and areas of external hardstanding. Much of the contamination is likely to be removed as part of the basement excavation and only in proposed garden areas could end users conceivably come into direct contact with the contaminated soils, although this pathway is already in existence.

As only a limited number of samples have been tested, it would be prudent to carry out contamination testing on additional samples of made ground / topsoil recovered from the areas of the site that are to remain as soft landscaped gardens, in order to ensure the absence of any significant contamination.

Site workers will be protected from the contamination through adherence to normal high standards of site safety.

### 7.6.2 Site Workers

Site workers should be made aware of the contamination and a programme of working should be identified to protect workers handling any soil. The method of site working should be in accordance with guidelines set out by HSE[5] and CIRIA[6] and the requirements of the Local Authority Environmental Health Officer.

## 7.7 Waste Disposal

Any spoil arising from excavations or landscaping works, which is not to be re-used in accordance with the CL:AIRE guidance[7], will need to be disposed of to a licensed tip. Under the European Waste Directive, waste is classified as being either Hazardous or Non-Hazardous and landfills receiving waste are classified as accepting hazardous or non-hazardous wastes or the non-hazardous sub-category of inert waste in accordance with the Waste Directive. Waste going to landfill is subject to landfill tax at either the standard rate of £64 per tonne (about £120 per $m^3$) or at the lower rate of £2.50 per tonne (roughly £5 per $m^3$). However, the classifications for tax purposes and disposal purposes differ and currently all made ground and topsoil is taxable at the 'standard' rate and only naturally occurring rocks and soils, which are accurately described as such in terms of the 2011 Order[8], would qualify for the 'lower rate' of landfill tax.

Based upon on the technical guidance provided by the Environment Agency[9] it is considered likely that the made ground from this site, as represented by the six chemical analyses carried out, would be classified as NON-HAZARDOUS waste under the waste code 17 05 04 (soils and stones not containing dangerous substances) and would be taxable at the standard rate. It is likely that the natural soils, if separated out, could be classified as an INERT waste also under the waste code 17 05 04. This material would be taxable at the lower rate, if accurately described as naturally occurring clay in terms of the 2011 Order on the waste transfer note. As the site has never been used for the storage of potentially hazardous materials, it is likely that WAC leaching tests would not be required for such inert waste going to landfill. This would however need to be confirmed by the receiving landfill site.

Under the requirements of the European Waste Directive all waste needs to be pre-treated prior to disposal. The pre-treatment process must be physical, thermal, chemical or biological, including sorting. It must change the characteristics of the waste in order to reduce its volume, hazardous nature, facilitate handling or enhance recovery. The waste producer can carry out the treatment but they will need to provide documentation to prove that this has been carried out. Alternatively, the treatment can be carried out by an approved contractor. The Environment Agency has issued a position paper[10] which states that in certain circumstances, segregation at source may be considered as pre-treatment and thus excavated material may not have to be treated prior to landfilling if the soils can be "segregated" onsite by sufficiently characterising the soils insitu prior to excavation.

The above opinion with regard to the classification of the excavated soils and its likely landfill taxable rate is provided for guidance only and should be confirmed by the receiving landfill once the soils to be discarded have been identified. The local waste regulation

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5 HSE (1992) HS(G)66 *Protection of workers and the general public during the development of contaminated land* HMSO

6 CIRIA (1996) *A guide for safe working on contaminated sites* Report 132, Construction Industry Research and Information Association

7 CL:AIRE (2011) *The Definition of Waste: Development Industry Code of Practice* Version 2, March 2011

8 *Landfill Tax (Qualifying Material) Order 2011*

9 Environment Agency (2008) *Hazardous Waste: Interpretation of the definition and classification of hazardous waste. Technical Guidance* WM2 Second Edition Version 2.2, May 2008

10 Regulatory Position Statement (2007) *Treating non-hazardous waste for landfill - Enforcing the new requirement* Environment Agency 23 Oct 2007

department of the Environment Agency (EA) should be contacted to obtain details of tips that are licensed to accept the soil represented by the test results. The tips will be able to provide costs for disposing of this material but may require further testing.

If consideration were to be given to the re-use of the soil as a structural fill on this or another site, in accordance with the Code of Practice for the definition of waste, it would be necessary to confirm its suitability for use, its certainty of use and to confirm that only as much material is to be used as is required for the specific purpose for which it was being used. A materials management plan could then be formulated and a tracking system put in place such that once placed the material would no longer be regarded as being a waste and thus waste management licensing and landfill tax would not apply.

## 8.0 OUTSTANDING RISKS AND ISSUES

This section of the report aims to highlight areas where further work is required as a result of limitations on the scope of this investigation, or where issues have been identified by this investigation that warrant further consideration. The scope of risks and issues discussed in this section is by no means exhaustive, but covers the main areas where additional work is considered to be required.

The ground is a heterogeneous natural material and variations will inevitably arise between the locations at which it is investigated. This report provides an assessment of the ground conditions based on the discrete points at which the ground was sampled, but the ground conditions should be subject to review as the work proceeds to ensure that any variations from the Ground Model are properly assessed by a suitably qualified person.

All foundations should extend beyond the zone of desiccation. In this respect it would be prudent to have all foundation excavations inspected by a suitably experienced engineer. If any trees are to be removed, foundations will need to be designed to accommodate heave movements.

An issue that requires careful consideration at this site is the extent to which groundwater will affect the basement excavation in the temporary condition and the level of the water table to be adopted in the permanent design. It would be prudent to carry out groundwater monitoring of the existing standpipe as a minimum, but it is important that the contractor is able to deal with inflows of groundwater that may be locally more significant than anticipated.

Consideration will also need to be given to measures to guard against heave as a result of the basement excavation. It is likely that the floor slab for the proposed basement will need to be suspended over a void to accommodate the anticipated heave unless the slab can be suitably reinforced to cope with these movements.

Further groundwater monitoring should be carried out to establish equilibrium levels and the extent of any seasonal fluctuations, as at this stage the depth of the groundwater is uncertain. It would be prudent to carry out a number of trial excavations, to depths as close to the full basement depth as possible, to investigate the extent to which the proposed basement excavation will be affected by groundwater inflows and to make an assessment of side stability.

If during ground works any visual or olfactory evidence of contamination is identified it is recommended that further investigation be carried out and that the risk assessment is reviewed.

These areas of doubt should be drawn to the attention of prospective contractors and further investigation will be required or sufficient contingency should be provided to cover the outstanding risk.

Further consideration will need to be given to any effect of the proposed development on the Network Rail tunnels once the foundation design has been finalised.

# APPENDIX

Borehole Records

SPT Summary Sheet

Trial Pit Records

Geotechnical Laboratory Test Results

SPT & Cohesion / Depth Graph

Chemical Analyses (soil)

Generic Risk Based Screening Values

Site Plan

| | | | |
|---|---|---|---|
| GEA Geotechnical & Environmental Associates, Tyttenhanger House, Coursers Road, St Albans, AL4 0PG | | **Site** 14 Netherhall Gardens, London, NW3 5TQ | **Number** BH1 |
| **Excavation Method** Drive-in Window Sampler | **Dimensions** | **Ground Level (mOD)** 71.54 | **Client** Netherhall Gardens Limited | **Job Number** J14290 |
| | **Location** | **Dates** 27/10/2014 | **Engineer** Fluid Structures | **Sheet** 1/1 |

| Depth (m) | Sample / Tests | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Legend | Water |
|---|---|---|---|---|---|---|---|---|
| | | | | | | MADE GROUND (brown slightly clayey slightly silty sandy gravel with brick fragments) | | |
| 0.30 | D1 | | | | (0.80) | | | |
| | | | | 70.74 | 0.80 | Firm brown mottled grey silty fissured CLAY with occasional partings of orange-brown fine sand and silt and carbonaceous material | | |
| 1.00 | D2 | | (PP) 3.0 | | | | | |
| 1.50 | D3 | | (PP) 3.0 | | | | | |
| 2.00 | D4 | | (PP) 2.5 | | | | | |
| 2.50 | D5 | | (PP) 2.0 | | | | | |
| | | | | | (4.20) | | | |
| 3.00 | D6 | | (PP) 2.5 | | | | | |
| 3.50 | D7 | | (PP) 3.5 | | | | | |
| 4.00 | D8 | | (PP) 3.0 | | | | | |
| 4.50 | D9 | | | | | | | |
| 4.80 | D10 | | | | | | | |
| | | | | 66.54 | 5.00 | Complete at 5.00m | | |

**Remarks**
Groundwater not encountered during drilling
PP denotes pocket penetrometer reading
Standpipe installed to a depth of 5.00 m - response zone from 1.00 m to 5.00 m
Groundwater measured at a depth of 2.22 m on 10/11/2014 and 1.85 m on 20/11/2014

**Scale (approx)** 1:50 | **Logged By** AI

**Figure No.** J14290.BH1

| | | | |
|---|---|---|---|
| **GEA** Geotechnical & Environmental Associates<br>Tyttenhanger House<br>Coursers Road<br>St Albans<br>AL4 0PG | | **Site**<br>14 Netherhall Gardens, London, NW3 5TQ | **Number**<br>**BH2** |
| **Excavation Method**<br>Drive-in Window Sampler | **Dimensions** | **Ground Level (mOD)**<br>71.33 | **Client**<br>Netherhall Gardens Limited | 
| | **Location** | **Dates**<br>27/10/2014 | **Engineer**<br>Fluid Structures |

| | | |
|---|---|---|
| **Job Number** | J14290 | |
| **Sheet** | 1/1 | |

| Depth (m) | Sample / Tests | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Legend | Water |
|---|---|---|---|---|---|---|---|---|
| | | | | | (0.70) | MADE GROUND (dark brown slightly gravelly sandy silt with rootlets, roots, coal and brick fragments) | | |
| | | | | 70.63 | 0.70 | 'Stiff' brown mottled grey silty fissured CLAY with occasional partings of orange-brown fine sand and silt, rare selenite crystals and carboncaeous material. Rootlets noted to a depth of 2.20 m. Supsected desiccated soil to a depth of 3.20 m | | |
| 0.90 | D1 | | (PP) >4.50 | | | | | |
| 1.30 | D2 | | (PP) 3.75 | | | | | |
| 1.80 | D3 | | (PP) 4.50 | | | | | |
| | | | | | (2.50) | | | |
| 2.20 | D4 | | (PP) 3.75 | | | | | |
| 2.80 | D5 | | (PP) 3.75 | | | | | |
| | | | | 68.13 | 3.20 | Firm brown mottled grey silty fissured CLAY with occasional partings of orange-brown fine sand and silt and rare selenite crystals | | |
| 3.20 | D6 | | (PP) 3.50 | | | | | |
| | | | | | (0.80) | | | |
| 3.80 | D7 | | (PP) 2.50 | | | | | |
| | | | | 67.33 | 4.00 | Complete at 4.00m | | |

**Remarks**
PP denotes pocket penetrometer reading
Groundwater not encountered

| Scale (approx) | Logged By |
|---|---|
| 1:50 | AI |

**Figure No.** J14290.BH2

| | | | |
|---|---|---|---|
| Geotechnical & Environmental Associates | Tyttenhanger House<br>Coursers Road<br>St Albans<br>AL4 0PG | **Site**<br>14 Netherhall Gardens, London, NW3 5TQ | **Number**<br>**BH3** |
| **Excavation Method**<br>Drive-in Window Sampler | **Dimensions** / **Ground Level (mOD)** 71.25 | **Client**<br>Netherhall Gardens Limited | **Job Number**<br>J14290 |
| | **Location** / **Dates** 27/10/2014 | **Engineer**<br>Fluid Structures | **Sheet**<br>1/1 |

| Depth (m) | Sample / Tests | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Legend | Water |
|---|---|---|---|---|---|---|---|---|
| | | | | 70.85 | (0.40)<br>0.40 | MADE GROUND (brown slightly sandy slightly gravelly silty clay with rootlets, abundant brick fragments and carbonaceous material) | | |
| 0.80 | D1 | | (PP) 2.25 | | | 'Stiff' brown mottled grey silty fissured CLAY with occasional partings of orange-brown fine sand and silt and rare carbonaceous material. Roots noted to a depth of 1.30 m. Suspected desiccated soil | | |
| 1.30 | D2 | | (PP) 4.5 | | | | | |
| 1.80 | D3 | | (PP) >4.5 | | (2.80) | | | |
| 2.20 | D4 | | (PP) >4.5 | | | | | |
| 2.80 | D5 | | (PP) >4.5 | | | | | |
| 3.00 | D6 | | | 68.05 | 3.20 | | | |
| | | | (PP) >4.5 | | | Complete at 3.20m | | |

**Remarks**
Groundwater not encountered
PP denotes pocket penetrometer reading

| **Scale (approx)** | **Logged By** |
|---|---|
| 1:50 | AI |
| **Figure No.** J14290.BH3 | |

| GEA Geotechnical & Environmental Associates<br>Tyttenhanger House<br>Coursers Road<br>St Albans<br>AL4 0PG | | | Site<br>14 Netherhall Gardens, London, NW3 5TQ | Borehole Number<br>BH4 |
|---|---|---|---|---|
| Boring Method<br>Cable Percussion | Casing Diameter<br>150mm cased to 2.00m | Ground Level (mOD)<br>71.17 | Client<br>Netherhall Gardens Limited | Job Number<br>J14290 |
| | Location | Dates<br>29/10/2014-<br>30/10/2014 | Engineer<br>Fluid Structures | Sheet<br>1/2 |

| Depth (m) | Sample / Tests | Casing Depth (m) | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Legend | Water |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | (0.25) | Topsoil (dark grey silty sand with roots) | | |
| 0.30 | D1 | | | | 70.92 | 0.25 | | | |
| | | | | | | (0.30) | MADE GROUND (brown mottled grey silty sandy clay with flint gravel, roots, burnt coal and rare brick fragments) | | |
| 0.50 | B2 | | | | 70.62 | 0.55 | Firm orange-brown mottled greenish grey silty sandy CLAY with rare fine to medium rounded flint gravel, carbonaceous material and rootlets | | |
| | | | | | | (1.20) | | | |
| 1.20-1.65 | SPT N=10 | | | 1,0/2,3,2,3 | | | | | |
| 1.20-1.65 | D3 | | | | | | | | |
| | | | | | 69.42 | 1.75 | Firm becoming stiff fissured medium strength becoming high strength brown mottled grey silty CLAY with occasional partings of orange-brown fine sand and silt, carbonaceous material and selenite crystals. Rootlets noted to a depth of 2.00 m | | |
| 1.75 | D4 | | | | | | | | |
| 2.00-2.45 | U5 | | | 23 blows | | | | | |
| 2.75 | D6 | | | | | | | | |
| 3.00-3.45 | SPT N=15 | | | 2,3/3,3,4,5 | | | | | |
| 3.00-3.45 | D7 | | | | | | | | |
| 3.75 | D8 | | | | | (4.25) | | | |
| 4.00-4.45 | U9 | | | 24 blows | | | | | |
| 4.75 | D10 | | | | | | | | |
| 5.00-5.45 | SPT N=18 | | | 2,2/3,4,4,7 | | | | | |
| 5.00-5.45 | D11 | | | | | | | | |
| | | | | | 65.17 | 6.00 | Stiff fissured high strength brownish grey silty CLAY with rare orange-brown partings of fine sand and silt and rare selenite crystals | | |
| 6.00 | D12 | | | | | | | | |
| 6.50-6.95 | U13 | | | 25 blows | | | | | |
| 7.50 | D14 | | | | | | | | |
| | | | | | | (4.00) | | | |
| 8.00-8.45 | SPT N=18 | | | 2,3/4,4,5,5 | | | | | |
| 8.00-8.45 | D15 | | | | | | | | |
| 9.00 | D16 | | | | | | | | |
| 9.50-9.95 | U17 | | | 32 blows | | | | | |

**Remarks**
Groundwater not encountered during drilling
Four hours spent manhandling rig to borehole position
Standpipe installed to a depth of 8.00 m - response zone from 1.00 m to 8.00 m
Groundwater measured at a depth of 2.60 m on 10/11/2014 and 2.13 m on 20/11/2014

| Scale (approx) | Logged By |
|---|---|
| 1:50 | HD |

Figure No.
J14290.BH4

| Geotechnical & Environmental Associates (GEA) | Tyttenhanger House<br>Coursers Road<br>St Albans<br>AL4 0PG | Site | Borehole Number |
|---|---|---|---|
| | | 14 Netherhall Gardens, London, NW3 5TQ | BH4 |

| Boring Method | Casing Diameter | Ground Level (mOD) | Client | Job Number |
|---|---|---|---|---|
| Cable Percussion | 150mm cased to 2.00m | 71.17 | Netherhall Gardens Limited | J14290 |
| | **Location** | **Dates** | **Engineer** | **Sheet** |
| | | 29/10/2014-30/10/2014 | Fluid Structures | 2/2 |

| Depth (m) | Sample / Tests | Casing Depth (m) | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Legend | Water |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | 61.17 | 10.00 | Stiff fissured high strength grey silty CLAY with rare partings of grey fine sand and silt and selenite crystals. Claystone encountered at a depth of 18.50 m | | |
| 10.50 | D18 | | | | | | | | |
| 11.00-11.45 | SPT N=22 | | | 3,3/4,5,6,7 | | | | | |
| 11.00-11.45 | D19 | | | | | | | | |
| 12.00 | D20 | | | | | | | | |
| 12.50-12.95 | U21 | | | 36 blows | | | | | |
| 13.50 | D22 | | | | | | | | |
| 14.00-14.45 | SPT N=26 | | | 3,5/6,6,6,8 | | | | | |
| 14.00-14.45 | D23 | | | | | | | | |
| 15.00 | D24 | | | | | (10.00) | | | |
| 15.50-15.95 | U25 | | | | | | | | |
| 16.50 | D26 | | | 40 blows | | | | | |
| 17.00-17.45 | SPT N=30 | | | 4,5/6,7,8,9 | | | | | |
| 17.00-17.45 | D27 | | | | | | | | |
| 18.00 | D28 | | | | | | | | |
| 18.50-18.95 | U29 | | | 99 blows | | | | | |
| 19.25 | D30 | | | | | | | | |
| 19.55-20.00 | SPT N=33 | | | 4,5/6,8,8,11 | | | | | |
| 19.55-20.00 | D31 | | | 33 blows | | | | | |
| | | | | | 51.17 | 20.00 | | | |

| Remarks | Scale (approx) | Logged By |
|---|---|---|
| | 1:50 | HD |
| | **Figure No.** | |
| | J14290.BH4 | |

| | | | |
|---|---|---|---|
| **GEA** Geotechnical & Environmental Associates<br>Tyttenhanger House, Coursers Road, St Albans, AL4 0PG | **Site**<br>14 Netherhall Gardens, London, NW3 5TQ | | **Borehole Number**<br>**BH5** |
| **Boring Method**<br>Cable Percussion | **Casing Diameter**<br>150mm cased to 2.00m | **Ground Level (mOD)**<br>70.93 | **Client**<br>Netherhall Gardens Limited | **Job Number**<br>J14290 |
| | **Location** | **Dates**<br>30/10/2014-31/10/2014 | **Engineer**<br>Fluid Structures | **Sheet**<br>1/2 |

| Depth (m) | Sample / Tests | Casing Depth (m) | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Legend | Water |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Topsoil (dark grey silty clayey sand with flint gravel, burnt coal, concrete, brick fragments and roots) | | |
| 0.25 | D1 | | | | | (0.65) | | | |
| 0.50 | B2 | | | | 70.28 | 0.65 | Soft to firm brown silty CLAY with roots | | |
| | | | | | | (0.35) | | | |
| 1.00 | D3 | | | | 69.93 | 1.00 | Firm brown silty CLAY with roots noted to a depth of 1.75 m | | |
| 1.20-1.65 | SPT N=9 | | | 1,0/2,2,2,3 | | | | | |
| 1.20 | D4 | | | | | (1.00) | | | |
| 1.50 | D5 | | | | | | | | |
| 1.65 | D6 | | | | | | | | |
| 2.00 | D7 | | | | 68.93 | 2.00 | 'Stiff' fissured 'very high strength' brown mottled grey silty CLAY with occasional partings of orange-brown fine sand and silt, selenite crystals and carbonaceous material. Claystone encountered at a depth of 3.00 m. Potentially desiccated soils to a depth of about 4.00 m | | |
| 2.00-2.45 | U8 | | | 20 blows | | | | | |
| 2.50 | D9 | | | | | | | | |
| 2.75 | D10 | | | | | | | | |
| 3.00-3.45 | SPT N=26 | | | 1,2/4,6,8,8 | | | | | |
| 3.00 | D11 | | | | | | | | |
| 3.00-3.45 | D12 | | | | | | | | |
| 3.50 | D13 | | | | | | | | |
| 3.75 | D14 | | | | | | | | |
| 4.00 | D15 | | | | | (4.00) | | | |
| 4.00-4.45 | U16 | | | 24 blows | | | | | |
| 4.50 | D17 | | | | | | | | |
| 4.75 | D18 | | | | | | | | |
| 5.00-5.45 | SPT N=16 | | | 2,2/3,4,4,5 | | | | | |
| 5.00 | D19 | | | | | | | | |
| 5.00-5.45 | D20 | | | | | | | | |
| 6.00 | D21 | | | | 64.93 | 6.00 | Stiff fissured high strength brownish grey silty CLAY with occasional orange-brown partings of fine sand and silt and selenite crystals | | |
| 6.50-6.95 | U22 | | | 34 blows | | | | | |
| 7.50 | D23 | | | | | (3.00) | | | |
| 8.00-8.45 | SPT N=19 | | | 2,3/4,4,5,6 | | | | | |
| 8.00-8.45 | D24 | | | | | | | | |
| 9.00 | D25 | | | | 61.93 | 9.00 | Stiff fissured high strength grey silty CLAY with rare partings of grey fine sand and silt | | |
| 9.50-9.95 | U26 | | | 36 blows | | | | | |

| | | |
|---|---|---|
| **Remarks**<br>Groundwater not encountered during drilling<br>Standpipe installed to a depth of 8.00 m - response zone from 1.00 m to 8.00 m<br>Groundwater measured at a depth of 6.65 m on 10/11/2014 and 1.25 m on 20/11/2014<br>Four hours spent demobilising drilling equipment | **Scale (approx)**<br>1:50 | **Logged By**<br>HD |
| | **Figure No.**<br>J14290.BH5 | |

Geotechnical & Environmental Associates

Tyttenhanger House
Coursers Road
St Albans
AL4 0PG

| Site | Borehole Number |
|---|---|
| 14 Netherhall Gardens, London, NW3 5TQ | BH5 |

| Boring Method | Casing Diameter | Ground Level (mOD) | Client | Job Number |
|---|---|---|---|---|
| Cable Percussion | 150mm cased to 2.00m | 70.93 | Netherhall Gardens Limited | J14290 |
| | **Location** | **Dates** | **Engineer** | **Sheet** |
| | | 30/10/2014-31/10/2014 | Fluid Structures | 2/2 |

| Depth (m) | Sample / Tests | Casing Depth (m) | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Legend | Water |
|---|---|---|---|---|---|---|---|---|---|
| 10.50 | D27 | | | | | | | | |
| 11.00-11.45 | SPT N=23 | | | 2,3/4,5,6,8 | | | | | |
| 11.00-11.45 | D28 | | | | | | | | |
| 12.00 | D29 | | | | | | | | |
| 12.50-12.95 | U30 | | | 36 blows | | | | | |
| 13.50 | D31 | | | | | | | | |
| 14.00-14.45 | SPT N=27 | | | 3,5/6,6,6,9 | | | | | |
| 14.00-14.45 | D32 | | | | | | | | |
| | | | | | | (11.00) | | | |
| 15.00 | D33 | | | | | | | | |
| 15.50-15.95 | D34 | | | 45 blows | | | | | |
| 16.50 | D35 | | | | | | | | |
| 17.00-17.45 | SPT N=28 | | | 4,5/6,7,7,8 | | | | | |
| 17.00-17.45 | D36 | | | | | | | | |
| 18.00 | D37 | | | | | | | | |
| 18.50-18.95 | U38 | | | 45 blows | | | | | |
| 19.55-20.00 | SPT N=32 | | | 4,6/7,7,8,10 | | | | | |
| | | | | | 50.93 | 20.00 | | | |

**Remarks**

| Scale (approx) | Logged By |
|---|---|
| 1:50 | HD |

**Figure No.**
J14290.BH5

Geotechnical & Environmental Associates

Tyttenhanger House
Coursers Road
St Albans
AL4 0PG

# Standard Penetration Test Results

**Site** : 14 Netherhall Gardens, London, NW3 5TQ

**Client** : Netherhall Gardens Limited

**Engineer** : Fluid Structures

**Job Number** J14290

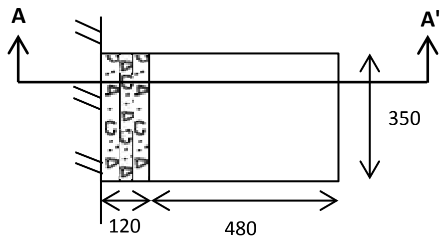
**Sheet** 1 / 1

| Borehole Number | Base of Borehole (m) | End of Seating Drive (m) | End of Test Drive (m) | Test Type | Seating Blows per 75mm | | Blows for each 75mm penetration | | | | Result | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 1 | 2 | 1 | 2 | 3 | 4 | | |
| BH4 | 1.20 | 1.35 | 1.65 | SPT | 1 | 0 | 2 | 3 | 2 | 3 | N=10 | |
| BH4 | 3.00 | 3.15 | 3.45 | SPT | 2 | 3 | 3 | 3 | 4 | 5 | N=15 | |
| BH4 | 5.00 | 5.15 | 5.45 | SPT | 2 | 2 | 3 | 4 | 4 | 7 | N=18 | |
| BH4 | 8.00 | 8.15 | 8.45 | SPT | 2 | 3 | 4 | 4 | 5 | 5 | N=18 | |
| BH4 | 11.00 | 11.15 | 11.45 | SPT | 3 | 3 | 4 | 5 | 6 | 7 | N=22 | |
| BH4 | 14.00 | 14.15 | 14.45 | SPT | 3 | 5 | 6 | 6 | 6 | 8 | N=26 | |
| BH4 | 17.00 | 17.15 | 17.45 | SPT | 4 | 5 | 6 | 7 | 8 | 9 | N=30 | |
| BH4 | 19.55 | 19.70 | 20.00 | SPT | 4 | 5 | 6 | 8 | 8 | 11 | N=33 | |
| BH5 | 1.20 | 1.35 | 1.65 | SPT | 1 | 0 | 2 | 2 | 2 | 3 | N=9 | |
| BH5 | 3.00 | 3.15 | 3.45 | SPT | 1 | 2 | 4 | 6 | 8 | 8 | N=26 | |
| BH5 | 5.00 | 5.15 | 5.45 | SPT | 2 | 2 | 3 | 4 | 4 | 5 | N=16 | |
| BH5 | 8.00 | 8.15 | 8.45 | SPT | 2 | 3 | 4 | 4 | 5 | 6 | N=19 | |
| BH5 | 11.00 | 11.15 | 11.45 | SPT | 2 | 3 | 4 | 5 | 6 | 8 | N=23 | |
| BH5 | 14.00 | 14.15 | 14.45 | SPT | 3 | 5 | 6 | 6 | 6 | 9 | N=27 | |
| BH5 | 17.00 | 17.15 | 17.45 | SPT | 4 | 5 | 6 | 7 | 7 | 8 | N=28 | |
| BH5 | 19.55 | 19.70 | 20.00 | SPT | 4 | 6 | 7 | 7 | 8 | 10 | N=32 | |

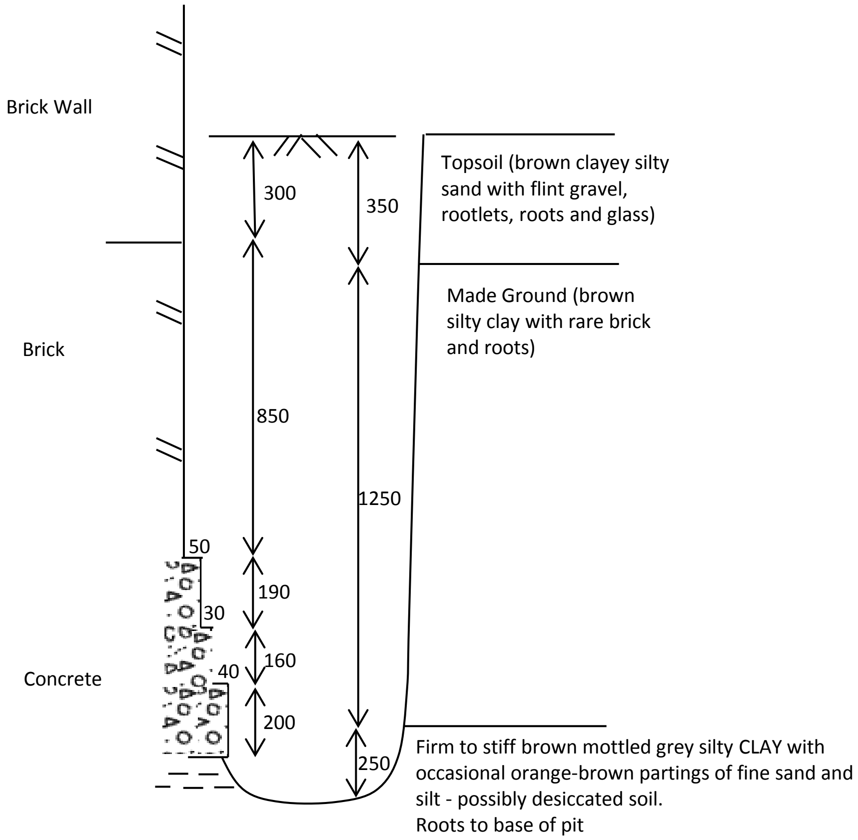
| GEA Geotechnical & Environmental Associates | Tyttenhanger House<br>Coursers Road<br>St Albans<br>Herts AL4 0PG | **Site**<br>14 Netherhall Gardens, London, NW3 5TQ | **Trial Pit Number**<br>**1** |
|---|---|---|---|

| **Excavation Method**<br>Manual | **Dimensions**<br>600 x 350 x 1850 | **Ground Level (mOD)** | **Client**<br>Netherhall Gardens Limited | **Job Number**<br>J14290 |
|---|---|---|---|---|
| | **Location** | **Dates**<br>24/10/2014 | **Engineer**<br>Fluid Structures | **Sheet**<br>1 / 1 |

**Plan: -**



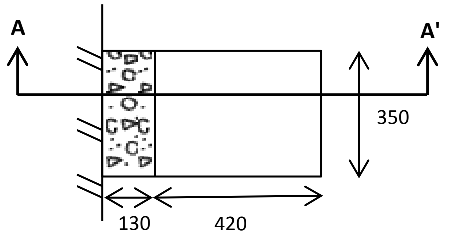

**Section A - A: -**




| Remarks: | Scale: |
|---|---|
| All dimensions in millimetres | 1:20 |
| Sides of trial pit remained stable during excavation | Logged by: |
| Ground water not encountered | HD |

| | | | | |
|---|---|---|---|---|
| **GEA** Geotechnical & Environmental Associates | | Tyttenhanger House, Coursers Road, St Albans, Herts AL4 0PG | **Site** 14 Netherhall Gardens, London, NW3 5TQ | **Trial Pit Number** 2 |
| **Excavation Method** Manual | **Dimensions** 550 x 350 x 1500 | **Ground Level (mOD)** | **Client** Netherhall Gardens Limited | **Job Number** J14290 |
| | **Location** | **Dates** 24/10/2014 | **Engineer** Fluid Structures | **Sheet** 1 / 1 |

**Plan: -**

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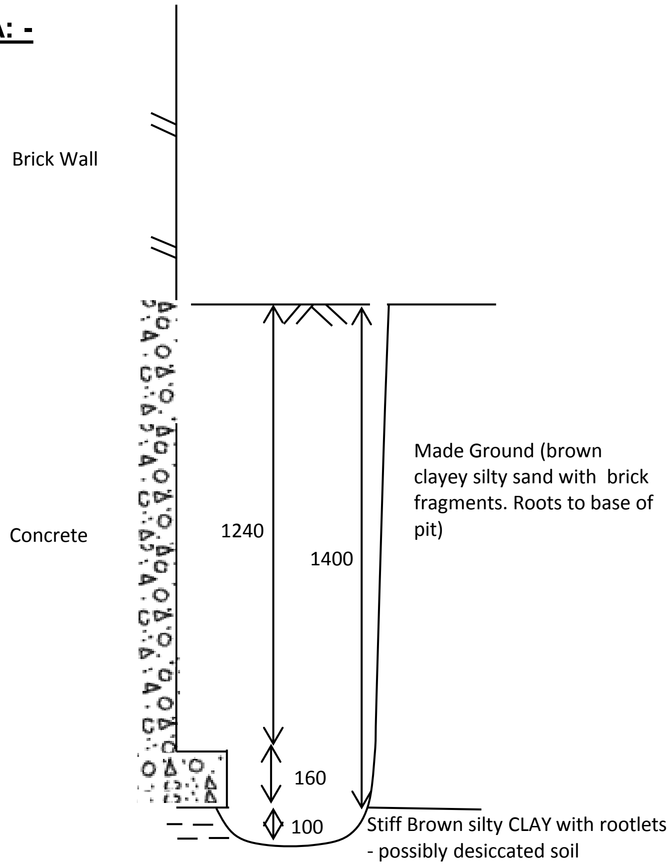
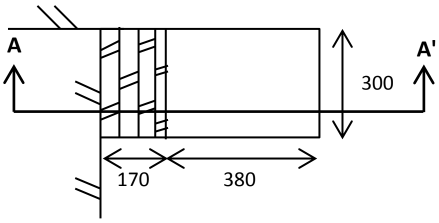



| | |
|---|---|
| Remarks: | Scale: |
| All dimensions in millimetres | 1:20 |
| Sides of trial pit remained stable during excavation | Logged by: |
| Ground water not encountered | HD |

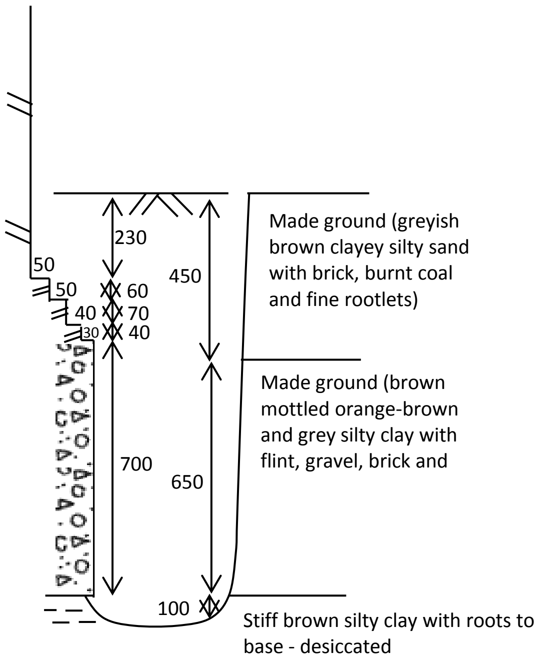
| GEA Geotechnical & Environmental Associates | Tyttenhanger House<br>Coursers Road<br>St Albans<br>Herts AL4 0PG | Site<br>14 Netherhall Gardens, London, NW3 5TQ | Trial Pit Number<br>3 |
|---|---|---|---|

| Excavation Method | Dimensions | Ground Level (mOD) | Client | Job Number |
|---|---|---|---|---|
| Manual | 300 x 500 x 1200 | | Netherhall Gardens Limited | J14290 |
| | **Location** | **Dates** | **Engineer** | **Sheet** |
| | | 24/10/2014 | Fluid Structures | 1 / 1 |

## Plan: -




## Section A - A: -

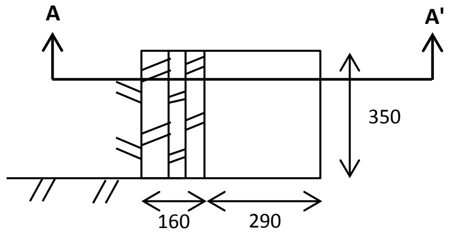



| Remarks: | Scale: |
|---|---|
| All dimensions in millimetres | 1:20 |
| Sides of trial pit remained stable during excavation | Logged by: |
| Ground water not encountered | HD |

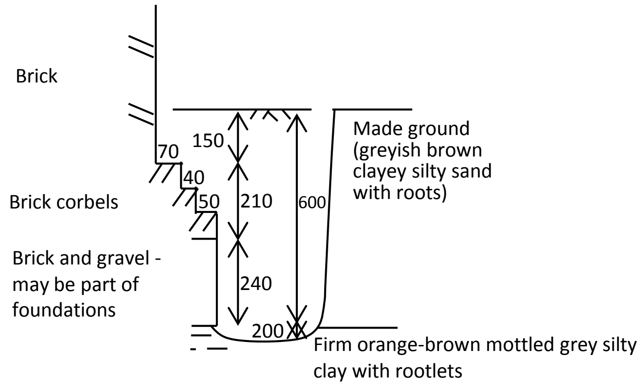
| GEA Geotechnical & Environmental Associates | Tyttenhanger House<br>Coursers Road<br>St Albans<br>Herts AL4 0PG | **Site**<br>14 Netherhall Gardens, London, NW3 5TQ | **Trial Pit Number**<br>4 |
|---|---|---|---|

| **Excavation Method**<br>Manual | **Dimensions**<br>450 x 350 x 800 | **Ground Level (mOD)** | **Client**<br>Netherhall Gardens Limited | **Job Number**<br>J14290 |
|---|---|---|---|---|
| | **Location** | **Dates**<br>24/10/2014 | **Engineer**<br>Fluid Structures | **Sheet**<br>1 / 1 |

**Plan: -**



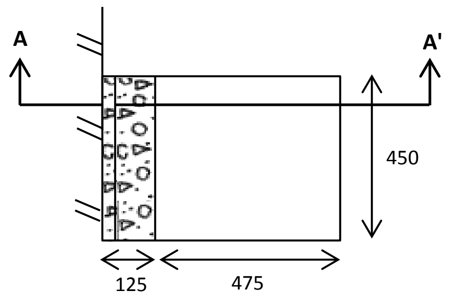

**Section A - A: -**



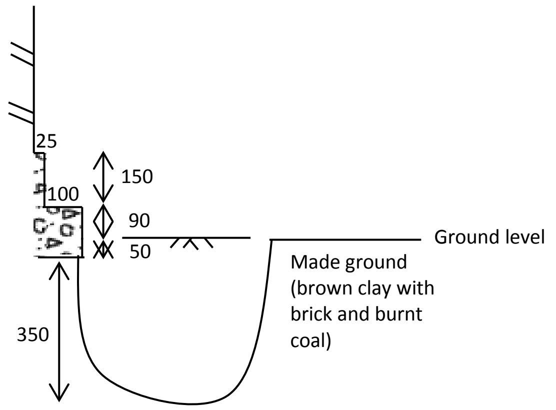

| Remarks: | Scale: |
|---|---|
| All dimensions in millimetres | 1:20 |
| Sides of trial pit remained stable during excavation | Logged by: |
| Ground water not encountered | HD |

| Geotechnical & Environmental Associates — Tyttenhanger House, Coursers Road, St Albans, Herts AL4 0PG | | | Site: 14 Netherhall Gardens, London, NW3 5TQ | Trial Pit Number: 5 |
|---|---|---|---|---|
| **Excavation Method**<br>Manual | **Dimensions**<br>450 x 600 x 400 | **Ground Level (mOD)** | **Client**<br>Netherhall Gardens Limited | **Job Number**<br>J14290 |
| | **Location** | **Dates**<br>24/10/2014 | **Engineer**<br>Fluid Structures | **Sheet**<br>1 / 1 |

**Plan: -**



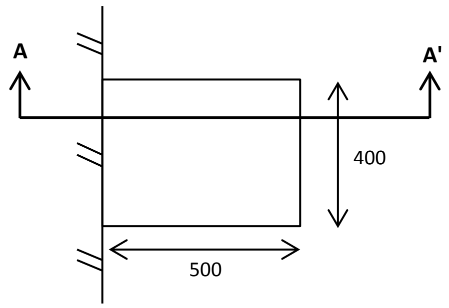

**Section A - A: -**



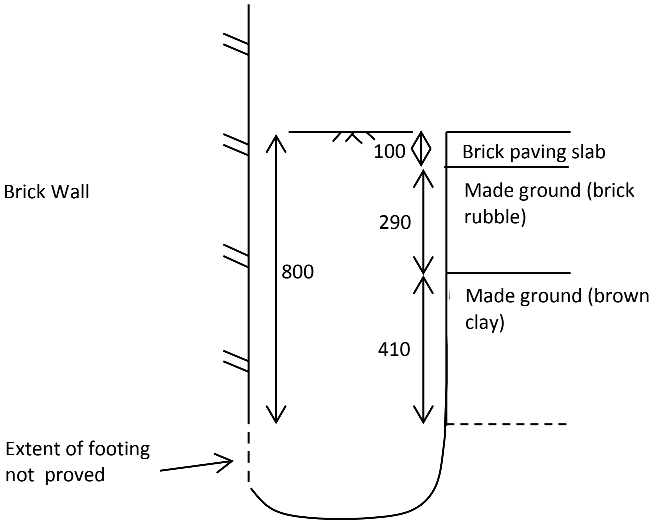

| Remarks: | Scale: |
|---|---|
| All dimensions in millimetres | 1:20 |
| Sides of trial pit remained stable during excavation | Logged by: |
| Ground water not encountered | HD |

| | | | | |
|---|---|---|---|---|
| GEA Geotechnical & Environmental Associates | | Tyttenhanger House<br>Coursers Road<br>St Albans<br>Herts AL4 0PG | **Site**<br>14 Netherhall Gardens, London, NW3 5TQ | **Trial Pit Number**<br>**6** |
| **Excavation Method**<br>Manual | **Dimensions**<br>400 x 500 x 800 | **Ground Level (mOD)** | **Client**<br>Netherhall Gardens Limited | **Job Number**<br>J14290 |
| | **Location** | **Dates**<br>24/10/2014 | **Engineer**<br>Fluid Structures | **Sheet**<br>1 / 1 |

## Plan: -




## Section A - A: -




| | |
|---|---|
| Remarks: | Scale: |
| All dimensions in millimetres | 1:20 |
| Sides of trial pit remained stable during excavation | Logged by: |
| Ground water not encountered | HD |

| Project Name: | 14 Netherhall Gardens, London, NW3 5TQ | | | Samples Received: | 31/10/2014 | K4 SOILS |
|---|---|---|---|---|---|---|
| | | | | Project Started: | 10/11/2014 | |
| Client: | GEA | | | Testing Started: | 19/11/2014 | |
| Project No: | J14290 | Our job/report no: | 17775 | Date Reported: | 20/11/2014 | |

| Borehole No: | Sample No: | Depth (m) | Description | Moisture content (%) | Liquid Limit (%) | Plastic Limit (%) | Plasticity Index (%) | Passing 0.425 mm (%) | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| BH1 | D3 | 1.50 | Brown and orange brown silty CLAY | 32 | 77 | 28 | 49 | 100 | |
| BH1 | D4 | 2.00 | Brown and occasional orange brown slightly sandy silty CLAY | 34 | | | | | |
| BH1 | D5 | 2.50 | Brown slightly sandy silty CLAY | 35 | | | | | |
| BH1 | D6 | 3.00 | Brown slightly mottled blue grey silty CLAY | 33 | 80 | 29 | 51 | 100 | |
| BH1 | D7 | 3.50 | Brown and occasional blue grey slightly sandy silty CLAY | 31 | | | | | |
| BH1 | D8 | 4.00 | Brown and occasional blue grey slightly sandy silty CLAY | 33 | | | | | |
| BH1 | D9 | 4.50 | Brown and occasional blue grey slightly sandy silty CLAY | 33 | | | | | |
| BH4 | U | 2.00 | Medium strength fissured brown and blue grey mottled silty CLAY with occasional brown fine sand partings | 30 | 77 | 29 | 48 | 100 | |
| BH4 | D | 3.00 | Brown and occasional grey slightly sandy silty CLAY | 31 | | | | | |
| BH4 | U | 4.00 | High strength fissured brown silty CLAY | 31 | 75 | 31 | 44 | 100 | |
| BH4 | D | 4.75 | Brown silty CLAY | 36 | | | | | |
| BH4 | U | 6.50 | High strength fissured brown silty CLAY with selenite crystals | 32 | | | | | |
| BH4 | U | 9.50 | High strength fissured brown silty CLAY with occasional selenite crystals | 31 | | | | | |
| BH4 | U | 12.50 | High strength fissured dark grey brown silty CLAY | 29 | | | | | |
| BH4 | U | 15.50 | High strength fissured dark grey silty CLAY | 27 | | | | | |
| BH5 | D | 1.00 | Brown and dark brown mottled slightly sandy silty CLAY with occasional rootlets | 37 | | | | | |
| BH5 | D | 1.50 | Brown slightly mottled grey silty CLAY | 25 | 82 | 26 | 56 | 100 | |
| BH5 | U | 2.00 | Very high strength fissured brown slightly blue grey mottled silty CLAY with occasional selenite crystals and roots | 24 | | | | | |
| BH5 | D | 2.50 | Brown and occasional brown slightly sandy silty CLAY | 26 | | | | | |

UKAS TESTING 2519

## Summary of Test Results

BS 1377 : Part 2 : Clause 4.4 : 1990 Determination of the liquid limit by the cone penetrometer method.
BS 1377 : Part 2 : Clause 5 : 1990 Determination of the plastic limit and plasticity index.
BS 1377 : Part 2 : Clause 3.2 : 1990 Determination of the moisture content by the oven-drying method.

**Checked and Approved**
Initials: K.P
Date: 20/11/2014

Test Report by K4 SOILS LABORATORY Unit 8 Olds Close Olds Approach Watford Herts WD18 9RU

Test Results relate only to the sample numbers shown above. Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

| Project Name: | 14 Netherhall Gardens, London, NW3 5TQ | Samples Received: | 31/10/2014 | K4 SOILS |
|---|---|---|---|---|
| | | Project Started: | 10/11/2014 | |
| Client: | GEA | Testing Started: | 19/11/2014 | |
| Project No: | J14290 Our job/report no: 17775 | Date Reported: | 20/11/2014 | |

| Borehole No: | Sample No: | Depth (m) | Description | Moisture content (%) | Liquid Limit (%) | Plastic Limit (%) | Plasticity Index (%) | Passing 0.425 mm (%) | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| BH5 | D | 3.00 | Brown slightly mottled blue grey silty CLAY with occasional selenite crystals | 27 | 78 | 28 | 50 | 100 | |
| BH5 | D | 3.50 | Brown slightly sandy slightly silty CLAY with occasional roots and scattered selenite crystals | 27 | | | | | |
| BH5 | U | 4.00 | Very high strength fissured brown slightly blue grey mottled silty CLAY with selenite crystals | 26 | 75 | 26 | 49 | 100 | |
| BH5 | D | 4.50 | Brown and occasional orange brown slightly sandy slightly silty CLAY with occasional scattered selenite crystals | 27 | | | | | |
| BH5 | U | 6.50 | High strength fissured brown silty CLAY with selenite crystals | 29 | | | | | |
| BH5 | U | 9.50 | High strength fissured dark grey brown silty CLAY | 30 | | | | | |
| BH5 | U | 12.50 | High strength fissured dark grey silty CLAY | 29 | | | | | |
| BH5 | U | 15.50 | High strength fissured dark grey silty CLAY | 28 | | | | | |
| BH5 | D | 18.00 | Grey and occasional grey brown CLAY | 31 | | | | | |

UKAS TESTING 2519

## Summary of Test Results

BS 1377 : Part 2 : Clause 4.4 : 1990 Determination of the liquid limit by the cone penetrometer method.
BS 1377 : Part 2 : Clause 5 : 1990 Determination of the plastic limit and plasticity index.
BS 1377 : Part 2 : Clause 3.2 : 1990 Determination of the moisture content by the oven-drying method.

**Checked and Approved**
Initials: K.P
Date: 20/11/2014

Test Report by K4 SOILS LABORATORY Unit 8 Olds Close Olds Approach Watford Herts WD18 9RU

Test Results relate only to the sample numbers shown above. Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

| Client : | GEA | | | | Our Job/report no: 17775 | | | Samples Rec : 30/10/2014 | | | Testing Started: 17/11/2014 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Project name: | 14 Netherhall Gardens, London, NW3 5TQ | | | | Project No: J14290 | | | Project Started: 10/11/2014 | | | Date reported: 20/11/2014 | |
| BH / TP No | Sample no / ref | Sample depth (m) | Description | Moisture content (%) | Bulk Density (Mg/m3) | Dry density (Mg/m3) | Cell Pressure (kPa) | Strain at failure (%) | Max Deviator Stress (kPa) | Mode of failure | Shear Strength (kPa) | Phi (deg) |
| BH4 | U | 2.00 | Medium strength fissured brown and blue grey mottled silty CLAY with occasional brown fine sand partings | 30 | 1.97 | 1.51 | 40 | 8.1 | 144 | Compound | 72 | NA |
| BH4 | U | 4.00 | High strength fissured brown silty CLAY | 31 | 1.97 | 1.50 | 80 | 13 | 153 | Compound | 77 | NA |
| BH4 | U | 6.50 | High strength fissured brown silty CLAY with selenite crystals | 32 | 1.95 | 1.48 | 130 | 8.6 | 201 | Compound | 100 | NA |
| BH4 | U | 9.50 | High strength fissured brown silty CLAY with occasional selenite crystals | 31 | 1.97 | 1.50 | 190 | 6.1 | 221 | Brittle | 111 | NA |
| BH4 | U | 12.50 | High strength fissured dark grey brown silty CLAY | 29 | 2.03 | 1.57 | 250 | 5.1 | 275 | Brittle | 138 | NA |
| BH4 | U | 15.50 | High strength fissured dark grey silty CLAY | 27 | 2.01 | 1.57 | 310 | 7.1 | 267 | Brittle | 133 | NA |
| BH5 | U | 2.00 | Very high strength fissured brown slightly blue grey mottled silty CLAY with occasional selenite crystals and roots | 24 | 1.99 | 1.60 | 40 | 3.0 | 340 | Brittle | 170 | NA |
| BH5 | U | 4.00 | Very high strength fissured brown slightly blue grey mottled silty CLAY with selenite crystals | 26 | 2.04 | 1.63 | 80 | 2.0 | 312 | Brittle | 156 | NA |
| BH5 | U | 6.50 | High strength fissured brown silty CLAY with selenite crystals | 29 | 2.00 | 1.54 | 130 | 4.5 | 211 | Brittle | 105 | NA |
| BH5 | U | 9.50 | High strength fissured dark grey brown silty CLAY | 30 | 1.95 | 1.50 | 190 | 7.1 | 237 | Compound | 119 | NA |
| BH5 | U | 12.50 | High strength fissured dark grey silty CLAY | 29 | 1.99 | 1.55 | 250 | 7.1 | 224 | Compound | 112 | NA |
| BH5 | U | 15.50 | High strength fissured dark grey silty CLAY | 28 | 2.02 | 1.58 | 310 | 6.6 | 287 | Compound | 143 | NA |
| BH5 | U | 18.50 | Very high strength fissured dark grey silty CLAY with occasional light grey fine sand partings | 26 | 2.04 | 1.63 | 370 | 7.6 | 305 | Compound | 153 | NA |

K4 SOILS

# Summary of Undrained Triaxial Compression Testing

BS 1377 : Part 7 : Clause 8 : 1990

Checked and approved

Initials kp



UKAS TESTING 2519

K4 SOILS

# Report of Undrained Triaxial Compression Test

**BS 1377 : Part 7 : 1990 Clause 8.0**

| | | | |
|---|---|---|---|
| **Project name:** 14 Netherhall Gardens, London, NW3 5TQ | | **Samples Received:** | 30/10/2014 |
| | | **Project Started:** | 10/11/2014 |
| **Client:** GEA | | **Testing Started:** | 17/11/2014 |
| **Project no:** J14290 | **Our job /report no:** 17775 | **Date Reported:** | 20/11/2014 |
| **BH / TP no:** BH4 | **Sample no:** U | **Depth (m):** | 2.00 |

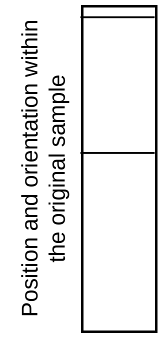
**Soil Description:** Medium strength fissured brown and blue grey mottled silty CLAY with occasional brown fine sand partings

## Sample Details — Specimen 1

| | | |
|---|---|---|
| Sample Condition | | Undisturbed |
| Height | mm | 198.0 |
| Diameter | mm | 102.0 |
| Moisture Content | % | 30 |
| Bulk Density | $Mg/m^3$ | 1.97 |
| Dry Density | $Mg/m^3$ | 1.51 |

## Test Details

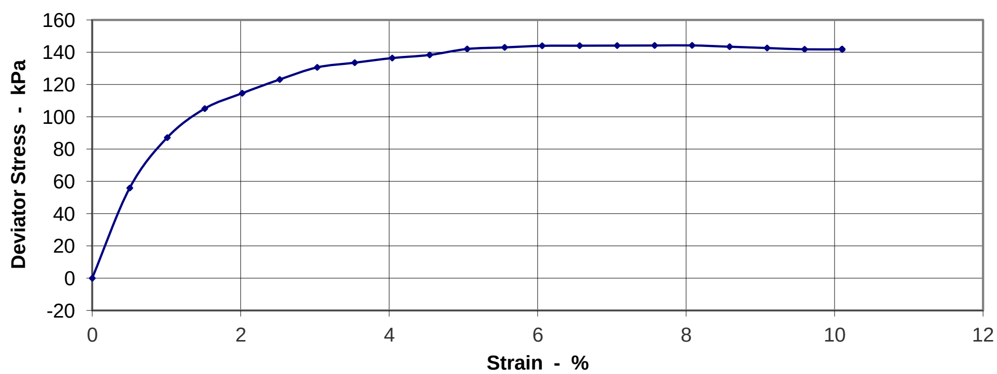
| | | |
|---|---|---|
| Membrane Thickness | mm | 0.2 |
| Membrane Correction | kPa | 0.38 |
| Rate of Axial Displacement | %/min | 2.02 |
| Cell Pressure | kPa | 40 |
| Strain at Failure | % | 8.1 |
| Maximum Deviator Stress | kPa | 144 |
| Shear Strength | kPa | 72 |
| Mode of Failure | | Compound |

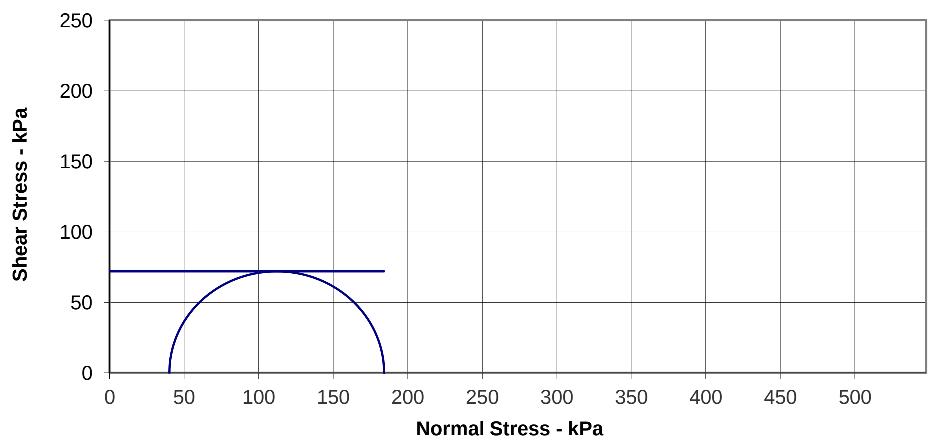



**Shear Strength Parameters**

| | | |
|---|---|---|
| C | 72 | kPa |
| Phi | 0.0 | ° |

Specimen 1





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**Approved Signatories:** K.Phaure(Tech.Mgr) J.Phaure(Lab.Mgr)

Test results relate only to the sample numbers shown above

**Checked and Approved**
Initials: kp
Date: 20/11/2014

UKAS TESTING 2519

| K4 SOILS | Report of Undrained Triaxial Compression Test |
|---|---|
| | BS 1377 : Part 7 : 1990 Clause 8.0 |

| | | | | | |
|---|---|---|---|---|---|
| **Project name:** | 14 Netherhall Gardens, London, NW3 5TQ | | | **Samples Received:** | 30/10/2014 |
| | | | | **Project Started:** | 10/11/2014 |
| **Client:** | GEA | | | **Testing Started:** | 17/11/2014 |
| **Project no:** | J14290 | **Our job /report no:** | 17775 | **Date Reported:** | 20/11/2014 |
| **BH / TP no:** | BH4 | **Sample no:** | U | **Depth (m):** | 4.00 |

**Soil Description:** High strength fissured brown silty CLAY

**Sample Details** — **Specimen 1**

| | | |
|---|---|---|
| Sample Condition | | Undisturbed |
| Height | mm | 198.0 |
| Diameter | mm | 102.0 |
| Moisture Content | % | 31 |
| Bulk Density | Mg/m³ | 1.97 |
| Dry Density | Mg/m³ | 1.50 |

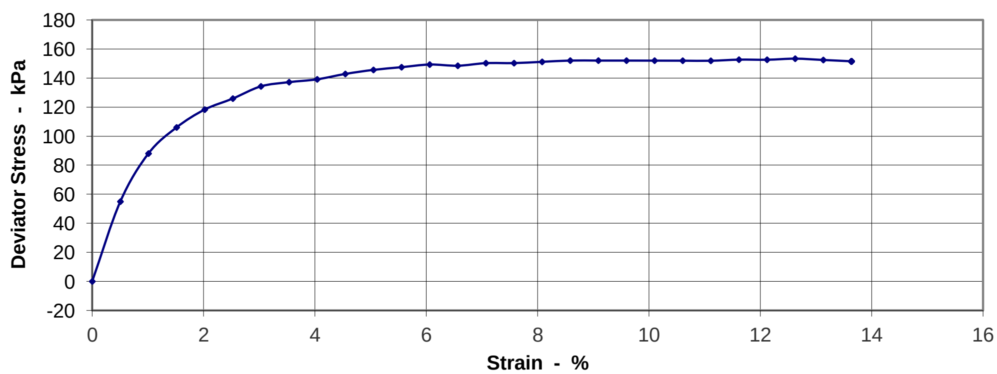
**Test Details**

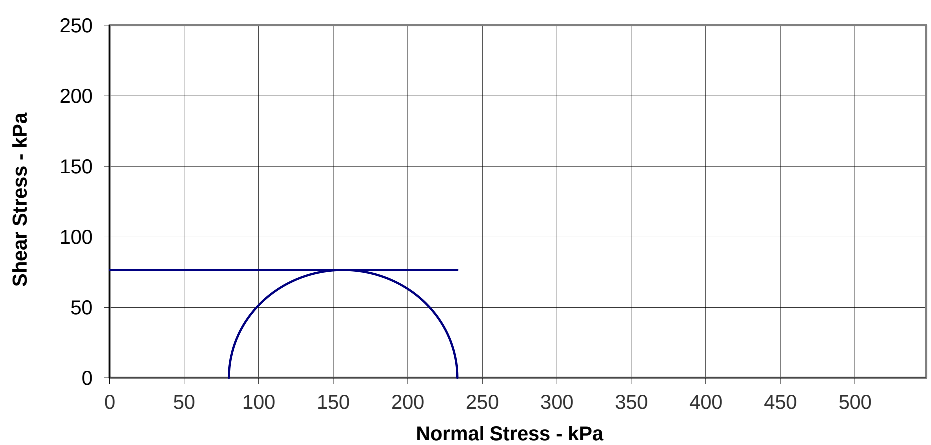
| | | |
|---|---|---|
| Membrane Thickness | mm | 0.2 |
| Membrane Correction | kPa | 0.53 |
| Rate of Axial Displacement | %/min | 2.02 |
| Cell Pressure | kPa | 80 |
| Strain at Failure | % | 12.6 |
| Maximum Deviator Stress | kPa | 153 |
| Shear Strength | kPa | 77 |
| Mode of Failure | | Compound |

Position and orientation within the original sample

| Shear Strength Parameters | | |
|---|---|---|
| C | 77 | kPa |
| Phi | 0.0 | ° |

Specimen 1





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**Checked and Approved**
Initials: kp
Date: 20/11/2014

UKAS TESTING 2519

| K4 SOILS | Report of Undrained Triaxial Compression Test |
|---|---|
| | BS 1377 : Part 7 : 1990 Clause 8.0 |

| | | | | | |
|---|---|---|---|---|---|
| **Project name:** | 14 Netherhall Gardens, London, NW3 5TQ | | | **Samples Received:** | 30/10/2014 |
| | | | | **Project Started:** | 10/11/2014 |
| **Client:** | GEA | | | **Testing Started:** | 17/11/2014 |
| **Project no:** | J14290 | **Our job /report no:** | 17775 | **Date Reported:** | 20/11/2014 |
| **BH / TP no:** | BH4 | **Sample no:** | U | **Depth (m):** | 6.50 |

**Soil Description:** High strength fissured brown silty CLAY with selenite crystals

**Sample Details** **Specimen 1**

| | | |
|---|---|---|
| Sample Condition | | Undisturbed |
| Height | mm | 198.0 |
| Diameter | mm | 102.0 |
| Moisture Content | % | 32 |
| Bulk Density | Mg/m³ | 1.95 |
| Dry Density | Mg/m³ | 1.48 |

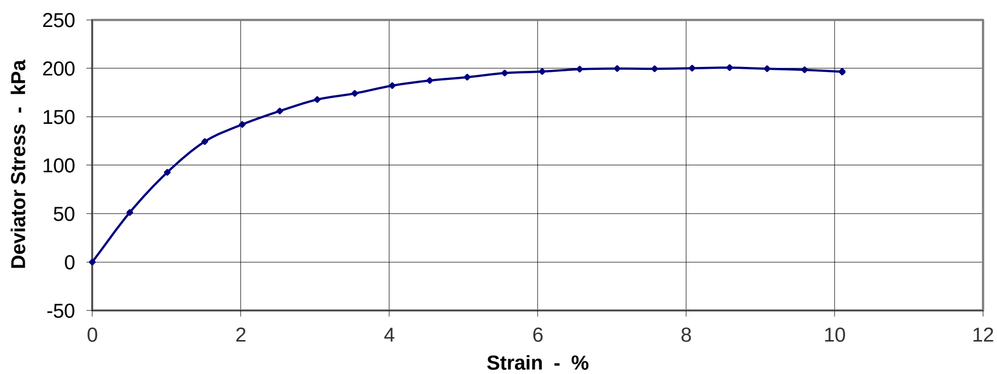
**Test Details**

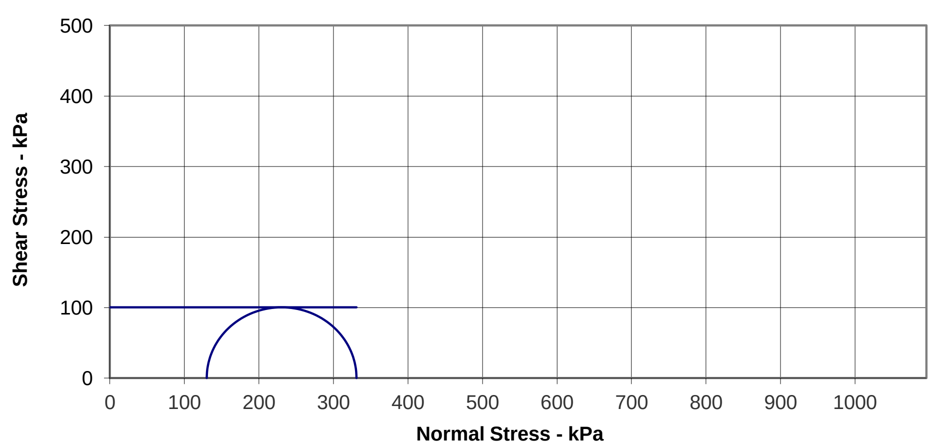
| | | |
|---|---|---|
| Membrane Thickness | mm | 0.2 |
| Membrane Correction | kPa | 0.39 |
| Rate of Axial Displacement | %/min | 2.02 |
| Cell Pressure | kPa | 130 |
| Strain at Failure | % | 8.6 |
| Maximum Deviator Stress | kPa | 201 |
| Shear Strength | kPa | 100 |
| Mode of Failure | | Compound |

Position and orientation within the original sample

| Shear Strength Parameters | |
|---|---|
| C | 100 kPa |
| Phi | 0.0 ° |

Specimen 1





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**Checked and Approved**
Initials: kp
Date: 20/11/2014

UKAS TESTING 2519

K4 SOILS

# Report of Undrained Triaxial Compression Test

## BS 1377 : Part 7 : 1990 Clause 8.0

| | | | |
|---|---|---|---|
| **Project name:** 14 Netherhall Gardens, London, NW3 5TQ | | **Samples Received:** | 30/10/2014 |
| | | **Project Started:** | 10/11/2014 |
| **Client:** GEA | | **Testing Started:** | 17/11/2014 |
| **Project no:** J14290 | **Our job /report no:** 17775 | **Date Reported:** | 20/11/2014 |
| **BH / TP no:** BH4 | **Sample no:** U | **Depth (m):** | 9.50 |

**Soil Description:** High strength fissured brown silty CLAY with occasional selenite crystals

### Sample Details — Specimen 1

| | | |
|---|---|---|
| Sample Condition | | Undisturbed |
| Height | mm | 198.0 |
| Diameter | mm | 102.0 |
| Moisture Content | % | 31 |
| Bulk Density | Mg/m³ | 1.97 |
| Dry Density | Mg/m³ | 1.50 |

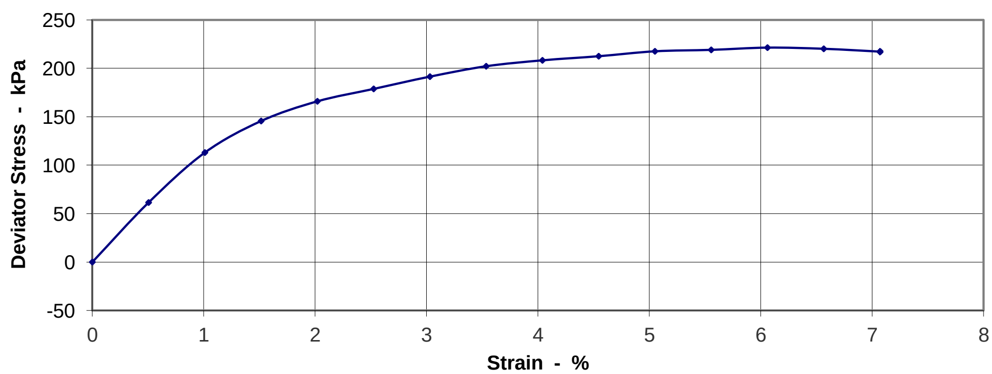
### Test Details

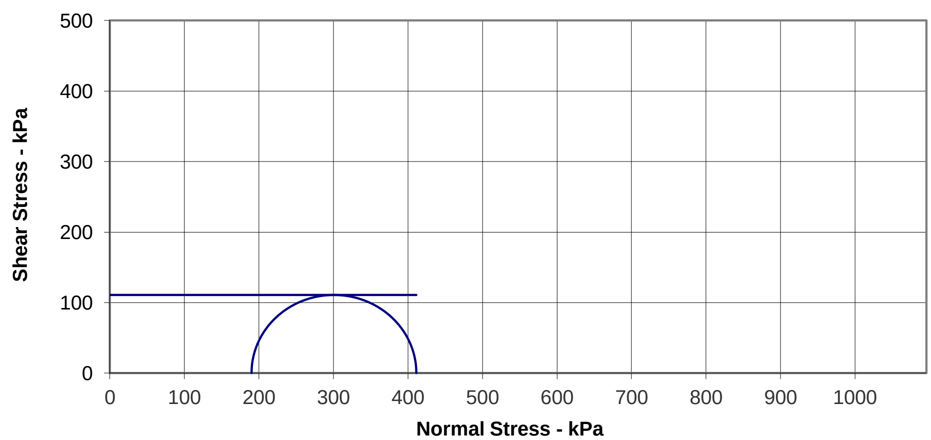
| | | |
|---|---|---|
| Membrane Thickness | mm | 0.2 |
| Membrane Correction | kPa | 0.30 |
| Rate of Axial Displacement | %/min | 2.02 |
| Cell Pressure | kPa | 190 |
| Strain at Failure | % | 6.1 |
| Maximum Deviator Stress | kPa | 221 |
| Shear Strength | kPa | 111 |
| Mode of Failure | | Brittle |

Position and orientation within the original sample

| Shear Strength Parameters | |
|---|---|
| C | 111 kPa |
| Phi | 0.0 ° |

Specimen 1

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Checked and Approved
Initials: kp
Date: 20/11/2014

UKAS TESTING 2519

# K4 SOILS

## Report of Undrained Triaxial Compression Test

**BS 1377 : Part 7 : 1990 Clause 8.0**

| | | | | | |
|---|---|---|---|---|---|
| **Project name:** | 14 Netherhall Gardens, London, NW3 5TQ | | | **Samples Received:** | 30/10/2014 |
| | | | | **Project Started:** | 10/11/2014 |
| **Client:** | GEA | | | **Testing Started:** | 17/11/2014 |
| **Project no:** | J14290 | **Our job /report no:** | 17775 | **Date Reported:** | 20/11/2014 |
| **BH / TP no:** | BH4 | **Sample no:** | U | **Depth (m):** | 12.50 |

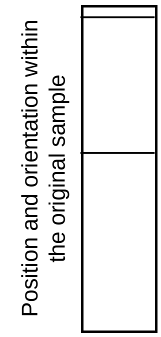
**Soil Description:** High strength fissured dark grey brown silty CLAY

### Sample Details — Specimen 1

| | | |
|---|---|---|
| Sample Condition | | Undisturbed |
| Height | mm | 198.0 |
| Diameter | mm | 102.0 |
| Moisture Content | % | 29 |
| Bulk Density | Mg/m³ | 2.03 |
| Dry Density | Mg/m³ | 1.57 |

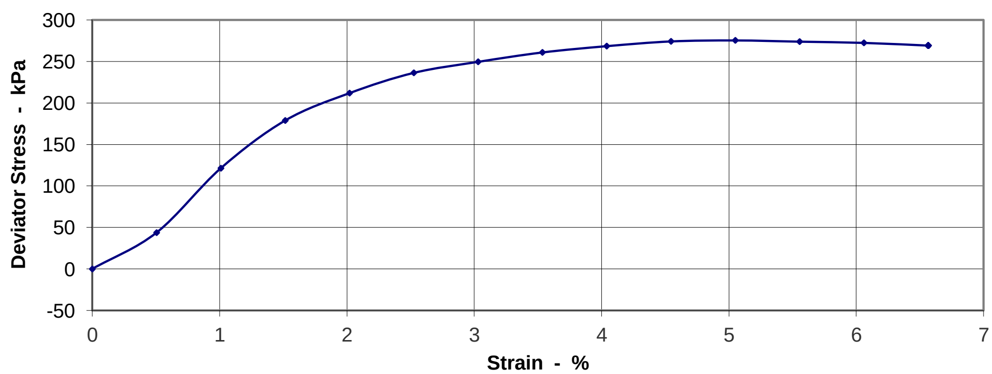
### Test Details

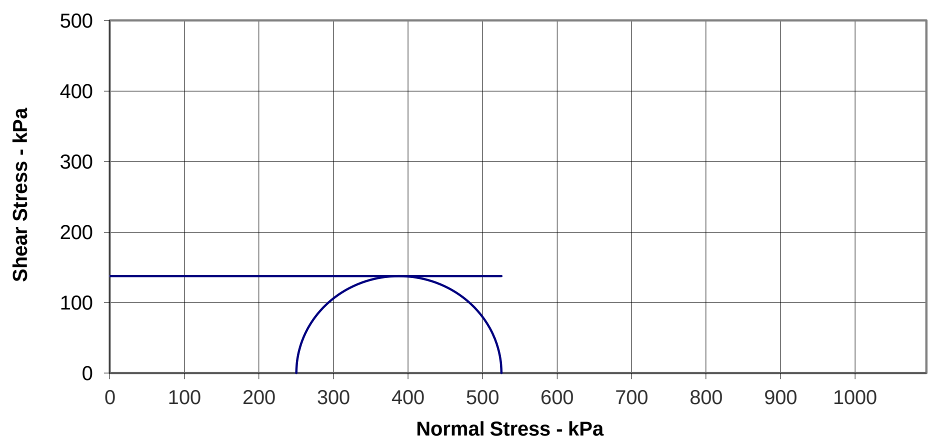
| | | |
|---|---|---|
| Membrane Thickness | mm | 0.2 |
| Membrane Correction | kPa | 0.26 |
| Rate of Axial Displacement | %/min | 2.02 |
| Cell Pressure | kPa | 250 |
| Strain at Failure | % | 5.1 |
| Maximum Deviator Stress | kPa | 275 |
| Shear Strength | kPa | 138 |
| Mode of Failure | | Brittle |




| Shear Strength Parameters | | |
|---|---|---|
| C | 138 | kPa |
| Phi | 0.0 | ° |

Specimen 1





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**Approved Signatories:** **K.Phaure(Tech.Mgr)**
J.Phaure(Lab.Mgr)

Test results relate only to the sample numbers shown above

**Checked and Approved**
Initials: kp
Date: 20/11/2014

2519

K4 SOILS

# Report of Undrained Triaxial Compression Test

## BS 1377 : Part 7 : 1990 Clause 8.0

| | | | |
|---|---|---|---|
| **Project name:** 14 Netherhall Gardens, London, NW3 5TQ | | **Samples Received:** | 30/10/2014 |
| | | **Project Started:** | 10/11/2014 |
| **Client:** GEA | | **Testing Started:** | 17/11/2014 |
| **Project no:** J14290 | **Our job /report no:** 17775 | **Date Reported:** | 20/11/2014 |
| **BH / TP no:** BH4 | **Sample no:** U | **Depth (m):** | 15.50 |

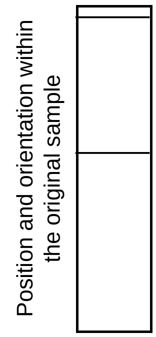
**Soil Description:** High strength fissured dark grey silty CLAY

### Sample Details — Specimen 1

| | | |
|---|---|---|
| Sample Condition | | Undisturbed |
| Height | mm | 198.0 |
| Diameter | mm | 102.0 |
| Moisture Content | % | 27 |
| Bulk Density | $Mg/m^3$ | 2.01 |
| Dry Density | $Mg/m^3$ | 1.57 |

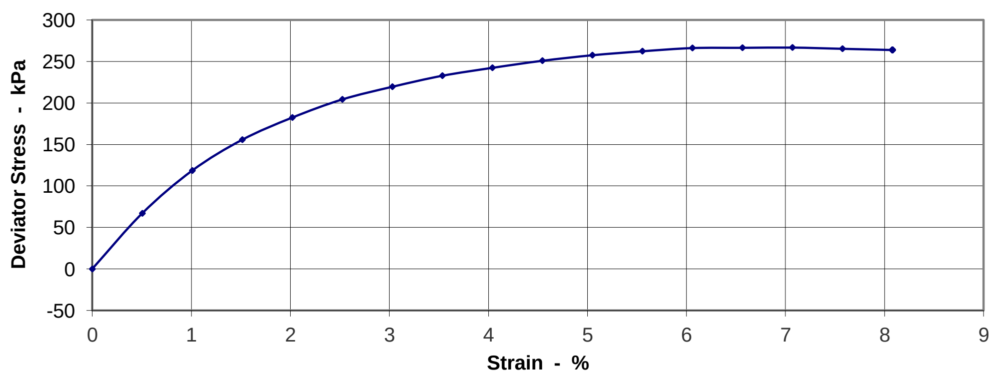
### Test Details

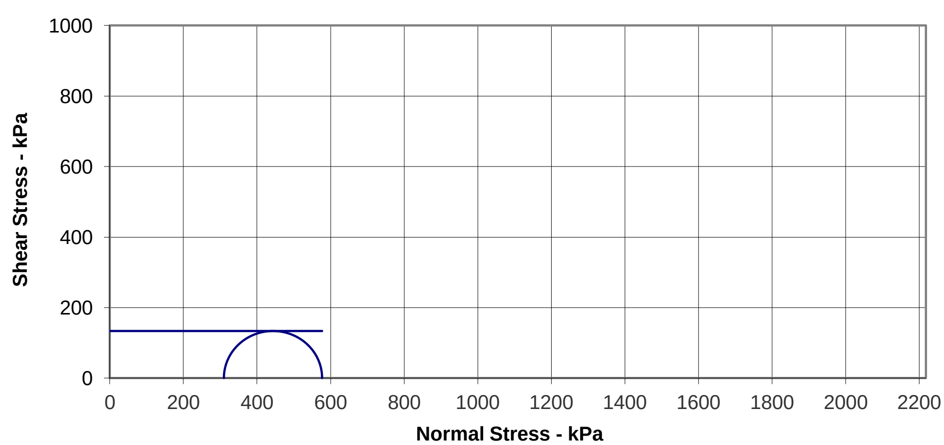
| | | |
|---|---|---|
| Membrane Thickness | mm | 0.2 |
| Membrane Correction | kPa | 0.34 |
| Rate of Axial Displacement | %/min | 2.02 |
| Cell Pressure | kPa | 310 |
| Strain at Failure | % | 7.1 |
| Maximum Deviator Stress | kPa | 267 |
| Shear Strength | kPa | 133 |
| Mode of Failure | | Brittle |




| Shear Strength Parameters | | |
|---|---|---|
| C | 133 | kPa |
| Phi | 0.0 | ° |

Specimen 1

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**Approved Signatories:** K.Phaure(Tech.Mgr)
J.Phaure(Lab.Mgr)

Test results relate only to the sample numbers shown above

Checked and Approved
Initials: kp
Date: 20/11/2014

UKAS TESTING 2519

| **K4 SOILS** | **Report of Undrained Triaxial Compression Test** |
|---|---|
| | **BS 1377 : Part 7 : 1990 Clause 8.0** |

| | | | | | |
|---|---|---|---|---|---|
| **Project name:** | 14 Netherhall Gardens, London, NW3 5TQ | | | **Samples Received:** | 30/10/2014 |
| | | | | **Project Started:** | 10/11/2014 |
| **Client:** | GEA | | | **Testing Started:** | 17/11/2014 |
| **Project no:** | J14290 | **Our job /report no:** | 17775 | **Date Reported:** | 20/11/2014 |
| **BH / TP no:** | BH5 | **Sample no:** | U | **Depth (m):** | 2.00 |

**Soil Description:** Very high strength fissured brown slightly blue grey mottled silty CLAY with occasional selenite crystals and roots

**Sample Details** **Specimen** **1**

| | | |
|---|---|---|
| Sample Condition | | Undisturbed |
| Height | mm | 198.0 |
| Diameter | mm | 102.0 |
| Moisture Content | % | 24 |
| Bulk Density | Mg/m³ | 1.99 |
| Dry Density | Mg/m³ | 1.60 |

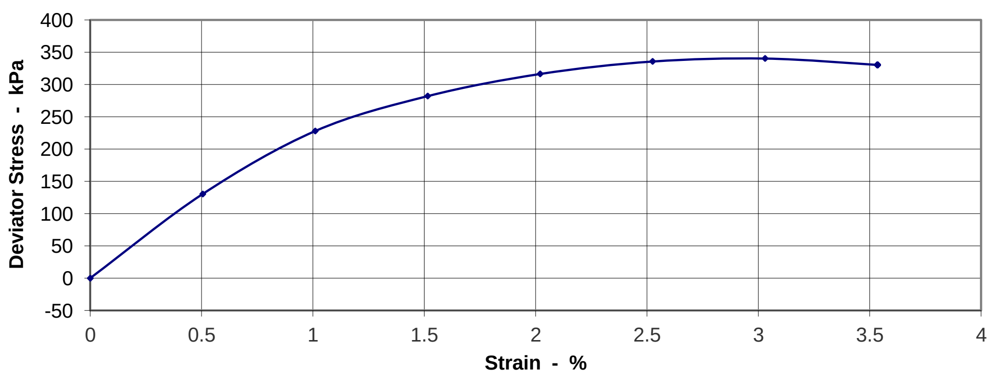
**Test Details**

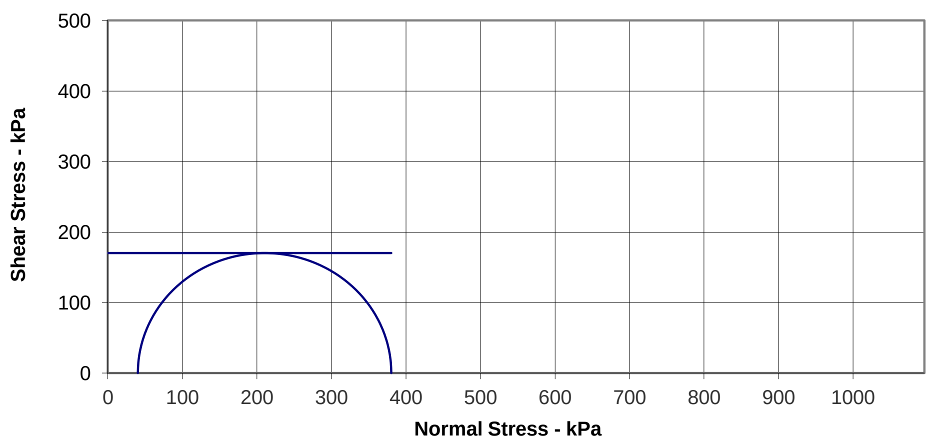
| | | |
|---|---|---|
| Membrane Thickness | mm | 0.2 |
| Membrane Correction | kPa | 0.16 |
| Rate of Axial Displacement | %/min | 2.02 |
| Cell Pressure | kPa | 40 |
| Strain at Failure | % | 3.0 |
| Maximum Deviator Stress | kPa | 340 |
| Shear Strength | kPa | 170 |
| Mode of Failure | | Brittle |

Position and orientation within the original sample

| Shear Strength Parameters | | |
|---|---|---|
| C | 170 | kPa |
| Phi | 0.0 | ° |

Specimen 1

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**Approved Signatories:** **K.Phaure(Tech.Mgr)**
J.Phaure(Lab.Mgr)

Test results relate only to the sample numbers shown above

**Checked and Approved**
Initials: kp
Date: 20/11/2014

UKAS TESTING 2519

| K4 SOILS | Report of Undrained Triaxial Compression Test |
|---|---|
| | BS 1377 : Part 7 : 1990 Clause 8.0 |

| | | | | | |
|---|---|---|---|---|---|
| **Project name:** | 14 Netherhall Gardens, London, NW3 5TQ | | | **Samples Received:** | 30/10/2014 |
| | | | | **Project Started:** | 10/11/2014 |
| **Client:** | GEA | | | **Testing Started:** | 17/11/2014 |
| **Project no:** | J14290 | **Our job /report no:** | 17775 | **Date Reported:** | 20/11/2014 |
| **BH / TP no:** | BH5 | **Sample no:** | U | **Depth (m):** | 4.00 |

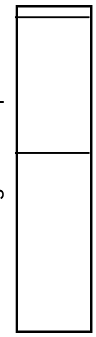
**Soil Description:** Very high strength fissured brown slightly blue grey mottled silty CLAY with selenite crystals

## Sample Details — Specimen 1

| Sample Condition | | Undisturbed |
|---|---|---|
| Height | mm | 198.0 |
| Diameter | mm | 102.0 |
| Moisture Content | % | 26 |
| Bulk Density | Mg/m³ | 2.04 |
| Dry Density | Mg/m³ | 1.63 |

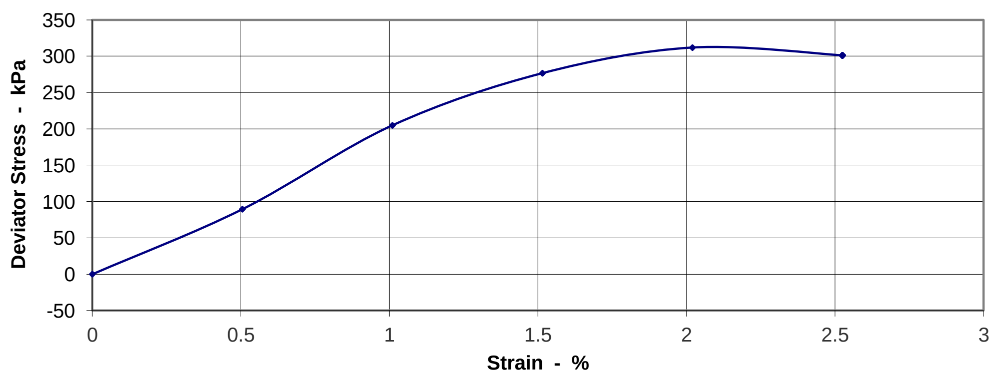
## Test Details

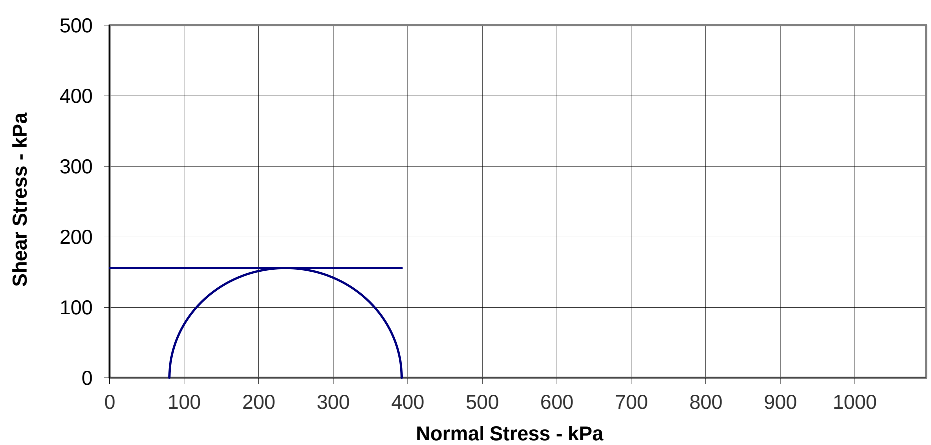
| Membrane Thickness | mm | 0.2 |
|---|---|---|
| Membrane Correction | kPa | 0.11 |
| Rate of Axial Displacement | %/min | 2.02 |
| Cell Pressure | kPa | 80 |
| Strain at Failure | % | 2.0 |
| Maximum Deviator Stress | kPa | 312 |
| Shear Strength | kPa | 156 |
| Mode of Failure | | Brittle |




| Shear Strength Parameters | | |
|---|---|---|
| C | 156 | kPa |
| Phi | 0.0 | ° |

Specimen 1




**K4 SOILS LABORATORY**
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Tel:01923711288 Fax:01923711311
E-mail: k4soils@aol.com

**Approved Signatories:** K.Phaure(Tech.Mgr) J.Phaure(Lab.Mgr)

Test results relate only to the sample numbers shown above

Checked and Approved
Initials: kp
Date: 20/11/2014

UKAS TESTING 2519

# K4 SOILS

## Report of Undrained Triaxial Compression Test

### BS 1377 : Part 7 : 1990 Clause 8.0

| | | | | | |
|---|---|---|---|---|---|
| **Project name:** | 14 Netherhall Gardens, London, NW3 5TQ | | | **Samples Received:** | 30/10/2014 |
| | | | | **Project Started:** | 10/11/2014 |
| **Client:** | GEA | | | **Testing Started:** | 17/11/2014 |
| **Project no:** | J14290 | **Our job /report no:** | 17775 | **Date Reported:** | 20/11/2014 |
| **BH / TP no:** | BH5 | **Sample no:** | U | **Depth (m):** | 6.50 |

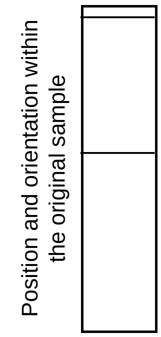
**Soil Description:** High strength fissured brown silty CLAY with selenite crystals

**Sample Details** — **Specimen 1**

| | | |
|---|---|---|
| Sample Condition | | Undisturbed |
| Height | mm | 198.0 |
| Diameter | mm | 102.0 |
| Moisture Content | % | 29 |
| Bulk Density | Mg/m³ | 2.00 |
| Dry Density | Mg/m³ | 1.54 |

**Test Details**

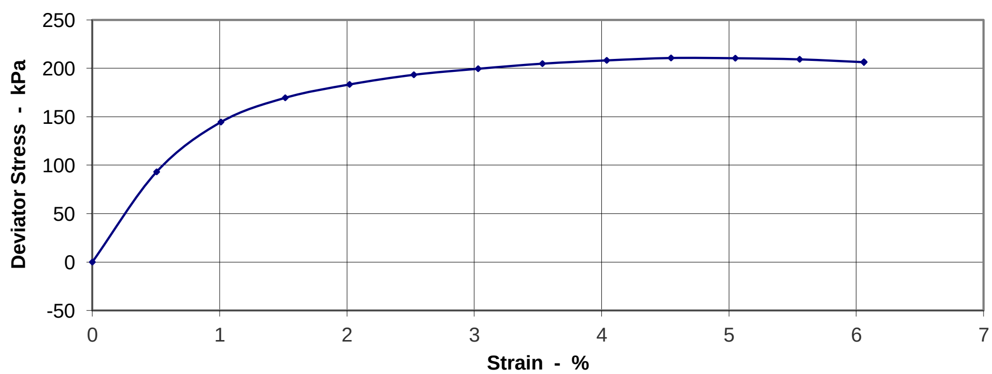
| | | |
|---|---|---|
| Membrane Thickness | mm | 0.2 |
| Membrane Correction | kPa | 0.23 |
| Rate of Axial Displacement | %/min | 2.02 |
| Cell Pressure | kPa | 130 |
| Strain at Failure | % | 4.5 |
| Maximum Deviator Stress | kPa | 211 |
| Shear Strength | kPa | 105 |
| Mode of Failure | | Brittle |

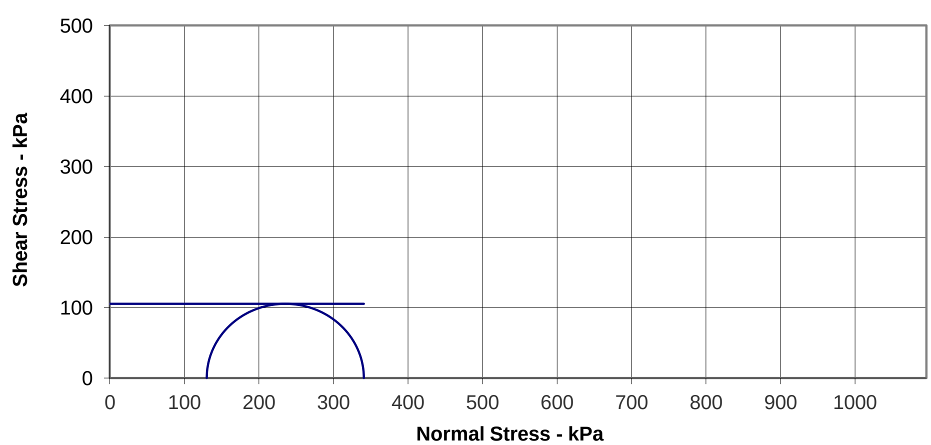



**Shear Strength Parameters**

| | | |
|---|---|---|
| C | 105 | kPa |
| Phi | 0.0 | ° |

Specimen 1





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**Checked and Approved**
Initials: kp
Date: 20/11/2014

UKAS TESTING 2519

# Report of Undrained Triaxial Compression Test

K4 SOILS

**BS 1377 : Part 7 : 1990 Clause 8.0**

| | | | |
|---|---|---|---|
| **Project name:** | 14 Netherhall Gardens, London, NW3 5TQ | **Samples Received:** | 30/10/2014 |
| | | **Project Started:** | 10/11/2014 |
| **Client:** | GEA | **Testing Started:** | 17/11/2014 |
| **Project no:** | J14290 **Our job /report no:** 17775 | **Date Reported:** | 20/11/2014 |
| **BH / TP no:** | BH5 **Sample no:** U | **Depth (m):** | 9.50 |

**Soil Description:** High strength fissured dark grey brown silty CLAY

## Sample Details — Specimen 1

| | | |
|---|---|---|
| Sample Condition | | Undisturbed |
| Height | mm | 198.0 |
| Diameter | mm | 102.0 |
| Moisture Content | % | 30 |
| Bulk Density | Mg/m³ | 1.95 |
| Dry Density | Mg/m³ | 1.50 |

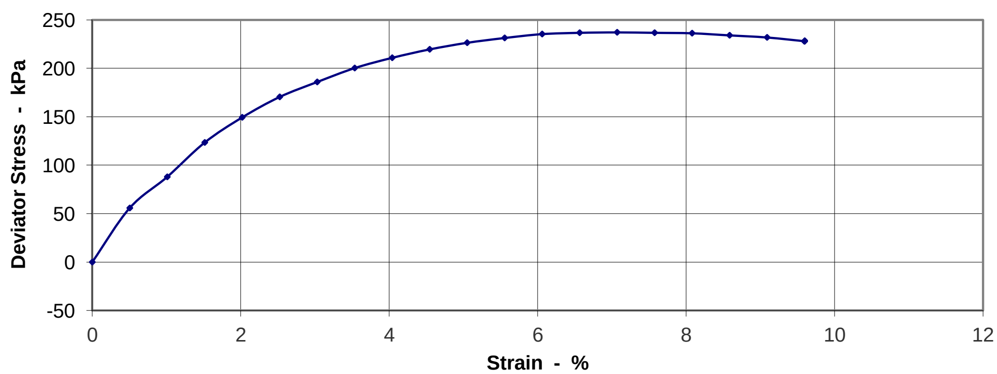
## Test Details

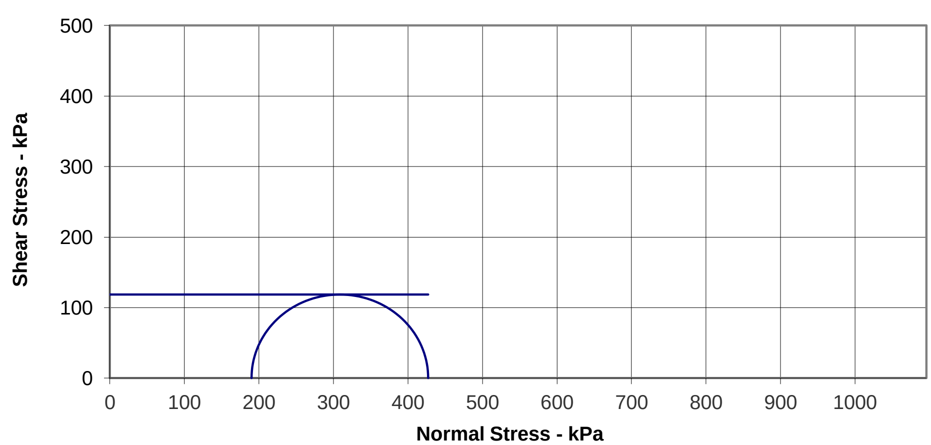
| | | |
|---|---|---|
| Membrane Thickness | mm | 0.2 |
| Membrane Correction | kPa | 0.34 |
| Rate of Axial Displacement | %/min | 2.02 |
| Cell Pressure | kPa | 190 |
| Strain at Failure | % | 7.1 |
| Maximum Deviator Stress | kPa | 237 |
| Shear Strength | kPa | 119 |
| Mode of Failure | | Compound |

Position and orientation within the original sample

| Shear Strength Parameters | |
|---|---|
| C | 119 kPa |
| Phi | 0.0 ° |

Specimen 1

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**Checked and Approved**
Initials: kp
Date: 20/11/2014

2519

# K4 SOILS

# Report of Undrained Triaxial Compression Test

## BS 1377 : Part 7 : 1990 Clause 8.0

| | | | | | |
|---|---|---|---|---|---|
| **Project name:** | 14 Netherhall Gardens, London, NW3 5TQ | | | **Samples Received:** | 30/10/2014 |
| | | | | **Project Started:** | 10/11/2014 |
| **Client:** | GEA | | | **Testing Started:** | 17/11/2014 |
| **Project no:** | J14290 | **Our job /report no:** | 17775 | **Date Reported:** | 20/11/2014 |
| **BH / TP no:** | BH5 | **Sample no:** | U | **Depth (m):** | 12.50 |

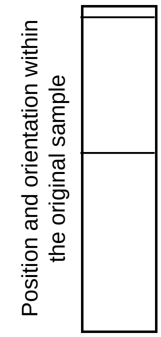
**Soil Description:** High strength fissured dark grey silty CLAY

### Sample Details — Specimen 1

| | | |
|---|---|---|
| Sample Condition | | Undisturbed |
| Height | mm | 198.0 |
| Diameter | mm | 102.0 |
| Moisture Content | % | 29 |
| Bulk Density | Mg/m³ | 1.99 |
| Dry Density | Mg/m³ | 1.55 |

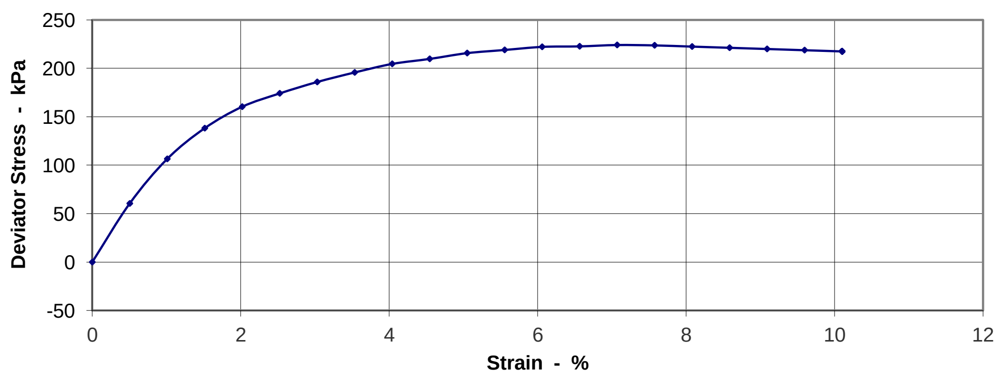
### Test Details

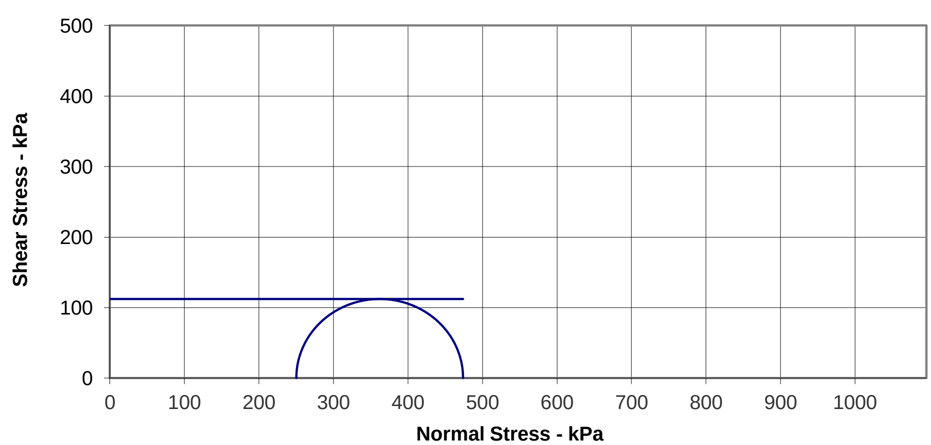
| | | |
|---|---|---|
| Membrane Thickness | mm | 0.2 |
| Membrane Correction | kPa | 0.34 |
| Rate of Axial Displacement | %/min | 2.02 |
| Cell Pressure | kPa | 250 |
| Strain at Failure | % | 7.1 |
| Maximum Deviator Stress | kPa | 224 |
| Shear Strength | kPa | 112 |
| Mode of Failure | | Compound |




| Shear Strength Parameters | | |
|---|---|---|
| C | 112 | kPa |
| Phi | 0.0 | ° |

Specimen 1





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**Checked and Approved**
Initials: kp
Date: 20/11/2014

2519

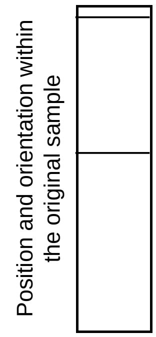
| K4 SOILS | Report of Undrained Triaxial Compression Test |
|---|---|
| | BS 1377 : Part 7 : 1990 Clause 8.0 |

| | | | | | |
|---|---|---|---|---|---|
| **Project name:** | 14 Netherhall Gardens, London, NW3 5TQ | | | **Samples Received:** | 30/10/2014 |
| | | | | **Project Started:** | 10/11/2014 |
| **Client:** | GEA | | | **Testing Started:** | 17/11/2014 |
| **Project no:** | J14290 | **Our job /report no:** | 17775 | **Date Reported:** | 20/11/2014 |
| **BH / TP no:** | BH5 | **Sample no:** | U | **Depth (m):** | 15.50 |

**Soil Description:** High strength fissured dark grey silty CLAY

## Sample Details — Specimen 1

| | | |
|---|---|---|
| Sample Condition | | Undisturbed |
| Height | mm | 198.0 |
| Diameter | mm | 102.0 |
| Moisture Content | % | 28 |
| Bulk Density | Mg/m³ | 2.02 |
| Dry Density | Mg/m³ | 1.58 |

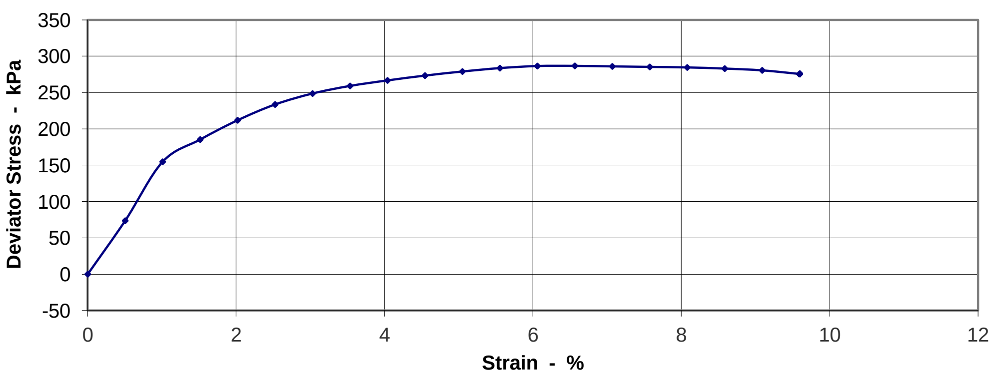


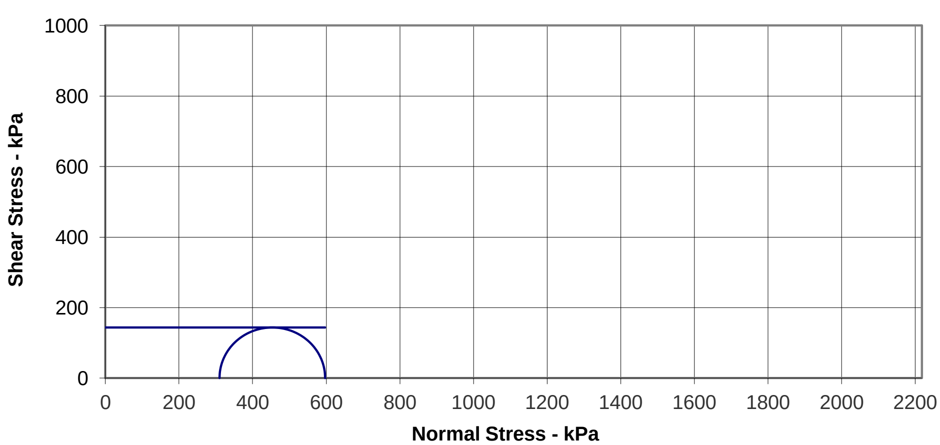

## Test Details

| | | |
|---|---|---|
| Membrane Thickness | mm | 0.2 |
| Membrane Correction | kPa | 0.32 |
| Rate of Axial Displacement | %/min | 2.02 |
| Cell Pressure | kPa | 310 |
| Strain at Failure | % | 6.6 |
| Maximum Deviator Stress | kPa | 287 |
| Shear Strength | kPa | 143 |
| Mode of Failure | | Compound |

| Shear Strength Parameters | | |
|---|---|---|
| C | 143 | kPa |
| Phi | 0.0 | ° |

Specimen 1





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**Checked and Approved**
Initials: kp
Date: 20/11/2014

UKAS TESTING 2519

| K4 SOILS | Report of Undrained Triaxial Compression Test |
|---|---|
| | BS 1377 : Part 7 : 1990 Clause 8.0 |

| | | | | | |
|---|---|---|---|---|---|
| **Project name:** | 14 Netherhall Gardens, London, NW3 5TQ | | | **Samples Received:** | 30/10/2014 |
| | | | | **Project Started:** | 10/11/2014 |
| **Client:** | GEA | | | **Testing Started:** | 17/11/2014 |
| **Project no:** | J14290 | **Our job /report no:** | 17775 | **Date Reported:** | 20/11/2014 |
| **BH / TP no:** | BH5 | **Sample no:** | U | **Depth (m):** | 18.50 |

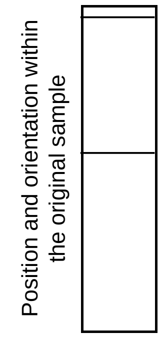
**Soil Description:** Very high strength fissured dark grey silty CLAY with occasional light grey fine sand partings

## Sample Details

| Specimen | | 1 |
|---|---|---|
| Sample Condition | | Undisturbed |
| Height | mm | 198.0 |
| Diameter | mm | 102.0 |
| Moisture Content | % | 26 |
| Bulk Density | Mg/m³ | 2.04 |
| Dry Density | Mg/m³ | 1.63 |

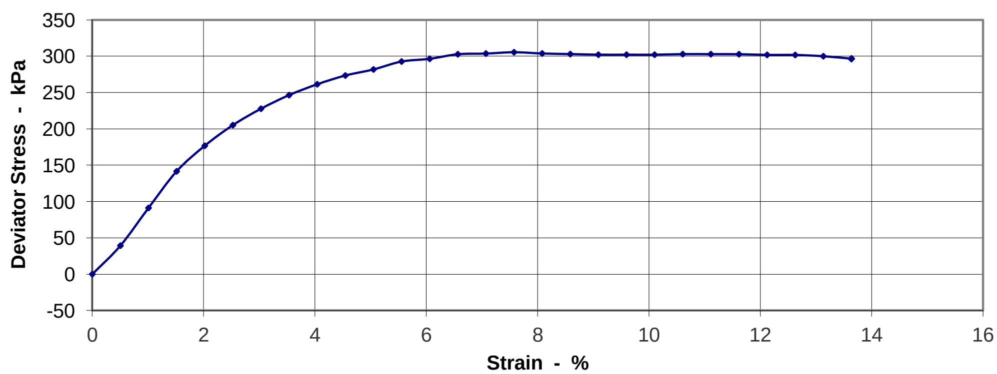
## Test Details

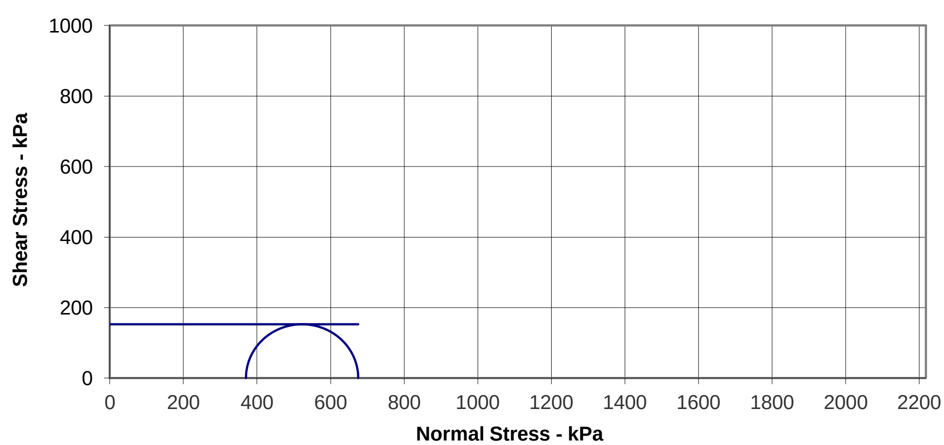
| | | |
|---|---|---|
| Membrane Thickness | mm | 0.2 |
| Membrane Correction | kPa | 0.36 |
| Rate of Axial Displacement | %/min | 2.02 |
| Cell Pressure | kPa | 370 |
| Strain at Failure | % | 7.6 |
| Maximum Deviator Stress | kPa | 305 |
| Shear Strength | kPa | 153 |
| Mode of Failure | | Compound |




| Shear Strength Parameters | | |
|---|---|---|
| C | 153 | kPa |
| Phi | 0.0 | ° |

Specimen 1

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**Approved Signatories:** K.Phaure(Tech.Mgr)
J.Phaure(Lab.Mgr)

Test results relate only to the sample numbers shown above

**Checked and Approved**
Initials: kp
Date: 20/11/2014

2519

| Project Name: | 14 Netherhall Gardens, London, NW3 5TQ | | K4 SOILS |
|---|---|---|---|
| Client: | GEA | Project no: J14290 | |
| | | Our job no: 17775 | |

| Borehole No: | Sample No: | Depth m | Description | pH | Sulphate content (g/l) |
|---|---|---|---|---|---|
| BH4 | D | 3.00 | Brown and occasional grey slightly sandy silty CLAY | 7.9 | 0.48 |
| BH5 | B | 0.50 | MADE GROUND (Dark grey slightly sandy gravelly silty clay with numerous fine concrete, fm brick fragments, occasional roots and rootlets (gravel is fmc and sub-angular to sub-rounded) | 7.5 | 0.15 |
| BH5 | D | 10.50 | Dark brownish grey silty CLAY | 7.8 | 2.06 |

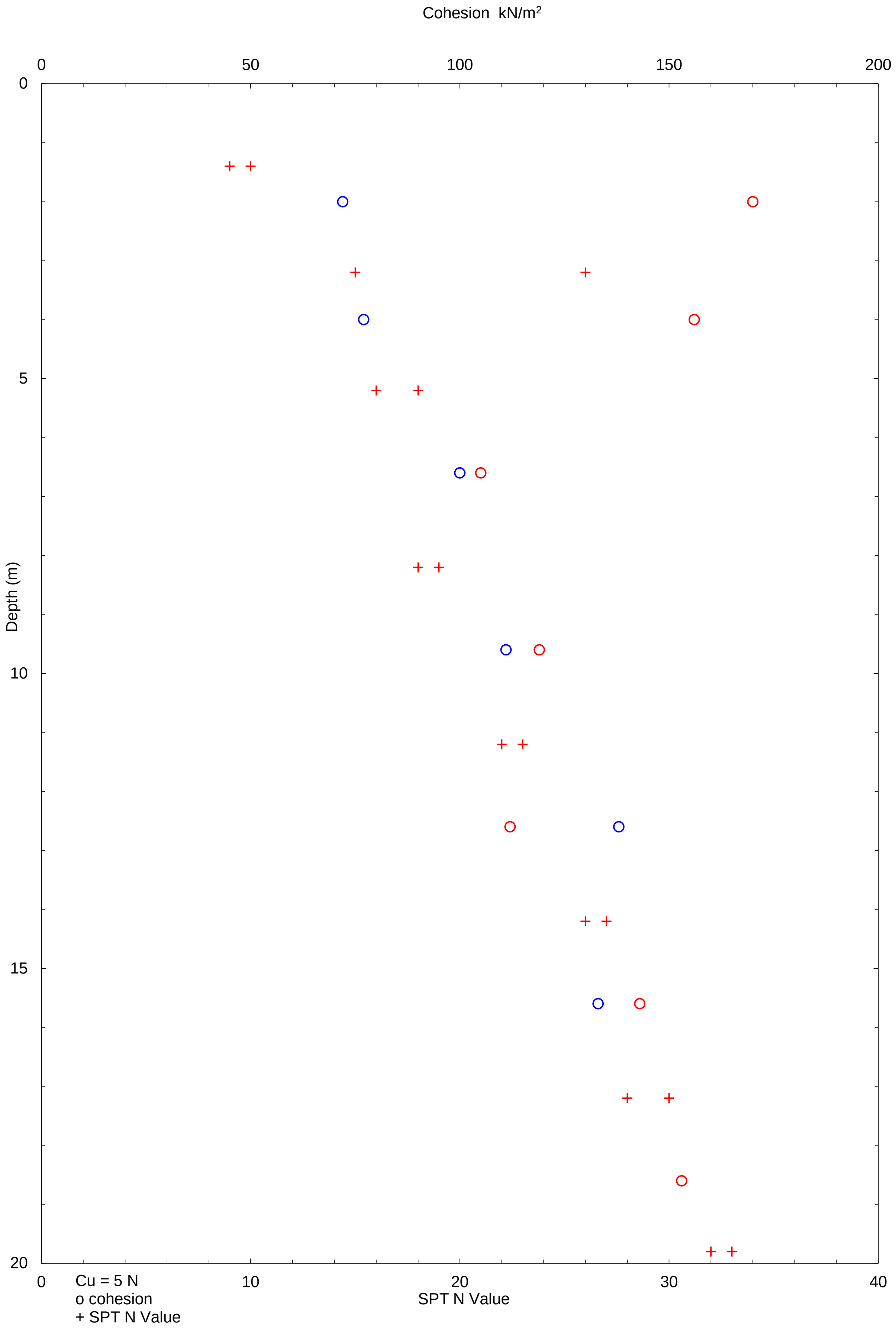
| Date | **Summary of Test Results** | Checked and Approved |
|---|---|---|
| 20/11/2014 | BS 1377 : Part 3 :Clause 5 : 1990 | Initials : kp |
| | Determination of sulphate content of soil and ground water : gravimetric method | |

Geotechnical & Environmental Associates

Tyttenhanger House
Coursers Road
St Albans
Herts AL4 0PG

# SPT & Cohesion / Depth Graph

| | |
|---|---|
| **Site** | 14 Netherhall Gardens, London, NW3 5TQ |
| **Client** | Netherhall Gardens Ltd |
| **Engineer** | Fluid Structures |
| **Job Number** | J14290 |
| **Sheet** | 1 / 1 |



Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.co.uk

# Amended Report

| | | | |
|---|---|---|---|
| **Report Number:** | 14-13368 Issue-2 | | |
| **Initial Date of Issue:** | 05-Nov-14 | **Date of Re-Issue:** | 07-Nov-14 |
| **Client:** | GEA | | |
| **Client Address:** | Tyttenhanger House<br>Coursers Road<br>Saint Albans<br>Hertfordshire<br>AL4 0PG | | |
| **Contact(s):** | Bryan O'Gorman<br>Hannah Dashfield | | |
| **Project:** | J14290 - 14 Netherhall Gardens, London, NW3 5TQ | | |
| **Quotation No.:** | | **Date Received:** | 03-Nov-14 |
| **Order No.:** | | **Date Instructed:** | 03-Nov-14 |
| **No. of Samples:** | 8 | **Results Due:** | 10-Nov-14 |
| **Turnaround: (Weekdays)** | 3 | | |
| **Date Approved:** | 07-Nov-14 | | |
| **Approved By:** | | | |

**Details:** Keith Jones, Technical Manager

Chemtest
The right chemistry to deliver results

# Results Summary - Soil

**Project: J14290 - 14 Netherhall Gardens, London, NW3 5TQ**

| Client: GEA | | | | **Chemtest Job No.:** | 14-13368 | 14-13368 | 14-13368 | 14-13368 | 14-13368 | 14-13368 |
|---|---|---|---|---|---|---|---|---|---|---|
| Quotation No.: | | | | **Chemtest Sample ID.:** | 65017 | 65018 | 65019 | 65020 | 65021 | 65022 |
| Order No.: | | | | Client Sample Ref.: | | | | | | |
| | | | | **Client Sample ID.:** | BH2 | BH3 | TP5 | TP3 | BH4 | BH5 |
| | | | | Sample Type: | SOIL | SOIL | SOIL | SOIL | SOIL | SOIL |
| | | | | Top Depth (m): | 0.2 | 0.3 | 0.3 | 0.4 | 0.5 | 0.5 |
| | | | | Bottom Depth(m): | | | | | | |
| | | | | Date Sampled: | 27-Oct-14 | 27-Oct-14 | 24-Oct-14 | 24-Oct-14 | 29-Oct-14 | 30-Oct-14 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | | | | |
| Moisture | N | 2030 | % | 0.02 | 18 | 16 | 23 | 11 | 15 | 20 |
| Stones | N | 2030 | % | 0.02 | < 0.020 | < 0.020 | < 0.020 | < 0.020 | < 0.020 | < 0.020 |
| Soil Colour | N | | | | brown | brown | brown | brown | brown | brown |
| Other Material | N | | | | stones, roots | stones | stones | stones, roots | stones | stones |
| Soil Texture | N | | | | sand | clay | clay | clay | clay | clay |
| pH | M | 2010 | | | 7.5 | 6.5 | 8.0 | 8.1 | 7.4 | 7.3 |
| Sulphate (2:1 Water Soluble) as SO4 | M | 2120 | g/l | 0.01 | 0.031 | | | | | |
| Chloride (Extractable) | U | 2220 | g/l | 0.01 | 0.025 | < 0.010 | < 0.010 | < 0.010 | < 0.010 | < 0.010 |
| Cyanide (Total) | M | 2300 | mg/kg | 0.5 | 0.50 | < 0.50 | < 0.50 | < 0.50 | < 0.50 | < 0.50 |
| Sulphide (Easily Liberatable) | M | 2325 | mg/kg | 0.5 | < 0.50 | < 0.50 | < 0.50 | < 0.50 | < 0.50 | < 0.50 |
| Sulphate (Total) | M | 2430 | mg/kg | 100 | 2600 | 1100 | 760 | 1300 | 240 | 800 |
| Arsenic | M | 2450 | mg/kg | 1 | 24 | 19 | 15 | 23 | 11 | 17 |
| Cadmium | M | 2450 | mg/kg | 0.1 | 0.87 | 0.38 | 0.26 | 0.39 | < 0.10 | 0.24 |
| Chromium | M | 2450 | mg/kg | 1 | 33 | 31 | 37 | 28 | 30 | 33 |
| Copper | M | 2450 | mg/kg | 1 | 96 | 47 | 32 | 58 | 16 | 44 |
| Mercury | M | 2450 | mg/kg | 0.1 | 0.53 | 0.64 | 0.19 | 1.9 | < 0.10 | 0.68 |
| Nickel | M | 2450 | mg/kg | 1 | 28 | 24 | 41 | 21 | 13 | 24 |
| Lead | M | 2450 | mg/kg | 1 | 940 | 430 | 270 | 1000 | 100 | 330 |
| Selenium | M | 2450 | mg/kg | 0.2 | < 0.20 | < 0.20 | < 0.20 | < 0.20 | < 0.20 | < 0.20 |
| Zinc | M | 2450 | mg/kg | 1 | 490 | 150 | 120 | 310 | 48 | 120 |
| Total Organic Carbon | M | 2625 | % | 0.2 | 7.2 | 2.3 | 1.1 | 2.8 | 0.55 | 2.6 |
| TPH >C5-C6 | N | 2670 | mg/kg | 1 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| TPH >C6-C7 | N | 2670 | mg/kg | 1 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| TPH >C7-C8 | N | 2670 | mg/kg | 1 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| TPH >C8-C10 | N | 2670 | mg/kg | 1 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| TPH >C10-C12 | N | 2670 | mg/kg | 1 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| TPH >C12-C16 | N | 2670 | mg/kg | 1 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| TPH >C16-C21 | N | 2670 | mg/kg | 1 | 4.5 | 1.6 | < 1.0 | < 1.0 | 7.5 | < 1.0 |
| TPH >C21-C35 | N | 2670 | mg/kg | 1 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | 29 | < 1.0 |
| Total TPH >C5-C35 | N | 2670 | mg/kg | 10 | < 10 | < 10 | < 10 | < 10 | 37 | < 10 |
| Naphthalene | M | 2700 | mg/kg | 0.1 | 0.12 | 0.20 | < 0.10 | < 0.10 | < 0.10 | 0.12 |
| Acenaphthylene | M | 2700 | mg/kg | 0.1 | 0.27 | 0.17 | < 0.10 | < 0.10 | < 0.10 | < 0.10 |
| Acenaphthene | M | 2700 | mg/kg | 0.1 | 0.18 | 0.14 | < 0.10 | < 0.10 | < 0.10 | 0.17 |

Chemtest
The right chemistry to deliver results

# Results Summary - Soil

**Project: J14290 - 14 Netherhall Gardens, London, NW3 5TQ**

| Client: GEA | | | | **Chemtest Job No.:** | 14-13368 | 14-13368 | 14-13368 | 14-13368 | 14-13368 | 14-13368 |
|---|---|---|---|---|---|---|---|---|---|---|
| Quotation No.: | | | | **Chemtest Sample ID.:** | 65017 | 65018 | 65019 | 65020 | 65021 | 65022 |
| Order No.: | | | | Client Sample Ref.: | | | | | | |
| | | | | **Client Sample ID.:** | BH2 | BH3 | TP5 | TP3 | BH4 | BH5 |
| | | | | Sample Type: | SOIL | SOIL | SOIL | SOIL | SOIL | SOIL |
| | | | | Top Depth (m): | 0.2 | 0.3 | 0.3 | 0.4 | 0.5 | 0.5 |
| | | | | Bottom Depth(m): | | | | | | |
| | | | | Date Sampled: | 27-Oct-14 | 27-Oct-14 | 24-Oct-14 | 24-Oct-14 | 29-Oct-14 | 30-Oct-14 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | | | | |
| Fluorene | M | 2700 | mg/kg | 0.1 | < 0.10 | < 0.10 | < 0.10 | < 0.10 | < 0.10 | 0.11 |
| Phenanthrene | M | 2700 | mg/kg | 0.1 | 0.84 | 0.71 | 0.17 | 0.99 | < 0.10 | 0.96 |
| Anthracene | M | 2700 | mg/kg | 0.1 | 0.15 | 0.23 | < 0.10 | 0.20 | < 0.10 | 0.25 |
| Fluoranthene | M | 2700 | mg/kg | 0.1 | 1.7 | 1.7 | 0.22 | 2.3 | < 0.10 | 2.4 |
| Pyrene | M | 2700 | mg/kg | 0.1 | 1.7 | 1.6 | 0.25 | 2.3 | < 0.10 | 2.3 |
| Benzo[a]anthracene | M | 2700 | mg/kg | 0.1 | 1.2 | 0.48 | < 0.10 | 1.2 | < 0.10 | 1.2 |
| Chrysene | M | 2700 | mg/kg | 0.1 | 1.8 | 0.65 | < 0.10 | 1.7 | < 0.10 | 1.7 |
| Benzo[b]fluoranthene | M | 2700 | mg/kg | 0.1 | 2.0 | 1.4 | < 0.10 | 2.1 | < 0.10 | 2.0 |
| Benzo[k]fluoranthene | M | 2700 | mg/kg | 0.1 | 0.56 | 0.41 | < 0.10 | 0.80 | < 0.10 | 0.79 |
| Benzo[a]pyrene | M | 2700 | mg/kg | 0.1 | 0.70 | 0.36 | < 0.10 | 1.2 | < 0.10 | 0.98 |
| Indeno(1,2,3-c,d)Pyrene | M | 2700 | mg/kg | 0.1 | 0.87 | 0.54 | < 0.10 | 0.82 | < 0.10 | 0.73 |
| Dibenz(a,h)Anthracene | M | 2700 | mg/kg | 0.1 | 0.17 | < 0.10 | < 0.10 | < 0.10 | < 0.10 | < 0.10 |
| Benzo[g,h,i]perylene | M | 2700 | mg/kg | 0.1 | 0.44 | 0.35 | < 0.10 | 0.79 | < 0.10 | 0.54 |
| Total Of 16 PAH's | M | 2700 | mg/kg | 2 | 13 | 8.9 | < 2.0 | 14 | < 2.0 | 14 |
| Total Phenols | M | 2920 | mg/kg | 0.3 | < 0.30 | < 0.30 | < 0.30 | < 0.30 | < 0.30 | < 0.30 |

Chemtest
The right chemistry to deliver results

# Report Information

**Key**

| | |
|---|---|
| U | UKAS accredited |
| M | MCERTS and UKAS accredited |
| N | Unaccredited |
| S | This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis |
| SN | This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis |
| T | This analysis has been subcontracted to an unaccredited laboratory |
| I/S | Insufficient Sample |
| U/S | Unsuitable sample |
| N/E | not evaluated |
| < | "less than" |
| > | "greater than" |

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVCOs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at our Coventry laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

**Sample Deviation Codes**

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container

**Sample Retention and Disposal**

All soil samples will be retained for a period of 1 month following the date of the test report
All water samples will be retained for 7 days following the date of the test report
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.co.uk

Geotechnical & Environmental Associates

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# Generic Risk-Based Soil Screening Values

| | | | |
|---|---|---|---|
| **Site** | 14 Netherhall Gardens, London, NW3 5TQ | **Job Number** | J14290 |
| **Client** | Netherhall Gardens Limited | **Sheet** | 1 / 1 |
| **Engineer** | Fluid Structures | | |

**Proposed End Use** Residential with plant uptake

**Soil pH** 7

**Soil Organic Matter content %** 6.0

| Contaminant | Screening Value mg/kg | Data Source |
|---|---|---|
| ***Metals*** | | |
| Arsenic | 37 | C4SL |
| Cadmium | 26 | C4SL |
| Chromium (III) | 3000 | LQM/CIEH |
| Chromium (VI) | 21 | C4SL |
| Copper | 2,330 | LQM/CIEH |
| Lead | 200 | C4SL |
| Elemental Mercury | 1 | SGV |
| Inorganic Mercury | 170 | SGV |
| Nickel | 130 | LQM/CIEH |
| Selenium | 350 | SGV |
| Zinc | 3,750 | LQM/CIEH |
| ***Hydrocarbons*** | | |
| Benzene | 0.87 | C4SL |
| Toluene | 610 | SGV |
| Ethyl Benzene | 350 | SGV |
| Xylene | 230 | SGV |
| Aliphatic C5-C6 | 110 | LQM/CIEH |
| Aliphatic C6-C8 | 370 | LQM/CIEH |
| Aliphatic C8-C10 | 110 | LQM/CIEH |
| Aliphatic C10-C12 | 540 | LQM/CIEH |
| Aliphatic C12-C16 | 3000 | LQM/CIEH |
| Aliphatic C16-C35 | 76,000 | LQM/CIEH |
| Aromatic C6-C7 | See Benzene | LQM/CIEH |
| Aromatic C7-C8 | See Toluene | LQM/CIEH |
| Aromatic C8-C10 | 151 | LQM/CIEH |
| Aromatic C10-C12 | 346 | LQM/CIEH |
| Aromatic C12-C16 | 593 | LQM/CIEH |
| Aromatic C16-C21 | 770 | LQM/CIEH |
| Aromatic C21-C35 | 1230 | LQM/CIEH |
| PRO ($C_5$ –$C_{10}$) | 1352 | Calc |
| DRO ($C_{12}$ –$C_{28}$) | 80,363 | Calc |
| Lube Oil ($C_{28}$ –$C_{44}$) | 77,230 | Calc |
| **TPH** | **1000** | Trigger for speciated testing |

| Contaminant | Screening Value mg/kg | Data Source |
|---|---|---|
| ***Anions*** | | |
| Soluble Sulphate | 0.5 g/l | Structures |
| Sulphide | 50 | Structures |
| Chloride | 400 | Structures |
| ***Others*** | | |
| Organic Carbon (%) | 6 | Methanogenic potential |
| Total Cyanide | 140 | WRAS |
| Total Mono Phenols | 420 | SGV |
| ***PAH*** | | |
| Naphthalene | 12.40 | C4SL exp & LQM/CIEH |
| Acenaphthylene | 850 | LQM/CIEH |
| Acenaphthene | 1,000 | LQM/CIEH |
| Fluorene | 780 | LQM/CIEH |
| Phenanthrene | 380 | LQM/CIEH |
| Anthracene | 9,200 | LQM/CIEH |
| Fluoranthene | 670 | LQM/CIEH |
| Pyrene | 1,600 | LQM/CIEH |
| Benzo(a) Anthracene | 8.7 | C4SL exp & LQM/CIEH |
| Chrysene | 14 | C4SL exp & LQM/CIEH |
| Benzo(b) Fluoranthene | 10.5 | C4SL exp & LQM/CIEH |
| Benzo(k) Fluoranthene | 15.0 | C4SL exp & LQM/CIEH |
| Benzo(a) pyrene | 5.00 | C4SL |
| Indeno(1 2 3 cd) Pyrene | 6.2 | C4SL exp & LQM/CIEH |
| Dibenzo(a h) Anthracene | 1.35 | C4SL exp & LQM/CIEH |
| Benzo (g h i) Perylene | 71 | C4SL exp & LQM/CIEH |
| **Screening value for PAH** | **71.4** | B(a)P / 0.15 |
| ***Chlorinated Solvents*** | | |
| 1,1,1 trichloroethane (TCA) | 53.1 | LQM/CIEH |
| tetrachloroethane (PCA) | 2.4 | LQM/CIEH |
| tetrachloroethene (PCE) | 4.5 | LQM/CIEH |
| trichloroethene (TCE) | 0.598 | LQM/CIEH |
| 1,2-dichloroethane (DCA) | 0.014 | LQM/CIEH |
| vinyl chloride (Chloroethene) | 0.00329 | LQM/CIEH |
| tetrachloromethane (Carbon tetra | 0.089 | LQM/CIEH |
| trichloromethane (Chloroform) | 3.86 | LQM/CIEH |

*Notes*

Concentrations measured below the above values may be considered to represent 'uncontaminated conditions' which pose 'LOW' risk to human health. Concentrations measured in excess of these valuesindicate a potential risk which require further, site specific risk assessment.

SGV - Soil Guideline Value, derived from the CLEA model and published by Environment Agency 2009

LQM/CIEH - Generic Assessment Criteria for Human Health Risk Assessment 2nd edition (2009)derived using CLEA 1.04 model 2009

C4SL - Defra Category 4 Screening value based on Low Level of Toxicological Risk

C4SL exp & LQM/CIEH calculated using C4SL revisions to exposure assessment but LQM/CIEH health croiteria values

Calc - sum of nearest available carbon range specified including BTEX for PRO fraction

B(a)P / 0.15 - GEA experince indicates that Benzo(a) pyrene (one of the most common and most carcenogenic of the PAHs) rarely exceeds 15% of the total PAH concentration, hence this Total PAH threshold is regarded as being conservative

Geotechnical & Environmental Associates

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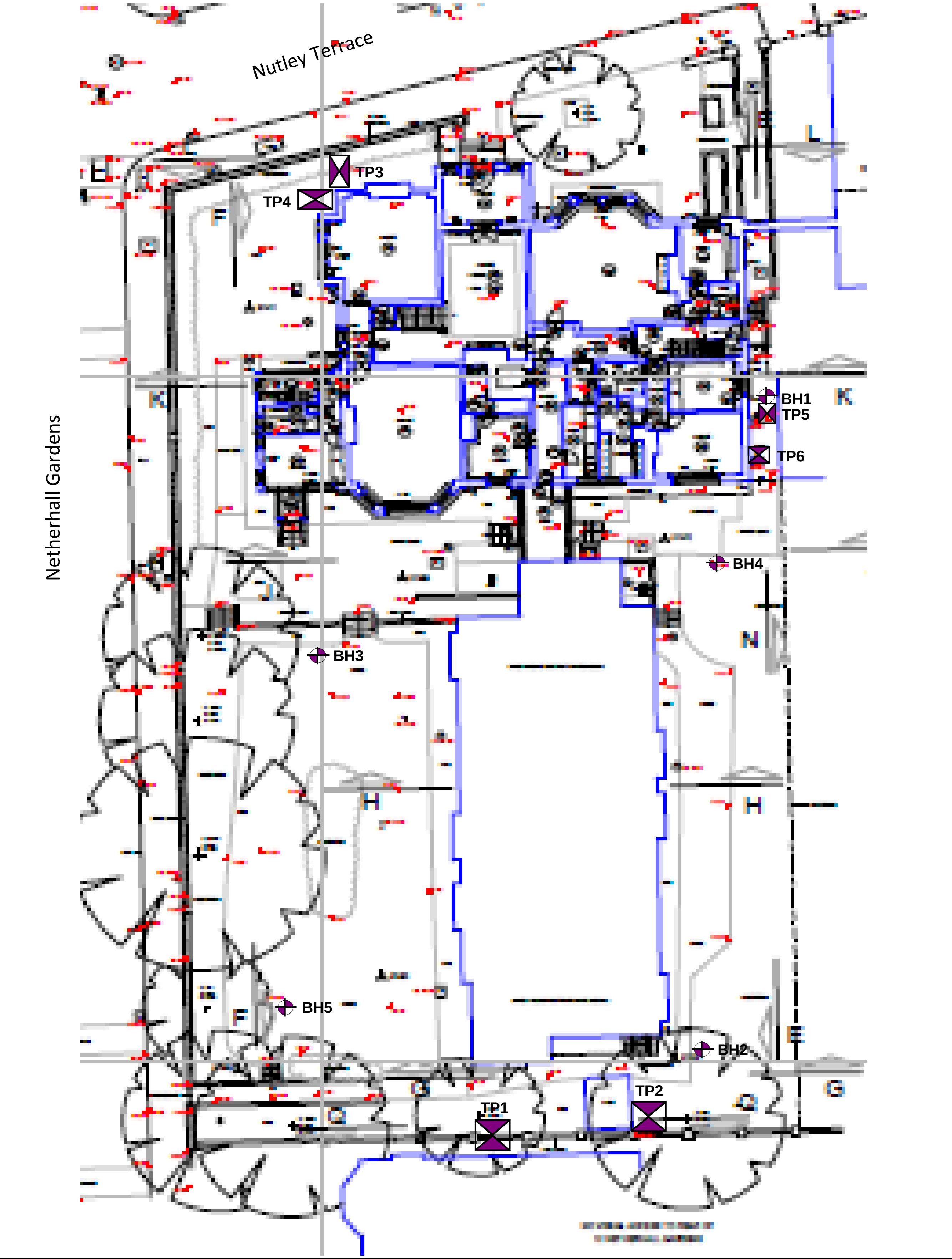
# Site Plan

| | |
|---|---|
| Site | 14 Netherhall Gardens, London, NW3 5TQ |
| Client | Netherhall Gardens Limited |
| Engineer | Fluid Structures |

Job Number
J14290

Sheet
1 / 2



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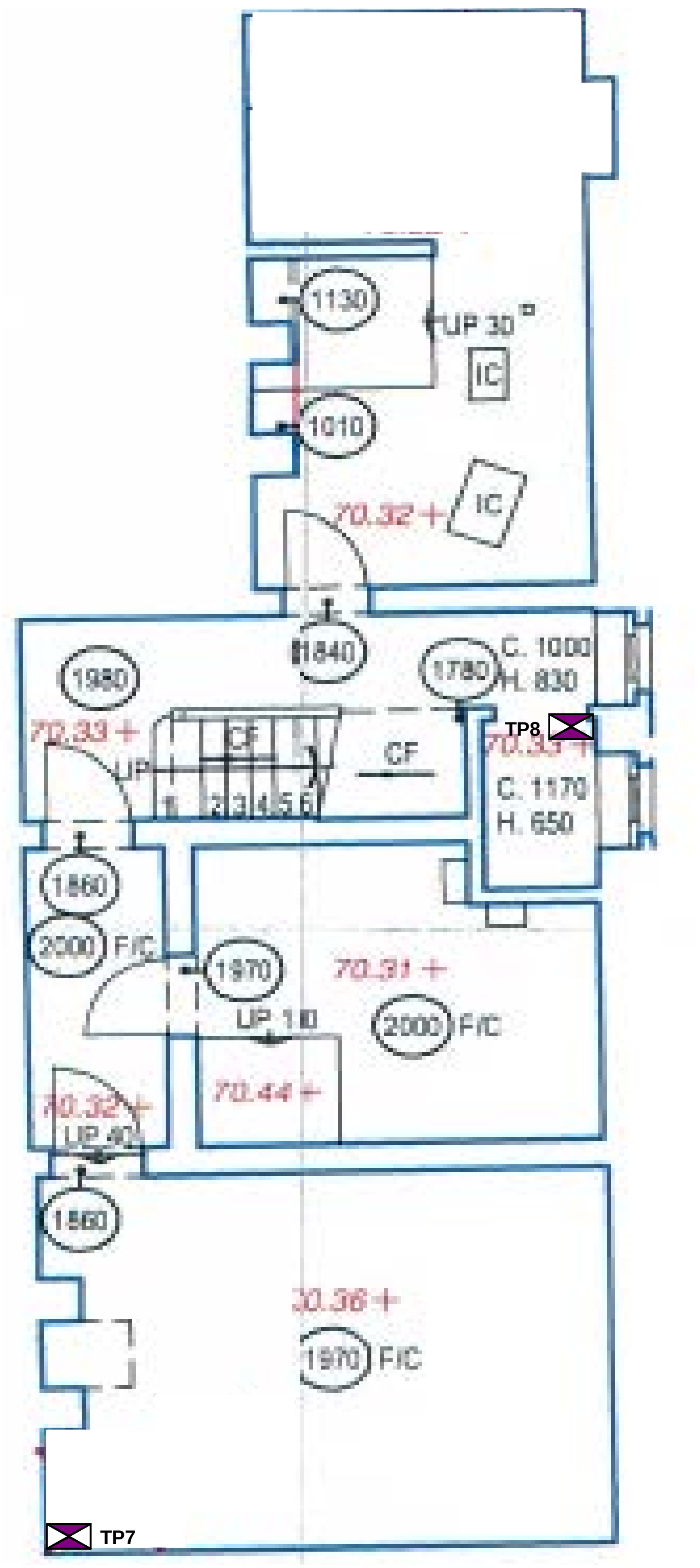
# Site Plan

| | |
|---|---|
| **Site** | 14 Netherhall Gardens, London, NW3 5TQ |
| **Client** | Netherhall Gardens Limited |
| **Engineer** | Fluid Structures |
| **Job Number** | J14290 |
| **Sheet** | 2/ 2 |



Geotechnical & Environmental Associates (GEA)
is an engineer-led and client-focused independent specialist providing a complete range of geotechnical and contaminated land investigation, analytical and consultancy services to the property and construction industries.

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