

# Basement Impact Assessment

Garages 33 Priory Road  
London  
N8 8LP

In Support of Planning Application

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1.0 INTRODUCTION

Symmetrys Limited have been engaged by Neil Brock to produce a Basement Impact Assessment for the proposed works to the existing garage units at the rear of 33 Priory Road. The proposal is to demolish the existing garages and construct a single storey property with subterranean basement.

- 1.1 The basement extension will be formed below the existing the footprint of the garages.The superstructure design of the single storey property is not discussed at length in this report, as this report is concerned mainly with the proposed basement works.
- 1.2 Symmetrys drawings and this report form part of the clients' planning application. These documents are not intended for, and should not be relied upon, by any third party for any other purpose. Symmetrys drawings are based on the existing and proposed drawings provided by Loren Design Ltd.
- 1.3 As part of the ground investigation works were carried out by Land Science Ltd in order to accurately assess the site-specific soil conditions and to expose and inspect existing foundations of the garage. This can be found in Appendix C.
- 1.4 The following reference documents have been used as guidance in compiling this report:
  - Haringey Council Planning Regeneration & Economy: Basement Development Guidance Note Policy DM18 Residential basement Development and Light wells.

The summary table below indicates where the Items laid out in DM18 have been discussed.

| Items |   | Comments                                         |
|-------|---|--------------------------------------------------|
| A     | a | Refer to Sections 5.0-8.0                        |
|       | b | Refer to Section 9.0                             |
|       | c | Refer to Architect's Design and Access Statement |
|       | d | Refer to Architect's Design and Access Statement |
|       | e | Refer to Architect's Design and Access Statement |
|       | f | N/A                                              |
|       | g | N/A                                              |
|       | h | Refer to Section 11.0                            |
|       | i | Refer to Section 12.0                            |
| B     |   | Refer to Architect's Design and Access Statement |

|   |   |                                                  |
|---|---|--------------------------------------------------|
| C | a | Refer to Architect's Design and Access Statement |
|   | b | Refer to Architect's Design and Access Statement |
|   | c | Refer to Architect's Design and Access Statement |

## 2.0 EXISTING CONDITION

- 2.1 The plot is currently housing 3No. single storey garage units that are set away from the pavement located in the Borough of Haringey. The structure of the garage units are assumed to be of typical construction comprising of solid load bearing masonry wall construction that are supporting flat roof structures. The floor construction of the existing Ground Floor is assumed to be of reinforced concrete construction.

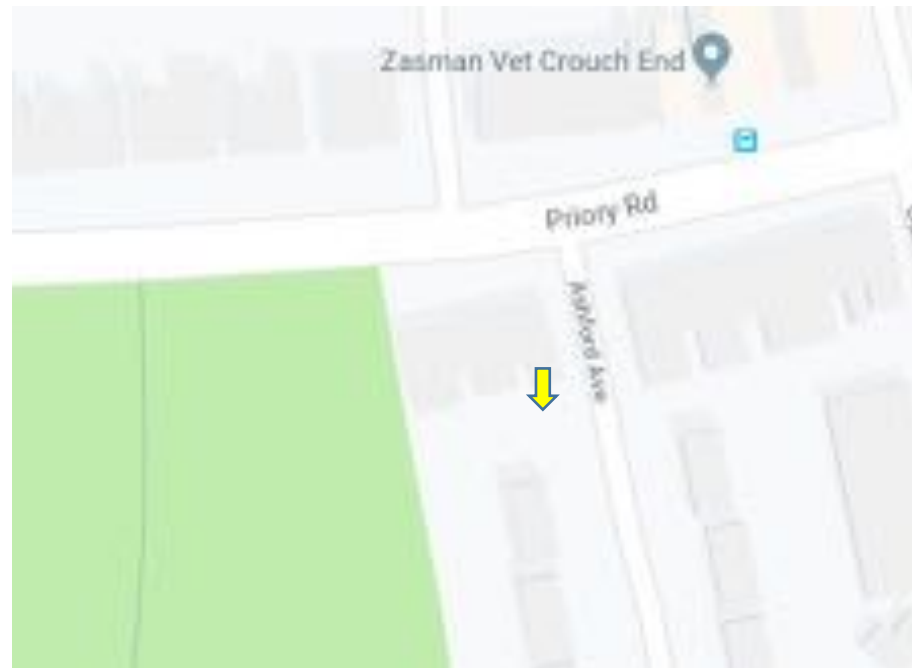


**Figure 1.** Site Location



**Figure 2.** Birds eye view of the site

## 3.0 DESK STUDY

### 3.1 Ground Conditions

- 3.1.1 The local geographical survey maps, accessible via the British Geological Survey which indicates London Clay Formation for the Bedrock Geology. Borehole scans show the nearest borehole to the property marked as TQ28NE9, confirming made ground overlaying London Clay Formation at a depth of 2 metres. (See Figure 3)



**Figure 3.** BGS Maps

### 3.2 Hydrology

- 3.2.1 “The Lost Rivers of London” by Nicholas Barton make no reference to any previous rivers or watercourses in the vicinity of the site.
- 3.2.2 The Flood Probability map provided by the Environmental Agency illustrates that the proposed basement lies in Flood Risk Zone 1 indicating ‘little or no risk of flooding (see Figure 4), therefore a full flood risk assessment is not required.



**Figure 4.** Flood Probability map by Environmental Agency

- 3.2.3 The extract of the Map of Haringey Rivers by the Haringey Council provided in Figure 5 illustrates that the site is circa 100m south of an Unnamed river and approximately 150m distant from the Moselle Brook and North of the Stonebridge Improvement Rivers. During the site investigation, no evidence of alluvium soil or river deposits was recorded that would indicate close proximity of a river presence nor a river running below the site.



**Figure 6.** Haringey Council - Haringey Rivers Map

## 3.3 Underground Infrastructure

- 3.3.1 According to Transport For London and Network Rail, there are no shallow railway structures in the location of the new basement. However, CAT scan and safe digging practices (as contained in HSE publications) and other appropriate investigative techniques should always be carried out.
- 3.3.2 Figure 7 shows the position of the nearest transport tunnel for the Northern Line circa 2km whilst the Picadilly Line is circa 1.6km away from the site. Given that these lines are a reasonable distance away from the site, no consultation with the London Underground Asset Protection Team is proposed



**Figure 7.** Location Plan

## 3.4 Bomb Damage Map

- 3.4.1 The WW2 Bomb Census Map provided in Figure 3 suggests that there is no record of any bombings in the vicinity of Garage units of 33 Priory Road, hence no UXO assessment of the site is required.

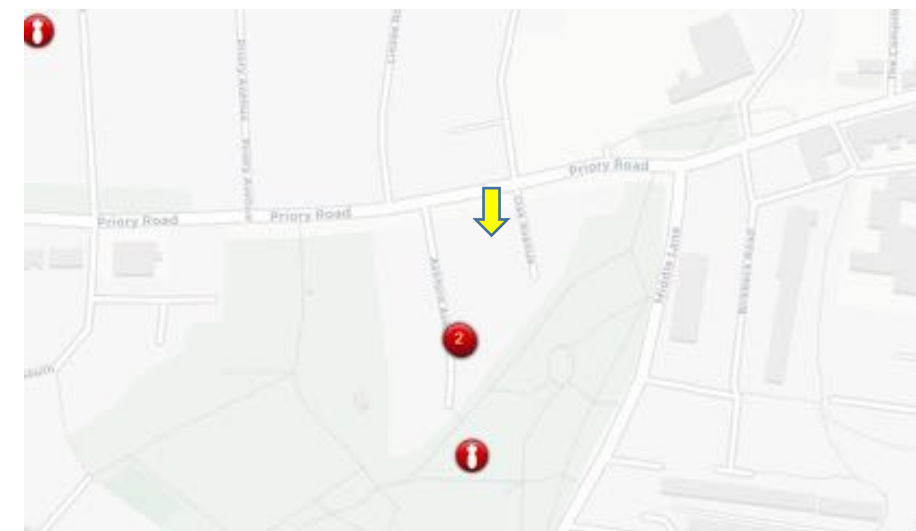


**Figure 8.** Bomb Sight Map in close proximity to the property

4.0 GROUND INVESTIGATION

4.1 A site investigation has been undertaken by Land Science Ltd in December 2019 and further information on the existing site can be found in their report provided in Appendix C. The scope of the ground investigation consisted of 1No. Borehole and 1No. hand excavated trial pits. The locations of these are illustrated in Figure 9.

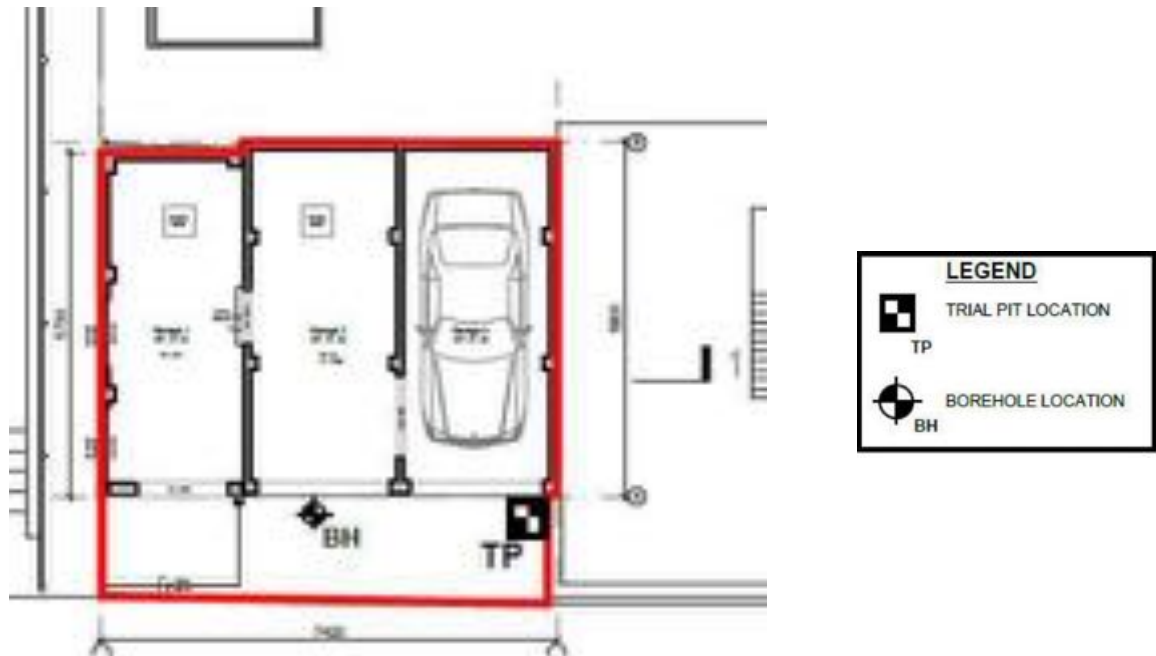


Figure 9. Site Investigation Location Plans

4.2 Results from Borehole Log

- The ground conditions are summarised as follows:

|                                                                 |                                                                                                                                                                                     |
|-----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Borehole– Maximum investigated depth of 10m below ground level. |                                                                                                                                                                                     |
| G.L. – 0.13m                                                    | HARDSTANDING – Concrete                                                                                                                                                             |
| 0.13 – 0.70m                                                    | MADE GROUND - Dark brown slightly sandy gravelly CLAY. Gravels comprised of brick, concrete, flint and rare clinker. Carbonaceous material was encountered between 0.30m and 0.50m. |
| 0.70m – 10.00m                                                  | LONDON CLAY FORMATION – Stiff to very stiff light brown CLAY with rare silt pockets and selenite crystals.                                                                          |

4.3 Ground Water monitoring

4.3.1 The report confirms that groundwater was not encountered in the borehole log that would indicate that the water table was reached. Subsequently, ground water was not encountered within the two monitoring visits. Conservatively, the basement shall be designed assuming that the water level is 1m below ground level. The ground investigation suggests that there is no evidence of alluvium soil or river deposits that would indicate close proximity of a river presence nor a river running below the site.

4.4 Allowable Ground Bearing Pressure

4.4.1 The report suggests that the proposed basement development would be founded on the London Formation allowing for a safe bearing pressure of 125 kN/m2.

5.0 DESIGN PROPOSALS

5.1 The development is a new single storey property comprising a ground floor with a subterranean basement level. The basement extension will be formed below the existing the footprint of the garages, see structural drawings in Appendix A. This will be undertaken by using sequential reinforced concrete retaining walls constructed at an underpinned sequence similar to the one shown on Symmetrys' drawing 192290-10. This is a well-known and frequently used technique to form basements. The use of temporary propping will ensure that the basement does not cause any local ground movements whilst construction is taking place.

5.2 The underpinning sequence is proposed to be carried out in maximum 1.0m width bays to avoid undermining the adjoining properties.

5.3 The expected heave forces cause short and long-term deformation. Short term heave deformation occurs instantaneously and can be remediated by removing the expanded ground during the excavation.

5.4 Our structural calculations provided in Appendix B also demonstrate that the existing structure can be safely supported on the proposed retaining wall structure within parameters for ground bearing capacity assumed.

5.5 Existing trees located in close proximity to the site are to be retained and protected with appropriate measures during the course of construction in agreement with a suitably qualified and experienced arboriculturist.

5.6 Waterproofing

5.6.1 BS8102 sets out guidance for the waterproofing of basement structures according to their use. With this in mind, the use of tanked, integral and/or drained methods of waterproofing will have to be considered. These items will be considered once a tanking specialist has been employed.

6.0 TEMPORARY WORKS

6.1 The proposed temporary works sequence for the basement is provided in Appendix A. This is for design development purposes only and for the purposes of this planning application. The appointed contractor will be responsible for all temporary supports and for the stability of the structure during the works. The method of construction adopted for the basement construction minimises the need for temporary works.

6.2 To ensure that the retained engineer's intent is correctly interpreted by the contractor, they will be required to submit all temporary works proposals to review a minimum of 7 working days prior to commencing works. The contractor should also submit a dewatering strategy to ensure a strategy is agreed should water be encountered.

7.0 CONSTRUCTION METHOD STATEMENT

7.1 A preliminary sequence of works is provided within the structural drawings in Appendix A.

## 8.0 STABILITY OF NEIGHBOURING STRUCTURES

- 8.1 Due to the robust engineering principles and construction methods applied, the extent of movement is limited in accordance with British and European codes. We can confirm that the proposed structural design and method of construction of the basement have been developed with a view to ensuring structural safety, and that is constructed in accordance with this document the works will be able to be completed without any adverse impact on the structural stability of the neighbouring properties, other adjacent structures, adjoining land and gardens or the adjoining Public Highway.
- 8.2 The reinforced concrete structure will be designed to accommodate surcharges from the neighbouring properties, public highway and ground pressures. The structure will have adequate stiffness to ensure that the lateral deflections do not exceed the appropriate limits recommended by British Standards Codes of Practice in order to ensure that potential ground movements be kept to acceptable limits.
- 8.3 The structure will be designed to withstand any uplift due to hydrostatic pressures as well as being designed to transfer vertical loads into the ground safely.

## 9.0 DRAINAGE AND SuDS

- 9.1 In line with the Haringey Local Planning Policy DM25, the drainage design should seek to achieve a greenfield run-off rate where possible and include at least one 'at source' SuDS measure. This may be achieved via installation of a green sedum roof.
- 9.2 The above ground drainage will be subject to invert levels, drained by gravity to the existing public sewage system.
- 9.3 The below ground drainage will be drained to a concrete sump proprietary foul pumping system and a concrete sump for proprietary cavity drainage system situated below the basement slab which will then be pumped via a rising drain to the nearest available inspection chamber on the existing gravity drainage system.
- 9.4 This can then flow by gravity into the existing combined sewage system which will be separated until the last manhole leaving site. To mitigate the risk of back flow suitable measures such as non-return valves will be incorporated into the drainage design.
- 9.5 Any new lengths of sewer required to connect to the existing network will be designed at RIBA Stage 3 in accordance with the following documents (where appropriate):
- Building Regulation – Approved Documents
  - BS EN 12056: Parts 1-5: Gravity Drainage systems inside Building
  - BS EN 752: Drain and sewer systems outside building
  - Sustainable drainage systems – Design manual for England and Wales (CIRIA)
  - Sewers for adoption – 7th edition
  - BS 8000- 14: Workmanship on Building Sites: Code of Practice for Below Ground Drainage
  - Local Authorities guidelines, rules and regulations

## 10.0 PARTY WALL MATTERS

- 10.1 The scope of works falls within the Party Wall Act 1996. Procedures under the Act will be dealt with by the client's Party Wall Surveyor. The Party Wall Surveyor will prepare and serve necessary Notices under the provision of the Acts and agreed Party Wall Awards in event of disputes. The Contractor will be required to provide the Party Wall Surveyor with the appropriate drawings, method statements and all other relevant information covering the works notifiable under the Act. The resolution of the matters under the Act and provision of Party Wall Awards will protect the interests of all owners.

### 10.1 Monitoring

- It is proposed that the structural stability of the surrounding/adjacent properties is safeguarded by a system of movement monitoring.
- The Contractor shall monitor the position and movements of the elevations of the adjacent properties around the perimeter of the proposed excavation. The monitoring shall be undertaken by a specialist survey company. The monitoring system will have at least the following characteristics:

The existing facades of the neighbouring properties, as well as the flank wall of the neighbouring building, will be monitored near ground level and at roof level, at intervals not exceeding 3m centres horizontally and vertically.

1. Monitoring points (targets) shall be firmly attached, to allow 3D position measurement, for the duration of the work, to a continuous and uninterrupted accuracy of  $\pm 1\text{mm}$ . A suitable remote reference base/datum unaffected by the works will be adopted, one located at least 50m from the site.
2. Points/targets shall be measured for 3D positioning on, at not less than the following intervals:
  - Before any works commence (base reading)
  - Weekly during the period of basement excavation/construction
  - Monthly during the course of the remainder of the works.
  - Six months after the completion of all construction works.
3. All measurements shall be plotted graphically, to clearly indicate the fluctuation of movement with time. The survey company shall submit the monitoring results to the Engineer (Symmetrys Ltd) and to the Adjoining Owners Party Wall Surveyors/Engineer within 24 hours of measurement, graphically and numerically.
4. The following trigger levels for movement are proposed for agreement. In the event of a trigger value being reached the Contractor will immediately stop any work that might cause further movement, assess the situation and propose alternative methods for proceeding, with definitive further movement limits for those later steps.
5. Trigger movement limits are proposed as follows:

#### A) Existing Buildings Horizontal or Vertical movement

|       |                   |                       |
|-------|-------------------|-----------------------|
| Amber | $\pm 10\text{mm}$ | All parties notified. |
| Red   | $\pm 15\text{mm}$ | Works reviewed        |

11.0 SUSTAINABILITY

- 11.1 As the basement construction will involve significant amounts of concrete, cement replacement alternatives should be considered. Cement replacements can be used to replace up to 40% of the cement in the concrete mix. These replacements are typically waste products from the energy production industry such as PFA (pulverised fuel ash) and GBFS (granulated blast furnace slag). By adopting them waste products from the energy production industry are recycled and not sent to landfill sites. Furthermore, this also reduces the amount of cement that needs to be mined. Concrete should be bought from a local supplier to further reduce the carbon footprint of transport.
- 11.2 There is a significant amount of reinforced concrete on the project for which steel reinforcement bars will be required. By specifying reinforcement from a UK supplier it ensures that the rebar is made from 100% recycled steel. Any structural steelwork should be sourced from a British manufacturer to ensure that rolled sections are made from at least 60% recycled steel. Sourcing the steel from a local supplier will further reduce the transport carbon footprint.

12.0 Construction Traffic Management Plan

- 12.1 Prior to the commencement of works a Construction Traffic Management Plan is to be carried out by the contractor.

13.0 Noise Vibration Dust Assessment

- 13.1 Prior to the commencement of works a Noise, Vibration and Dust Assessment is to be carried out by the contractor.

14.0 SUMMARY

- 14.1 The proposed basement below the development of the existing garage units at the rear of 33 Priory Road has been designed with robust structural principals and methods of construction that are widely used and known. This will ensure the integrity of neighbouring structures and roadways are not compromised during its construction.
- 14.2 It is essential that a thorough review of all temporary works, contractors' method statements and calculations for these works are undertaken by a suitably qualified structural engineer prior to works starting. The permanent works will also be submitted to Building Control and the necessary Party Wall Surveyors for approval prior to the works commencing on site.
- 14.3 This assumed Method Statement and Structural report has been completed by Symmetrys Limited and checked by Christopher Atkins CEng MIStructE who is the Managing Director of Symmetrys Limited.

Report Prepared by:

Report Reviewed by:



**Mohamed Sharif MEng**  
Structural Engineer



**Christopher Atkins CEng MIStructE**  
Managing Director of Symmetrys

APPENDIX A  
PROPOSED DRAWINGS AND STRUCTURAL METHOD STATEMENTS

REFER TO ARCHITECTS DRAWINGS FOR ALL SETTING OUT DETAILS

THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE DESIGN, INSTALLATION AND SEQUENCING OF ALL TEMPORARY WORKS AND MUST ENSURE THAT STABILITY OF THE STRUCTURE IS NOT COMPROMISED DURING THE WORKS

## LEGEND

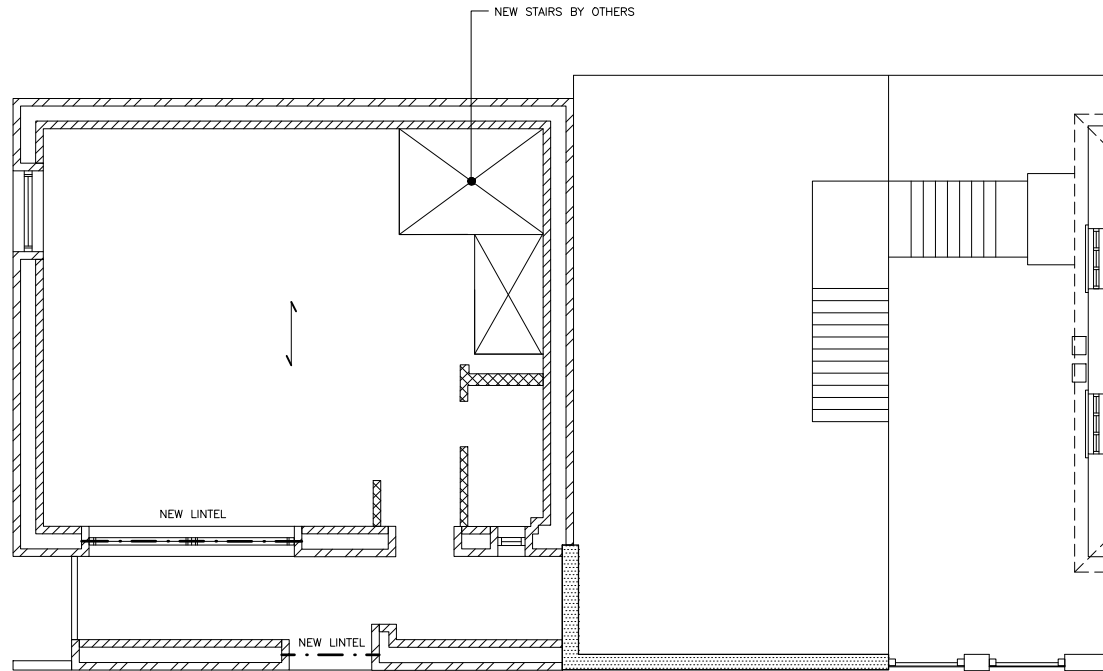
-  DENOTES EXISTING MASONRY OR TIMBER WALLS
-  DENOTES NEW MASONRY WALLS BUILT IN 15N/mm² COMPRESSIVE STRENGTH BRICKWORK AND GRADE iii MORTAR
-  DENOTES NEW MASONRY WALLS BUILT IN 7N/mm² COMPRESSIVE STRENGTH BLOCKWORK AND GRADE iii MORTAR
-  DENOTES NEW NON LOAD BEARING STUD WALL BY ARCHITECT
-  DENOTES NEW 300mm THICK RC SLAB
-  DENOTES NEW SUSPENDED RC FLOOR
-  DENOTES 440 LONG x 100 WIDE x 215mm HIGH MASS CONCRETE C30 PADSTONE UNLESS NOTED OTHERWISE
-  :  DENOTES JOISTS DOUBLED UP UNDER NEW PARTITIONS AND BOLTED TOGETHER USING M12 BOLTS AT 400mm CENTRES
-  DENOTES SEQUENCE OF PROPOSED UNDERPINS, THE CONTRACTOR WILL HAVE TO PROVIDE HIS OWN SEQUENCE OF WORKS AND ALL METHOD STATEMENTS ONCE APPOINTED

## CONTRACTOR/SPECIALIST DESIGN ELEMENTS

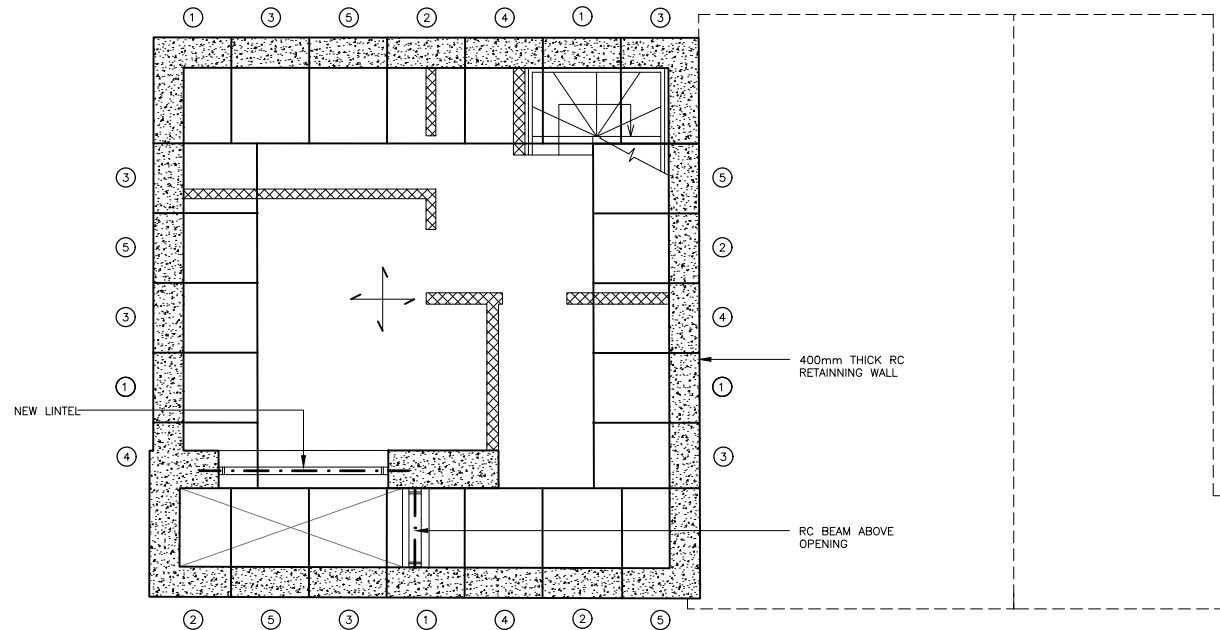
- ALL TEMPORARY WORKS
- ALL TANKING DETAILS
- ALL REINFORCEMENT DRAWINGS AND BAR BENDING SCHEDULES
- DESIGN OF ALL STEELWORK CONNECTIONS. THE FABRICATOR WILL HAVE TO SUBMIT THEIR CALCULATIONS TO BUILDING CONTROL FOR APPROVAL
- STEEL FABRICATION DRAWINGS

## NOTES

- ALL STEELWORK IN THE EXTERNAL WALLS IS TO BE GALVANISED (125 MICRONS)
- ALL STEELWORK TO BE ENCASED IN CONCRETE IS TO BE UN-PAINTED
- LOCATION OF EXISTING AND PROPOSED DRAIN RUNS ARE TO BE CONFIRMED BY THE SERVICE ENGINEER
- PLEASE REFER TO ARCHITECTS DRAWINGS FOR ALL SETTING OUT DETAILS, INSULATION AND VENTILATION DETAILS, DAMP PROOF COURSES AND ALL TANKING DETAILS
- FOR ALL FIRE WORK PROTECTION TO STEELWORK REFER TO THE ARCHITECTS DRAWINGS
- CONTRACTOR SHOULD ALSO REVIEW MECHANICAL ENGINEERS DRAWINGS FOR EXACT LOCATION OF SERVICE PENETRATION PRIOR TO CUTTING



GROUND FLOOR PLAN



LOWER GROUND FLOOR PLAN

## Notes

- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS & ENGINEERS DRAWINGS AND SPECIFICATIONS
- DO NOT SCALE FROM THIS DRAWING

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| P1  | 05.02.20 | MS   | PRELIMINARY ISSUE |
| Rev | Date     | Chkd | Amendments        |

Drawing Status  
**PRELIMINARY**



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Job Title

**33 PRIORY ROAD  
LONDON, N8**

Drawing Title

**LOWER GROUND FLOOR  
AND GROND FLOOR  
PLANS**

|              |             |           |
|--------------|-------------|-----------|
| Job No.      | Drawing No. | Revision  |
| <b>19229</b> | <b>01</b>   | <b>P1</b> |

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| Scales   | 1:50 AT A1 | Original Size A1       |
| Drawn By | MS         | Date JULY 2019 Chkd DB |

REFER TO ARCHITECTS DRAWINGS FOR ALL SETTING OUT DETAILS

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LEGEND

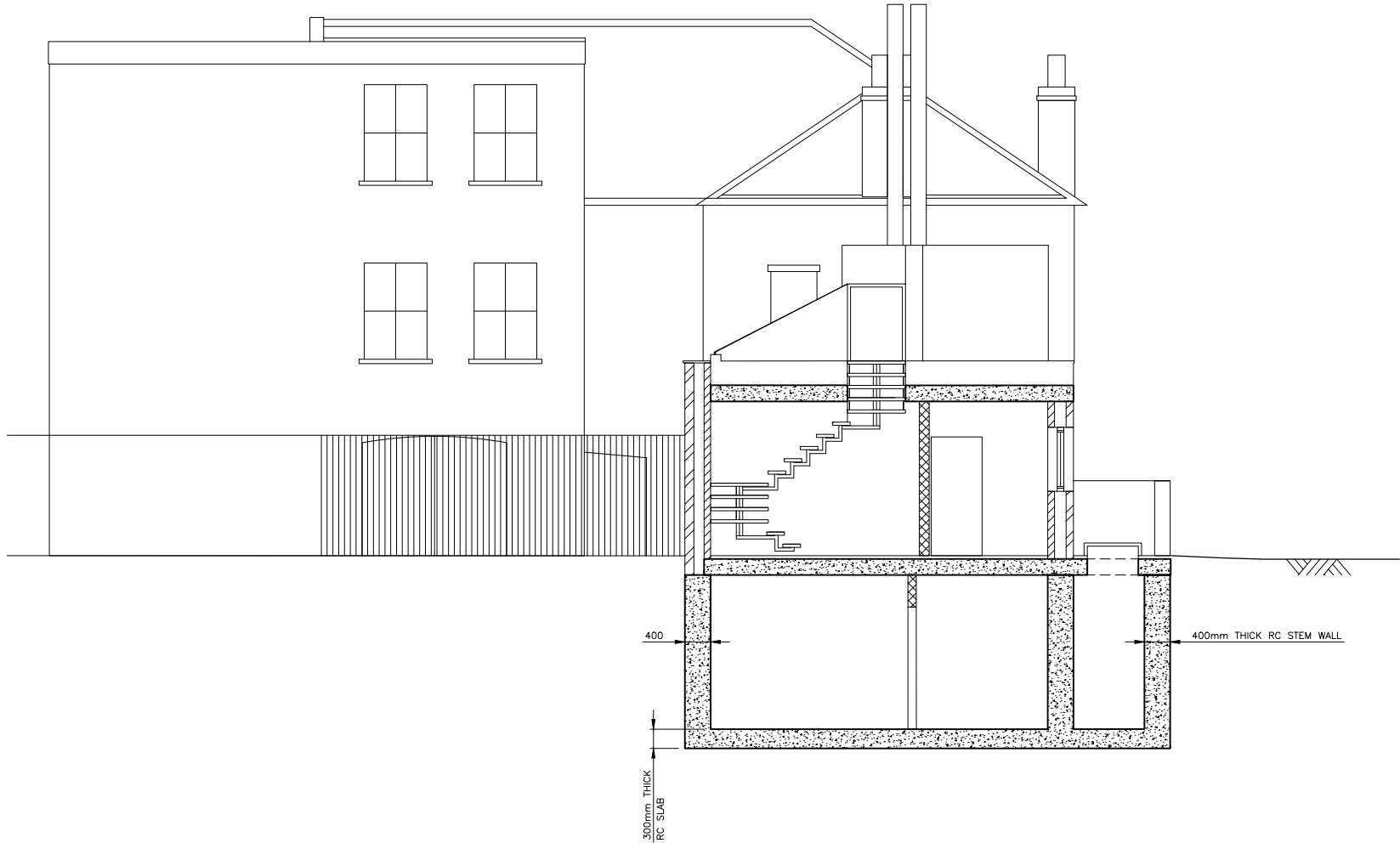
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CONTRACTOR/SPECIALIST DESIGN ELEMENTS

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2. ALL TANKING DETAILS
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Notes

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2. DO NOT SCALE FROM THIS DRAWING

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Job Title

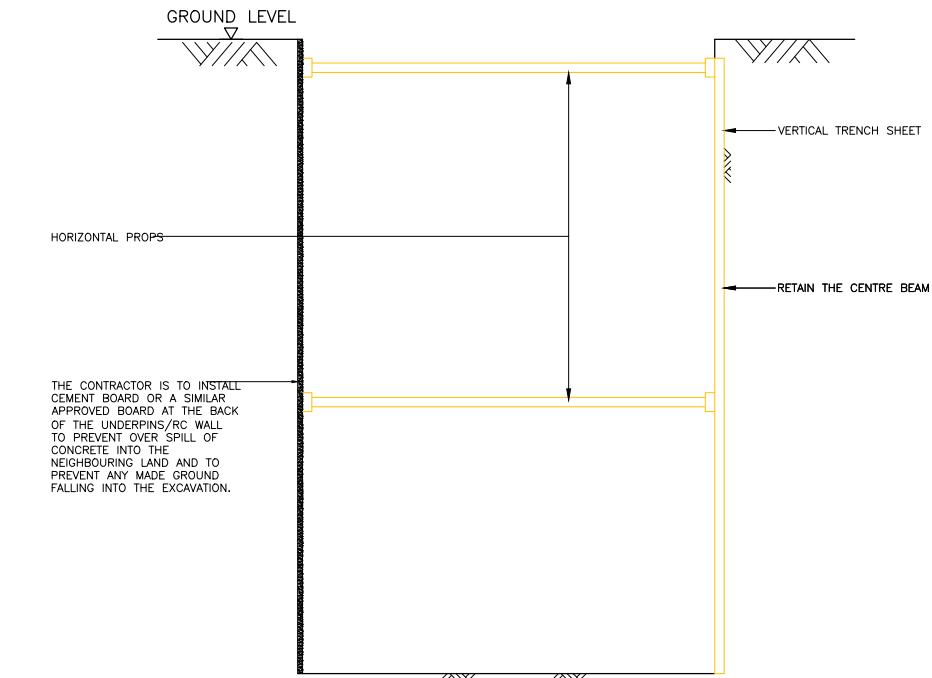
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LONDON, N8

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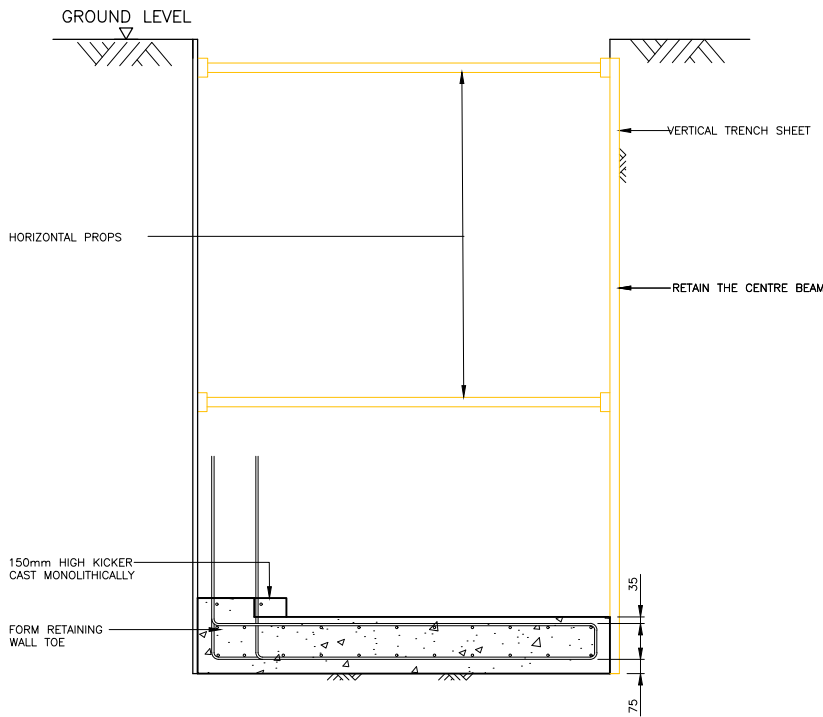
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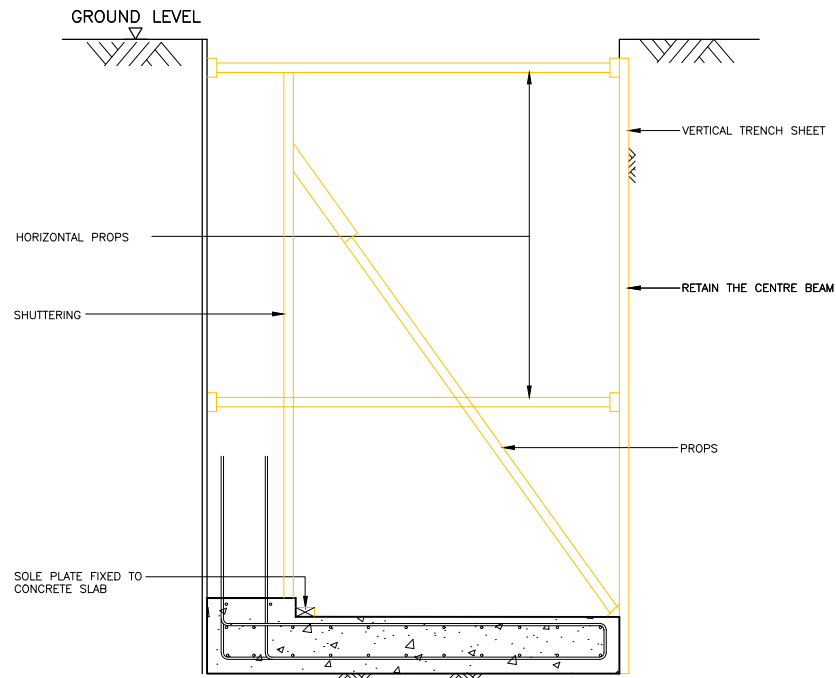
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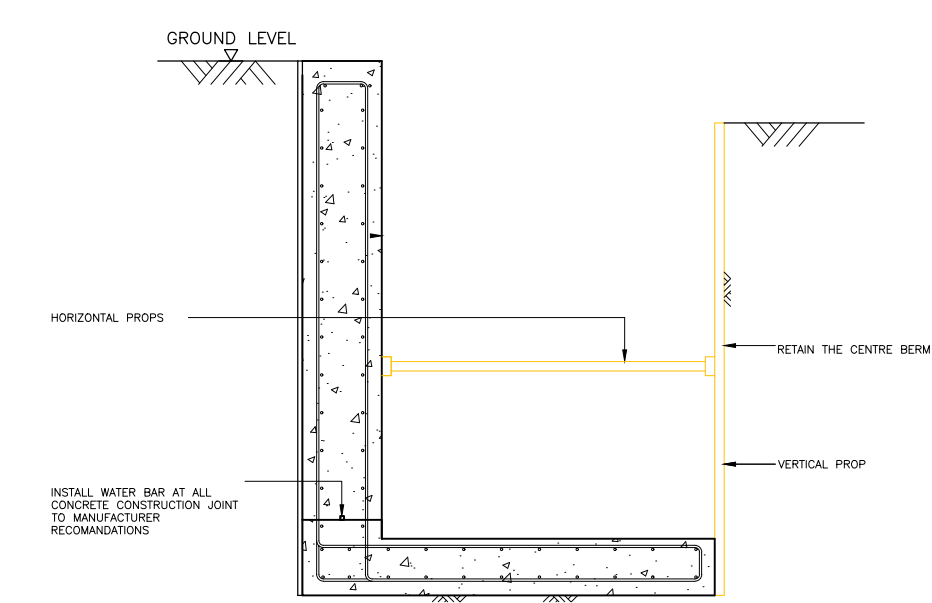
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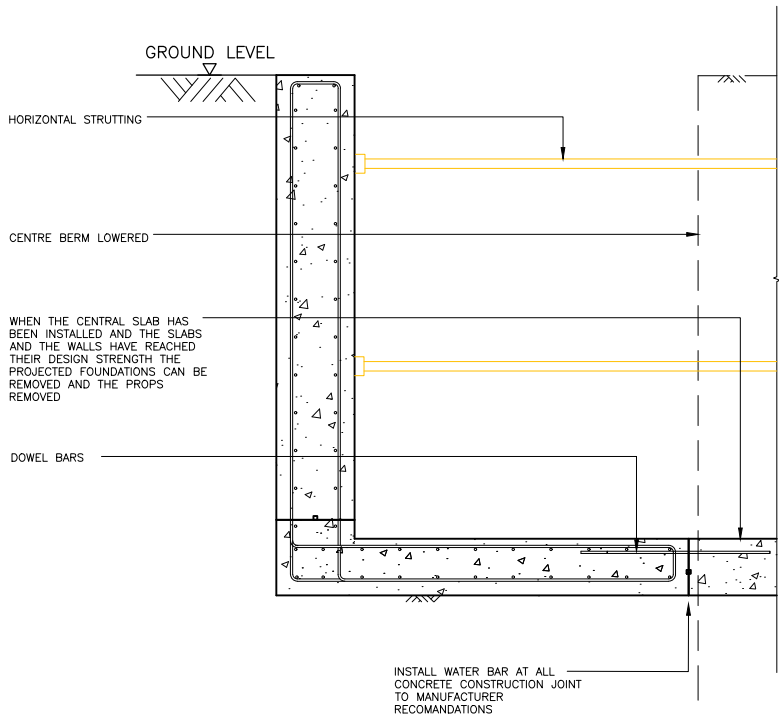
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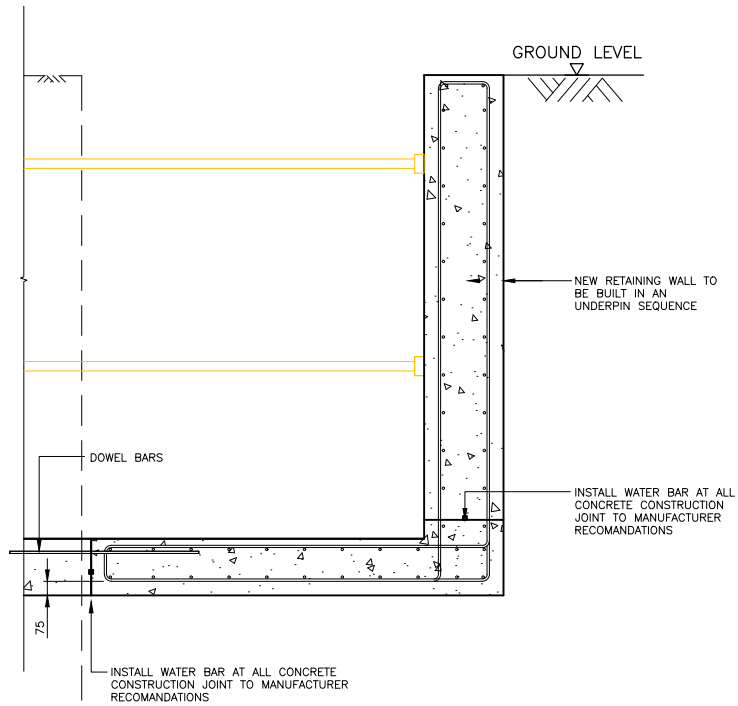
SEQUENCE 3



SEQUENCE 4



SEQUENCE 5



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Drawing Title

TYPICAL SEQUENCE

|         |             |          |
|---------|-------------|----------|
| Job No. | Drawing No. | Revision |
| 19229   | 10          | P1       |

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| Drawn By | MS         | Date JAN 2020 Chkd DB |

APPENDIX B  
STRUCTURAL CALCULATIONS



**Symmetrys Ltd**  
Structural Engineers

# Appendix B

## Construction Method Statement

## Structural Calculation Package

Garages 33 Priory Road  
London  
N8 8LP

19233-BIA CAL-001  
Feb 2020  
Rev. A

# Appendix B -Structural Calculation Package

## 1.0 Introduction

- 1.1 Symmetrys Limited have been engaged by Neil Brock to produce a Basement Impact Assessment for the proposed works to the existing garages at the rear of 33 Priory Road. The proposal is to demolish the existing garages and construct a single storey property with subterranean basement.
- 1.2 The plot is currently housing 3No. single storey garage units that are set away from the pavement located in the Borough of Haringey. The structure of the garage units are assumed to be of typical construction comprising of solid load bearing masonry wall construction that are supporting flat roof structures. The floor construction of the existing Ground Floor is assumed to be of reinforced concrete construction.
- 1.1 The proposal is to demolish the existing garages and construct a single storey property with subterranean basement.

## 2.0 Design Codes

- 2.1 The following design codes/guidance were used to carry out the design:

- BS 648: 1964 – Weights of Building Materials
- Eurocode: Basis of Structural Design (EN 1990)
- Eurocode 1: Actions on Structures (EN 1991)
- Eurocode 2: Design of Concrete Structures (EN 1992)
- Eurocode 3: Design of Steel Structures (EN 1993)
- Eurocode 5: Design of Timber Structures (EN 1995)
- Eurocode 6: Design of Masonry Structures (EN 1996)

## 3.0 Ground Conditions

- 3.1 Design assumes London Clay with an allowable bearing pressure of 125kPa based on the findings of the ground investigation report by Land Science LTD.

## 4.0 Substructure Design

- 4.1 The basement underpin consists of reinforced concrete underpin retaining walls with a ground bearing reinforced concrete slab. The water table is conservatively assumed to be 1m below ground level.

## 5.0 Superstructure

- 5.1 The superstructure design of the new building is not included in this calculation package as this calculation package is mainly concerned with the proposed basement works

## Appendix B -Structural Calculation Package

### 6.0 Loading

6.1 The loadings used throughout the design are shown in the table below:

| Item                            | DL<br>(kPa) | LL<br>(kPa) |
|---------------------------------|-------------|-------------|
| <u>Tiled Roof (With Lining)</u> |             |             |
| Plain Tiles                     | 0.50        |             |
| Felt & Battens                  | 0.05        |             |
| Ply deck                        | 0.12        |             |
| Rafters & Insulation            | 0.20        |             |
| Plasterboard & Skim             | 0.12        |             |
|                                 | <b>1.00</b> | 0.75        |
| Plan load 30°                   | <b>1.15</b> | 0.70        |
| <u>Timber Floor</u>             |             |             |
| Ceiling and services            | 0.15        |             |
| Joists                          | 0.20        |             |
| Plyboard and finishes           | 0.25        |             |
| Partitions                      | 0.50        |             |
|                                 | <b>1.00</b> | <b>1.5</b>  |
| <u>Solid Masonry</u>            |             |             |
| 100mm thick                     | 1.9         |             |
| 15mm plaster                    | 0.3         |             |
|                                 | <b>2.2</b>  |             |
| 215mm thick                     | 4.0         |             |
| 15mm plaster                    | 0.3         |             |
|                                 | <b>4.3</b>  |             |
| 330mm thick                     | 6.14        |             |
| 15mm plaster                    | 0.3         |             |
|                                 | <b>6.44</b> |             |
| <u>Cavity Wall</u>              |             |             |
| 102 brick                       | 2.1         |             |
| 100 block                       | 1.5         |             |
| Finishes                        | 0.4         |             |
|                                 | <b>4.0</b>  |             |
| <u>Timber Stud Wall</u>         |             |             |
| Plasterboards                   | 0.20        |             |
| Skim Coats                      | 0.15        |             |
| Studs (75x50 @ 400 c/c)         | 0.15        |             |
|                                 | <b>0.5</b>  |             |

# Appendix B -Structural Calculation Package

## 7.0 Structural Calculations



# Appendix B -Structural Calculation Package

## PERIMETER RETAINING WALL PERMENENT CONDITION

### RETAINING WALL ANALYSIS

In accordance with EN1997-1:2004 incorporating Corrigendum dated February 2009 and the UK National Annex incorporating Corrigendum No.1

Tedds calculation version 2.9.11

#### **Retaining wall details**

|                             |                                            |
|-----------------------------|--------------------------------------------|
| Stem type;                  | Cantilever                                 |
| Stem height;                | $h_{\text{stem}} = 3000 \text{ mm}$        |
| Stem thickness;             | $t_{\text{stem}} = 300 \text{ mm}$         |
| Angle to rear face of stem; | $\alpha = 90 \text{ deg}$                  |
| Stem density;               | $\gamma_{\text{stem}} = 25 \text{ kN/m}^3$ |
| Toe length;                 | $l_{\text{toe}} = 3200 \text{ mm}$         |
| Base thickness;             | $t_{\text{base}} = 300 \text{ mm}$         |
| Base density;               | $\gamma_{\text{base}} = 25 \text{ kN/m}^3$ |
| Height of retained soil;    | $h_{\text{ret}} = 3000 \text{ mm}$         |
| Angle of soil surface;      | $\beta = 0 \text{ deg}$                    |
| Depth of cover;             | $d_{\text{cover}} = 0 \text{ mm}$          |
| Height of water;            | $h_{\text{water}} = 2000 \text{ mm}$       |
| Water density;              | $\gamma_w = 9.8 \text{ kN/m}^3$            |

#### **Retained soil properties**

|                                                  |                                          |
|--------------------------------------------------|------------------------------------------|
| Soil type;                                       | Organic clay                             |
| Moist density;                                   | $\gamma_{\text{mr}} = 15 \text{ kN/m}^3$ |
| Saturated density;                               | $\gamma_{\text{sr}} = 15 \text{ kN/m}^3$ |
| Characteristic effective shear resistance angle; | $\phi'_{\text{r.k}} = 18 \text{ deg}$    |
| Characteristic wall friction angle;              | $\delta_{\text{r.k}} = 9 \text{ deg}$    |

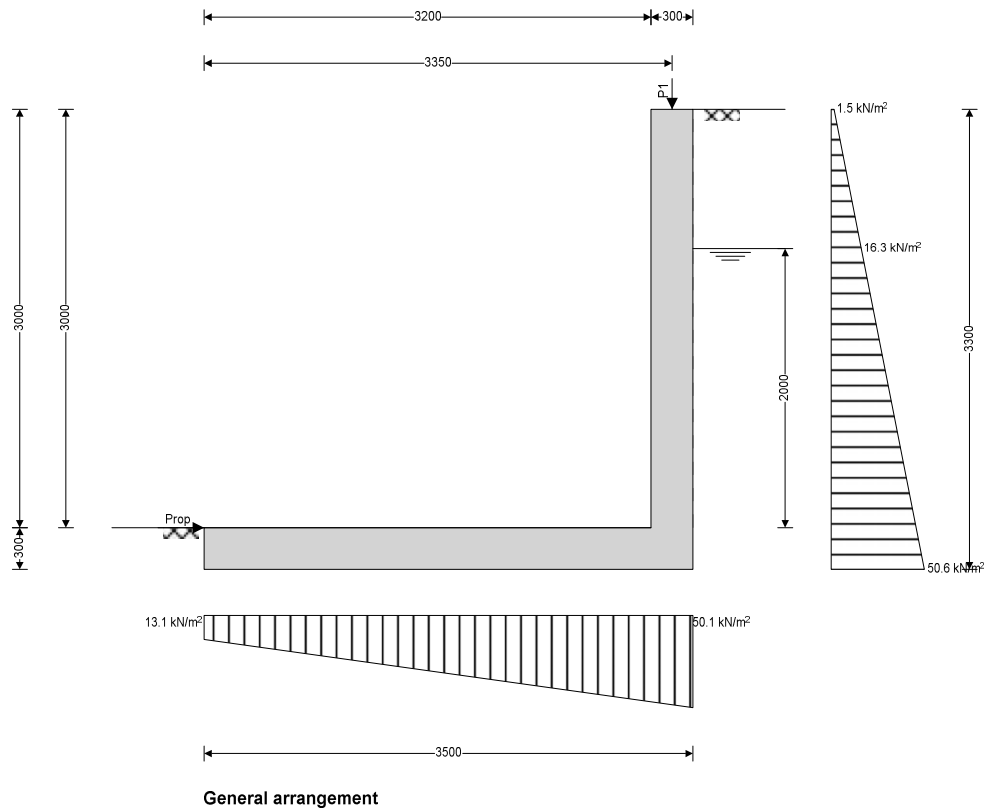
#### **Base soil properties**

|                                                  |                                           |
|--------------------------------------------------|-------------------------------------------|
| Soil type;                                       | Organic clay                              |
| Soil density;                                    | $\gamma_b = 15 \text{ kN/m}^3$            |
| Characteristic effective shear resistance angle; | $\phi'_{\text{b.k}} = 18 \text{ deg}$     |
| Characteristic wall friction angle;              | $\delta_{\text{b.k}} = 9 \text{ deg}$     |
| Characteristic base friction angle;              | $\delta_{\text{bb.k}} = 12 \text{ deg}$   |
| Presumed bearing capacity;                       | $P_{\text{bearing}} = 100 \text{ kN/m}^2$ |

#### **Loading details**

|                                |                                                      |
|--------------------------------|------------------------------------------------------|
| Variable surcharge load;       | Surcharge <sub>Q</sub> = <b>1.5 kN/m<sup>2</sup></b> |
| Vertical line load at 3350 mm; | $P_{G1} = 51.2 \text{ kN/m}$                         |
| ;                              | $P_{Q1} = 10.6 \text{ kN/m}$                         |

# Appendix B -Structural Calculation Package



## Calculate retaining wall geometry

Base length;

Saturated soil height;

Moist soil height;

Length of surcharge load;

- Distance to vertical component;

Effective height of wall;

- Distance to horizontal component;

Area of wall stem;

- Distance to vertical component;

Area of wall base;

- Distance to vertical component;

$$l_{\text{base}} = l_{\text{toe}} + t_{\text{stem}} = \mathbf{3500 \text{ mm}}$$

$$h_{\text{sat}} = h_{\text{water}} + d_{\text{cover}} = \mathbf{2000 \text{ mm}}$$

$$h_{\text{moist}} = h_{\text{ret}} - h_{\text{water}} = \mathbf{1000 \text{ mm}}$$

$$l_{\text{sur}} = l_{\text{heel}} = \mathbf{0 \text{ mm}}$$

$$x_{\text{sur}_v} = l_{\text{base}} - l_{\text{heel}} / 2 = \mathbf{3500 \text{ mm}}$$

$$h_{\text{eff}} = h_{\text{base}} + d_{\text{cover}} + h_{\text{ret}} = \mathbf{3300 \text{ mm}}$$

$$x_{\text{sur}_h} = h_{\text{eff}} / 2 = \mathbf{1650 \text{ mm}}$$

$$A_{\text{stem}} = h_{\text{stem}} \times t_{\text{stem}} = \mathbf{0.9 \text{ m}^2}$$

$$x_{\text{stem}} = l_{\text{toe}} + t_{\text{stem}} / 2 = \mathbf{3350 \text{ mm}}$$

$$A_{\text{base}} = l_{\text{base}} \times t_{\text{base}} = \mathbf{1.05 \text{ m}^2}$$

$$x_{\text{base}} = l_{\text{base}} / 2 = \mathbf{1750 \text{ mm}}$$

## For undrained soils - Annex C.1(2)

Active pressure coefficient;

$$K_A = \mathbf{1.000}$$

Passive pressure coefficient;

$$K_P = \mathbf{1.000}$$

## Bearing pressure check

### Vertical forces on wall

Wall stem;

$$F_{\text{stem}} = A_{\text{stem}} \times \gamma_{\text{stem}} = \mathbf{22.5 \text{ kN/m}}$$

Wall base;

$$F_{\text{base}} = A_{\text{base}} \times \gamma_{\text{base}} = \mathbf{26.3 \text{ kN/m}}$$

Line loads;

$$F_{P_v} = P_{G1} + P_{Q1} = \mathbf{61.8 \text{ kN/m}}$$

Total;

$$F_{\text{total}_v} = F_{\text{stem}} + F_{\text{base}} + F_{P_v} + F_{\text{water}_v} = \mathbf{110.6 \text{ kN/m}}$$

### Horizontal forces on wall

Surcharge load;

$$F_{\text{sur}_h} = K_A \times \cos(\delta_{r.k}) \times \text{Surcharge}_Q \times h_{\text{eff}} = \mathbf{4.9 \text{ kN/m}}$$

Saturated retained soil;

$$F_{\text{sat}_h} = K_A \times \cos(\delta_{r.k}) \times (\gamma_{\text{sr}} - \gamma_w) \times (h_{\text{sat}} + h_{\text{base}})^2 / 2 = \mathbf{13.6 \text{ kN/m}}$$

# Appendix B -Structural Calculation Package

Water;

$$F_{\text{water}_h} = \gamma_w \times (h_{\text{water}} + d_{\text{cover}} + h_{\text{base}})^2 / 2 = \mathbf{25.9 \text{ kN/m}}$$

Moist retained soil;

$$F_{\text{moist}_h} = K_A \times \cos(\delta_{r,k}) \times \gamma_{mr} \times ((h_{\text{eff}} - h_{\text{sat}} - h_{\text{base}})^2 / 2 + (h_{\text{eff}} - h_{\text{sat}} - h_{\text{base}}) \times (h_{\text{sat}} + h_{\text{base}})) = \mathbf{41.5 \text{ kN/m}}$$

Base soil;

$$F_{\text{pass}_h} = -K_P \times \cos(\delta_{b,k}) \times \gamma_b \times (d_{\text{cover}} + h_{\text{base}})^2 / 2 = \mathbf{-0.7 \text{ kN/m}}$$

Total;

$$F_{\text{total}_h} = F_{\text{sur}_h} + F_{\text{sat}_h} + F_{\text{water}_h} + F_{\text{moist}_h} + F_{\text{pass}_h} = \mathbf{85.2 \text{ kN/m}}$$

## Moments on wall

Wall stem;

$$M_{\text{stem}} = F_{\text{stem}} \times X_{\text{stem}} = \mathbf{75.4 \text{ kNm/m}}$$

Wall base;

$$M_{\text{base}} = F_{\text{base}} \times X_{\text{base}} = \mathbf{45.9 \text{ kNm/m}}$$

Surcharge load;

$$M_{\text{sur}} = -F_{\text{sur}_h} \times X_{\text{sur}_h} = \mathbf{-8.1 \text{ kNm/m}}$$

Line loads;

$$M_P = (P_{G1} + P_{Q1}) \times p_1 = \mathbf{207 \text{ kNm/m}}$$

Saturated retained soil;

$$M_{\text{sat}} = -F_{\text{sat}_h} \times X_{\text{sat}_h} = \mathbf{-10.4 \text{ kNm/m}}$$

Water;

$$M_{\text{water}} = -F_{\text{water}_h} \times X_{\text{water}_h} = \mathbf{-19.9 \text{ kNm/m}}$$

Moist retained soil;

$$M_{\text{moist}} = -F_{\text{moist}_h} \times X_{\text{moist}_h} = \mathbf{-58.7 \text{ kNm/m}}$$

Total;

$$M_{\text{total}} = M_{\text{stem}} + M_{\text{base}} + M_{\text{sur}} + M_P + M_{\text{sat}} + M_{\text{water}} + M_{\text{moist}} = \mathbf{231.3 \text{ kNm/m}}$$

## Check bearing pressure

Propping force;

$$F_{\text{prop}_\text{base}} = F_{\text{total}_h} = \mathbf{85.2 \text{ kN/m}}$$

Distance to reaction;

$$\bar{x} = M_{\text{total}} / F_{\text{total}_v} = \mathbf{2092 \text{ mm}}$$

Eccentricity of reaction;

$$e = \bar{x} - l_{\text{base}} / 2 = \mathbf{342 \text{ mm}}$$

Loaded length of base;

$$l_{\text{load}} = l_{\text{base}} = \mathbf{3500 \text{ mm}}$$

Bearing pressure at toe;

$$q_{\text{toe}} = F_{\text{total}_v} / l_{\text{base}} \times (1 - 6 \times e / l_{\text{base}}) = \mathbf{13.1 \text{ kN/m}^2}$$

Bearing pressure at heel;

$$q_{\text{heel}} = F_{\text{total}_v} / l_{\text{base}} \times (1 + 6 \times e / l_{\text{base}}) = \mathbf{50.1 \text{ kN/m}^2}$$

Factor of safety;

$$FoS_{\text{bp}} = P_{\text{bearing}} / \max(q_{\text{toe}}, q_{\text{heel}}) = \mathbf{1.995}$$

**PASS - Allowable bearing pressure exceeds maximum applied bearing pressure**

# Appendix B -Structural Calculation Package

## PERIMETER WALL RETAINING WALL TEMPORARY CONDITION

### RETAINING WALL ANALYSIS

In accordance with EN1997-1:2004 incorporating Corrigendum dated February 2009 and the UK National Annex incorporating Corrigendum No.1

Tedds calculation version 2.9.11

#### **Retaining wall details**

|                             |                                            |
|-----------------------------|--------------------------------------------|
| Stem type;                  | Propped cantilever                         |
| Stem height;                | $h_{\text{stem}} = 3000 \text{ mm}$        |
| Prop height;                | $h_{\text{prop}} = 3000 \text{ mm}$        |
| Stem thickness;             | $t_{\text{stem}} = 300 \text{ mm}$         |
| Angle to rear face of stem; | $\alpha = 90 \text{ deg}$                  |
| Stem density;               | $\gamma_{\text{stem}} = 25 \text{ kN/m}^3$ |
| Toe length;                 | $l_{\text{toe}} = 3200 \text{ mm}$         |
| Base thickness;             | $t_{\text{base}} = 300 \text{ mm}$         |
| Base density;               | $\gamma_{\text{base}} = 25 \text{ kN/m}^3$ |
| Height of retained soil;    | $h_{\text{ret}} = 3000 \text{ mm}$         |
| Angle of soil surface;      | $\beta = 0 \text{ deg}$                    |
| Depth of cover;             | $d_{\text{cover}} = 0 \text{ mm}$          |
| Height of water;            | $h_{\text{water}} = 2000 \text{ mm}$       |
| Water density;              | $\gamma_w = 9.8 \text{ kN/m}^3$            |

#### **Retained soil properties**

|                                                  |                                          |
|--------------------------------------------------|------------------------------------------|
| Soil type;                                       | Organic clay                             |
| Moist density;                                   | $\gamma_{\text{mr}} = 15 \text{ kN/m}^3$ |
| Saturated density;                               | $\gamma_{\text{sr}} = 15 \text{ kN/m}^3$ |
| Characteristic effective shear resistance angle; | $\phi'_{\text{r.k}} = 18 \text{ deg}$    |
| Characteristic wall friction angle;              | $\delta_{\text{r.k}} = 9 \text{ deg}$    |

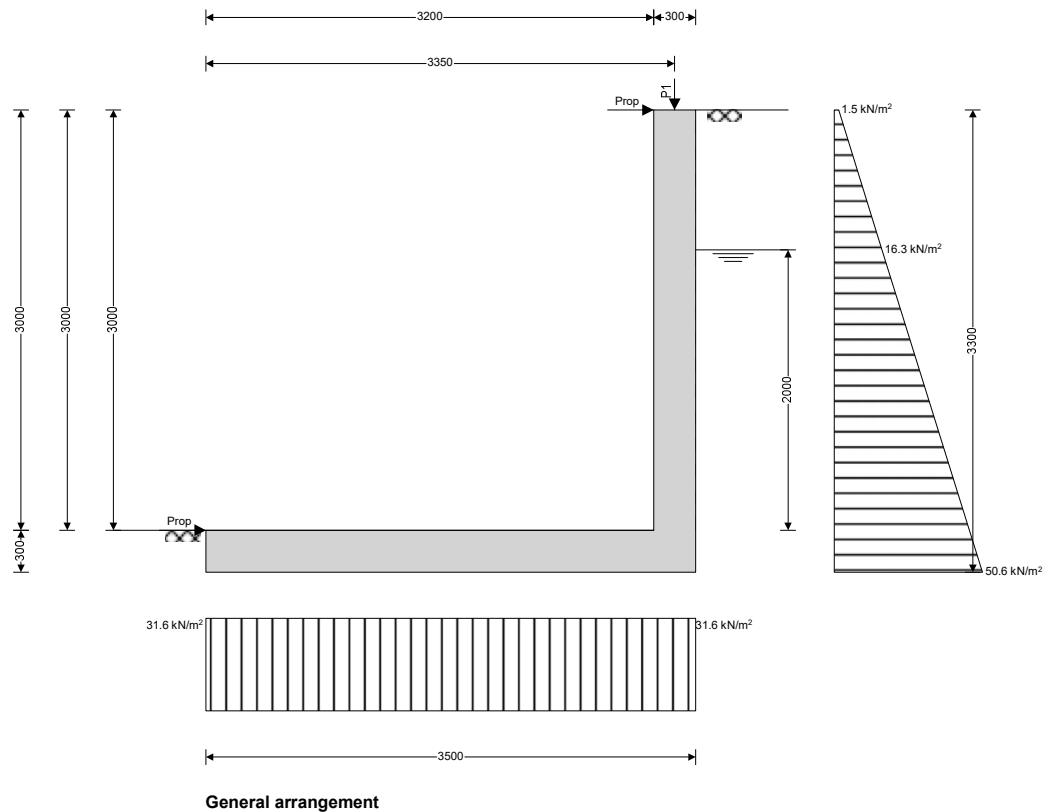
#### **Base soil properties**

|                                                  |                                           |
|--------------------------------------------------|-------------------------------------------|
| Soil type;                                       | Organic clay                              |
| Soil density;                                    | $\gamma_b = 15 \text{ kN/m}^3$            |
| Characteristic effective shear resistance angle; | $\phi'_{\text{b.k}} = 18 \text{ deg}$     |
| Characteristic wall friction angle;              | $\delta_{\text{b.k}} = 9 \text{ deg}$     |
| Characteristic base friction angle;              | $\delta_{\text{bb.k}} = 12 \text{ deg}$   |
| Presumed bearing capacity;                       | $P_{\text{bearing}} = 100 \text{ kN/m}^2$ |

#### **Loading details**

|                                |                                           |
|--------------------------------|-------------------------------------------|
| Variable surcharge load;       | $\text{Surcharge}_Q = 1.5 \text{ kN/m}^2$ |
| Vertical line load at 3350 mm; | $P_{G1} = 51.2 \text{ kN/m}$              |
| ;                              | $P_{Q1} = 10.6 \text{ kN/m}$              |

# Appendix B -Structural Calculation Package



## Calculate retaining wall geometry

Base length;

Saturated soil height;

Moist soil height;

Length of surcharge load;

- Distance to vertical component;

Effective height of wall;

- Distance to horizontal component;

Area of wall stem;

- Distance to vertical component;

Area of wall base;

- Distance to vertical component;

$$l_{\text{base}} = l_{\text{toe}} + t_{\text{stem}} = \mathbf{3500 \text{ mm}}$$

$$h_{\text{sat}} = h_{\text{water}} + d_{\text{cover}} = \mathbf{2000 \text{ mm}}$$

$$h_{\text{moist}} = h_{\text{ret}} - h_{\text{water}} = \mathbf{1000 \text{ mm}}$$

$$l_{\text{sur}} = l_{\text{heel}} = \mathbf{0 \text{ mm}}$$

$$x_{\text{sur}_v} = l_{\text{base}} - l_{\text{heel}} / 2 = \mathbf{3500 \text{ mm}}$$

$$h_{\text{eff}} = h_{\text{base}} + d_{\text{cover}} + h_{\text{ret}} = \mathbf{3300 \text{ mm}}$$

$$x_{\text{sur}_h} = h_{\text{eff}} / 2 = \mathbf{1650 \text{ mm}}$$

$$A_{\text{stem}} = h_{\text{stem}} \times t_{\text{stem}} = \mathbf{0.9 \text{ m}^2}$$

$$x_{\text{stem}} = l_{\text{toe}} + t_{\text{stem}} / 2 = \mathbf{3350 \text{ mm}}$$

$$A_{\text{base}} = l_{\text{base}} \times t_{\text{base}} = \mathbf{1.05 \text{ m}^2}$$

$$x_{\text{base}} = l_{\text{base}} / 2 = \mathbf{1750 \text{ mm}}$$

## For undrained soils - Annex C.1(2)

Active pressure coefficient;

$$K_A = \mathbf{1.000}$$

Passive pressure coefficient;

$$K_P = \mathbf{1.000}$$

## Bearing pressure check

### Vertical forces on wall

Wall stem;

$$F_{\text{stem}} = A_{\text{stem}} \times \gamma_{\text{stem}} = \mathbf{22.5 \text{ kN/m}}$$

Wall base;

$$F_{\text{base}} = A_{\text{base}} \times \gamma_{\text{base}} = \mathbf{26.3 \text{ kN/m}}$$

Line loads;

$$F_{P_v} = P_{G1} + P_{Q1} = \mathbf{61.8 \text{ kN/m}}$$

Total;

$$F_{\text{total}_v} = F_{\text{stem}} + F_{\text{base}} + F_{P_v} + F_{\text{water}_v} = \mathbf{110.6 \text{ kN/m}}$$

### Horizontal forces on wall

Surcharge load;

$$F_{\text{sur}_h} = K_A \times \cos(\delta_{r,k}) \times \text{Surcharge}_Q \times h_{\text{eff}} = \mathbf{4.9 \text{ kN/m}}$$

Saturated retained soil;

$$F_{\text{sat}_h} = K_A \times \cos(\delta_{r,k}) \times (\gamma_{\text{sr}} - \gamma_w) \times (h_{\text{sat}} + h_{\text{base}})^2 / 2 = \mathbf{13.6 \text{ kN/m}}$$

# Appendix B -Structural Calculation Package

|                      |                                                                                                                                                                                                                                                                         |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Water;               | $F_{\text{water}_h} = \gamma_w \times (h_{\text{water}} + d_{\text{cover}} + h_{\text{base}})^2 / 2 = \mathbf{25.9 \text{ kN/m}}$                                                                                                                                       |
| Moist retained soil; | $F_{\text{moist}_h} = K_A \times \cos(\delta_{r,k}) \times \gamma_{mr} \times ((h_{\text{eff}} - h_{\text{sat}} - h_{\text{base}})^2 / 2 + (h_{\text{eff}} - h_{\text{sat}} - h_{\text{base}}) \times (h_{\text{sat}} + h_{\text{base}})) = \mathbf{41.5 \text{ kN/m}}$ |
| Base soil;           | $F_{\text{pass}_h} = -K_P \times \cos(\delta_{b,k}) \times \gamma_b \times (d_{\text{cover}} + h_{\text{base}})^2 / 2 = \mathbf{-0.7 \text{ kN/m}}$                                                                                                                     |
| Total;               | $F_{\text{total}_h} = F_{\text{sur}_h} + F_{\text{sat}_h} + F_{\text{water}_h} + F_{\text{moist}_h} + F_{\text{pass}_h} = \mathbf{85.2 \text{ kN/m}}$                                                                                                                   |

## Moments on wall

|                          |                                                                                                                                                                     |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Wall stem;               | $M_{\text{stem}} = F_{\text{stem}} \times X_{\text{stem}} = \mathbf{75.4 \text{ kNm/m}}$                                                                            |
| Wall base;               | $M_{\text{base}} = F_{\text{base}} \times X_{\text{base}} = \mathbf{45.9 \text{ kNm/m}}$                                                                            |
| Surcharge load;          | $M_{\text{sur}} = -F_{\text{sur}_h} \times X_{\text{sur}_h} = \mathbf{-8.1 \text{ kNm/m}}$                                                                          |
| Line loads;              | $M_P = (P_{G1} + P_{Q1}) \times p_1 = \mathbf{207 \text{ kNm/m}}$                                                                                                   |
| Saturated retained soil; | $M_{\text{sat}} = -F_{\text{sat}_h} \times X_{\text{sat}_h} = \mathbf{-10.4 \text{ kNm/m}}$                                                                         |
| Water;                   | $M_{\text{water}} = -F_{\text{water}_h} \times X_{\text{water}_h} = \mathbf{-19.9 \text{ kNm/m}}$                                                                   |
| Moist retained soil;     | $M_{\text{moist}} = -F_{\text{moist}_h} \times X_{\text{moist}_h} = \mathbf{-58.7 \text{ kNm/m}}$                                                                   |
| Total;                   | $M_{\text{total}} = M_{\text{stem}} + M_{\text{base}} + M_{\text{sur}} + M_P + M_{\text{sat}} + M_{\text{water}} + M_{\text{moist}} = \mathbf{231.3 \text{ kNm/m}}$ |

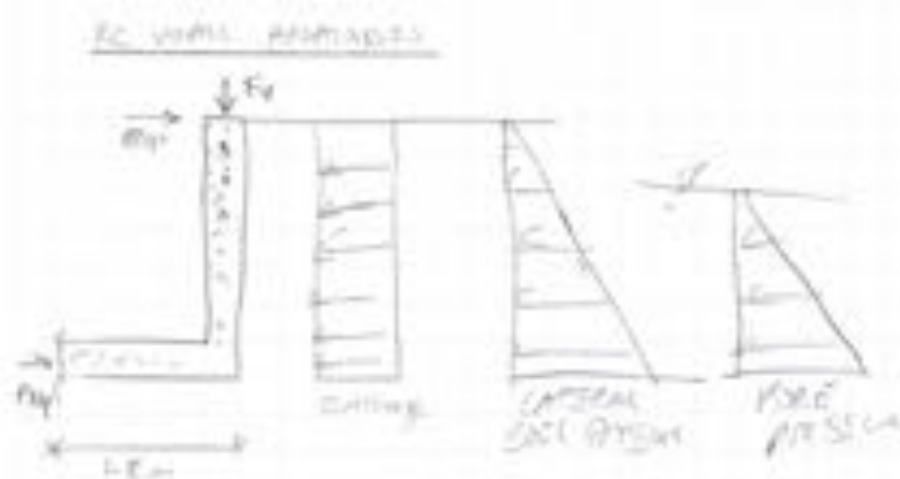
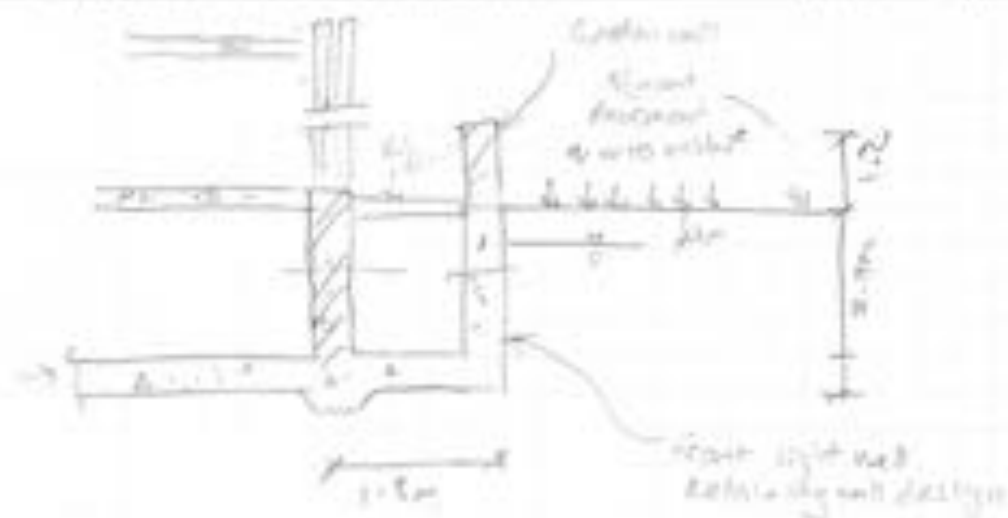
## Check bearing pressure

|                             |                                                                                                                                                                  |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Propping force to stem;     | $F_{\text{prop\_stem}} = (F_{\text{total}_v} \times l_{\text{base}} / 2 - M_{\text{total}}) / (h_{\text{prop}} + t_{\text{base}}) = \mathbf{-11.5 \text{ kN/m}}$ |
| Propping force to base;     | $F_{\text{prop\_base}} = F_{\text{total}_h} - F_{\text{prop\_stem}} = \mathbf{96.7 \text{ kN/m}}$                                                                |
| Moment from propping force; | $M_{\text{prop}} = F_{\text{prop\_stem}} \times (h_{\text{prop}} + t_{\text{base}}) = \mathbf{-37.8 \text{ kNm/m}}$                                              |
| Distance to reaction;       | $\bar{x} = (M_{\text{total}} + M_{\text{prop}}) / F_{\text{total}_v} = \mathbf{1750 \text{ mm}}$                                                                 |
| Eccentricity of reaction;   | $e = \bar{x} - l_{\text{base}} / 2 = \mathbf{0 \text{ mm}}$                                                                                                      |
| Loaded length of base;      | $l_{\text{load}} = l_{\text{base}} = \mathbf{3500 \text{ mm}}$                                                                                                   |
| Bearing pressure at toe;    | $q_{\text{toe}} = F_{\text{total}_v} / l_{\text{base}} \times (1 - 6 \times e / l_{\text{base}}) = \mathbf{31.6 \text{ kN/m}^2}$                                 |
| Bearing pressure at heel;   | $q_{\text{heel}} = F_{\text{total}_v} / l_{\text{base}} \times (1 + 6 \times e / l_{\text{base}}) = \mathbf{31.6 \text{ kN/m}^2}$                                |
| Factor of safety;           | $FoS_{bp} = P_{\text{bearing}} / \max(q_{\text{toe}}, q_{\text{heel}}) = \mathbf{3.166}$                                                                         |

**PASS - Allowable bearing pressure exceeds maximum applied bearing pressure**



|           | Job No.                         | Sheet No. | Revision |
|-----------|---------------------------------|-----------|----------|
|           | M229                            |           |          |
| Job Title | 23.25.2024 ROAD DEVELOPMENT     | Date      | Made By  |
| Section   | FRONT / SIDEWALK ELEVATING WALL | DEC 24    | MS       |



$$F_x = 9.8 \text{ kN/m}^2, F_y = 5.2 \text{ kN/m}^2$$

# Appendix B -Structural Calculation Package

## FRONT LIGHT WELL RETAINING WALL

### RETAINING WALL ANALYSIS

In accordance with EN1997-1:2004 incorporating Corrigendum dated February 2009 and the UK National Annex incorporating Corrigendum No.1

Tedds calculation version 2.9.11

#### **Retaining wall details**

|                             |                                            |
|-----------------------------|--------------------------------------------|
| Stem type;                  | Propped cantilever                         |
| Stem height;                | $h_{\text{stem}} = 3000 \text{ mm}$        |
| Prop height;                | $h_{\text{prop}} = 3000 \text{ mm}$        |
| Stem thickness;             | $t_{\text{stem}} = 300 \text{ mm}$         |
| Angle to rear face of stem; | $\alpha = 90 \text{ deg}$                  |
| Stem density;               | $\gamma_{\text{stem}} = 25 \text{ kN/m}^3$ |
| Toe length;                 | $l_{\text{toe}} = 1000 \text{ mm}$         |
| Base thickness;             | $t_{\text{base}} = 300 \text{ mm}$         |
| Base density;               | $\gamma_{\text{base}} = 25 \text{ kN/m}^3$ |
| Height of retained soil;    | $h_{\text{ret}} = 3000 \text{ mm}$         |
| Angle of soil surface;      | $\beta = 0 \text{ deg}$                    |
| Depth of cover;             | $d_{\text{cover}} = 0 \text{ mm}$          |
| Height of water;            | $h_{\text{water}} = 2000 \text{ mm}$       |
| Water density;              | $\gamma_w = 9.8 \text{ kN/m}^3$            |

#### **Retained soil properties**

|                                                  |                                          |
|--------------------------------------------------|------------------------------------------|
| Soil type;                                       | Organic clay                             |
| Moist density;                                   | $\gamma_{\text{mr}} = 15 \text{ kN/m}^3$ |
| Saturated density;                               | $\gamma_{\text{sr}} = 15 \text{ kN/m}^3$ |
| Characteristic effective shear resistance angle; | $\phi'_{\text{r.k}} = 18 \text{ deg}$    |
| Characteristic wall friction angle;              | $\delta_{\text{r.k}} = 9 \text{ deg}$    |

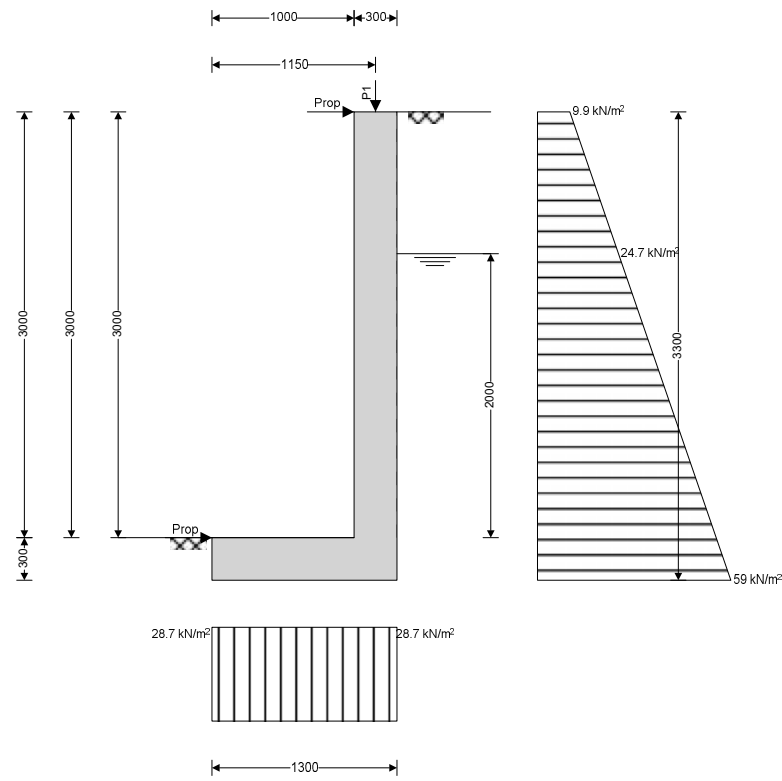
#### **Base soil properties**

|                                                  |                                           |
|--------------------------------------------------|-------------------------------------------|
| Soil type;                                       | Organic clay                              |
| Soil density;                                    | $\gamma_b = 15 \text{ kN/m}^3$            |
| Characteristic effective shear resistance angle; | $\phi'_{\text{b.k}} = 18 \text{ deg}$     |
| Characteristic wall friction angle;              | $\delta_{\text{b.k}} = 9 \text{ deg}$     |
| Characteristic base friction angle;              | $\delta_{\text{bb.k}} = 12 \text{ deg}$   |
| Presumed bearing capacity;                       | $P_{\text{bearing}} = 100 \text{ kN/m}^2$ |

#### **Loading details**

|                                |                                               |
|--------------------------------|-----------------------------------------------|
| Variable surcharge load;       | Surcharge <sub>Q</sub> = 10 kN/m <sup>2</sup> |
| Vertical line load at 1150 mm; | $P_{G1} = 5 \text{ kN/m}$                     |

# Appendix B -Structural Calculation Package



General arrangement

## Calculate retaining wall geometry

Base length;

Saturated soil height;

Moist soil height;

Length of surcharge load;

- Distance to vertical component;

Effective height of wall;

- Distance to horizontal component;

Area of wall stem;

- Distance to vertical component;

Area of wall base;

- Distance to vertical component;

$$l_{base} = l_{toe} + t_{stem} = \mathbf{1300 \text{ mm}}$$

$$h_{sat} = h_{water} + d_{cover} = \mathbf{2000 \text{ mm}}$$

$$h_{moist} = h_{ret} - h_{water} = \mathbf{1000 \text{ mm}}$$

$$l_{sur} = l_{heel} = \mathbf{0 \text{ mm}}$$

$$x_{sur\_v} = l_{base} - l_{heel} / 2 = \mathbf{1300 \text{ mm}}$$

$$h_{eff} = h_{base} + d_{cover} + h_{ret} = \mathbf{3300 \text{ mm}}$$

$$x_{sur\_h} = h_{eff} / 2 = \mathbf{1650 \text{ mm}}$$

$$A_{stem} = h_{stem} \times t_{stem} = \mathbf{0.9 \text{ m}^2}$$

$$x_{stem} = l_{toe} + t_{stem} / 2 = \mathbf{1150 \text{ mm}}$$

$$A_{base} = l_{base} \times t_{base} = \mathbf{0.39 \text{ m}^2}$$

$$x_{base} = l_{base} / 2 = \mathbf{650 \text{ mm}}$$

## For undrained soils - Annex C.1(2)

Active pressure coefficient;

$$K_A = \mathbf{1.000}$$

Passive pressure coefficient;

$$K_P = \mathbf{1.000}$$

## Bearing pressure check

### Vertical forces on wall

Wall stem;

$$F_{stem} = A_{stem} \times \gamma_{stem} = \mathbf{22.5 \text{ kN/m}}$$

Wall base;

$$F_{base} = A_{base} \times \gamma_{base} = \mathbf{9.8 \text{ kN/m}}$$

Line loads;

$$F_{P\_v} = P_{G1} = \mathbf{5 \text{ kN/m}}$$

Total;

$$F_{total\_v} = F_{stem} + F_{base} + F_{P\_v} + F_{water\_v} = \mathbf{37.3 \text{ kN/m}}$$

### Horizontal forces on wall

Surcharge load;

$$F_{sur\_h} = K_A \times \cos(\delta_{r,k}) \times \text{Surcharge}_Q \times h_{eff} = \mathbf{32.6 \text{ kN/m}}$$

# Appendix B -Structural Calculation Package

Saturated retained soil;

Water;

Moist retained soil;

Base soil;

Total;

## Moments on wall

Wall stem;

Wall base;

Surcharge load;

Line loads;

Saturated retained soil;

Water;

Moist retained soil;

Total;

$$F_{sat\_h} = K_A \times \cos(\delta_{r,k}) \times (\gamma_{sr} - \gamma_w) \times (h_{sat} + h_{base})^2 / 2 = \mathbf{13.6 \text{ kN/m}}$$

$$F_{water\_h} = \gamma_w \times (h_{water} + d_{cover} + h_{base})^2 / 2 = \mathbf{25.9 \text{ kN/m}}$$

$$F_{moist\_h} = K_A \times \cos(\delta_{r,k}) \times \gamma_{mr} \times ((h_{eff} - h_{sat} - h_{base})^2 / 2 + (h_{eff} - h_{sat} - h_{base}) \times (h_{sat} + h_{base})) = \mathbf{41.5 \text{ kN/m}}$$

$$F_{pass\_h} = -K_P \times \cos(\delta_{b,k}) \times \gamma_b \times (d_{cover} + h_{base})^2 / 2 = \mathbf{-0.7 \text{ kN/m}}$$

$$F_{total\_h} = F_{sur\_h} + F_{sat\_h} + F_{water\_h} + F_{moist\_h} + F_{pass\_h} = \mathbf{112.9 \text{ kN/m}}$$

$$M_{stem} = F_{stem} \times x_{stem} = \mathbf{25.9 \text{ kNm/m}}$$

$$M_{base} = F_{base} \times x_{base} = \mathbf{6.3 \text{ kNm/m}}$$

$$M_{sur} = -F_{sur\_h} \times x_{sur\_h} = \mathbf{-53.8 \text{ kNm/m}}$$

$$M_P = P_{G1} \times p_1 = \mathbf{5.8 \text{ kNm/m}}$$

$$M_{sat} = -F_{sat\_h} \times x_{sat\_h} = \mathbf{-10.4 \text{ kNm/m}}$$

$$M_{water} = -F_{water\_h} \times x_{water\_h} = \mathbf{-19.9 \text{ kNm/m}}$$

$$M_{moist} = -F_{moist\_h} \times x_{moist\_h} = \mathbf{-58.7 \text{ kNm/m}}$$

$$M_{total} = M_{stem} + M_{base} + M_{sur} + M_P + M_{sat} + M_{water} + M_{moist} = \mathbf{-104.8 \text{ kNm/m}}$$

## Check bearing pressure

Propping force to stem;

Propping force to base;

Moment from propping force;

Distance to reaction;

Eccentricity of reaction;

Loaded length of base;

Bearing pressure at toe;

Bearing pressure at heel;

Factor of safety;

$$F_{prop\_stem} = (F_{total\_v} \times l_{base} / 2 - M_{total}) / (h_{prop} + t_{base}) = \mathbf{39.1 \text{ kN/m}}$$

$$F_{prop\_base} = F_{total\_h} - F_{prop\_stem} = \mathbf{73.8 \text{ kN/m}}$$

$$M_{prop} = F_{prop\_stem} \times (h_{prop} + t_{base}) = \mathbf{129 \text{ kNm/m}}$$

$$\bar{x} = (M_{total} + M_{prop}) / F_{total\_v} = \mathbf{650 \text{ mm}}$$

$$e = \bar{x} - l_{base} / 2 = \mathbf{0 \text{ mm}}$$

$$l_{load} = l_{base} = \mathbf{1300 \text{ mm}}$$

$$q_{toe} = F_{total\_v} / l_{base} \times (1 - 6 \times e / l_{base}) = \mathbf{28.7 \text{ kN/m}^2}$$

$$q_{heel} = F_{total\_v} / l_{base} \times (1 + 6 \times e / l_{base}) = \mathbf{28.7 \text{ kN/m}^2}$$

$$FoS_{bp} = P_{bearing} / \max(q_{toe}, q_{heel}) = \mathbf{3.49}$$

**PASS - Allowable bearing pressure exceeds maximum applied bearing pressure**



|           |                                 | Job No. | Sheet No. | Revision   |
|-----------|---------------------------------|---------|-----------|------------|
|           |                                 | 19229   |           |            |
| Job Title | 33 PERSON ROAD TUNNELLING       | Date    | Made By   | Checked By |
| Section   | DETAIL OF PARKING SLAB FOR HOVE | DEC 19  | MC        |            |

APPROXIMATE CONSERVATION HEAVE FORCE

- Excavation Depth = 3m (WAS C/S)
- HYDRO STATIC PRESSURE =  $3m \times 10 kN/m^3 = 30 kN/m^2$
- OVERBURDEN RECEIVED =  $3m \times 18 kN/m^3 = 54 kN/m^2$

$$\therefore \text{EXPECTED HEAVE} = 30 + 0.5(54 - 30) = 42 kN/m^2$$

BASEMENT SLAB SELF WEIGHT

$$\begin{aligned} \text{SELFWEIGHT} &= 25 kN/m^3 \times 0.3m = 7.5 \\ \text{SLOPED} &= 24 kN/m^3 \times 0.075m = 1.8 \\ &9.3 kN/m^2 \end{aligned}$$

UPLIFT

$$\text{OVERALL UPLIFT} = 42 kN/m^2 - 9.3 kN/m^2 = 32.7 kN/m^2$$

$$\therefore \text{ULTIMATE} = 1.5 \times 32.7 = 49 kN/m^2$$

THE BASEMENT SLAB WILL BE DESIGNED TO TRANSMIT UPLIFT FORCES TO RETAINING WALLS/BEAMS

MAX MOMENT DUE TO UPLIFT

$$M_{max} = \frac{wL^2}{8} = \frac{49 \times 5.5^2}{8} = 150 kNm$$

**INPUT** Location 33 Priory Road Basement Slab DesignDesign moment, M 75.0 kNm/m fcu 30 N/mm<sup>2</sup> gc = 1.50βb 1.00 fy 500 N/mm<sup>2</sup> gs = 1.15span 3500 mm steel class AHeight, h 300 mm Section location SIMPLY SUPPORTED SPBar Ø 16 mm Compression steel NOMINALcover 50 mm to these bars (deflection control only)**ONE or TWO WAY SLAB****OUTPUT** 33 Priory Road Basement Slab Design Compression steel = NOMINAL 0.13%

d = 300 - 50 - 16/2 = 242.0 mm

(3.4.4.4) K' = 0.156 &gt; K = 0.043 ok

(3.4.4.4) z = 242.0 [0.5 + (0.25 - 0.043 / 0.893)]<sup>1/2</sup> = 229.9 < 0.95d = 229.9 mm(3.4.4.1) As = 75.00E6 / 500 / 229.8 x 1.15 = 751 > min As = 390 mm<sup>2</sup>/mPROVIDE H16 @ 250 = 804 mm<sup>2</sup>/m(Eqn 8) fs = 2/3 x 500 x 751 / 804 / 1.00 = 311.1 N/mm<sup>2</sup>

(Eqn 7) Tens mod factor = 0.55 + (477 - 311.1) / 120 / (0.9 + 1.281) = 1.184

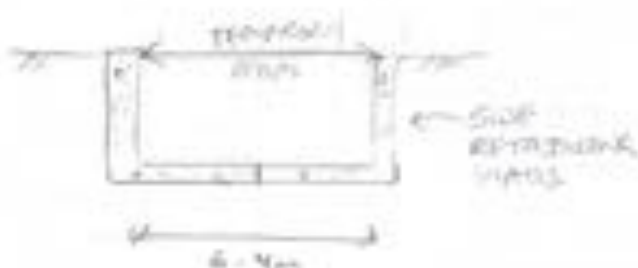
(Equation 9) Comp mod factor = 1 + 0.130 / (3 + 0.130) = 1.042

(3.4.6.3) Permissible L/d = 20.0 x 1.184 x 1.042 = 24.664

Actual L/d = 3500 / 242.0 = 14.463 ok



|                           | Job No. | Sheet No. | Revision   |
|---------------------------|---------|-----------|------------|
|                           |         |           |            |
| Job Title                 | 19224   |           |            |
| Section                   | Date    | Made By   | Checked By |
| DESIGN OF TEMPORARY PROPS | DEC 19  | MS        |            |



DESIGN OF TEMPORARY PROPS

LENGTH OF PROPS = 6.4m

PROP FORCE AT TOP OF RETAINING WALL = 11.5 kN/m

UPLIFT =  $1.2 \times 11.5 = 13.8 \text{ kN/m}$

PROVIDE S3/6P/9 MAGEY PUSH/PULL PROPS

LOAD CAPACITY 80 kN

PROVIDE PROPS AT 1m U.C.  $\frac{80 \text{ kN}}{1 \text{ m}} = 80 \text{ kN/m}$

$\therefore 13.8 \text{ kN/m} < 80 \text{ kN/m} \therefore \text{Adequate}$

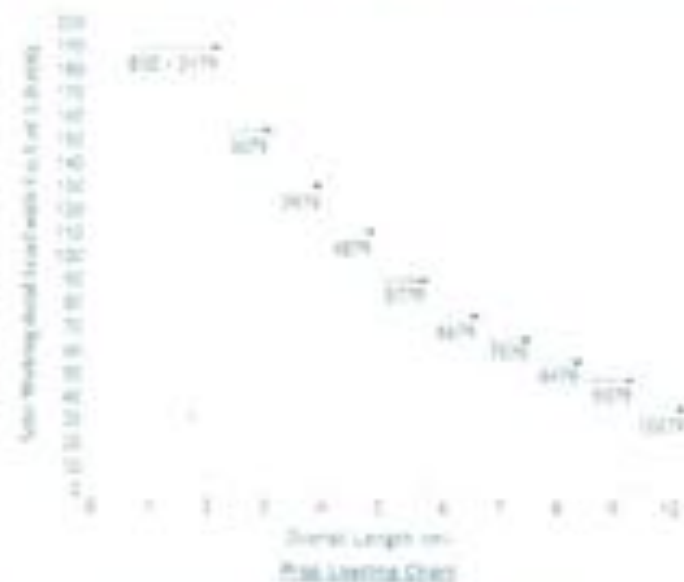
# push pull props - lengths and capacities

Head of prop will comprise S3110 or S3104 used 10

S3110 Use A - To prop wall sockets

S3110A Use B - To prop vertical members other than sockets

S3110A Use C - To prop wall sockets



For general use a Factor of Safety of 2 is recommended. However, for controlled situations where the loading is predictable a Factor of Safety of 1.7 may be used.

The self working loads shown in the table are for props used to compress either vertically or horizontally in horizontal applications. The props should always be used with the socket working against loads in the vertical plane.

When used to tension the self working load should not exceed 120kN.

Other tubular props are an alternative to wall sockets for any of the applications shown. Tubular props and sockets should not be combined in any single prop.

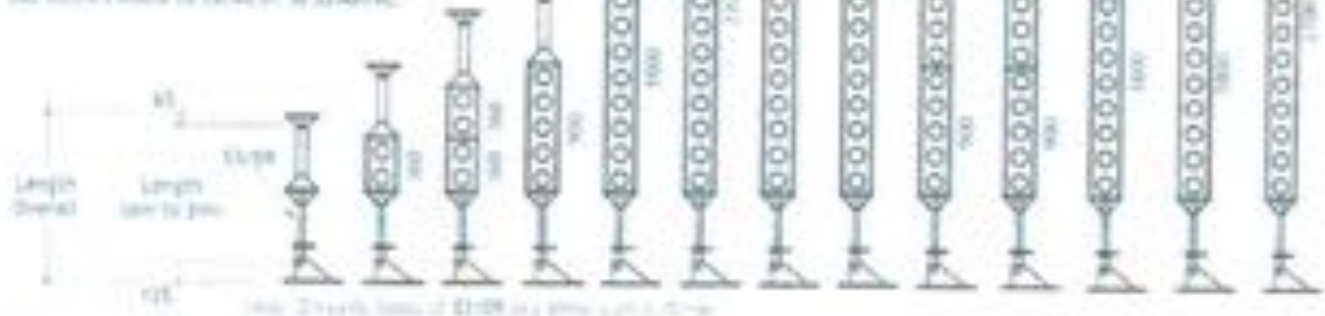
For props a recommended working stress reference is given below, indicated by the Offset Size (mm). Should the prop fail within the range shown, the components should be checked for local damage to end plates.

All tested props require a No. S3110 base.

Intermediate lengths may be obtained by joining 1 or 2 (where units S3110/360 or S3110/400) in a same cases when props can be fixed at each end.

Allowance is to be made for elastic shortening of Push Pull Prop + 0.02mm/mm/mm/mm.

A fit assembly reference is given to assist in ordering the props. The fit includes all parts and bolts necessary depending upon the manner in which the prop is used. The fit assembly reference number must be followed by the A, B or C suffix i.e. a Type B Prop to support wall sockets would be called off as S3110/B/C.

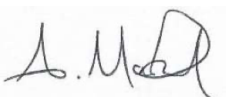
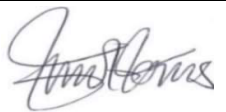


| Prop                    | 1       | 2       | 3       | 4       | 5       | 6       | 7       | 8       | 9       | 10       | 11       | 12       | 13       |
|-------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|
| Fit Assembly Ref        | S3110/1 | S3110/2 | S3110/3 | S3110/4 | S3110/5 | S3110/6 | S3110/7 | S3110/8 | S3110/9 | S3110/10 | S3110/11 | S3110/12 | S3110/13 |
| Max Length Overall (mm) | 1375    | 1575    | 1900    | 2175    | 2575    | 3475    | 4875    | 5775    | 6875    | 7775     | 8675     | 9575     | 10475    |
| Min Length Overall (mm) | 830     | 1190    | 1550    | 1750    | 2050    | 2550    | 3450    | 4350    | 5250    | 6150     | 7050     | 7950     | 8850     |
| Weight (kg)             | 30      | 44      | 67      | 79      | 90      | 113     | 122     | 131     | 133     | 138      | 144      | 150      | 156      |
| Load Capacity (kN) (A)  | 200     | 200     | 200     | 200     | 170     | 140     | 110     | 100     | 90      | 80       | 70       | 60       | 50       |
| Load Capacity (kN) (B)  | 200     | 200     | 200     | 200     | 170     | 140     | 110     | 100     | 90      | 80       | 70       | 60       | 50       |
| Max Offset Size (mm)    | 3.0     | 3.0     | 3.0     | 3.0     | 3.0     | 3.0     | 3.0     | 3.0     | 3.0     | 3.0      | 3.0      | 3.0      | 3.0      |

APPENDIX C  
GROUND INVESTIGATION REPORT– LAND SCIENCE LTD



**REAR OF 33 PRIORY ROAD, LONDON,  
NW8 8LP**  
GEOTECHNICAL GROUND INVESTIGATION  
**MR NEIL BROCK**  
20<sup>TH</sup> DECEMBER 2019

|                       |                                                                                    |                                                                                    |
|-----------------------|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| <b>Site:</b>          | REAR OF 33 PRIORY ROAD, LONDON, N8 8LP                                             |                                                                                    |
| <b>Title:</b>         | GEOTECHNICAL GROUND INVESTIGATION                                                  |                                                                                    |
| <b>Project:</b>       | TWO-STOREY DWELLING WITH LOWER GROUND FLOOR                                        |                                                                                    |
| <b>Client:</b>        | MR NEIL BROCK                                                                      |                                                                                    |
| <b>Date:</b>          | 20 <sup>th</sup> DECEMBER 2019                                                     |                                                                                    |
| <b>Reference:</b>     | LS 4570                                                                            |                                                                                    |
| <b>Version:</b>       | V1.0                                                                               |                                                                                    |
| <b>Prepared by:</b>   |   | SAMUEL PRIOR, B.Sc. (Hons.)<br><u>Project Geologist</u>                            |
| <b>Checked by:</b>    |   | ANGUS MACDONALD B.Eng. (Hons.), FGS<br><u>Geotechnical Engineer</u>                |
| <b>Authorised by:</b> |  | ELLIOT TOMS CEnv M.Sc., B.Sc. (Hons.), FGS,<br>MEnvSci<br><u>Managing Director</u> |



## DESK STUDIES GROUND INVESTIGATION CONSULTANCY

You depend on a project team to get it right, first time.

At Land Science we aim to understand our clients needs, and appreciate the role ground issues play within a wider context. That's why we provide our clients with a reliable service and first class expertise tailored to specific requirements.



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## FIGURES

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| FIGURE 2: | Existing Layout / Investigation Layout |
| FIGURE 3: | Proposed Layout                        |

## APPENDICES

|             |                                       |
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| APPENDIX A: | Photographs                           |
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| APPENDIX C: | Ground gas and Groundwater Monitoring |
| APPENDIX D: | Geotechnical Testing Results          |
| APPENDIX E: | Contamination Testing Results         |

## 1 INTRODUCTION

### 1.1 General

Land Science was instructed by Mr Neil Brock (the Client) to undertake a geotechnical investigation in relation to the proposed redevelopment at the rear of 33 Priory Road, London, N8 8LP. The location of the site is shown on Figure 1, which is centred at grid reference TQ 30037 89179.

### 1.2 The Site

The area under investigation comprised three single storey adjoining residential garage units to the rear of 33 Priory Road. The site was flat and level and several large mature deciduous trees were noted to the rear of the garages. The site was bordered by residential gardens to the west, a block of flats to the south and Ashford Avenue to the east.

The layout of the existing site is indicated on Figure 2. The area was approximately 0.008 hectares. It was assumed that the Client was in ownership of the site, and that this investigation was not a pre-purchase appraisal.

### 1.3 Form of Development

The proposed development was understood to comprise the demolition of the existing garage units and construction of a two-storey dwelling with lower ground floor founded at approximately 3.00mbgl.

Figure 3 illustrates the layout of the proposed redevelopment. The findings of this report may be not valid if the proposed development is altered.

### 1.4 Previous Investigations

Land Science was not aware of any previous desk studies or ground investigation(s) undertaken on this site and for this scheme.

### 1.5 Scope of Works

The proposed scope of works was to comprise the following:

- A desk study
- 1no 10m dynamic (windowless) sampler borehole

- 1no foundation exposure
- A standpipe installation, to be monitored on two return visits

The fieldwork was conducted on 18<sup>th</sup> November 2019. The two return monitoring visits were conducted on 27<sup>th</sup> November and 6<sup>th</sup> December 2019.

### 1.6 Geotechnical Objectives

A geotechnical investigation was required to provide an interpretation of ground conditions with respect to foundations, pavements, concrete specification, excavations, and basement construction.

### 1.7 Standards

Where practicable, the investigation was undertaken in accordance with the following standards and guidance:

- BS 5930:2015 Code of Practice for Site Investigations
- BS 1377:2018 Soils for Civil Engineering Purposes

Other technical sources have been cited in respect of specific aspects of the investigation, as referenced throughout the text. If a long delay exists between the investigation and commencement on site, it may be necessary to check whether any standards have changed in the intervening period.

### 1.8 Conditions and other matters

Reference should be made to the Report Conditions section at the end of this report.

## 2 SITE SETTING

### 2.1 Geological Mapping

Based on mapping published online by the British Geological Survey (BGS), the geology of the site was anticipated to comprise the following succession:

| Strata                | Generic description                                                                                                                                                      |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| London Clay Formation | Bioturbated or poorly laminated, blue-grey or grey-brown, slightly calcareous, silty to very silty clay, clayey silt and sometimes silt, with some layers of sandy clay. |

No superficial deposits were mapped.

### 2.2 Historical Borehole Records

Records of old boreholes are held by the BGS. However, no relevant borehole records were available within the vicinity of the site.

### 2.3 Radon Potential

The requirement for Radon Protection Measures (RPM) has been assessed in accordance with BRE 211:2015<sup>1</sup>. Public Health England and the BGS estimate the potential for radon and the requirement for Radon Protection Measures on site as follows:

| Probability:                                                                                               | Protection measure:                                                                                           |
|------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| Less than 1% of homes are estimated by PHE to exceed the threshold for Radon gas in residential dwellings. | No Radon Protection Measures (RPM) are required for new dwellings or extensions constructed at this location. |

### 2.4 Hydrogeology

Based on the geology and topography of the local area, shallow groundwater was not anticipated.

### 2.5 Aquifer Designations

The Environment Agency classifies geological units across England into different designations as Aquifers. The designations for strata beneath the site are given below, which corresponds to an overall designation as Unproductive Strata.

| Strata          | Classification      | Details                                                                                       |
|-----------------|---------------------|-----------------------------------------------------------------------------------------------|
| Bedrock Aquifer | Unproductive Strata | Low permeability strata that have negligible significance for water supply or river base flow |

### 2.6 Source Protection Zones

A groundwater Source Protection Zone (SPZ) is an area of protection placed around a well or borehole that supplies groundwater of potable quality. The following data has been identified on and within 250m of the site according to Environment Agency mapping:

| Location | Classification | Details                                                                            |
|----------|----------------|------------------------------------------------------------------------------------|
| On site  | No SPZ         | No groundwater Source Protection Zones were identified.                            |
| 165m E   | SPZ I          | Defined as the travel time (of water) of 50 days or less to the groundwater source |

### 2.7 Surface Water Features

No significant surface water features were identified within the immediate vicinity of the site.

### 2.8 Surface Water Flooding

Land potentially susceptible to flooding from seas, rivers, reservoirs and surface water is identified by the Environment Agency. Current mapping indicated the following:

| Source                               | Details                                     |
|--------------------------------------|---------------------------------------------|
| Areas Benefiting from Flood Defences | None identified on site or in the vicinity. |
| Flood Water Storage Areas            |                                             |
| Flood Defences                       |                                             |

The site lies within Flood Zone 1. Land and property within this zone have a low probability of flooding.

## 2.9 Waste Management Facilities

No waste management facilities were identified within 500m of the site.

## 2.10 Geological Hazards

The BGS produce hazard assessment maps for a selection of common geotechnical datasets, and the classifications referring to the site (and immediate vicinity – if relevant) are summarised below:

| Dataset:                                  | Location | Hazard:   |
|-------------------------------------------|----------|-----------|
| Potential for compressible ground         | On site  | No hazard |
| Potential for ground dissolution features |          |           |
| Potential for landslide                   |          | Very low  |
| Potential for running sand                |          |           |
| Potential for collapsible ground          |          |           |
| Potential for shrinking or swelling clay  |          | Moderate  |

A moderate level of risk was associated with the potential for shrinking or swelling clay, laboratory tests have been carried out in section 8 with those results discussed in section 9.2.

## 2.11 Mining and Natural Cavities

A search of various databases for coal mining, mining, brine compensation, and natural cavities was carried-out, and the findings are summarised below:

| Database                               | Results           |
|----------------------------------------|-------------------|
| CBSCB Compensation District            | No features found |
| Coal Mining Affected Areas             |                   |
| Non Coal Mining Areas of Great Britain |                   |
| Mining Instability                     |                   |
| Man-Made Mining Cavities               |                   |
| Natural Cavities                       |                   |

### 3 SITE HISTORY

#### 3.1 Historical Maps

Large scale (e.g. 1:2,500) historical maps dating between 1863 and 1996 were reviewed to identify the history of the site and local area. The outline of the site shown is geo-referenced to the current grid system; due to inaccuracies in mapping techniques the actual boundary on older maps may vary.

In summary, the site initially comprised part of an open field with trees; by 1886 a building was noted to the north of the site with land to the south remaining undeveloped. By 1913 the site was situated within a residential garden. By 1971 the garden of 33 Priory Road had been shortened with the addition of two garages; no further significant changes were noted, and the site remained commensurate to present day.

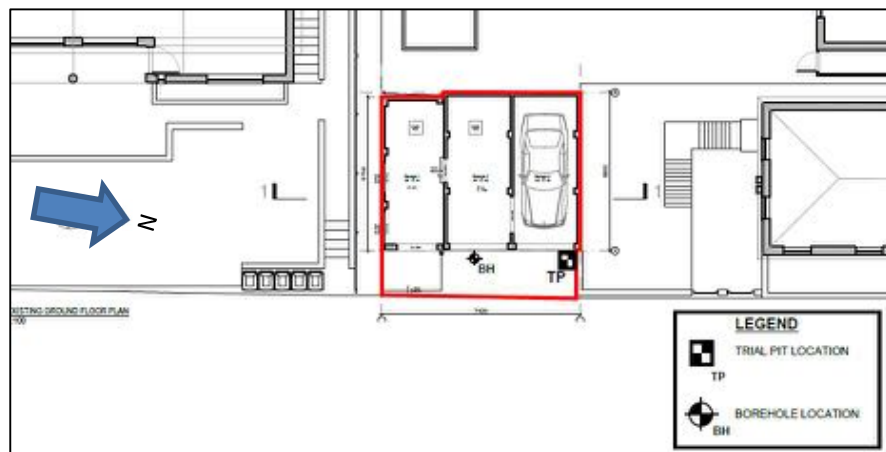
No evidence of potential contaminative land uses was noted within the surrounding area.

## 4 INTRUSIVE INVESTIGATION

A factual record of the conditions encountered during the physical investigation of the site is presented in the following sections.

### 4.1 Investigation Strategy

The layout of the investigation was specified by the client (document no. 19229-SI-Rev P1) and comprised of a 10m deep dynamic samples borehole (with monitoring well) fronting the existing garages (DS01) and a foundation exposure to be undertaken on the corner of the northern garage and the southern boundary wall of 33 Priory Road's garden.



### 4.2 Dynamic (Windowless) Sampling (DS)

Dynamic Sampling entails 1m long hollow tubes with liners driven into the ground and retracted in order to obtain samples. The process is repeated sequentially to the target depth, unless impenetrable strata or borehole instability prevent further progress. The liners are split, logged, tested, and subsampled. Sample compression can occur within the liners, and the sampler can sometimes become blocked. Sample recovery is typically class 2 as defined in Eurocode 7.

### 4.3 Monitoring Wells (MW)

Monitoring wells were installed in BH1. The installation was sealed through the Made Ground, with the response zone in the London Clay Formation. The pipework was 50mm diameter HDPE, sealed using hydrated bentonite pellets and the slotted response zone packed with 10mm pea shingle.

### 4.4 Trial Pits (TP)

A single trial pit was undertaken to expose existing foundations on both the existing garage and garden wall. Sketches can be found in Appendix B.

## 5 GROUND CONDITIONS

### 5.1 General

The expected ground conditions were anticipated to comprise London Clay Formation to the full depth of the borehole. The investigation confirmed the anticipated ground conditions.

A summary of the encountered conditions from DS01 is presented below.

| Base Depth | Strata                | Description                                                                                                                                                           |
|------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0.13m      | Hardstanding          | Concrete                                                                                                                                                              |
| 0.70m      | Made Ground           | Dark brown slightly sandy gravelly CLAY. Gravels comprised of brick, concrete, flint and rare clinker. Carbonaceous material was encountered between 0.30m and 0.50m. |
| 10.00m+    | London Clay Formation | Stiff to very stiff light brown CLAY with rare silt pockets and selenite crystals.                                                                                    |

The identification of materials encountered as specific geological strata is tentative and should be used as a guide, and interpolation between or below investigation points should be treated with caution.

### 5.2 Roots and Rootlets

Rare roots and rootlets were identified within the Made Ground to 0.70mbgl. None were noted within the London Clay Formation

### 5.3 Field Evidence of Contamination

No evidence of possible soil contamination (such as staining, malodours, or brightly coloured soils) was identified in the field.

Made Ground was identified to 0.70mbgl, and such materials may be imported from an unknown source or mixed with hazardous materials, and as such may contain a wide range of potential contaminants. All such materials should be treated as suspect unless proven otherwise. Preliminary testing has been carried out, as described in section 10.

### 5.4 Groundwater

Groundwater was not encountered during the field work; in addition, no groundwater was noted within the two monitoring visits.

Groundwater levels may vary seasonally and with variations in rainfall. Water may also become perched upon cohesive strata or around features such as foundations, and may also occur from leaking drains and water mains etc.

### 5.5 Foundation Exposures

A summary of the excavations made to expose, and log existing foundations is presented in Appendix B.

## 6 GEO-ENVIRONMENTAL TESTING

### 6.1 Geochemical Laboratory Analysis

A selected sample of Made Ground (DS01 0.50mbgl) was tested for a routine screening suite (LS1), an asbestos screen and a Waste Assessment Criteria (WAC) test (LS2) to provide information on waste disposal.

The relevant screening suites are defined below. Where duplicate analysis exists between suites, each test is performed only once:

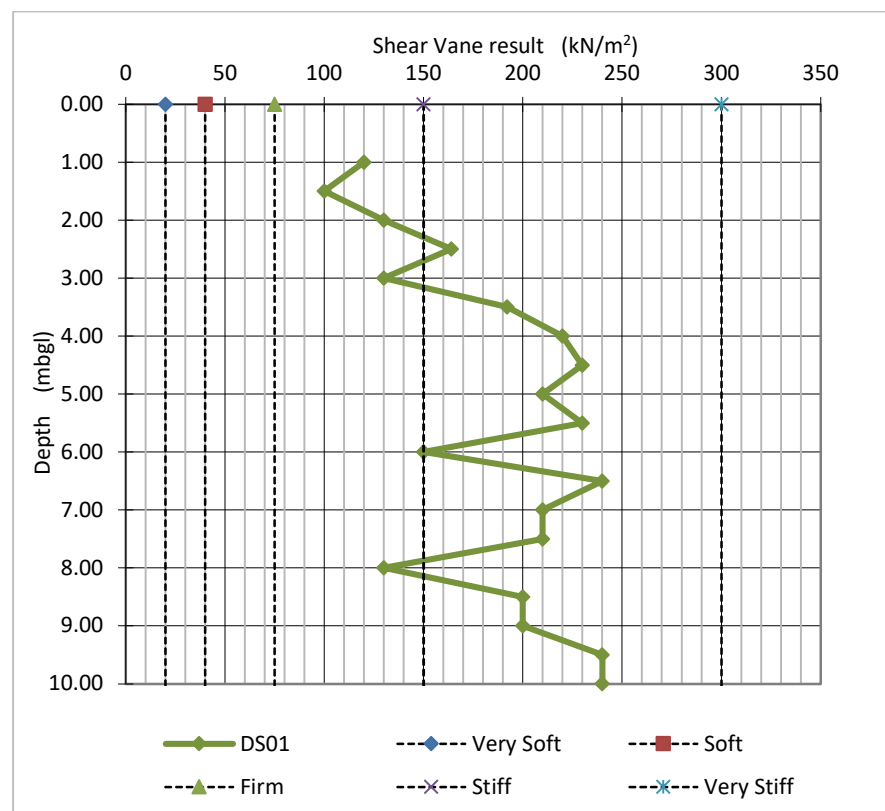
| Suite    | Definition                                                                                                                                                                                                                                                      |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LS1      | Screening suite: pH, fraction of organic carbon, Metals and Non Metals, water soluble Sulphate, Sulphide, total Cyanide, total Phenols, speciated PAH's.                                                                                                        |
| Asbestos | Asbestos screen: Laboratory screening for fibres and Asbestos Containing Materials; identification where identified. Using polarising light and dispersion staining as described in HSG 248, HSE Contract Research Report No 83/1996 and in Davies et al, 1996. |
| LS2      | Waste Acceptance Criteria: Total Organic Carbon, Loss on Ignition, BTEX, speciated PCB's, Mineral Oil (EC10 – EC40), pH, Acid Neutralisation Capacity, speciated PAH's, 10:1 leachable Metals and Non Metals.                                                   |

The results of geochemical analysis are discussed in Section 10 and 11.

## 7 GEOTECHNICAL FIELD TESTING

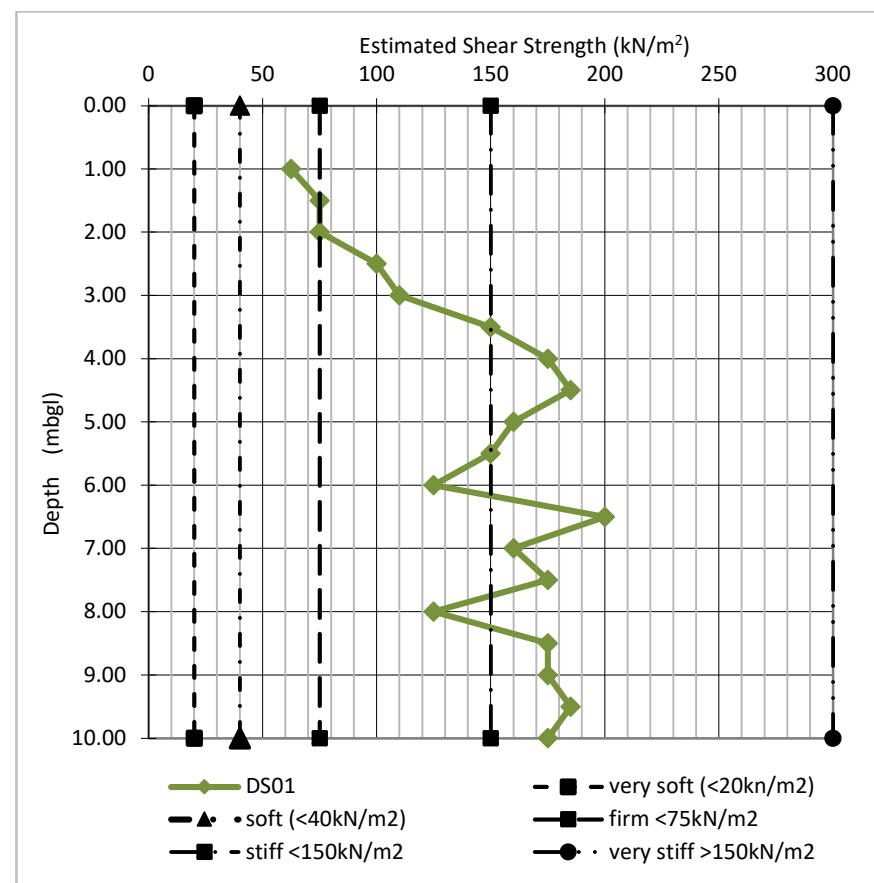
### 7.1 Shear Vanes

Laboratory shear vane tests were performed on samples of cohesive materials recovered within the boreholes. The test provides a direct estimate of undrained shear strength, and in turn may be used to give an indication of consistency as defined in BS5930. The results are summarised below. The maximum reading using this method is 240kN/m<sup>2</sup>.



### 7.2 Penetrometers

Hand penetrometer tests were performed on samples of cohesive materials recovered within the boreholes. The test is used to approximate undrained shear strength and in turn has been used to give an indication of consistency as defined in BS5930. The results are summarised below. The maximum reading using this method is 4.5kg/cm<sup>2</sup> (225kN/m<sup>2</sup>).



## 8 GEOTECHNICAL LABORATORY TESTING

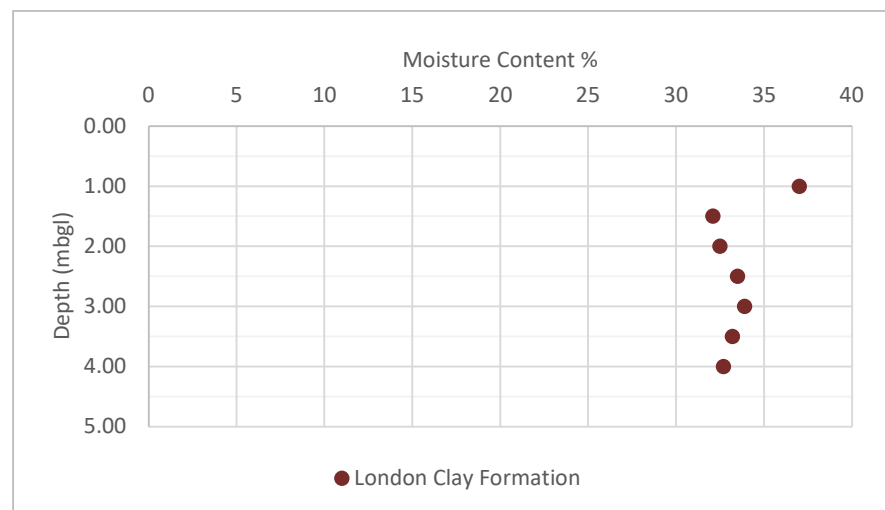
### 8.1 General

Samples of soil were sent for laboratory geotechnical testing; copies of the results are appended, and summaries are given in the following tables. The testing was undertaken in accordance with the relevant British Standards in BS1377 following documented quality procedures.

### 8.2 Water Content

Water content determinations (formerly known as *moisture content*) were undertaken in combination with various classification tests, and the results are summarised below.

| Strata                | No. of tests | Moisture content % |         |         |
|-----------------------|--------------|--------------------|---------|---------|
|                       |              | Minimum            | Maximum | Average |
| London Clay Formation | 7            | 32.1               | 37.0    | 33.6    |



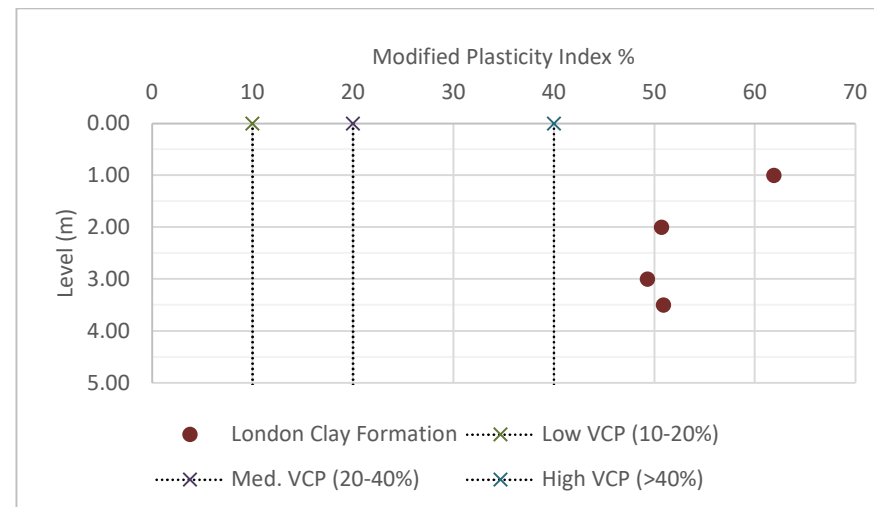
### 8.3 Plasticity Indexes (Atterberg Limits)

Atterberg Limit tests were undertaken on selected samples of cohesive soils, as summarised below.

| Strata                | No. of tests | Plasticity Index % |         |         |
|-----------------------|--------------|--------------------|---------|---------|
|                       |              | Minimum            | Maximum | Average |
| London Clay Formation | 4            | 49.3               | 61.9    | 53.2    |

A modified plasticity index (PI') was calculated following the NHBC methodology, to account for any non-shrinkable percentage not passing the 425µm sieve:

| Strata                | No. of tests | Modified Plasticity Index % |         |         |
|-----------------------|--------------|-----------------------------|---------|---------|
|                       |              | Minimum                     | Maximum | Average |
| London Clay Formation | 4            | 49.3                        | 61.9    | 53.2    |



#### 8.4 pH and Sulphate

Geochemical testing for water soluble Sulphate and pH were undertaken, and the results are summarised on the following table.

| Strata                | No. of tests | Water soluble Sulphate (SO <sub>4</sub> g/l) | pH (value) |
|-----------------------|--------------|----------------------------------------------|------------|
| London Clay Formation | 3            | 0.17 to 1.9                                  | 7.5 to 8.3 |

#### 8.5 Triaxial testing

A Laboratory quick undrained triaxial test was undertaken on selected “undisturbed” samples recovered from DS01, as summarised below. The mode of failure was brittle.

| Strata                | Depth (mbgl) | Bulk density (Mg/m <sup>3</sup> ) | Dry density (Mg/m <sup>3</sup> ) | Shear strength (kPa) |
|-----------------------|--------------|-----------------------------------|----------------------------------|----------------------|
| London Clay Formation | 3.00 to 3.45 | 1.91                              | 1.55                             | 61                   |

## 9 GEOTECHNICAL ASSESSMENT

The following recommendations have been made with respect to geotechnical design.

### 9.1 General Foundation Design

The proposed development was understood to comprise a two-storey residential dwelling with lower ground floor.

It was understood that the proposed basement was to be constructed using a reinforced concrete raft foundation. Based on the ground and groundwater conditions encountered, it is considered that such a foundation design would appropriate for the proposed development.

### 9.2 Volume Change Potential

Soil shrinkability has been assessed following the NHBC Standards Chapter 4.2 (January 2018 edition). It is recommended that the advice of this publication (or similar guidance) is taken when designing and constructing foundations in the zone of influence of trees and hedgerows that currently exist, are to be planted, or have recently been felled.

The average modified plasticity index result from the London Clay Formation was 53.2%, this classified the stratum as susceptible to high volume change potential.

| Strata                | % passing 425µm sieve | Modified Plasticity Index | Shrinkability classification |
|-----------------------|-----------------------|---------------------------|------------------------------|
| London Clay Formation | 100                   | >40%                      | High volume change potential |

Specifications for heave precautions on high volume change potential soils are summarised below. In addition to the depths marked \*, localised deepening of foundations will be required in the influence of trees; it will be necessary to evaluate tree species and height in relation to the proposed building footprints. If not already carried out, an arboricultural survey will be required.

Granular infill will be required beneath the raft foundation to a minimum depth equal to half that specified for strip foundations, and the infill should be of a uniform thickness beneath the raft given the possibility for differential settlements.

Checks should be made to ensure that the proposed basement is below the zone of influence of trees in accordance with the NHBC Standards, as it may still be necessary to take further precautions.

| Volume Change Potential                                        | High  |
|----------------------------------------------------------------|-------|
| Minimum allowance for potential ground movement for new drains | 150mm |

### 9.3 Basement Construction

The proposed development included a lower ground floor over the site building footprint, assumed to be constructed at a formation level of approximately 3.00mbgl. The design of the basement temporary works and in the final condition will need to take account of the ground and groundwater conditions, as well as site constraints. Reference should be made to advice on the design of retaining walls (section 9.4) and advice on excavations (section 9.6).

An open excavation is not considered suitable. It will be necessary to form a perimeter wall. These are typically cantilever piles, either bored (contiguous or secant) or driven (usually steel sheet piles); mass concrete can also be considered.

Given the proximity of adjacent structures, driven steel sheet piles are unlikely to be acceptable on account of the vibration risk and nuisance to neighbouring property. Bored piles are suitable under most ground and groundwater conditions.

Openings such as light-wells or vents etc. should be carefully positioned, and construction joints should be detailed appropriately.

It is recommended that all inhabitable basements are to be afforded an appropriate level of protection against water and soil moisture in accordance with grade 3 of BS8102:2009. It should be noted that water may also occur from other sources such as leaking drainage or water mains, and groundwater levels may vary seasonally or with changes in drainage.

The basement is to be constructed within low permeability clays within which water will pond and accumulate.

Heave forces caused by the removal of overburden are not expected to be significant as long as there are no undue delays in the construction program. The basement slab should be properly reinforced and tied into the perimeter walls. If left for a prolonged period it may be necessary to trim the formation level. Water should not be allowed to pond on accumulate on the formation.

## 9.4 Retaining Walls

The following design values are suggested as a guide to assist in the design of retaining walls. The values have been obtained from BS8002 and BS EN 1997-1:2004 (Eurocode 7 – Geotechnical Design). A value of  $\delta/\phi' = 1.0$  may be appropriate for bored cast in-situ concrete.

| Stiff Clay                                                 | $\delta/\phi' = 0$ | $\delta/\phi' = 0.66$ | $\delta/\phi' = 1.0$ |
|------------------------------------------------------------|--------------------|-----------------------|----------------------|
| Critical state angle of shearing resistance ( $\phi'$ )    | 20                 |                       |                      |
| Effective Cohesion kN/m <sup>2</sup>                       | 0                  |                       |                      |
| Saturated Bulk Weight ( $\gamma_{sat}$ ) kN/m <sup>3</sup> | 19                 |                       |                      |
| Passive Resistance $K_p$                                   | 2.2                | 2.7                   | 2.9                  |
| Active Pressure $K_a$                                      | 0.49               | 0.43                  | 0.41                 |

## 9.5 Raft Foundations

Reference should be made to the NHBC Standards (especially chapter 4.4) when designing raft foundations.

The formation level is anticipated to comprise London Clay Formation at a depth in the order of 3.00m. Any Made Ground and any soft or loose zones should be replaced with granular fill well-compacted to a suitable specification. If necessary, further granular fill may be placed across the formation.

Integral pad and strip foundations within the raft may be designed based on a maximum net allowable bearing capacity of 125kN/m<sup>2</sup> on the stiff clay materials. The overall slab should not exceed an overall maximum net allowable bearing capacity of 60kN/m<sup>2</sup>. The raft should be of a suitable thickness and reinforced to be suitably rigid.

Where used in the design of a raft foundation, typical published values for the Modulus of Subgrade Reaction in the order of 14,000kN/m<sup>3</sup> for the stiff clay materials. A range of values should be evaluated, and the resulting design should be checked to ensure it is sensible.

The London Clay Formation will soften rapidly when exposed to free water. The final 50mm of any foundation trench should not be excavated until immediately before concreting, unless blinded or otherwise protected immediately after excavation.

## 9.6 Excavations

The risks arising from excavation works should be properly assessed and appropriate safety precautions should be adopted. Reference may be made to various guidance including BS8000-1:1989, BS6031:2009 and CIRIA C97.

The likelihood of excavation instability through different strata has been assessed as summarised below. It should be noted that all open unsupported excavations have the potential to collapse.

| Strata                | Stability                                                                                                |
|-----------------------|----------------------------------------------------------------------------------------------------------|
| Made Ground           | Generally unstable. May be battered back to a safe angle. Deeper excavations may require trench support. |
| London Clay Formation | Generally stable in the short to medium term.                                                            |

Excavations which are to remain open for prolonged periods will require trench support.

It is considered that normal-rated plant and machinery will be sufficient for undertaking excavations. Breakers will be required for removing any former foundations, retaining walls etc. Care should be taken so as not to undermine existing structures, services, or adjacent property.

Adjacent excavations should generally be tackled in order of depth with the deepest first. Vehicles and spoil heaps etc. should not surcharge excavations, and edge protection and fencing should be used as appropriate. Frozen materials should generally not be used as backfill.

## 9.7 Building Materials

Based on BS8500-1:2015+A1:2016, the results of the Sulphate and pH analyses fell into Class DS-3 and an ACEC class AC-2s is deemed appropriate. The advice of this publication should be taken for the design and specification of all sub surface concrete.

## 10 PRELIMINARY CONTAMINATION ASSESSMENT

Contaminated land risks are evaluated on following a source-pathway-receptor ('SPR') approach, in accordance with best practice. A full geo-environmental risk assessment was outside the scope of this report. However, based on the findings of the desk study, no significant sources of potential contamination, natural or man-made, arising in soils, ground gases or groundwater phases, were suspected.

However, as always, any Made Ground, shallow soils which have been disturbed, or those showing field evidence of possible contamination such as staining, should be treated as suspect, handled with appropriate care, and relevant advice sought from a qualified professional.

A preliminary screen of the geochemical analysis was undertaken and compared was compared with standards relating to residential land use without plant uptake. The results show slightly elevated levels Beryllium were noted. Given the confines of the site, all Made Ground is expected to be removed from site, no pathways will exist to end users.

No risk from contamination was identified therefore no remediation was considered necessary.

## 11 PRELIMINARY WASTE ASSESSMENT

### 11.1 General

Waste may be defined as any substance or object in Annex 1 of the Waste Framework Directive<sup>2</sup> which the holder discards, intends to discard, or is required to discard. Subject to certain provisions, soils may either be handled as either:

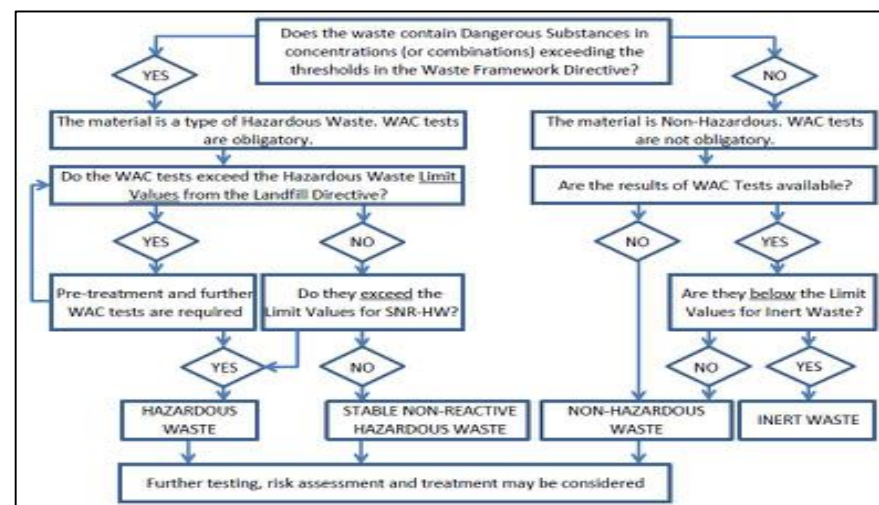
- Non-Waste, and re-used (on or off-site), or
- Waste, and disposed of (to a waste management facility).

Given the confines of the site, it was anticipated that all materials would be disposed of from site as waste.

The waste producer has a legal duty of care to ensure that waste materials are handled properly and sent to the appropriate licenced facility. Further inspection, testing, segregation etc will be required on site, and the advice of a suitably qualified consultant sought wherever necessary. Substantial tax penalties and fines are being levied by the regulators. The advice contained in this section is preliminary only.

### 11.2 Waste Disposal

Where materials are not re-used they must be handled as Waste, and must be sent to a licenced waste management facility. The classification of waste is prescribed under the Waste Framework Directive<sup>3</sup> and the Landfill Directive<sup>4</sup>, as summarised below. Different waste management facilities may also have specific acceptance criteria, and their advice should be sought.



The results of the soil analysis have been classified as follows:

| Soil                   | Hazardous |                     | Non Hazardous |       | Details                                                                                                                         |
|------------------------|-----------|---------------------|---------------|-------|---------------------------------------------------------------------------------------------------------------------------------|
|                        | Hazardous | Stable Non-Reactive | Non-Hazardous | Inert |                                                                                                                                 |
| Made Ground DS01 0.50m |           |                     |               | ✓     | The soil analysis was not identified as hazardous and the WAC test met the requirements for Inert. Interpretation: Inert Waste. |

With reference to the current List of Wastes (formerly European Waste Catalogue), waste soils and stone derived from construction and demolition sites may be disposed of under either of the following codes as appropriate:

| Waste         | Code      | Description                                            |
|---------------|-----------|--------------------------------------------------------|
| Hazardous     | 17 05 03* | soil and stones containing dangerous substances        |
| Non-Hazardous | 17 05 04  | soil and stones other than those mentioned in 17 05 03 |

(Note, the asterix is a Mirror Entry, as defined in the List of Wastes, conferring the relationship with the non-hazardous code 17-05-04).

## 12 SUMMARY AND CONCLUSIONS

*This summary is a brief precis of the main findings and conclusions of the investigation. For detailed information, the reader is referred to the main report.*

### 12.1 General

The intrusive investigation included 1no dynamic sampler borehole (DS01) and a foundation exposure trial pit. The site comprised three adjoining residential garage units to the rear of 33 Priory Road.

### 12.2 Soils Encountered

| Strata                | Depth   | Summary                                                                                                                                 |
|-----------------------|---------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Hardstanding          | 0.13m   | Concrete.                                                                                                                               |
| Made Ground           | 0.70m   | Dark brown slightly sandy gravelly CLAY. Gravels comprised of brick, concrete, flint, rare clinker and localised carbonaceous material. |
| London Clay Formation | 10.00m+ | Stiff to very stiff light brown CLAY with rare silt pockets and selenite crystals.                                                      |

### 12.3 Groundwater

No groundwater encountered within with excavation of DS01 (10.00m) or within the 6.00m deep standpipe on the two monitoring visits.

### 12.4 Foundations

Traditional raft foundations are recommended, and design parameters are given. The London Clay Formation should be treated as being susceptible to high volume change potential.

### 12.5 Excavations

The London Clay is generally likely to remain stable. Risk assessments should be prepared, and appropriate safety measures provided.

### 12.6 Building Materials

DS-3 and AC-2s in accordance with BS8500. Water supply pipe work should not require protection from aggressive soil contaminants.

### 12.7 Ground Gases

No issues with respect to ground gases and Radon have been identified.

### 12.8 Waste Disposal

The chemical results confirmed that the Made Ground should be handled as Inert Waste for disposal purposes. It is likely that natural soils could also be handled as Inert Waste.

### 12.9 Further Action

No immediate requirements for further ground investigation have been identified. This report should be submitted to relevant regulatory bodies and warranty providers in good time for approval.

## 13 REPORT CONDITIONS

### 13.1 General

Interpretation of ground conditions inherently depends on the conditions revealed by a limited data set. Land Science takes all reasonable professional care in preparation of this report, using current standards and industry best practice. However, we accept no liability whatsoever expressed or implied in respect of:

- The scope, extent or design of an investigation.
- Any conditions not directly revealed by the investigation.
- Published standards or methodologies used or adopted in this report.
- The opinion of any other party including any regulator, authority or stakeholder.
- Any dispute, claim or consequential loss arising from this report.
- Any matter other than ground conditions.

Land Science does not accept any risk or any direct or consequential liability relating to ground conditions. The client should understand their risks and liabilities and seek further professional advice.

No aspect of this report constitutes a design. Where this information is used in design, the designer should verify that the information has been used appropriately.

No aspect of this report constitutes the supply of Goods.

Our appointment is covered under our Terms and Conditions, agreed and accepted by the Client.

### 13.2 Confidentiality

This report may only be relied upon by the Client and their design team, and should only be read and used in full. No responsibly will be accepted where this report is used, by any other party, who do so at their peril. The report may not be relied upon or transferred to any other parties without the express written agreement of Land Science.

### 13.3 Third Party Information

Third party information used in the production of this report has been relied upon as being accurate. Land Science cannot warrant or accept any liability for errors and/or omissions in third party information.

### 13.4 Regulators and Approvals

It is recommended that this report is submitted to any relevant authorities for their own assessments and to provide their approval or comments accordingly. This should be in good time before commencing on site in case additional work is to be carried out.

Standards, technical guidance and regulatory positions change over time and which may therefore affect the findings and recommendations made in this report. This should be verified by the client prior to any critical contractual points or commencing on site.

### 13.5 Variations with time

The report relates to conditions revealed at the time of the investigation and any monitoring visits. A number of parameters may vary over time or seasonally. Groundwater levels, ground gas compositions, or concentrations of contaminants are particularly variable in this respect. Further monitoring or verification should be considered as appropriate.

### 13.6 Other Matters

This report makes no representation on other matters such as ecology, agronomy, arboriculture, structural condition, building materials, boundaries and planning etc.

This report and findings may not be valid if the proposals for the site e.g. design of the development (if relevant) are changed. This must be checked.

No aspect of this report should be taken as a guarantee whatsoever that a site is free of pollution, contamination or hazardous materials.

## GLOSSARY OF TERMS

|         |                                                            |         |                                                |
|---------|------------------------------------------------------------|---------|------------------------------------------------|
| ACM     | Asbestos Containing Material                               | PQRA    | Preliminary Quantitative Risk Assessment       |
| BGS     | British Geological Survey                                  | PSD     | Particle Size Distribution Test                |
| BRE     | Building Research Establishment                            | RMS     | Remediation Method Statement                   |
| BS      | British Standard                                           | SGV     | Soil Guideline Value                           |
| CBR     | California Bearing Ratio                                   | SOM     | Soil Organic Matter                            |
| CDM     | Construction Design and Management regulations             | SPZ     | Source Protection Zone                         |
| CIRIA   | Construction Industry Research and Information Association | SPT     | Standard Penetration Test                      |
| CL:AIRE | Contaminated Land: Applications in Real Environments       | SSSI    | Sites of Special Scientific Interest           |
| CLEA    | Contaminated Land Exposure Assessment model                | ST-WEL  | Short Term Workplace Exposure Limit            |
| CoC     | Chemical of Concern                                        | SVOC's  | Semi-Volatile Organic Compounds                |
| CSM     | Conceptual Site Model                                      | TPH     | Total Petroleum Hydrocarbons                   |
| EA      | Environment Agency                                         | TRRL    | Transport Road Research Laboratory             |
| EQS     | Environmental Quality Standards                            | TWA-WEL | Time Weighted Average Workplace Exposure Limit |
| FOC     | Fraction of Organic Carbon                                 | UK HBF  | United Kingdom House Building Federation       |
| GAC     | Generic Assessment Criterion                               | VOC's   | Volatile Organic Compounds                     |
| mbgl    | Meters Below Ground Level                                  | WAC     | Waste Acceptance Criteria                      |
| NHBC    | National House Building Council                            |         |                                                |
| mod     | Metres above Ordnance Datum                                |         |                                                |
| PAH's   | Polycyclic Aromatic Hydrocarbons                           |         |                                                |
| PCoC    | Potential Contaminant of Concern                           |         |                                                |
| PBET    | Physiological Based Extraction Testing                     |         |                                                |
| PHE     | Public Health England                                      |         |                                                |
| PID     | Photo-Ionisation Detector                                  |         |                                                |

## ACCOMPANYING NOTES – SOIL CONTAMINATION

### LS1 routine screening suite

The LS1 suite is based broadly upon determinands listed within the former ICRL guidance note 59/83 2nd edition 1987, CLR publication CLR8, and Environment Agency R&D66 publication. Stone and moisture content, fraction of organic carbon ('foc'), and pH value, are also undertaken. Total Sulphate is not a priority in terms of human health, so water soluble Sulphate is analysed instead to assess the risks to buried concrete.

### Site Workers

Site managers are responsible for the safety of persons in their employ under a variety of instruments including the CDM regulations and Health & Safety at Work Act. In terms of working on contaminated sites, guidance can be sought from the CIRIA publication entitled "A Guide for Safe Working on Contaminated Sites". Any work in confined spaces confined spaces should only be carried out following appropriate risk assessment. Detailed risk assessment for workers is outside the scope of this report.

### Discovery Strategy

Unexpected soil conditions may be encountered during the process of site demolition and construction. Examples may include oily pockets within the soil, pockets of cement boarding or fibrous materials within the soil, black ashy materials, soils exhibiting strong odours, brightly coloured materials, and former structures or brickwork.

Should previously undiscovered contamination be encountered during construction by the ground worker's, this should be reported to the Geo-Environmental Consultant immediately in order that any necessary inspection may be made. All site workers should be made aware of their responsibility to observe, report, and act on any potentially suspicious or contaminated materials they may encounter.

### General

Contamination may be identified as the occurrence of a substance in or on the ground which has a potential to cause significant harm (humans, ecological systems, or property) or pollution of a controlled water.

### Sources – Pathways – Receptors

Primary Source – the point at which contamination starts to occur e.g. a leaking tank

Secondary source – the media affected by contamination, including soil, groundwater and ground gases, as summarised below

Receptor – Persons, living organisms, ecological systems, controlled water, atmosphere, structures and property, and utilities.

| Secondary source | Summary                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Soil             | Contaminants bound into or entrained with the soil matrix, for instance ashes, clinkers, bituminous materials, asbestos containing materials, etc. Also, soils may become contaminated by other activities, such as leaking chemical storage, drainage and the like, becoming bound into the soil mineralogy or organic matter. Soils may also generate soil-borne dusts and volatile organic compounds may generate organic vapours. |
| Volatile vapours | Many organic compounds are either volatile or semi volatile (at different temperatures and pressures) which mean they will volatilise and generate vapours. In an enclosed system, the ratio of vapours to other compartments will come into equilibrium, but in open systems the process may continue until the source has been depleted.                                                                                            |
| Ground gases     | Organic matter, including wastes, hydrocarbons and other compounds, will decay through microbial action. This will primarily release Carbon Dioxide but may also release Methane under anaerobic conditions. This may be an issue in natural soils (e.g. alluvium and dock silt) in man-made soils (e.g. landfill sites and filled ground) and other environments (e.g. mine workings).                                               |
| Groundwater      | Contaminants may dissolve into pore water which in turn can percolate downwards into the groundwater table. Rapid discharge of fluids may also enter groundwater directly. Organic compounds may form separate light or dense non-aqueous phase liquids upon or at the base of the water column. Organic contaminants may generate organic vapours.                                                                                   |

## REFERENCES

- <sup>1</sup> Radon: Guidance on protective measures for new buildings, BRE Report BR 211, 2015 2<sup>ND</sup> edition
- <sup>2</sup> Revised EU Waste Framework Directive 2008 2008/98/EC [transposed into English law under The Waste (England and Wales) Regulations 2011]
- <sup>3</sup> Revised EU Waste Framework Directive 2008 2008/98/EC [transposed into English law under The Waste (England and Wales) Regulations 2011]
- <sup>4</sup> European Community (EC) Directive 1999/31/EC [transposed into English law under the Landfill (England and Wales) Regulations 2002]

## FIGURES



|                                          |                |             |                    |
|------------------------------------------|----------------|-------------|--------------------|
| Title: Site Location                     |                |             | Reference: LS 4750 |
| Project: S33 Priory Road, London, N8 8LP |                |             | Figure: 1          |
| Client: Mr Neil Brock                    |                |             | Date: 16/12/2019   |
| Prepared by: AC                          | Checked by: SP | Version: 01 | Sheet: 1 of 1      |



Title: Exploratory Hole Location Plan

Reference: LS 4750

Project: 33 Priory Road, London, N8 8LP

Figure: 2

Client: Mr Neil Brock

Date: 16/12/2019

Prepared by: AC

Checked by: SP

Version: 01

Sheet: 1 of 1



|                                         |                    |                 |
|-----------------------------------------|--------------------|-----------------|
| Title: Proposed Development Layout      | Reference: LS 4750 | Prepared by: AC |
| Project: 33 Proiry Road, London, N8 8LP | Figure: 3          | Checked by: SP  |
| Client: Mr Neil Brock                   | Date: 16/12/2019   | Version: 01     |

## **APPENDIX A**

**Machine** : Archway Dart  
**Method** : Drive-in Windowless Sampler

**Dimensions**
**Ground Level (mOD)**
**Client**

Mr Neil Brock

**Job Number**  
LS4570

**Location**
**Dates**

18/11/2019

**Engineer**

Land Science

**Sheet**  
1/2

| Depth (m) | Sample / Tests | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Description                                                                                                                                                                                                                | Legend | Water | Instr |
|-----------|----------------|-----------------|---------------|-------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-------|-------|
| 0.15-0.30 | D              |                 |               |             |                       | Concrete over dark brown , slightly sandy, slightly gravelly CLAY. Sands are fine. Gravels are fine to coarse, angular to subrounded brick, concrete, flint and occasional clinker. Rare roots and rootlets. (MADE GROUND) |        |       |       |
| 0.30-0.50 | D              |                 |               |             | (0.70)                | ... clinker and carbonaceous material from 0.30m to 0.50m                                                                                                                                                                  |        |       |       |
| 0.50-0.70 | D              |                 |               |             | 0.70                  | Stiff to very stiff, dry, light brown CLAY. (LONDON CLAY FORMATION)                                                                                                                                                        |        |       |       |
| 0.70-1.00 | D              |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 0.80      | D              |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 1.00      | SV 120kPa      |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 1.00      | D              |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 1.00      | HP 63kPa       |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 1.50      | SV 100kPa      |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 1.50      | D              |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 1.50      | HP 75kPa       |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 2.00      | SV 130kPa      |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 2.00      | D              |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 2.00      | HP 75kPa       |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 2.50      | HP 100kPa      |                 |               |             |                       | ... rare grey mottling and selenite crystal clusters from 2.50m                                                                                                                                                            |        |       |       |
| 2.50      | D              |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 2.50      | SV 164kPa      |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 3.00      | HP 110kPa      |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 3.00      | D              |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 3.00      | SV 130kPa      |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 3.50      | HP 150kPa      |                 |               |             |                       | ...rare small orange silt pockets from 3.50m to 4.00m                                                                                                                                                                      |        |       |       |
| 3.50      | D              |                 |               |             |                       | ... becoming stiff to very stiff from 3.50m                                                                                                                                                                                |        |       |       |
| 3.50      | SV 192kPa      |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 4.00      | SV 220kPa      |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 4.00      | D              |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 4.00      | HP 175kPa      |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 4.50      | SV 230kPa      |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 4.50      | D              |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 4.50      | HP 185kPa      |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 5.00      | SV 210kPa      |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 5.00      | D              |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 5.00      | HP 160kPa      |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 5.50      | HP 150kPa      |                 |               |             | (9.30)                |                                                                                                                                                                                                                            |        |       |       |
| 5.50      | D              |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 5.50      | SV 230kPa      |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 6.00      | SV 150kPa      |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 6.00      | D              |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 6.00      | HP 125kPa      |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 6.50      | HP 200kPa      |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 6.50      | D              |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 6.50      | SV 240kPa      |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 7.00      | HP 160kPa      |                 |               |             |                       | ... becoming dark brown from 7.00m                                                                                                                                                                                         |        |       |       |
| 7.00      | D              |                 |               |             |                       | ... abundant selenite crystal clusters from 7.00m to 8.00m                                                                                                                                                                 |        |       |       |
| 7.00      | SV 210kPa      |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 7.50      | SV 210kPa      |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 7.50      | D              |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 7.50      | HP 175kPa      |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 8.00      | HP 125kPa      |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 8.00      | D              |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 8.00      | SV 130kPa      |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 8.50      | HP 175kPa      |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 8.50      | D              |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 8.50      | SV 200kPa      |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 9.00      | SV 200kPa      |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 9.00      | D              |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 9.00      | HP 175kPa      |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 9.50      | HP 185kPa      |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 9.50      | D              |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 9.50      | SV 240kPa      |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 10.00     | HP 175kPa      |                 |               |             |                       |                                                                                                                                                                                                                            |        |       |       |
| 10.00     | SV 240kPa      |                 |               |             | 10.00                 |                                                                                                                                                                                                                            |        |       |       |

**Remarks**

Stability: No instability encountered  
Backfill: Position backfilled with bentonite pellets and 6m standpipe (1m plain, 5m slotted pipe) with 10mm pea gravel filter pack.  
Casing/dia: Not applicable  
Chiselling: Not applicable  
Groundwater: No groundwater encountered  
Notes: Hand excavated to 1.20mbgl

**Scale (approx)**

1:50

**Logged By**

SP

**Figure No.**

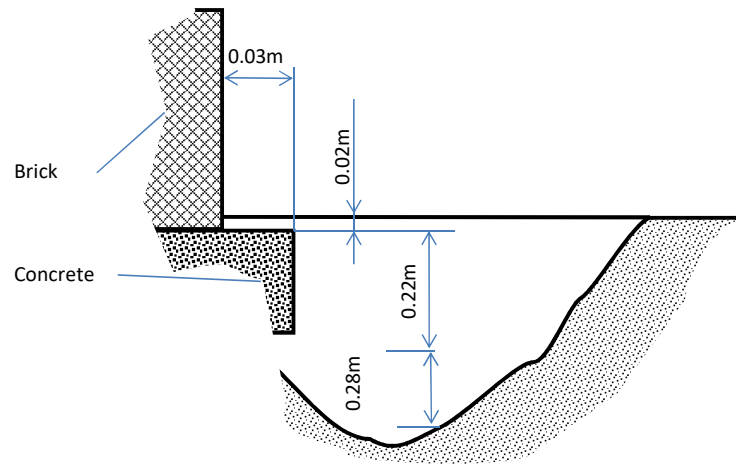
LS4570.DS01

|                                                                              |                   |                            |                                 |                             |
|------------------------------------------------------------------------------|-------------------|----------------------------|---------------------------------|-----------------------------|
| <b>Machine</b> : Archway Dart<br><b>Method</b> : Drive-in Windowless Sampler | <b>Dimensions</b> | <b>Ground Level (mOD)</b>  | <b>Client</b><br>Mr Neil Brock  | <b>Job Number</b><br>LS4570 |
|                                                                              | <b>Location</b>   | <b>Dates</b><br>18/11/2019 | <b>Engineer</b><br>Land Science | <b>Sheet</b><br>2/2         |

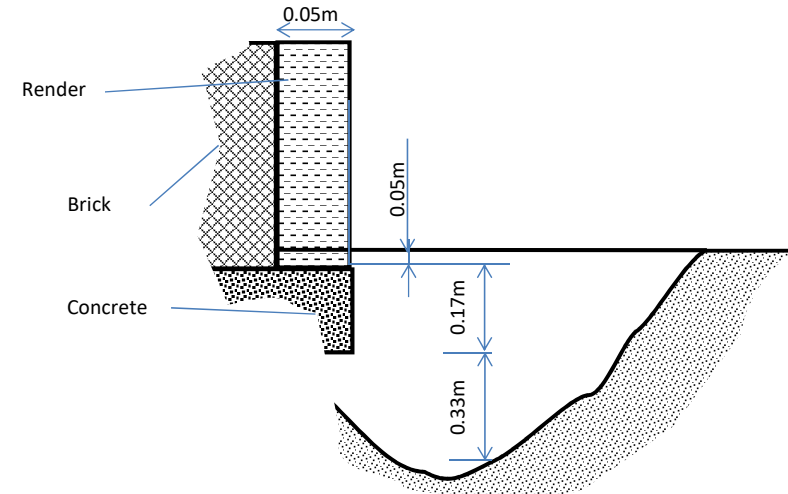
| Depth (m) | Sample / Tests | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Legend | Water | Instr |
|-----------|----------------|-----------------|---------------|-------------|-----------------------|-------------|--------|-------|-------|
| 10.00     | D              |                 |               |             |                       |             |        |       |       |

|                |                                  |                        |
|----------------|----------------------------------|------------------------|
| <b>Remarks</b> | <b>Scale (approx)</b><br>1:50    | <b>Logged By</b><br>SP |
|                | <b>Figure No.</b><br>LS4570.DS01 |                        |

## FE1 - Garage



## FE2 - Wall



0.0-0.13m - Concrete

0.13-0.50m - Loose dark brown sandy, gravelly CLAY with brick cobbles and roots - Gravel is fine to coarse angular to sub-rounded (MADE GROUND)

|                 |                                 |                 |        |                  |            |
|-----------------|---------------------------------|-----------------|--------|------------------|------------|
| <b>TITLE:</b>   | Foundation Exposures            | <b>REF:</b>     | LS4570 | <b>PREPARED:</b> | SP         |
| <b>PROJECT:</b> | 33 Priory Road, London, NW8 8LP | <b>VERSION:</b> | v1     | <b>CHECKED:</b>  | ET         |
| <b>CLIENT:</b>  | Mr Neil Brock                   | <b>FIGURE:</b>  | 1      | <b>DATE:</b>     | 20/11/2019 |

## **APPENDIX B**

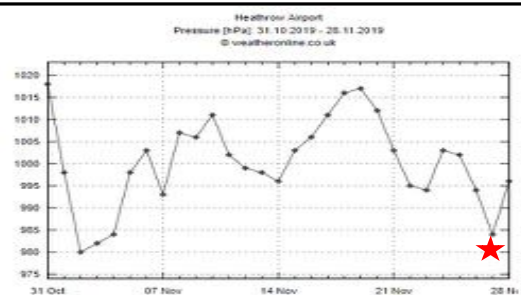
# GROUND GAS AND GROUNDWATER MONITORING

**Project:** 33 Priory Road  
**Date:** 27/11/2019  
**Engineer:** JZ  
**Weather:** Dry

**Ref:** LS4570  
**Visit:** 1 of 2  
**Check:** SP  
**Page:** 1 of 1

**Atmospheric Pressure**  
 before: 980mB  
 after: 980mB  
**Published pressure trend:** Fluctuating low pressure. (Heathrow Airport)

**Remarks:** Equipment used: GFX 430, Phoccheck PID, Dipmeter

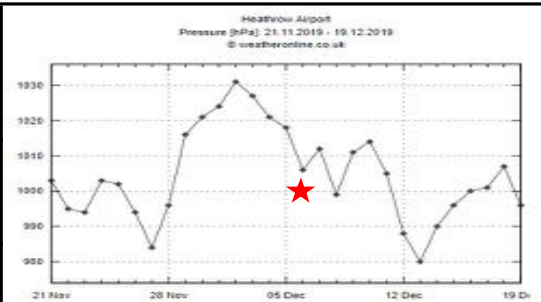


| Position          | Flow (l/hr) |     | Common Gases (%) |     |     |      | VOC's (ppm) | Groundwater (m) |       |       |      | Remarks                  |
|-------------------|-------------|-----|------------------|-----|-----|------|-------------|-----------------|-------|-------|------|--------------------------|
|                   | High        | Low | Time             | CO2 | CH4 | O2   |             | LNAPL           | Water | DNAPL | Base |                          |
| Calibration Check | 0.0         | 0.0 | 15s              | 0.0 | 0.0 | 20.0 | 0.0         | -               | -     | -     | -    | Calibration check passed |
|                   |             |     | 30s              | 0.0 | 0.0 | 20.1 |             |                 |       |       |      |                          |
|                   |             |     | 60s              | 0.0 | 0.0 | 20.2 |             |                 |       |       |      |                          |
| DS01              | 0.0         | 0.0 | 15s              | 0.0 | 0.0 | 19.4 | 0.0         | -               | Dry   | -     | 6.00 | -                        |
|                   |             |     | 30s              | 0.0 | 0.0 | 18.9 |             |                 |       |       |      |                          |
|                   |             |     | 60s              | 0.0 | 0.0 | 18.8 |             |                 |       |       |      |                          |
|                   |             |     | 120s             | 0.0 | 0.0 | 18.7 |             |                 |       |       |      |                          |
|                   |             |     | 180s             | 0.0 | 0.0 | 18.7 |             |                 |       |       |      |                          |
|                   |             |     | 240s             | 0.0 | 0.0 | 18.7 |             |                 |       |       |      |                          |
|                   |             |     | 300s             | 0.0 | 0.0 | 18.7 |             |                 |       |       |      |                          |
|                   |             |     | 15s              |     |     |      |             |                 |       |       |      |                          |
|                   |             |     | 30s              |     |     |      |             |                 |       |       |      |                          |
|                   |             |     | 60s              |     |     |      |             |                 |       |       |      |                          |
|                   |             |     | 120s             |     |     |      |             |                 |       |       |      |                          |
|                   |             |     | 180s             |     |     |      |             |                 |       |       |      |                          |
|                   |             |     | 240s             |     |     |      |             |                 |       |       |      |                          |
|                   |             |     | 300s             |     |     |      |             |                 |       |       |      |                          |
|                   |             |     | 15s              |     |     |      |             |                 |       |       |      |                          |
|                   |             |     | 30s              |     |     |      |             |                 |       |       |      |                          |
|                   |             |     | 60s              |     |     |      |             |                 |       |       |      |                          |
|                   |             |     | 120s             |     |     |      |             |                 |       |       |      |                          |
|                   |             |     | 180s             |     |     |      |             |                 |       |       |      |                          |
|                   |             |     | 240s             |     |     |      |             |                 |       |       |      |                          |
|                   |             |     | 300s             |     |     |      |             |                 |       |       |      |                          |
|                   |             |     | 15s              |     |     |      |             |                 |       |       |      |                          |
|                   |             |     | 30s              |     |     |      |             |                 |       |       |      |                          |
|                   |             |     | 60s              |     |     |      |             |                 |       |       |      |                          |
|                   |             |     | 120s             |     |     |      |             |                 |       |       |      |                          |
|                   |             |     | 180s             |     |     |      |             |                 |       |       |      |                          |
|                   |             |     | 240s             |     |     |      |             |                 |       |       |      |                          |
|                   |             |     | 300s             |     |     |      |             |                 |       |       |      |                          |
| Calibration Check | 0.0         | 0.0 | 15s              | 0.0 | 0.0 | 20.3 |             | -               | -     | -     | -    |                          |
|                   |             |     | 30s              | 0.0 | 0.0 | 20.3 |             |                 |       |       |      |                          |
|                   |             |     | 60s              | 0.0 | 0.0 | 20.3 |             |                 |       |       |      |                          |

# GROUND GAS AND GROUNDWATER MONITORING

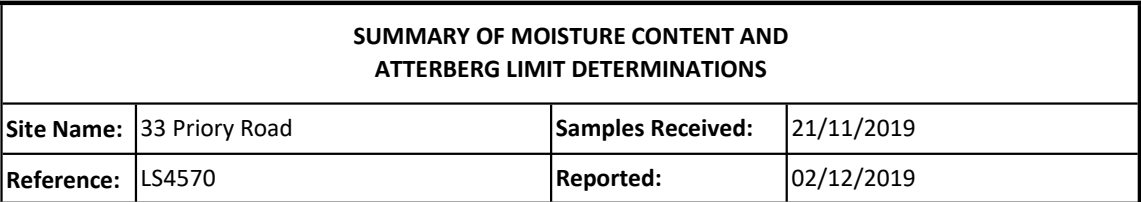
|                                  |                |                                              |        |
|----------------------------------|----------------|----------------------------------------------|--------|
| <b>Project:</b>                  | 33 Priory Road | <b>Ref:</b>                                  | LS4570 |
| <b>Date:</b>                     | 06/12/2019     | <b>Visit:</b>                                | 2 of 2 |
| <b>Engineer:</b>                 | LB             | <b>Check:</b>                                | SP     |
| <b>Weather:</b>                  | Overcast       | <b>Page:</b>                                 | 1 of 1 |
| <b>Atmospheric Pressure</b>      |                | <b>before:</b>                               | 1001mB |
|                                  |                | <b>after:</b>                                | 1000mB |
| <b>Published pressure trend:</b> |                | Fluctuating low pressure. (Heathrow Airport) |        |

**Remarks:** Equipment used: GFX 430, Phoccheck PID, Dipmeter



| Position          | Flow (l/hr) |     | Common Gases (%) |     |     |      | VOC's (ppm) | Groundwater (m) |       |       |       | Remarks                  |
|-------------------|-------------|-----|------------------|-----|-----|------|-------------|-----------------|-------|-------|-------|--------------------------|
|                   | High        | Low | Time             | CO2 | CH4 | O2   |             | LNAPL           | Water | DNAPL | Base  |                          |
| Calibration Check | 0.0         | 0.0 | 15s              | 0.0 | 0.0 | 20.5 | 0.0         | -               | -     | -     | -     | Calibration check passed |
|                   |             |     | 30s              | 0.0 | 0.0 | 20.4 |             |                 |       |       |       |                          |
|                   |             |     | 60s              | 0.0 | 0.0 | 20.4 |             |                 |       |       |       |                          |
| DS01              | 0.0         | 0.0 | 15s              | 0.0 | 0.0 | 20.2 | 0.2         | -               | Dry   | -     | 5.90m | -                        |
|                   |             |     | 30s              | 0.0 | 0.0 | 20.2 |             |                 |       |       |       |                          |
|                   |             |     | 60s              | 0.0 | 0.0 | 20.0 |             |                 |       |       |       |                          |
|                   |             |     | 120s             | 0.0 | 0.0 | 20.2 |             |                 |       |       |       |                          |
|                   |             |     | 180s             | 0.0 | 0.0 | 20.2 |             |                 |       |       |       |                          |
|                   |             |     | 240s             | 0.0 | 0.0 | 20.3 |             |                 |       |       |       |                          |
|                   |             |     | 300s             | 0.0 | 0.0 | 20.2 |             |                 |       |       |       |                          |
|                   |             |     | 15s              |     |     |      |             |                 |       |       |       |                          |
|                   |             |     | 30s              |     |     |      |             |                 |       |       |       |                          |
|                   |             |     | 60s              |     |     |      |             |                 |       |       |       |                          |
|                   |             |     | 120s             |     |     |      |             |                 |       |       |       |                          |
|                   |             |     | 180s             |     |     |      |             |                 |       |       |       |                          |
|                   |             |     | 240s             |     |     |      |             |                 |       |       |       |                          |
|                   |             |     | 300s             |     |     |      |             |                 |       |       |       |                          |
|                   |             |     | 15s              |     |     |      |             |                 |       |       |       |                          |
|                   |             |     | 30s              |     |     |      |             |                 |       |       |       |                          |
|                   |             |     | 60s              |     |     |      |             |                 |       |       |       |                          |
|                   |             |     | 120s             |     |     |      |             |                 |       |       |       |                          |
|                   |             |     | 180s             |     |     |      |             |                 |       |       |       |                          |
|                   |             |     | 240s             |     |     |      |             |                 |       |       |       |                          |
|                   |             |     | 300s             |     |     |      |             |                 |       |       |       |                          |
|                   |             |     | 15s              |     |     |      |             |                 |       |       |       |                          |
|                   |             |     | 30s              |     |     |      |             |                 |       |       |       |                          |
|                   |             |     | 60s              |     |     |      |             |                 |       |       |       |                          |
|                   |             |     | 120s             |     |     |      |             |                 |       |       |       |                          |
|                   |             |     | 180s             |     |     |      |             |                 |       |       |       |                          |
|                   |             |     | 240s             |     |     |      |             |                 |       |       |       |                          |
|                   |             |     | 300s             |     |     |      |             |                 |       |       |       |                          |
|                   |             |     | 15s              |     |     |      |             |                 |       |       |       |                          |
|                   |             |     | 30s              |     |     |      |             |                 |       |       |       |                          |
|                   |             |     | 60s              |     |     |      |             |                 |       |       |       |                          |
|                   |             |     | 120s             |     |     |      |             |                 |       |       |       |                          |
|                   |             |     | 180s             |     |     |      |             |                 |       |       |       |                          |
|                   |             |     | 240s             |     |     |      |             |                 |       |       |       |                          |
|                   |             |     | 300s             |     |     |      |             |                 |       |       |       |                          |
| Calibration Check | 0.0         | 0.0 | 15s              | 0.0 | 0.0 | 20.7 | 0.0         | -               | -     | -     | -     |                          |
|                   |             |     | 30s              | 0.0 | 0.0 | 20.5 |             |                 |       |       |       |                          |
|                   |             |     | 60s              | 0.0 | 0.0 | 20.4 |             |                 |       |       |       |                          |

## **APPENDIX C**

[illegible]



# TEST CERTIFICATE

## Unconsolidated Undrained Triaxial Compression

i2 Analytical Ltd  
7 Woodshots Meadow  
Croxley Green Business Park  
Watford Herts WD18 8YS



Tested in Accordance with: BS 1377-7: 1990: Clause 9

Client: Land Science  
Client Address: The Old Police Station, Jobs Lane,  
Sayers Common, West Sussex,  
BN6 9HE  
Contact: Tom Kistruck  
Site Name: 33 Priory Road, London  
Site Address: Not Given

Client Reference: LS4570  
Job Number: 19-73290  
Date Sampled: 20/11/2019  
Date Received: 21/11/2019  
Date Tested: 26/11/2019  
Sampled By: Not Given

### Test Results:

Laboratory Reference: 1369518  
Hole No.: DS01  
Sample Reference: Not Given  
Sample Description: Brown slightly gravelly CLAY

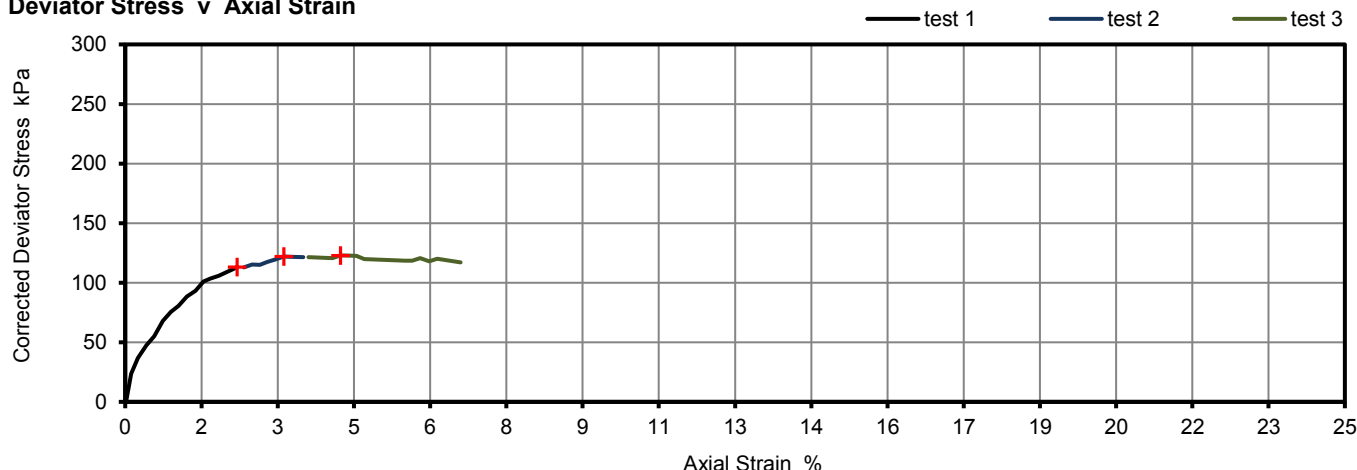
Depth Top [m]: 3.00  
Depth Base [m]: Not Given  
Sample Type: C

|                    |        |                   |
|--------------------|--------|-------------------|
| Length             | 141.10 | mm                |
| Diameter           | 69.50  | mm                |
| Bulk Density       | 1.91   | Mg/m <sup>3</sup> |
| Moisture Content   | 23     | %                 |
| Dry Density        | 1.55   | Mg/m <sup>3</sup> |
| Membrane thickness | 0.31   | mm                |

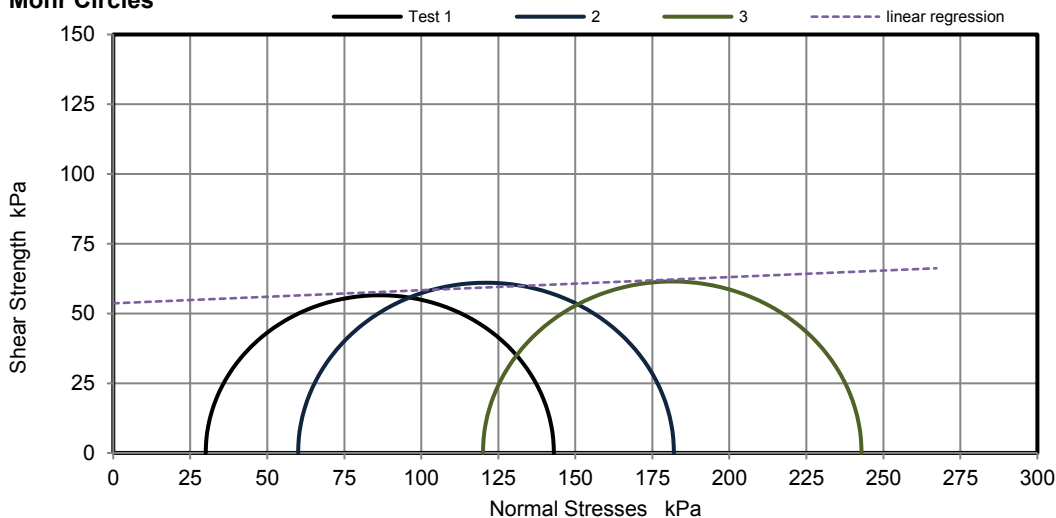
Rate of Strain  
Stage Number  
Cell Pressure  
Axial Strain at failure  
Deviator Stress, ( $\sigma_1 - \sigma_3$ )  
Shear strength,  $c_u$   
Mode of failure  
Membrane Correction

| 2.00    |      |      | %/min |
|---------|------|------|-------|
| 1       | 2    | 3    |       |
| 30      | 60   | 120  | kPa   |
| 2.3     | 3.3  | 4.4  | %     |
| 113     | 122  | 123  | kPa   |
| 57      | 61   | 61   | kPa   |
| Brittle |      |      |       |
| 0.28    | 0.40 | 0.54 | kPa   |

### Deviator Stress v Axial Strain



### Mohr Circles



Position within sample



Linear Regression  
 $\phi_u$  2.7 °  
 $c_u$  54 kPa

Note: Mohr circles and their interpretation is not covered by BS1377. These are provided for information only.

Remarks: Correction values: 30kPa=17N, 60kPa=31N, 120kPa=60N.

Approved: Dariusz Piotrowski  
PL Geotechnical Laboratory Manager  
Date Reported: 02/12/2019

Signed: Darren Berrill  
Geotechnical General Manager

for and on behalf of i2 Analytical Ltd GF 186.7

\*Opinions and interpretations expressed herein are outside of the scope of the UKAS Accreditation.  
This report may not be reproduced other than in full without the prior written approval of the issuing laboratory.  
The results included within the report are representative of the samples submitted for analysis.  
The analysis was carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland.\*

## **APPENDIX D**

**Sam Prior**

Land Science  
The Old Police Station  
Jobs Lane  
Sayers Common  
West Sussex  
BN6 9HE

**t:** 0845 604 6494

**e:** sam.prior@landscience.co.uk

i2 Analytical Ltd.  
7 Woodshots Meadow,  
Croxley Green  
Business Park,  
Watford,  
Herts,  
WD18 8YS

**t:** 01923 225404

**f:** 01923 237404

**e:** reception@i2analytical.com

## **Analytical Report Number : 19-73160**

**Project / Site name:** 33 Priory Road, London, NW8 8LP

**Samples received on:** 21/11/2019

**Your job number:** LS4570

**Samples instructed on:** 21/11/2019

**Your order number:**

**Analysis completed by:** 02/12/2019

**Report Issue Number:** 1

**Report issued on:** 02/12/2019

**Samples Analysed:** 1 leachate sample - 4 soil samples

**Signed:**

Zina Abdul Razzak  
Senior Quality Specialist

**For & on behalf of i2 Analytical Ltd.**

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

|           |                           |
|-----------|---------------------------|
| soils     | - 4 weeks from reporting  |
| leachates | - 2 weeks from reporting  |
| waters    | - 2 weeks from reporting  |
| asbestos  | - 6 months from reporting |

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.

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The results included within the report are representative of the samples submitted for analysis.

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Analytical Report Number: 19-73160

Project / Site name: 33 Priory Road, London, NW8 8LP

| Lab Sample Number                       |       |                       |                         | 1368793       | 1368794       | 1368795       | 1368796       |  |
|-----------------------------------------|-------|-----------------------|-------------------------|---------------|---------------|---------------|---------------|--|
| Sample Reference                        |       |                       |                         | DS01          | DS01          | DS01          | DS01          |  |
| Sample Number                           |       |                       |                         | None Supplied | None Supplied | None Supplied | None Supplied |  |
| Depth (m)                               |       |                       |                         | 0.50          | 0.80          | 1.50          | 2.50          |  |
| Date Sampled                            |       |                       |                         | 18/11/2019    | 18/11/2019    | 18/11/2019    | 18/11/2019    |  |
| Time Taken                              |       |                       |                         | None Supplied | None Supplied | None Supplied | None Supplied |  |
| Analytical Parameter<br>(Soil Analysis) | Units | Limit of<br>detection | Accreditation<br>Status |               |               |               |               |  |
| Stone Content                           | %     | 0.1                   | NONE                    | < 0.1         | < 0.1         | < 0.1         | < 0.1         |  |
| Moisture Content                        | %     | N/A                   | NONE                    | 16            | 18            | 17            | 20            |  |
| Total mass of sample received           | kg    | 0.001                 | NONE                    | 0.78          | 0.58          | 0.78          | 0.70          |  |

|                  |      |     |           |              |   |   |   |  |
|------------------|------|-----|-----------|--------------|---|---|---|--|
| Asbestos in Soil | Type | N/A | ISO 17025 | Not-detected | - | - | - |  |
|------------------|------|-----|-----------|--------------|---|---|---|--|

#### General Inorganics

|                                                                         |            |         |        |       |      |      |     |  |
|-------------------------------------------------------------------------|------------|---------|--------|-------|------|------|-----|--|
| pH - Manual                                                             | pH Units   | N/A     | MCERTS | 5.6   | -    | -    | -   |  |
| pH - Automated                                                          | pH Units   | N/A     | MCERTS | 6.9   | 7.9  | 8.3  | 7.5 |  |
| Total Cyanide                                                           | mg/kg      | 1       | MCERTS | < 1   | -    | -    | -   |  |
| Water Soluble SO <sub>4</sub> 16hr extraction (2:1 Leachate Equivalent) | g/l        | 0.00125 | MCERTS | 0.24  | 0.28 | 0.17 | 1.9 |  |
| Sulphide                                                                | mg/kg      | 1       | MCERTS | < 1.0 | -    | -    | -   |  |
| Fraction Organic Carbon (FOC)                                           | N/A        | 0.001   | MCERTS | 0.013 | -    | -    | -   |  |
| Total Organic Carbon (TOC)                                              | %          | 0.1     | MCERTS | 1.3   | -    | -    | -   |  |
| Loss on Ignition @ 450°C                                                | %          | 0.2     | MCERTS | 6.1   | -    | -    | -   |  |
| Acid Neutralisation Capacity                                            | +/- mol/kg | -999    | NONE   | -8.3  | -    | -    | -   |  |

#### Total Phenols

|                            |       |   |        |       |   |   |   |  |
|----------------------------|-------|---|--------|-------|---|---|---|--|
| Total Phenols (monohydric) | mg/kg | 1 | MCERTS | < 1.0 | - | - | - |  |
|----------------------------|-------|---|--------|-------|---|---|---|--|

#### Speciated PAHs

|                        |       |      |        |        |   |   |   |  |
|------------------------|-------|------|--------|--------|---|---|---|--|
| Naphthalene            | mg/kg | 0.05 | MCERTS | < 0.05 | - | - | - |  |
| Acenaphthylene         | mg/kg | 0.05 | MCERTS | < 0.05 | - | - | - |  |
| Acenaphthene           | mg/kg | 0.05 | MCERTS | < 0.05 | - | - | - |  |
| Fluorene               | mg/kg | 0.05 | MCERTS | < 0.05 | - | - | - |  |
| Phenanthrene           | mg/kg | 0.05 | MCERTS | 0.40   | - | - | - |  |
| Anthracene             | mg/kg | 0.05 | MCERTS | 0.12   | - | - | - |  |
| Fluoranthene           | mg/kg | 0.05 | MCERTS | 1.1    | - | - | - |  |
| Pyrene                 | mg/kg | 0.05 | MCERTS | 1.4    | - | - | - |  |
| Benzo(a)anthracene     | mg/kg | 0.05 | MCERTS | 0.85   | - | - | - |  |
| Chrysene               | mg/kg | 0.05 | MCERTS | 0.59   | - | - | - |  |
| Benzo(b)fluoranthene   | mg/kg | 0.05 | MCERTS | 0.73   | - | - | - |  |
| Benzo(k)fluoranthene   | mg/kg | 0.05 | MCERTS | 0.55   | - | - | - |  |
| Benzo(a)pyrene         | mg/kg | 0.05 | MCERTS | 0.69   | - | - | - |  |
| Indeno(1,2,3-cd)pyrene | mg/kg | 0.05 | MCERTS | 0.34   | - | - | - |  |
| Dibenz(a,h)anthracene  | mg/kg | 0.05 | MCERTS | < 0.05 | - | - | - |  |
| Benzo(ghi)perylene     | mg/kg | 0.05 | MCERTS | 0.37   | - | - | - |  |
| Coronene               | mg/kg | 0.05 | NONE   | < 0.05 | - | - | - |  |

#### Total PAH

|                   |       |      |      |     |   |   |   |  |
|-------------------|-------|------|------|-----|---|---|---|--|
| Total WAC-17 PAHs | mg/kg | 0.85 | NONE | 7.2 | - | - | - |  |
|-------------------|-------|------|------|-----|---|---|---|--|

Analytical Report Number: 19-73160

Project / Site name: 33 Priory Road, London, NW8 8LP

|                                         |               |                       |                         |               |  |
|-----------------------------------------|---------------|-----------------------|-------------------------|---------------|--|
| Lab Sample Number                       | 1368793       | 1368794               | 1368795                 | 1368796       |  |
| Sample Reference                        | DS01          | DS01                  | DS01                    | DS01          |  |
| Sample Number                           | None Supplied | None Supplied         | None Supplied           | None Supplied |  |
| Depth (m)                               | 0.50          | 0.80                  | 1.50                    | 2.50          |  |
| Date Sampled                            | 18/11/2019    | 18/11/2019            | 18/11/2019              | 18/11/2019    |  |
| Time Taken                              | None Supplied | None Supplied         | None Supplied           | None Supplied |  |
| Analytical Parameter<br>(Soil Analysis) | Units         | Limit of<br>detection | Accreditation<br>Status |               |  |

#### Heavy Metals / Metalloids

|                                    |       |      |        |       |   |   |   |  |
|------------------------------------|-------|------|--------|-------|---|---|---|--|
| Arsenic (aqua regia extractable)   | mg/kg | 1    | MCERTS | 20    | - | - | - |  |
| Barium (aqua regia extractable)    | mg/kg | 1    | MCERTS | 150   | - | - | - |  |
| Beryllium (aqua regia extractable) | mg/kg | 0.06 | MCERTS | 2.1   | - | - | - |  |
| Boron (water soluble)              | mg/kg | 0.2  | MCERTS | 2.5   | - | - | - |  |
| Cadmium (aqua regia extractable)   | mg/kg | 0.2  | MCERTS | < 0.2 | - | - | - |  |
| Chromium (hexavalent)              | mg/kg | 1.2  | MCERTS | < 1.2 | - | - | - |  |
| Chromium (aqua regia extractable)  | mg/kg | 1    | MCERTS | 48    | - | - | - |  |
| Copper (aqua regia extractable)    | mg/kg | 1    | MCERTS | 45    | - | - | - |  |
| Lead (aqua regia extractable)      | mg/kg | 1    | MCERTS | 220   | - | - | - |  |
| Mercury (aqua regia extractable)   | mg/kg | 0.3  | MCERTS | 0.5   | - | - | - |  |
| Nickel (aqua regia extractable)    | mg/kg | 1    | MCERTS | 39    | - | - | - |  |
| Selenium (aqua regia extractable)  | mg/kg | 1    | MCERTS | < 1.0 | - | - | - |  |
| Vanadium (aqua regia extractable)  | mg/kg | 1    | MCERTS | 95    | - | - | - |  |
| Zinc (aqua regia extractable)      | mg/kg | 1    | MCERTS | 190   | - | - | - |  |

#### Monoaromatics & Oxygenates

|              |       |    |        |       |   |   |   |  |
|--------------|-------|----|--------|-------|---|---|---|--|
| Benzene      | µg/kg | 1  | MCERTS | < 1.0 | - | - | - |  |
| Toluene      | µg/kg | 1  | MCERTS | < 1.0 | - | - | - |  |
| Ethylbenzene | µg/kg | 1  | MCERTS | < 1.0 | - | - | - |  |
| p & m-xylene | µg/kg | 1  | MCERTS | < 1.0 | - | - | - |  |
| o-xylene     | µg/kg | 1  | MCERTS | < 1.0 | - | - | - |  |
| Total BTEX   | µg/kg | 10 | MCERTS | < 10  | - | - | - |  |

#### Petroleum Hydrocarbons

|                         |       |    |      |      |   |   |   |  |
|-------------------------|-------|----|------|------|---|---|---|--|
| Mineral Oil (C10 - C40) | mg/kg | 10 | NONE | < 10 | - | - | - |  |
|-------------------------|-------|----|------|------|---|---|---|--|

#### PCBs by GC-MS

|                  |       |       |        |         |   |   |   |  |
|------------------|-------|-------|--------|---------|---|---|---|--|
| PCB Congener 28  | mg/kg | 0.001 | MCERTS | < 0.001 | - | - | - |  |
| PCB Congener 52  | mg/kg | 0.001 | MCERTS | < 0.001 | - | - | - |  |
| PCB Congener 101 | mg/kg | 0.001 | MCERTS | < 0.001 | - | - | - |  |
| PCB Congener 118 | mg/kg | 0.001 | MCERTS | < 0.001 | - | - | - |  |
| PCB Congener 138 | mg/kg | 0.001 | MCERTS | < 0.001 | - | - | - |  |
| PCB Congener 153 | mg/kg | 0.001 | MCERTS | < 0.001 | - | - | - |  |
| PCB Congener 180 | mg/kg | 0.001 | MCERTS | < 0.001 | - | - | - |  |

#### Total PCBs by GC-MS

|            |       |       |        |         |   |   |   |  |
|------------|-------|-------|--------|---------|---|---|---|--|
| Total PCBs | mg/kg | 0.007 | MCERTS | < 0.007 | - | - | - |  |
|------------|-------|-------|--------|---------|---|---|---|--|



Analytical Report Number: 19-73160

Project / Site name: 33 Priory Road, London, NW8 8LP

|                                             |  |  |  |               |                       |                         |  |  |
|---------------------------------------------|--|--|--|---------------|-----------------------|-------------------------|--|--|
| Lab Sample Number                           |  |  |  | 1368797       |                       |                         |  |  |
| Sample Reference                            |  |  |  | DS01          |                       |                         |  |  |
| Sample Number                               |  |  |  | None Supplied |                       |                         |  |  |
| Depth (m)                                   |  |  |  | 0.50          |                       |                         |  |  |
| Date Sampled                                |  |  |  | 18/11/2019    |                       |                         |  |  |
| Time Taken                                  |  |  |  | None Supplied |                       |                         |  |  |
| Analytical Parameter<br>(Leachate Analysis) |  |  |  | Units         | Limit of<br>detection | Accreditation<br>Status |  |  |

#### 10:1 WAC Leachate

|                          |      |         |           |          |  |  |  |  |
|--------------------------|------|---------|-----------|----------|--|--|--|--|
| Arsenic                  | mg/l | 0.0011  | ISO 17025 | 0.0063   |  |  |  |  |
| Barium                   | mg/l | 0.00005 | ISO 17025 | 0.0529   |  |  |  |  |
| Cadmium                  | mg/l | 0.0001  | ISO 17025 | < 0.0001 |  |  |  |  |
| Chromium                 | mg/l | 0.0004  | ISO 17025 | 0.0011   |  |  |  |  |
| Copper                   | mg/l | 0.0007  | ISO 17025 | 0.0097   |  |  |  |  |
| Mercury                  | mg/l | 0.0005  | ISO 17025 | 0.0014   |  |  |  |  |
| Molybdenum               | mg/l | 0.0004  | ISO 17025 | 0.0212   |  |  |  |  |
| Nickel                   | mg/l | 0.0003  | ISO 17025 | 0.0033   |  |  |  |  |
| Lead                     | mg/l | 0.001   | ISO 17025 | 0.0042   |  |  |  |  |
| Antimony                 | mg/l | 0.0017  | ISO 17025 | < 0.0017 |  |  |  |  |
| Selenium                 | mg/l | 0.004   | ISO 17025 | < 0.0040 |  |  |  |  |
| Zinc                     | mg/l | 0.0004  | ISO 17025 | 0.0029   |  |  |  |  |
| Chloride                 | mg/l | 0.15    | ISO 17025 | 18       |  |  |  |  |
| Fluoride                 | mg/l | 0.05    | ISO 17025 | 1.2      |  |  |  |  |
| Sulphate                 | mg/l | 0.1     | ISO 17025 | 42       |  |  |  |  |
| Total dissolved solids   | mg/l | 4       | NONE      | 220      |  |  |  |  |
| Total monohydric phenols | mg/l | 0.01    | ISO 17025 | < 0.010  |  |  |  |  |
| Dissolved organic carbon | mg/l | 0.1     | NONE      | 12.0     |  |  |  |  |

#### 10:1 WAC Leachate

|                          |       |        |      |          |  |  |  |  |
|--------------------------|-------|--------|------|----------|--|--|--|--|
| Arsenic                  | mg/kg | 0.011  | NONE | 0.0538   |  |  |  |  |
| Barium                   | mg/kg | 0.0005 | NONE | 0.450    |  |  |  |  |
| Cadmium                  | mg/kg | 0.0008 | NONE | < 0.0008 |  |  |  |  |
| Chromium                 | mg/kg | 0.004  | NONE | 0.0094   |  |  |  |  |
| Copper                   | mg/kg | 0.007  | NONE | 0.082    |  |  |  |  |
| Mercury                  | mg/kg | 0.005  | NONE | 0.0120   |  |  |  |  |
| Molybdenum               | mg/kg | 0.004  | NONE | 0.180    |  |  |  |  |
| Nickel                   | mg/kg | 0.003  | NONE | 0.028    |  |  |  |  |
| Lead                     | mg/kg | 0.01   | NONE | 0.035    |  |  |  |  |
| Antimony                 | mg/kg | 0.017  | NONE | < 0.017  |  |  |  |  |
| Selenium                 | mg/kg | 0.04   | NONE | < 0.040  |  |  |  |  |
| Zinc                     | mg/kg | 0.004  | NONE | 0.025    |  |  |  |  |
| Chloride                 | mg/kg | 1.5    | NONE | 150      |  |  |  |  |
| Fluoride                 | mg/kg | 0.5    | NONE | 10       |  |  |  |  |
| Sulphate                 | mg/kg | 1      | NONE | 350      |  |  |  |  |
| Total dissolved solids   | mg/kg | 40     | NONE | 1800     |  |  |  |  |
| Total monohydric phenols | mg/kg | 0.1    | NONE | < 0.10   |  |  |  |  |
| Dissolved organic carbon | mg/kg | 1      | NONE | 102      |  |  |  |  |



**Analytical Report Number : 19-73160**

**Project / Site name: 33 Priory Road, London, NW8 8LP**

\* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

| Lab Sample Number | Sample Reference | Sample Number | Depth (m) | Sample Description *          |
|-------------------|------------------|---------------|-----------|-------------------------------|
| 1368793           | DS01             | None Supplied | 0.50      | Brown sandy clay with gravel. |
| 1368794           | DS01             | None Supplied | 0.80      | Brown clay.                   |
| 1368795           | DS01             | None Supplied | 1.50      | Brown clay.                   |
| 1368796           | DS01             | None Supplied | 2.50      | Brown clay.                   |

**Analytical Report Number : 19-73160**

**Project / Site name: 33 Priory Road, London, NW8 8LP**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

| Analytical Test Name                             | Analytical Method Description                                                                                                                         | Analytical Method Reference                                                                            | Method number | Wet / Dry Analysis | Accreditation Status |
|--------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|---------------|--------------------|----------------------|
| Acid neutralisation capacity of soil             | Determination of acid neutralisation capacity by addition of acid or alkali followed by electronic probe.                                             | In-house method based on Guidance on Sampling and Testing of Wastes to Meet Landfill Waste Acceptance" | L046-PL       | W                  | NONE                 |
| Asbestos identification in soil                  | Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques.                                | In house method based on HSG 248                                                                       | A001-PL       | D                  | ISO 17025            |
| Boron, water soluble, in soil                    | Determination of water soluble boron in soil by hot water extract followed by ICP-OES.                                                                | In-house method based on Second Site Properties version 3                                              | L038-PL       | D                  | MCERTS               |
| BS EN 12457-2 (10:1) Leachate Prep               | 10:1 (as received, moisture adjusted) end over end extraction with water for 24 hours. Eluate filtered prior to analysis.                             | In-house method based on BSEN12457-2.                                                                  | L043-PL       | W                  | NONE                 |
| BTEX in soil (Monoaromatics)                     | Determination of BTEX in soil by headspace GC-MS.                                                                                                     | In-house method based on USEPA8260                                                                     | L073B-PL      | W                  | MCERTS               |
| Chloride 10:1 WAC                                | Determination of Chloride colorimetrically by discrete analyser.                                                                                      | In house based on MEWAM Method ISBN 0117516260.                                                        | L082-PL       | W                  | ISO 17025            |
| D.O. for Gravimetric Quant if Screen/ID positive | Dependent option for Gravimetric Quant if Screen/ID positive scheduled.                                                                               | In house asbestos methods A001 & A006.                                                                 | A006-PL       | D                  | NONE                 |
| Dissolved organic carbon 10:1 WAC                | Determination of dissolved inorganic carbon in leachate by TOC/DOC NDIR Analyser.                                                                     | In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton | L037-PL       | W                  | NONE                 |
| Fluoride 10:1 WAC                                | Determination of fluoride in leachate by 1:1ratio with a buffer solution followed by Ion Selective Electrode.                                         | In-house method based on Use of Total Ionic Strength Adjustment Buffer for Electrode Determination"    | L033B-PL      | W                  | ISO 17025            |
| Fraction of Organic Carbon in soil               | Determination of fraction of organic carbon in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.             | In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests                       | L009-PL       | D                  | MCERTS               |
| Hexavalent chromium in soil (Lower Level)        | Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry. | In-house method                                                                                        | L080-PL       | W                  | MCERTS               |
| Loss on ignition of soil @ 450oC                 | Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace.                                       | In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests                       | L047-PL       | D                  | MCERTS               |
| Metals in leachate by ICP-OES                    | Determination of metals in leachate by acidification followed by ICP-OES.                                                                             | In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil"                   | L039-PL       | W                  | ISO 17025            |
| Metals in soil by ICP-OES                        | Determination of metals in soil by aqua-regia digestion followed by ICP-OES.                                                                          | In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.                   | L038-PL       | D                  | MCERTS               |
| Mineral Oil (Soil) C10 - C40                     | Determination of mineral oil fraction extractable hydrocarbons in soil by GC-MS/GC-FID.                                                               | In-house method with silica gel split/clean up.                                                        | L076-PL       | D                  | NONE                 |
| Moisture Content                                 | Moisture content, determined gravimetrically. (30 oC)                                                                                                 | In-house method based on BS1377 Part 2, 1990, Classification tests                                     | L019-UK/PL    | W                  | NONE                 |
| Monohydric phenols 10:1 WAC                      | Determination of phenols in leachate by distillation followed by colorimetry.                                                                         | In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton | L080-PL       | W                  | ISO 17025            |

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**Project / Site name: 33 Priory Road, London, NW8 8LP**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

| Analytical Test Name                               | Analytical Method Description                                                                                                                                          | Analytical Method Reference                                                                                                       | Method number | Wet / Dry Analysis | Accreditation Status |
|----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|---------------|--------------------|----------------------|
| Monohydric phenols in soil                         | Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.                                                 | In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)                   | L080-PL       | W                  | MCERTS               |
| PCB's By GC-MS in soil                             | Determination of PCB by extraction with acetone and hexane followed by GC-MS.                                                                                          | In-house method based on USEPA 8082                                                                                               | L027-PL       | D                  | MCERTS               |
| pH in soil                                         | Determination of pH in soil by addition of water followed by electrometric measurement.                                                                                | In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests                                                  | L005-PL       | W                  | MCERTS               |
| pH in soil (automated)                             | Determination of pH in soil by addition of water followed by automated electrometric measurement.                                                                      | In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests                                                  | L099-PL       | D                  | MCERTS               |
| Speciated WAC-17 PAHs in soil                      | Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.                 | In-house method based on USEPA 8270. MCERTS accredited except Coronene.                                                           | L064-PL       | D                  | NONE                 |
| Stones content of soil                             | Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.                                            | In-house method based on British Standard Methods and MCERTS requirements.                                                        | L019-UK/PL    | D                  | NONE                 |
| Sulphate 10:1 WAC                                  | Determination of sulphate in leachate by ICP-OES                                                                                                                       | In-house method based on MEWAM 1986 Methods for the Determination of Metals in Soil"                                              | L039-PL       | W                  | ISO 17025            |
| Sulphate, water soluble, in soil (16hr extraction) | Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).              | In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP-OES. | L038-PL       | D                  | MCERTS               |
| Sulphide in soil                                   | Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode. | In-house method                                                                                                                   | L010-PL       | D                  | MCERTS               |
| Total cyanide in soil                              | Determination of total cyanide by distillation followed by colorimetry.                                                                                                | In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)                   | L080-PL       | W                  | MCERTS               |
| Total dissolved solids 10:1 WAC                    | Determination of total dissolved solids in water by electrometric measurement.                                                                                         | In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton                            | L004-PL       | W                  | NONE                 |
| Total organic carbon (Automated) in soil           | Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.                                          | In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests"                                                 | L009-PL       | D                  | MCERTS               |

**For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.**

**For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.**

**Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.**