2 Gayton Road, NW3

Basement Impact Assessment

Prepared for

Mr Ben Van Bruggen

August 2015

2 Gayton Road

Basement Impact Assessment

Contents

1.0 Introduction

Alan Baxter Limited have been appointed as consulting civil and structural engineers to Mr Ben Van Bruggen to provide design services in relation to proposed additions to No. 2 Gayton Road, NW3, in the London Borough of Camden. The client has also appointed Madoc Architects as their architect and lead consultant.

The proposed development comprises the extension of the existing basement of this late Victorian semi-detached house and the construction of a two storey extension above the new basement. This Basement Impact assessment has been produced as part of the planning application

The BIA describes the structural scheme design of the basement and the overall sequence of construction assumed in the design. It also considers the impact of the basement construction on adjacent properties, surface and groundwater flows and slope stability.

This report has been based on the following information:

- Historical maps and an in house desk study
- Geological survey maps and BGS borehole records
- Proposed layout drawings by Madoc Architecture
- A site investigation carried out by Southern testing during July 2015 (Appendix E)

In preparing the BIA reference has been made to the following London Borough of Camden documents:

- Camden Local Development Framework (LDF) Policy DP27
- Camden Planning Guidance – Basements and Lightwells CPG4
- Camden Geological, Hydrogeological and Hydrological Study – Guidance for Subterranean Development prepared by ARUP

The BIA has been undertaken by the following persons, holding the stated qualifications:

Alan Baxter Limited	David Probert	MEng
	Jim Gardiner	BSc MICE MIStructE
Southern Testing	David Vooght	MSc
	J.N. Race	MSc CGeol

1.1 Site history

The site is located in the London Borough of Camden in the Hampstead Conservation area and it comprises 4 storey building including one storey of basement (for a site location plan and photos refer to Appendix A). A brief summary of the development of the site based on the historical maps for the area is:

1766 – Hampstead has been developed with the High Street laid out. The location of the site appears to be undeveloped.

1866 – The high street is lined with terraced houses on each side and further up the hill Hampstead is well developed. The site is in the rear garden of a property on the High street.

1894 – There is a large development to the north of the High Street which includes the formation of Gayton Road with a row of terraced houses on each side. No.2 Gayton Road appears in its current form.

1945 – The site suffered no bomb damage along with most of the houses in the near vicinity

For historical maps please refer to the section titled 'Historical Maps' in Appendix E.

1.2 Site geology

A 6m deep borehole has been completed as part of the site investigation undertaken by Southern Testing in June 2015 (See Appendix E for full SI Report). This found that there is approximately 1m of made ground over the Claygate Beds. The Claygate Beds extend to at least 6m below ground level where the borehole terminated. The Claygate Beds are typically identified as finely interbedded sequences of orange-brown clay, silt and fine grained sands. The Claygate Beds are very variable but the sand lenses contain ground water which can flow where there is continuity of the permeable layers. Based on the geology map the Claygate Beds overlay London Clay.

A stand pipe was installed in the borehole and the perched water table was found to range between 3.41m and 3.51m below ground level over the 3 monitoring visits.

The findings from the borehole were as expected from the information shown on the British Geological Survey maps (Appendix B).

1.3 Form and condition of existing structure

Drawings summarising our understanding of the existing structures and details of the foundations of the adjacent walls are summarised in Appendix D.

No.2 Gayton Road is a semi-detached building comprising of 4 storeys including one storey of basement. The building is double fronted but is unusual in that it is only one room deep. The structure is made up of loadbearing masonry external walls in a rectangular shape which support timber joisted floors from ground floor up. The basement floor is assumed to be a ground bearing concrete slab. In both of the main rooms the timber joisted floors appear to span between the front and rear walls of the building. The corridor at the centre of the building has loadbearing walls either side, which are formed of timber studs above ground floor level and brickwork at lower ground floor. These walls support the timber staircases which run up the centre of the building and the landings.

The building has two chimney stacks; the stack to the south is shared between No.1 and No.2 Gayton Road. In the basement there appears to be what used to be a coal chute.

The foundations to the adjoining No. 1 Gayton Road were exposed by K F Geotechnical in 2014, during the investigation works carried out as part of the neighbours proposed basement extension. The party wall between No.1 and No. 2 was found to corbel at its base which is to be expected of a building of this age and type. The foundations to No.2 are likely to be of a similar

form and depth. The building is founded in the Claygate Beds, which is firm clay with laminations of silts and sand, as described in section 1.2.

The rear (west) and north boundaries of the property are formed with a brick wall around 2.5m in height.

The building appears to have been altered in the past, the notable alterations to the structure are:

- To the rear of the building, at ground floor level, a single storey steel framed extension has been added. A large opening in the rear façade at ground floor level has also been created.
- At first floor level, the timber stud wall on one side of the stair has been removed. It is assumed that it has been replaced with a steel beam.
- The fireplaces in the party wall between No. 1 and No.2 Gayton Road appear to have been removed at all floor levels except the basement.
- An original opening in one of the internal basement walls appears to have been enlarged.

1.4 The proposals

The proposed new build comprises the following:

- Extension of the existing basement into the rear garden by approximately 2.0m on plan over the full length of the building.
- Construction of a two storey extension above the new basement.
- Removal of the rear wall of the building at ground and lower ground floor level to connect the rear rooms of the existing property to the new basement and ground floor extension.

This report relates to the proposed construction of the basement. The approach to the design of the new basement includes consideration of the following key items:

- Ground conditions
- Groundwater regime
- Surface flow and flooding
- Slope and ground stability
- The structure of the existing adjacent buildings
- The effects on surrounding and adjoining properties
- An appropriate design and construction methodology

1.5 Characteristics of the Project

The existing rear courtyard to No.2 Gayton Road is a paved yard with a few small flower beds. The proposal is to extend the existing basement to the line of the rear boundary wall to the west and into part of the courtyard to the north. The new basement will be an extension of the existing and will therefore be founded at the same level.

The proposed basement extension is bounded to the east by the existing basement and to the south by the proposed basement extension to No. 1 Gayton Road. To allow the excavation of the soil to form the basement the boundary wall with the car park yard, to the west, is to be underpinned and to the north a concrete retaining wall will be constructed using a similar sequence of construction to that of the underpinning. Refer to Appendix F for the proposed structure drawings.

The neighbouring property, No. 1 Gayton Road, has also proposed a basement extension into their rear garden, which is to extend up to the party wall line between the two buildings. This has planning consent and the construction of the basement is now underway. As part of this the boundary wall between the properties will be have a special foundation formed beneath.

The basement structure will be formed of an RC box which will be tied to the existing basement walls of No. 2 and the party wall with No.1 Gayton Road. Steel columns and beams will be used to support the rear walls of the building above first floor level and the RC slab at ground floor level.

2.0 Screening (stage 1)

The purpose of the screening stage of the BIA is to identify any matters of concern which should be investigated further through the BIA process. The screening process has been undertaken as outlined in the Camden Planning Guidance – Basement and Lightwells CPG4 and the Camden geological, hydrogeological and hydrological study prepared by ARUP.

The screening flow charts given in GPG4 have been used and are provided in Appendix C. Several items in the screening checklists were identified as being relevant to this proposal and therefore a BIA is necessary. Those that have been identified as being relevant are discussed in the following Scoping Stage.

3.0 Scoping (stage 2)

The purpose of the scoping stage of the BIA is to define further the potential impacts identified within the screening stage as requiring additional investigation. The scoping stage has been undertaken as outlined in Camden Planning Guidance – Basements and LIghtwells CPG4 and the Camden geological, hydrogeological and hydrological study prepare by ARUP.

3.1 Conceptual Ground model

To assist the scoping stage a conceptual ground model has been produced using the following;

- Information obtained during the screening stage of the BIA
- The site investigation conducted in June 2015
- Readily available published data
- An in house search
- Application of hydrogeological principles

This is as follows:

Site location	Hampstead, London
Local geology	Made Ground over Claygate Beds over London Clay. Beneath the thick London Clay is the Lambeth Group, Thanet Sands and Chalk which together make up the lower Aquifer.
Local ground levels	The site gently slopes to the south east.
Local surface water or below ground water features	There are no local surface or below ground water features close to site.
Local groundwater level	A site investigation carried out in June 2015 by Southern Testing. This recorded a ground water level at approximately 3.5m below ground level which is approximately 1m below the proposed basement level. The Claygate Beds have a degree of permeability which can be high locally, whereas the underlying London Clay is generally considered as impermeable. The site investigation results show groundwater present within the Claygate Beds. The proposed basement does not extend any deeper than the current basement and so will not impact on the groundwater
Local surface finishes	The surrounding area is mostly hard standing with the land around being relatively intensely developed. To the north and west of the site, the yard to the rear of the property is covered in hard paving. To the south the building of No.1 Gayton Road covers the majority of the site and to the east is Gayton Road.
Current local surface water pathway	A large proportion of local rainfall will run off the hard surfaced areas on and adjacent to site, into the main combined sewers. A small proportion of local rainfall will be retained in the near surface soil (made ground and topsoil) with a proportion evaporating into the atmosphere or being taken up by plant and tree root systems and some may percolate down and enter the groundwater system. The remaining water within the topsoil is likely to either sit within the made ground or, where possible, permeate into the Claygate Beds

Using the above conceptual ground model, the potential issues identified during the screening stage are discussed further.

3.2 Hydrology (surface water flow and flooding)

3	Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	Yes, there will be a very minor increase in the percentage of the site covered in hardstanding. A total reduction of approximately $5m^2$ in soft landscaped areas.	Y

The area of hardstanding on the site will be increased, however currently the site is almost entirely hardstanding with the exception of some areas around the driveway which are soft landscaped. The volume of rainfall seeping into the ground below will decrease however the difference will be negligible and is unlikely to affect the adjacent properties and nearby water

courses. The site is surrounded by walls on all sides and therefore is relatively isolated from surrounding surface water flows.

3.3 Hydrogeology (groundwater flow)

1	Is the site located directly above an aquifer?	Figure 8 in Arup's report – Camden Aquifer Designation Map - shows there to be a secondary aquifer under the site which in this instance relates to the Claygate Beds. This typically only relates to ground water which collects in localised pockets of sand and gravels within the clay.	Y
1b	Will the proposed basement extend beneath the water table surface	No, the findings from a site investigation carried out in June 2015 showed the water table to be approximately 1m below the level of the existing and proposed basement slab	N

The groundwater level was recorded as part of the site investigation using a standpipe monitored over a month after installation. The results showed that the water level at the time was at least 1m lower than the existing basement level. As the proposals are to extend and not lower the basement, the new basement should not have an effect on water within the Claygate Beds.

4	Will the proposed basement development result in a change in the area of hard surfaced / paved areas?	Yes, there will be a very minor increase in the percentage of the site covered in hardstanding. A loss of approximately $5m^2$ flower beds	Y

The area of hardstanding will be slightly increased, which will slightly reduce the volume of water seeping into the ground below and subsequently into underground aquifers, however, as the area is small, the resulting change will have negligible effect on volume of surface water in the local area infiltrating into the groundwater below.

3.4 Slope and ground stability

10	Is the site within an aquifer?	Yes, Figure 8 in Arup's report – Camden Aquifer Designation Map - shows there to be a secondary aquifer under the site which in this instance relates to the Claygate Beds. This typically only relates to ground water which collects in localised pockets of sand and gravels within the clay.	Y

Refer to item 1 discussed in the hydrology (groundwater flow) screening

12	Is the site within 5m of a highway or pedestrian right of way?	Yes, the proposed basement is within 5m of the pavement to Gayton Road , refer to site location map in Appendix A.	Y

The existing basement to No. 2 Gayton Road is between the majority of the proposed excavation and the public highway so the proposed basement shall not impact on the highway.

The excavation will be propped during construction to prevent earth movements and the basement walls will be designed to withstand the appropriate surcharge loading caused by a public road. The amount of ground movement as a result of construction works is discussed further in section 5.5.

4.0 Site Investigation and study (stage 3)

A site investigation has been carried by Southern Testing in June 2015. A copy of their report can be found in Appendix E, which includes a desk study, factual and interpretative reports.

In summary the ground conditions comprise made ground over the Claygate Beds. The top of the London Clay is more than 6m below ground level. Groundwater was recorded in the borehole at a depth of 3.4m below ground level. Monitoring over the next month found the groundwater level to be constant at a similar level. The level of the top of the borehole was approximately 104.1m above Ordinance Datum.

The recorded groundwater level was approximately 1m below the underside of the existing, and therefore the proposed basement which will not affect the groundwater regime within the site or neighbouring sites. Local dewatering may however be required to deal with rain water falling on the site during the construction of the basement.

The site investigation indicated that there is no obvious contamination of the underlying ground. However, Southern Testing suggested due to the presence of made ground, a strategy should be in place to identify and deal with any areas of contamination that may be uncovered during the works.

5.0 Impact Assessment (stage 4)

The impact assessment stage of the BIA describes the impacts of the proposed basement development on the environment and how this will be mitigated in the design and construction. For the factual and interpretative site investigation reports refer to Appendix E.

5.1 Design of basement

Proposed structure drawings can be found in Appendix F.

To the rear of the garden a 13m stretch boundary wall to the car park is to be underpinned with mass concrete pins dowelled together. Underpinning these foundations will lower the founding level of the wall to the same level as the existing basement and therefore differential movements due to varying founding material are unlikely. To form the boundary to the excavation to the north a concrete wall will be installed around the extension of the basement, which will be formed using a similar process to underpinning. Using a concrete wall rather than a piled wall means that no structure will extend below the water table. Following the installation of the concrete wall and the construction of the 1st level of underpins, temporary propping will be installed before the basement excavation proceeds, as shown in the assumed sequence of construction in Appendix G, to maintain the structural stability of the yard to the west, site access to the north and the highway to the east.

The residents at No.1 have received planning permission to construct a basement which will include a 200mm thick RC wall under the party wall between No.1 and No. 2 at basement level. On the current programme this should be completed prior to the start of construction work at

No. 2. The proposed basement slab and walls to No. 2 will be dowelled in to the new RC party wall.

The basement slab will comprise of a 200mm thick ground bearing slab which is founded in the Claygate Beds. Slab thickenings will spread the loads beneath the walls and columns onto the bearing strata.

The site investigation has indicated the Claygate Beds are capable of supporting the loads and construction techniques being proposed. An allowable bearing pressure in the order of 150kN/m^2 has been given by Southern Testing which has been used for the design.

CPG27 requires that the proposed basements to avoid cumulative impacts upon structural stability or the water environment. The underside of the basement is more than a metre above the groundwater level and is a relatively modest extension of an existing basement. As the neighbouring properties basements are founded at the same level the combination of these will have no effect on any groundwater flows which may occur.

5.2 Sequence of construction for the basement

The structural proposals have been developed to suit normal construction techniques. A construction sequence for the basement and the temporary works required have been carefully considered and in order to demonstrate that the basement can be constructed safely without impacting on adjacent properties. A sequence of construction for the basement is summarised below and illustrated in Appendix G.

Access to the site will be through the driveway, however as a proportion of this area will be excavated, the suspension of a parking bay may be required in Gayton Road.

Stage 1 – Form underpins and concrete wall

- Demolish existing porch, including grubbing out any foundations
- Carry out first lift of underpins to boundary wall in maximum 1m wide sections and pack tight to underside of footings.
- Install concrete wall in similar sequence to underpins
- Excavate to the bottom of the first lift of underpins and wall, installing propping as required

Stage 2 – Complete underpins, excavate and needle through walls at first floor level

- Carry out the second lift of underpins and wall, excavate and prop as required
- Dewater the excavation if required
- Break out lower ground floor slab and form temporary foundations for needles
- Locally form pockets in the brickwork walls at first floor level and install needles
- Prop the walls in the northern half of the building at ground floor level and remove the timber joist floor
- Remove brickwork walls beneath needles

Stage 3 – Construct RC basement and steel frame

- Install new below ground drainage as required

- Construct steel frame up to first floor level to support brickwork and install drypack
- Construct new RC basement box, altering props as construction progresses. Pockets are left in slab for props to needles which are removed later
- Remove needles and props making good the remaining structure

Stage 4 – Construct above ground structure

- Install timber floor at ground floor level in northern room and remove props
- Continue with the construction of the above ground structure

5.3 Programme

The construction of the basement and superstructure is expected to last around 5-7 months.

5.4 Construction Management Plan

- The Contractor will be required to submit his own Construction Management Plan and Site Waste Management Plan prior to work commencing on site. The contents of this plan must be in accordance with The London Borough of Camden's guidance and be agreed by them.
- The contractor will be required to demonstrate due diligence and commitment toward minimising environmental disturbance to local residents and will be required to complete the work in accordance with the Considerate Constructors Scheme standards.
- Noise, dust and vibration will be controlled by employing best practicable means as prescribed in legislation such as; The Control of Pollution Act, 1972; The Health & Safety at Work Act, 1974; The Environmental Protection Act, 1990; Construction Design and Management Regulations, 1994 and The Clean Air Act, 1993. Noise, vibration and dust monitoring to be implemented.
- The contractor will need to produce a Traffic Management Plan. This should carefully consider vehicle movements and their impact on other Road users, pedestrians, residents and the environment. Mitigation measures should be implemented where necessary.
- The work is to be carried out in one phase.
- The contractor will erect a site hoarding to define the boundaries of the site and to discourage access to site from passers-by.
- Working hours to be restricted as required by the London Borough of Camden
- Vehicles should be washed and cleaned before leaving site and vehicles should not be left idling
- Measures should be adopted to prevent site runoff of water or mud
- Water to be used as a dust suppressant
- Skips should be covered
- All temporary works are to be designed by a qualified Temporary Works Coordinator

- Movements of surrounding buildings should be monitored throughout construction, the results reviewed and action taken to mitigate excessive movements.

5.5 Ground Movements and Structural Damage

The stiff RC lining wall, underpins and concrete wall, will be propped by the ground and basement slabs, will limit ground movement in the permanent case. A carefully considered system of propping during construction, designed by the Contractor, will limit ground movement in the temporary case. The underpinning of the surrounding walls will extend their foundations down to a level just below the basement, where movements of the ground will be negligible.

At the time of construction, the basement extension to 1 Gayton Road should have been completed; effectively founding the building at the same level of the proposed basement at No.2 and therefore ground movements will not affect the structure. On the remaining sides of the proposed basement extension, are areas of hardstanding in the car park with no significant structures. The closest building other than No. 1, is No. 3 Gayton Road which is approximately 6m away from the excavation, which is sufficient distance for ground movements to be insignificant. Therefore, by inspection it is clear that structural damage caused by ground movements will be negligible.

5.6 Impact of basement on groundwater, surface water and soil

The measured ground water level is below the level of the base of the existing basement. The proposed basement will be founded at the same level and therefore the proposals will not affect any flow of groundwater. Despite groundwater levels being below the basement, the basement slab will be designed to resist hydrostatic pressure in line with current good practice. The proposal is to retain the existing drainage or reinstate it in a similar position where this is not quite possible.

The area of hardstanding will be increased slightly by the works (approximately $5m^2$). The increase in hardstanding as a proportion of the whole site will be small so will not have a particular effect on the overall surface water infiltration for the local area.

The site investigation carried out by Southern Testing found there were no obvious contaminants in the soil. If contaminants are found during the construction process they are likely to be in the made ground which was found to be the first metre of soil. Much of the made ground will be removed from the site as part of the works and disposed of accordingly, which Southern Testing have stated, under the Waste Acceptance Criteria, can be classified as inert.

5.7 Impact of the proposed development on existing trees

There are no trees on site. Gayton Road is an avenue with trees lining either side of the Road. There are two trees located within 20m of the site. The tree to the south of the site has the existing basement to No.1 and No.2 between the tree and the proposed basement, so it can therefore be assumed that there are no roots from this tree on site.

The second tree to the north east is approximately 10m away and has Gayton Road between the tree and the proposed basements. The development is outside of the root protection area and crown spread of this tree.

5.8 Baseline values vs. as constructed

The findings from the Impact Assessment have been assessed against the potential impacts carried forward from the Scoping section and assessed in comparison to the existing baseline value. Refer to the table below.

Impact carried forward from Scoping	Baseline value	As constructed value
Is the site directly located above an aquifer?	Groundwater was found approx. 3.5m below ground level	Groundwater at the levels found from the site investigation remains uninterrupted by extension of basement as shown in Section 5.1, as it is no deeper than the existing basement
Is the site within 5m of a highway or pedestrian right of way?	Gayton Road and its footpath are adjacent to the existing and proposed basement	Section 5.5 explains that the basement can be constructed safely and without damage caused to Gayton Road and adjacent properties. Section 5.4 provides a construction management plan outlining how the project can be completed with minimal disruption to the local environment.
Will the proposed basement result in a change in the proportion of hard standing	Majority of site covered in hard standing	The increase in hardstanding is very minor (approx. $5m^2$) so will not have noticeable effect on the overall surface water infiltration for the local area as show in Section 5.6

5.9 Conclusions

A basement impact assessment, as required for planning by the London Borough of Camden, has been undertaken by Alan Baxter Limited in conjunction with Southern Testing geotechnical consultants for the proposed basement extension at No.2 Gayton Road

The engineering rationale and construction issues associated with the proposed construction of a basement extension and two storey structure above have been explored and summarised in this report. A structural scheme design has been prepared along with a construction sequence to demonstrate that the proposals can be built safely by a contractor with the right skill and care without causing detriment to the local groundwater regime, slope stability, surface water regime or adjacent structures.

The structural proposals and construction methodology for the proposed basement have been developed with due regard to the existing site constraints and site specific ground conditions. The structure has been designed to maintain the stability and integrity of the surrounding land and existing structures. Anticipated ground movements have been shown not to cause structural damage to the existing buildings. Ground movements are limited to acceptable values by a combination of the structural design, suitably designed temporary works and good workmanship.

Prepared by	David Probert
Reviewed by	Jim Gardiner
Issued	12/08/15

Alan Baxter Limited is a limited company registered in England and Wales, number 06600598.
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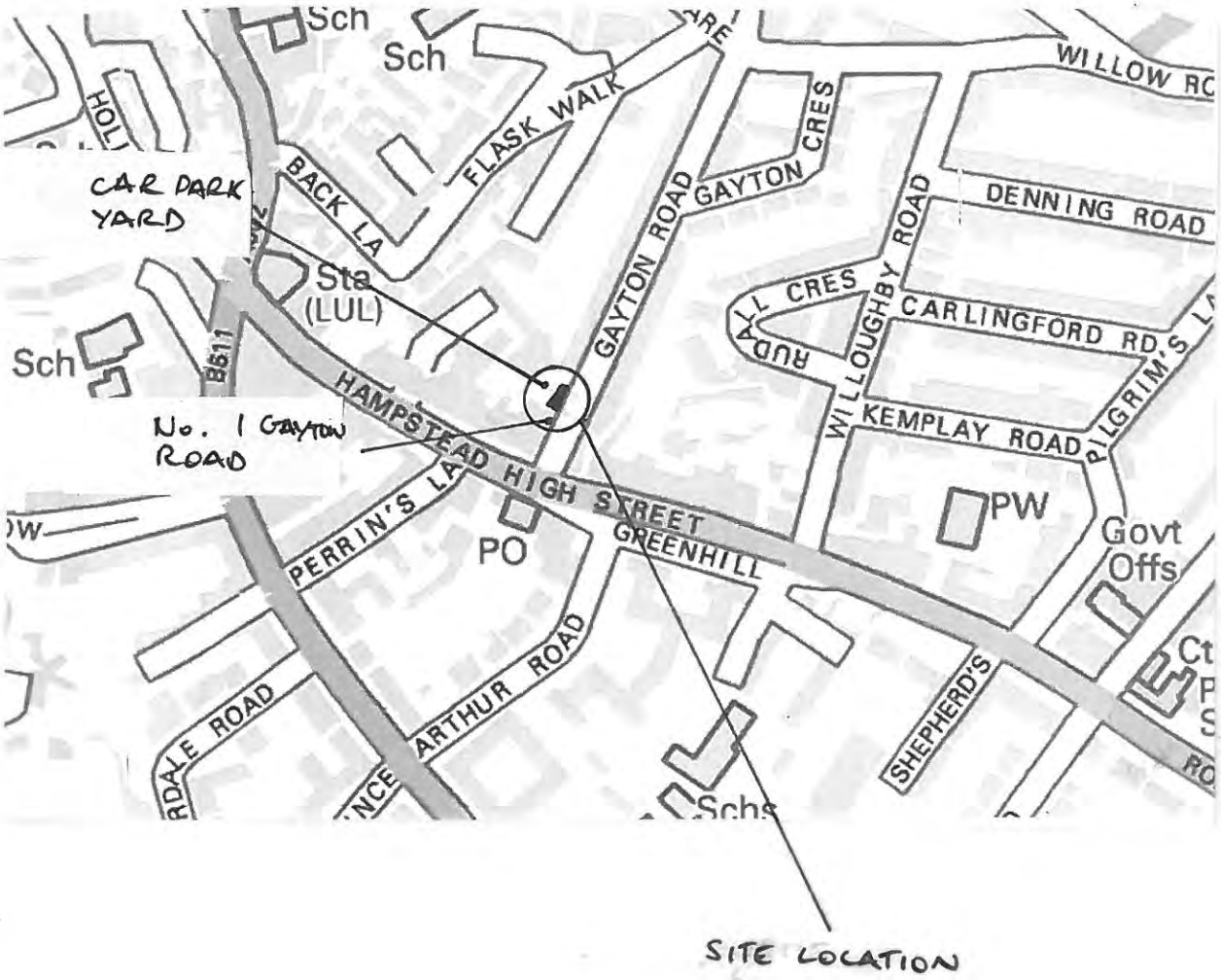
Appendix A Site plan and photos



-	27.1.15	ISSUED AS PART OF A REPORT	DP

date: JULY '15	drawn: DP	checked: LF	scale (original - A4): NTS
job: 2 GAYTON ROAD, NW3	dwg.: SITE PLAN	drg. no.: 1727/70/01	rev.: -

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Photo Sheet

Project	Job no.		Sheet	
2 Gayton Road, NW3	1727/70		1	Alan Baxter 75 Cowcross Street London EC1M 6EL tel 020 7250 1555 fax 020 7250 3022 email aba@alanbaxter.co.uk www.alanbaxter.co.uk
	Taken by Google Street View	Date 15/07/15		

01

02

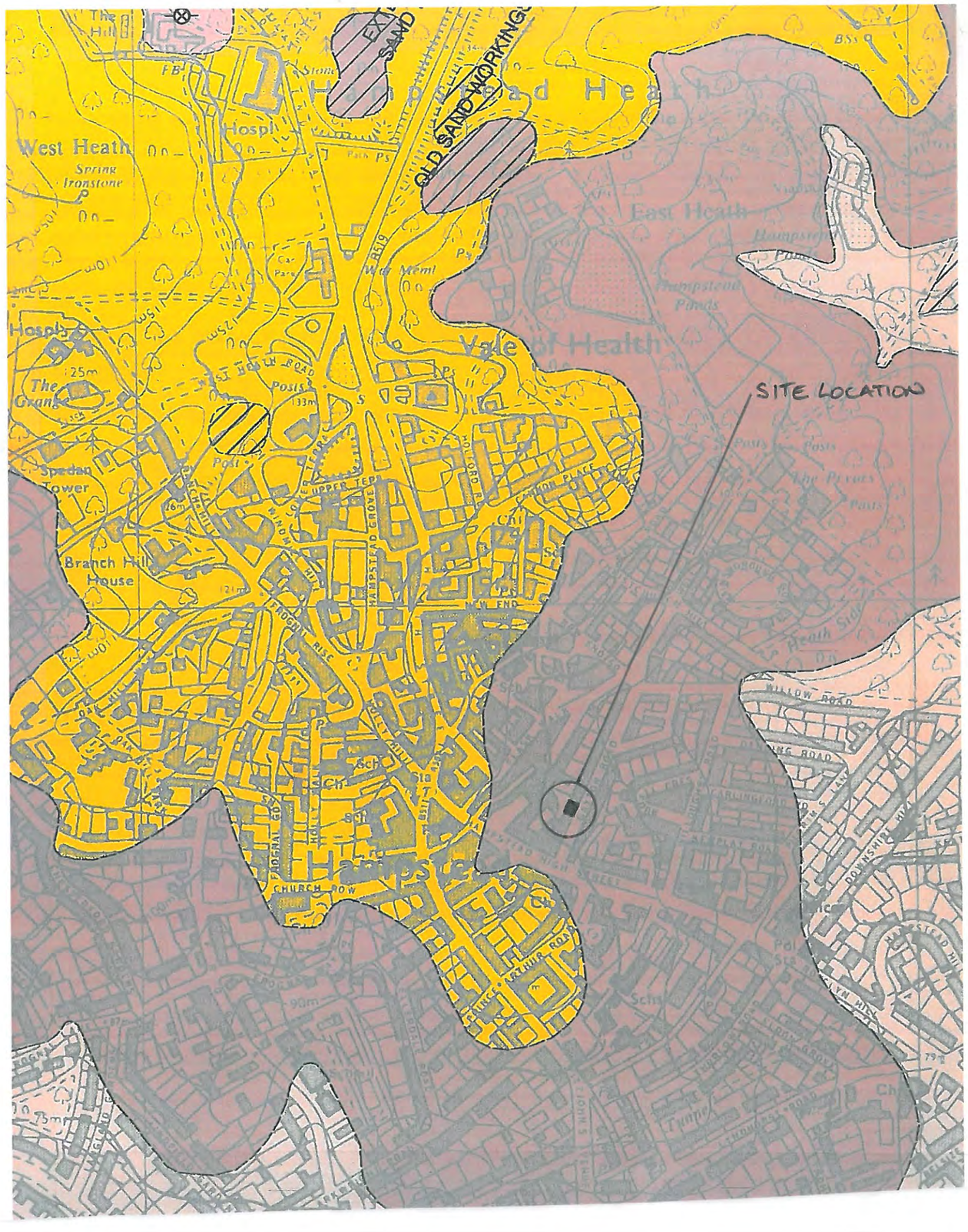
Photo Sheet

Project	Job no.		Sheet	
2 Gayton Road, NW3	1727/70		2	Alan Baxter 75 Cowcross Street London EC1M 6EL tel 020 7250 1555 fax 020 7250 3022 email aba@alanbaxter.co.uk www.alanbaxter.co.uk
	Taken by Google Street View	Date 15/07/15		

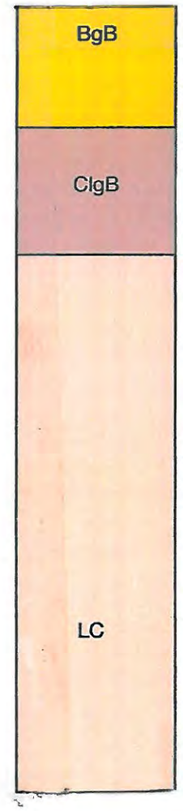
03

04

Appendix B Geology map and summary of local boreholes



SCHEMATIC INTERRELATIONSHIPS OF THE QUATERNARY DEPOSITS
(not to scale)



BgB	BAGSHOT FORMATION Yellow fine-grained sand
ClgB	CLAYGATE MEMBER Finely laminated brown sand and silt
LC	LONDON CLAY Blue or grey clay

notes

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND THE SPECIFICATION.
2. DO NOT SCALE FROM THIS DRAWING.
3. THIS DRAWING IS BASED ON THE 2002 BRITISH GEOLOGICAL MARE TQ28NE
4. KEY:

SITE LOCATION

–	21.7.15	ISSUED AS PART OF A REPORT	LF

job
2 GAYTON ROAD, NW3

title
GEOLOGICAL SUMMARY

drawn: DP
checked: LF
date: JULY' 15
scale (original - A3): NTS

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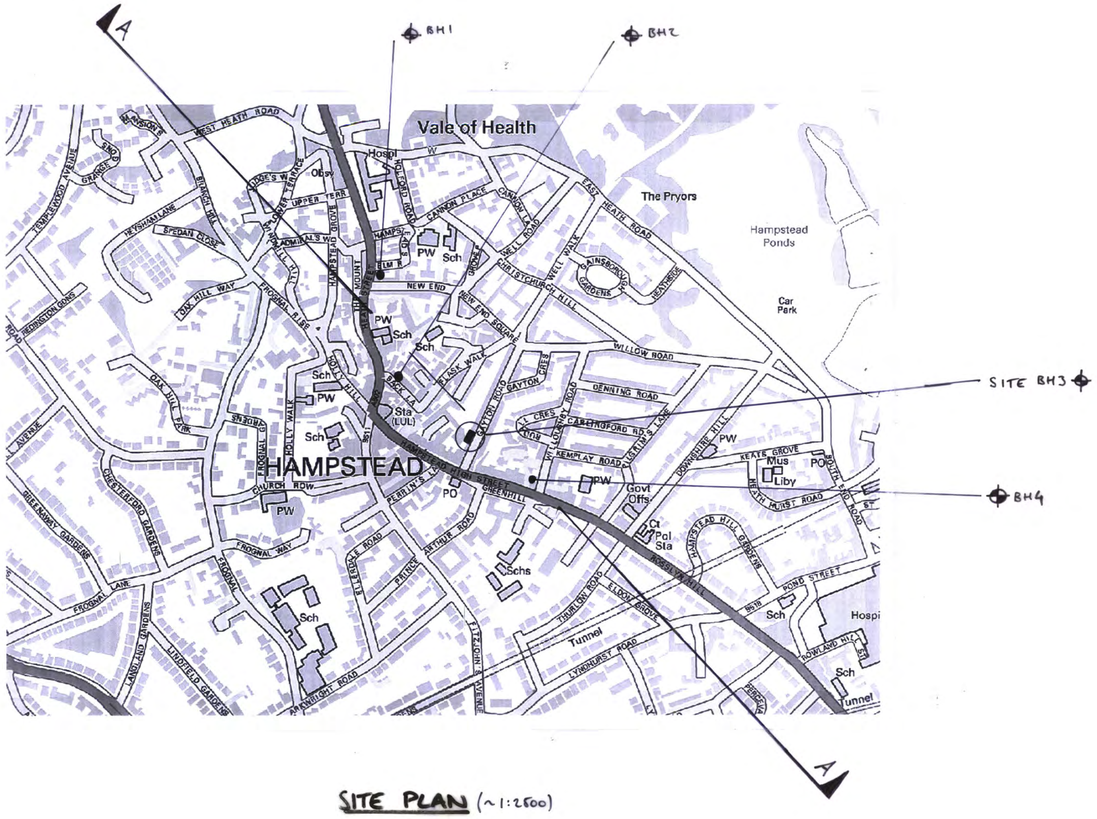
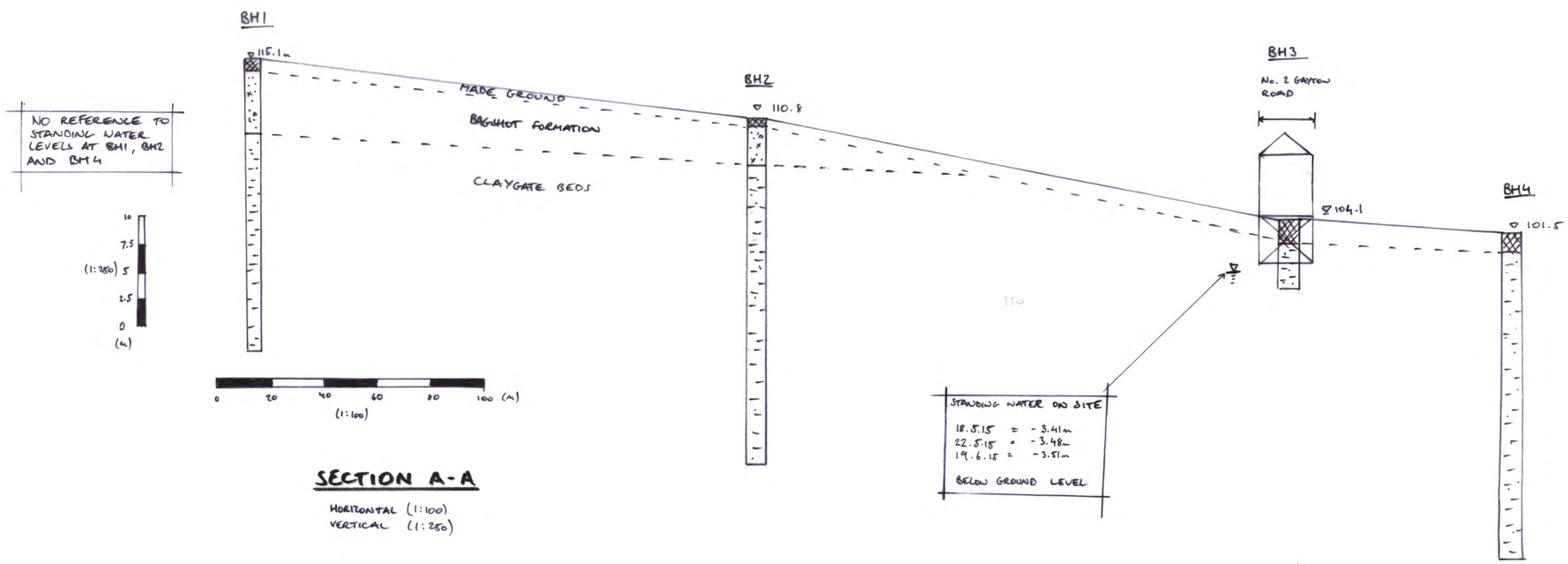
drg. no.: **1727/70/02**
rev.: -



SITE PLAN (~1:2500)



SECTION A-A

HORIZONTAL (1:100)
VERTICAL (1:250)

notes

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATION.
2. DO NOT SCALE FROM THIS DRAWING.
3. KEY:
   - MADE GROUND.
   - SANDS AND GRAVEL (BAGSHOT FORMATION)
   - CLAYGATE BEDS
4. THE INFORMATION OF THIS DRAWING WAS OBTAINED FROM BGS BOREHOLE LOGS AND SITE INVESTIGATION CARRIED OUT AT NO.2 GAYTON ROAD.

   BH1: TQ28NE8

   BH2: TQ28NE94

   BH3: CARRIED OUT BY SOUTHER TESTING IN JUNE 2015

   BH4: TQ28NE304

-	28.7.15	ISSUED AS PART OF A REPORT	LF

job
2 GAYTON ROAD, NW3

title
SUMMARY OF BOREHOLE LOGS AROUND THE SITE

drawn	checked
DP	LF
date	**scale (original - A1)**
JULY' 15	AS SHOWN

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www.alanbaxter.co.uk

org. no.	rev.
1727/10/05	-

Appendix C Screening flowcharts

Appendix C – screening flowcharts

Hydrology (surface water flow and flooding) screening

	Screening flowchart question	Response	Scoping stage?
1	Is the site within the catchment of the pond chains on Hampstead Heath	No, the site is well removed from these ponds and outside the catchment area as shown on Figure 14 of Arup's hydro-geological study – Hampstead Heath Surface Water Catchments and Drainage.	N
2	As part of the site drainage, will surface water flows (e.g. rainfall and run-off) be materially changed from the existing route	No, the site drains from a number of down pipes and gullies which are to be retained as part of the works	N
3	Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	Yes, there will be a small increase in the percentage of the site covered in hardstanding.	Y
4	Will the proposed basement result in changes to the profile of the inflows (instantaneous and long-term) of surface water being received by adjacent properties or downstream watercourses?	No, there will be no surface water flow off-site as a result of this proposal.	N
5	Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No, there will be no surface water flow off-site as a result of this proposal.	N
6	Is the site in an area known to be at risk from surface water flooding, such as South Hampstead, Gospel Oak and King's Cross, or is it at risk from flooding, for example because the proposed basement is below the static water level of a nearby surface water feature?	No, refer to Figure 15 of Arup's hydro-geological study – Hydrogeological and Hydrological Study Flood Map.	N

Hydrogeology (groundwater) flow screening

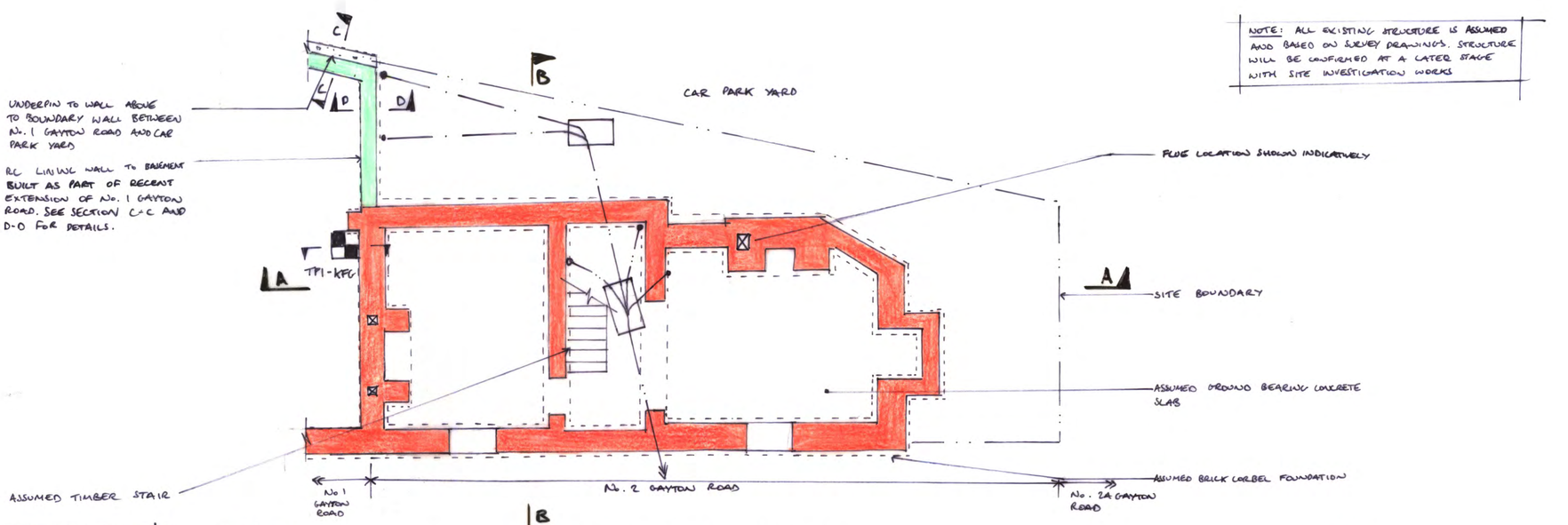
	Screening flowchart question	Response	Scoping stage?
1	Is the site located directly above an aquifer?	Figure 8 in Arup's report – Camden Aquifer Designation Map - shows there to be a secondary aquifer under the site.	Y
1b	Will the proposed basement extend beneath the water table surface	No	N
2	Is the site within 100m of a watercourse, well (used/disused) or potential spring line?	The site is within 100m of a lost river of London which has since been diverted underground (Figure 11 – Arup report). However it is not within 100m a current watercourse, well or potential spring line. Refer to Figure 12 of Arup report and Appendix E.	N
3	Is the site within in catchment of the pond chains on Hampstead Heath?	No, as shown on Figure 14 of Arup Report – Hampstead Heath Surface Water Catchment and Drainage.	N
4	Will the proposed basement development result in a change in the area of hard surfaced / paved areas?	Yes the amount of hardstanding will increase slightly	Y
5	As part of the site drainage, will more surface water (e.g. rainfall and run-off) than present be discharged to the ground (e.g. via soakaways and/or SUDS)?	No, rainfall will be channelled into the surface water sewers as there is no space on site for of SUDS.	N
6	Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to, or lower than, the mean water level in any local pond (not just the pond chains on Hampstead Heath) or spring line.	No, the elevation of the site is approximately 100m AOD and there are no ponds or spring lines hydraulically connected to the site.	N

Slope and ground stability screening

	Screening flowchart question	Response	Scoping stage?
1	Does the existing site include slopes, natural or manmade, greater than 7°? (approximately 1 in 8)	No, Figure 16 of Arup Report – Slope Angle Map – and site observations confirm the site's gradient is less than 7°.	N
2	Will the proposed re-profiling of landscaping at site change slopes at the property boundary to more than 7°?	No, the proposal does not include landscaping that affects the boundaries	N
3	Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7°?	No, from Figure 16 of Arup Report, show that the neighbouring sites have a similar gradient.	N
4	Is the site within a wider hillside setting in which the general slope is greater than 7°?	No, Figure 16 of Arup Report – Slope angle map confirm the wider gradient is less than 7°.	N
5	Is the London Clay the shallowest strata on site?	No, refer to Figure 3 of Arup Report – Camden Geological Map. The strata is shown as Claygate Member over London Clay.	N
6	Will any tree/s be felled as part of the proposed development and/or any works proposed within any tree protection zones where trees are to be retained? (Note that consent is required from LB Camden to undertake any work to any tree/s protected by a Tree Protection Order or to tree/s in a Conservation Area if the tree is over certain dimensions).	No, no trees will be felled on site	N
7	Is there a history of seasonal shrink-swell subsidence in the local area, and/or evidence of such effects at the site?	No, There is no evidence of subsidence in the local area.	N
8	Is the site within 100m of a watercourse or potential spring line?	No, the closest watercourse is the river fleet which is 400m away from the site (see Figure 11 – Arup report).	N
9	Is the site within an area of previously worked ground?	No, Historical records and Figure 3 from Arup's report – Camden geological map indicate the site is not on worked ground	N
10	Is the site within an aquifer?	Yes, The maps in Appendix E show the site is located above an aquifer within the Bedrock geology and Figure 8 in Arup's report – Camden Aquifer Designation Map - shows there to be a secondary aquifer under the site.	Y
11	Is the site within 50m of the Hampstead Heath Ponds?	No, Figure 14 of Arup's report – Hampstead Heath Surface Water Catchments and Drainage – and Figure 13	N

		– Hampstead Heath Map – indicate the site is not within 50m of the Hampstead Heath ponds.	
12	Is the site within 5m of a highway or pedestrian right of way?	Yes, the proposed basement is within 5m of the pavement to Gayton road, refer to site location map in Appendix A.	Y
13	Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	No, the surrounding buildings have basements founded at the same level	N
14	Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines?	No, based on our in-house information, the site is outside any exclusion zones.	N

Appendix D Existing structure drawings

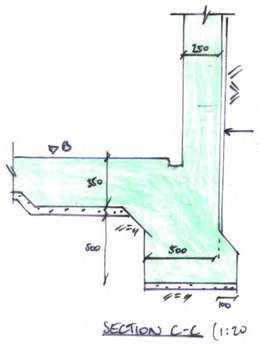


B

LOWER GROUND FLOOR

NOTE: ALL EXISTING STRUCTURE IS ASSUMED AND BASED ON SURVEY DRAWINGS. STRUCTURE WILL BE CONFIRMED AT A LATER STAGE WITH SITE INVESTIGATION WORKS

NOTE: SECTION C-C AND D-D ARE PROPOSED STRUCTURAL DETAILS AT No. 1 GAYTON ROAD AND ARE LIKELY TO BE COMPLETED PRIOR TO WORK AT No. 2 GAYTON ROAD



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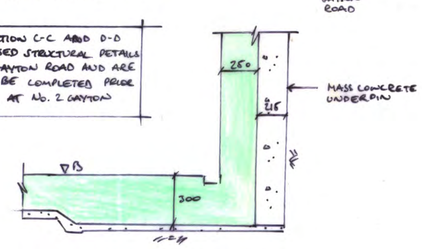
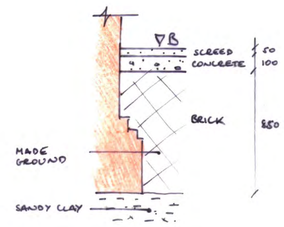
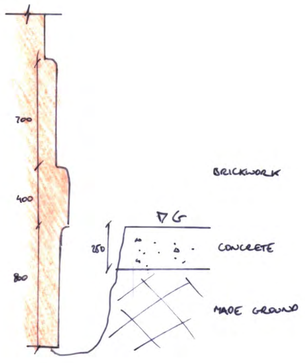


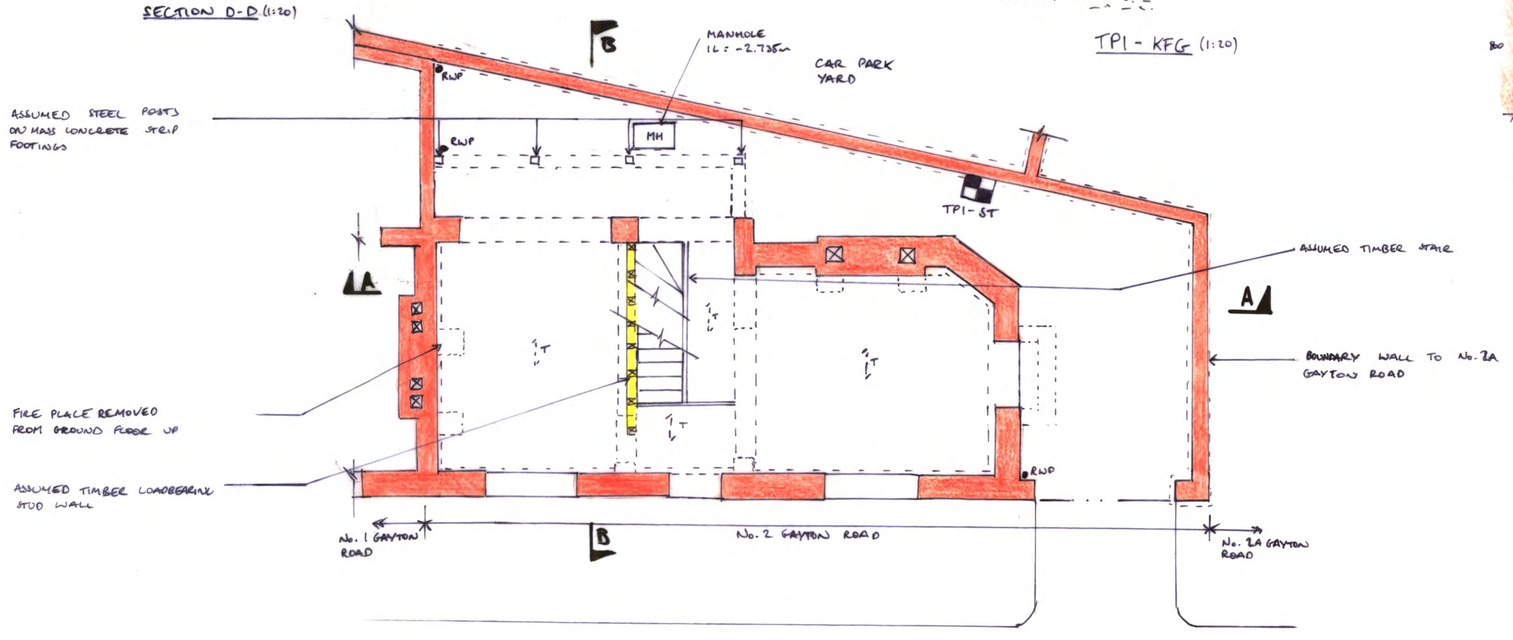
SECTION D-D (1:20)



TP1 - KFG (1:20)



TP1 - ST (1:20)



B

GROUND FLOOR

GAYTON ROAD

notes

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND THE SPECIFICATION.
2. THE TRIAL PIT LOGS ARE BASED ON THE FINDINGS FROM A SI CARRIED OUT BY KF GEOTECHNICAL IN DECEMBER 2013 AND BY SOUTHERN TESTING IN JUNE 2015.

KEY:

- EXISTING LOADBEARING BRICKWORK.
- EXISTING MASS CONCRETE FOUNDATION/UNDERPINNING.
- EXISTING MASS CONCRETE FOUNDATION/UNDERPINNING BELOW.
- NEW LOADBEARING BRICKWORK.
- NEW MASS CONCRETE PADSTONE.
- NEW STEEL BEAM.
- EXISTING STEEL BEAM.
- SECTION NUMBER. (1-1 / 01)
- DRAWING NUMBER.
- ASSUMED APPROX. LOCATION OF EXISTING CHIMNEY FLUE.
- ASSUMED DIRECTION OF SPAN OF EXISTING TIMBER FLOOR JOISTS. (T)
- DIRECTION OF SPAN OF EXISTING TIMBER FLOOR JOISTS. (t)
- DIRECTION OF SPAN OF PROPOSED TIMBER FLOOR JOISTS. (T)

-	28.7.15	ISSUED AS PART OF A REPORT	LF

job
2 GAYTON ROAD, N3

title
EXISTING STRUCTURE - LOWER GROUND & GROUND FLOOR PLAN

drawn	checked
DP	LF
date	scale (original - A1)
JULY '15	1:50

Alan Baxter

75 Cowcross Street London EC1M 6EL
tel 020 7250 1555
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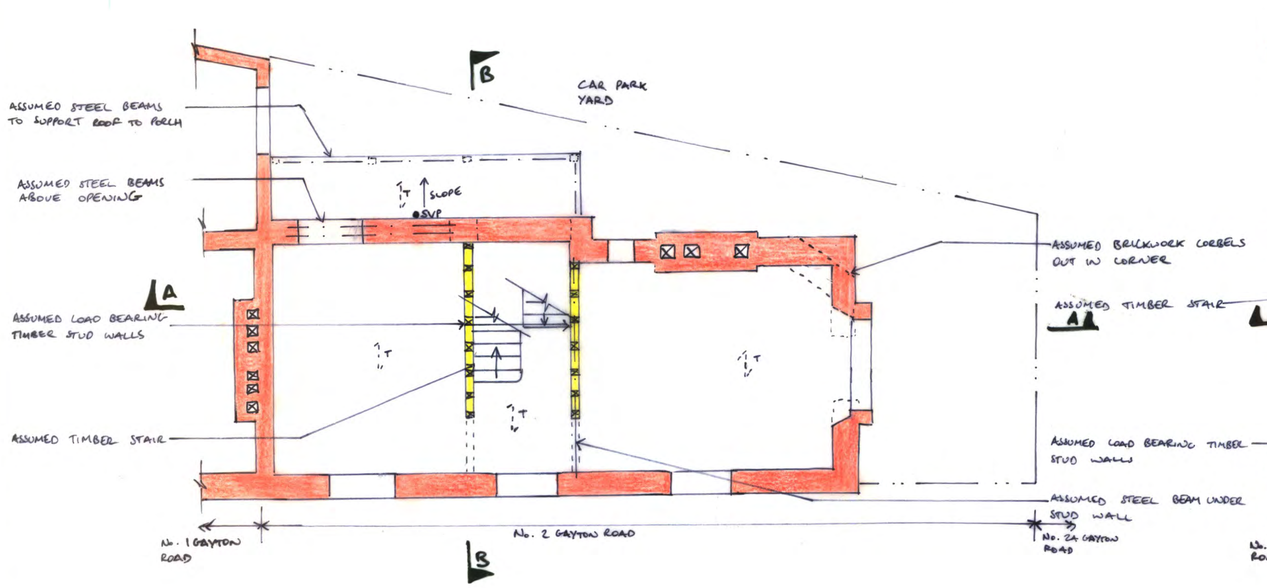
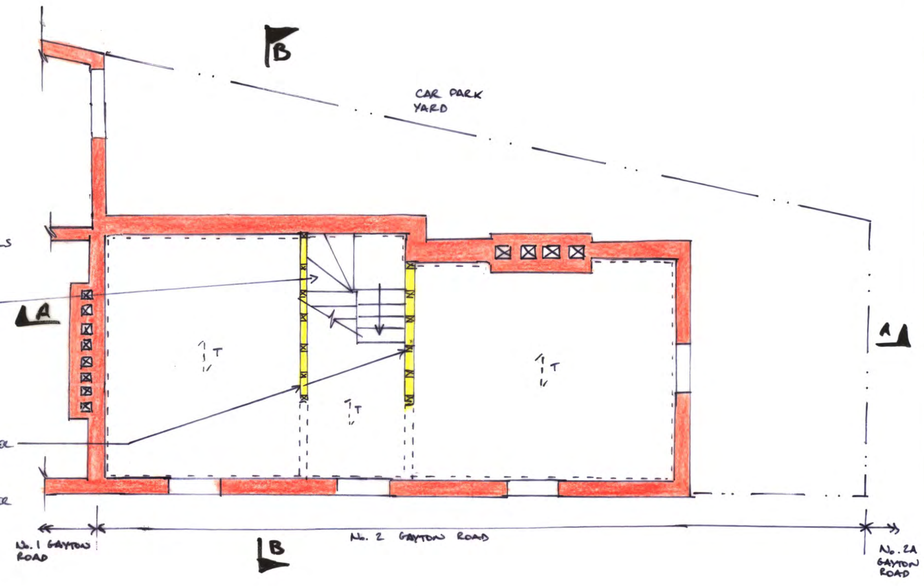
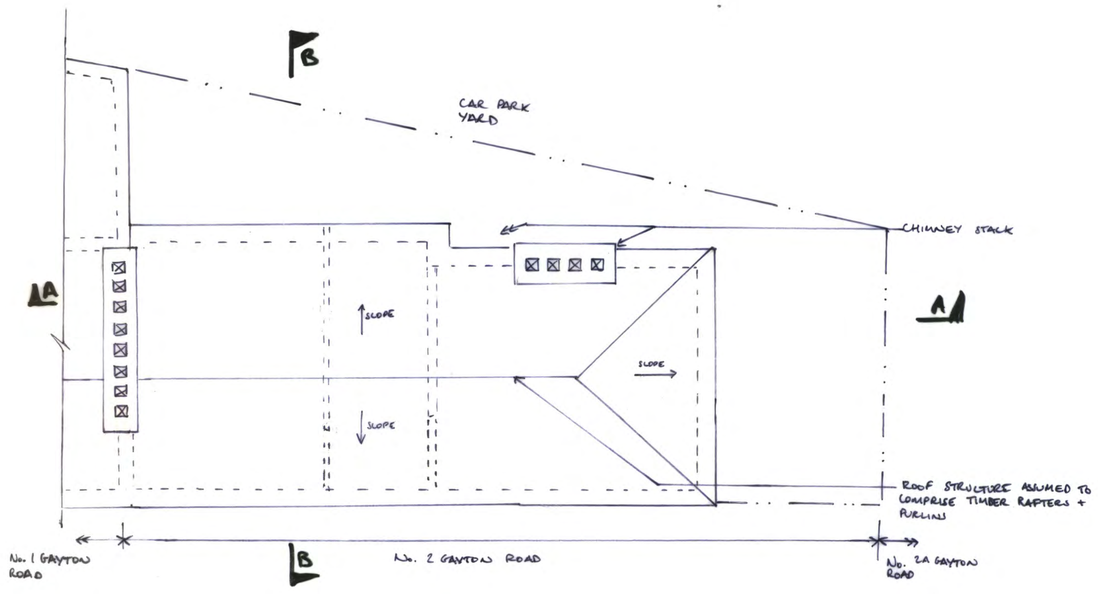
org. no. 1727/70/11 | rev. -



FIRST FLOOR



SECOND FLOOR



ROOF

notes

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND THE SPECIFICATION.
2. FOR GENERAL NOTES AND KEY SEE DRAWING 1727/70/11

–	28.7.15	ISSUED AS PART OF A REPORT	LF

job
2 GAYTON ROAD, N3

title
EXISTING STRUCTURE
FIRST TO ROOF PLANS

drawn	checked
DP	LF
date	scale (original - A1)
JULY '15	1:100

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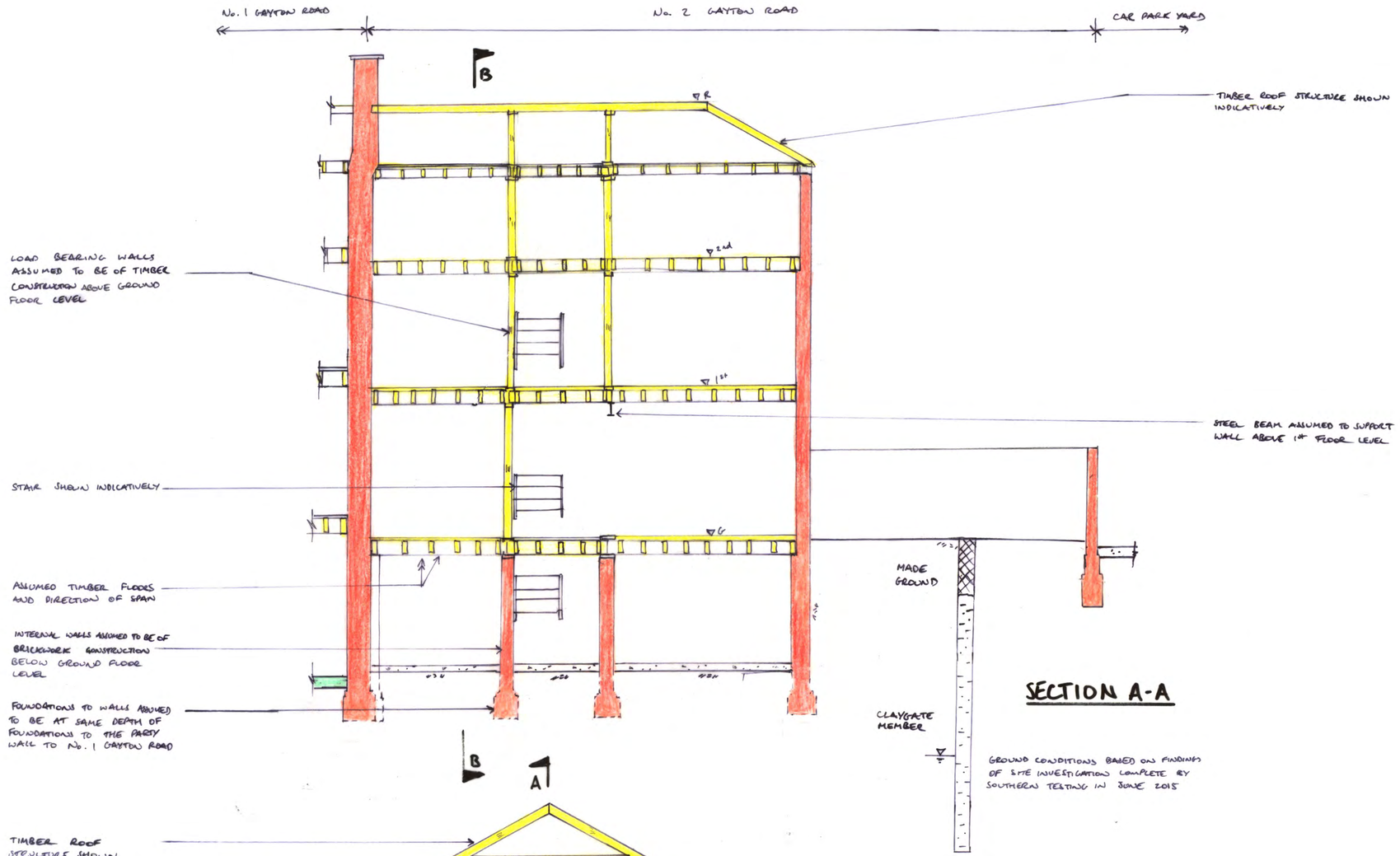
drg. no.	rev.
1727/70/12	-



notes

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND THE SPECIFICATION.
2. FOR GENERAL NOTES AND KEY SEE DRAWING 1727/70/11

–	28.7.15	ISSUED AS PART OF A REPORT	LF

job
2 GAYTON ROAD, N3

title
EXISTING STRUCTURE - SECTION A-A AND B-B

drawn	checked
DP	LF
date	scale (original - A1)
JULY '15	1:50

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org. no.	rev.
1727/70/13	-

Appendix E Site Investigation Report 2015

Southern Testing
Environmental & Geotechnical

ST Consult
Environmental & Geotechnical

Desk Study and Factual Site Investigation Report

Desk Studies | Risk Assessments | Site Investigations | Geotechnical | Contamination Investigations | Remediation Design and Validation

Site: 2 Gayton Road, London NW3

Client: Van Bruggen Limited

Report Date: 25 June 2015

Project Reference: J12252

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SUMMARY

The site comprises a 4-storey semi-detached house including a basement, with a small garden area to the north. It is proposed to extend the existing basement to the rear boundary wall, with a double level extension.

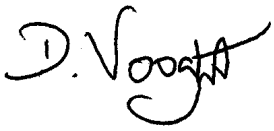
Geological records indicate the site to be underlain by the Claygate Member over the London Clay Formation.

A desk study was carried out and indicates that the site has a history of residential use. The land directly to the west, however, shows previous use as garages, with possible underground fuel tanks.

A single phase of intrusive investigation was carried out.

The soils encountered comprised made ground over sandy clay (Claygate Beds)

At the time of the fieldwork, groundwater levels were recorded at 3.41m (bgl) in WS1. In the subsequent groundwater monitoring visits, groundwater levels were measured in the range 3.48-3.51m (bgl).



D. Vooght MSc
(Countersigned)

J.N. Race MSc CGeol
(Countersigned)

H. Coombs BSc
(Signed)

For and on behalf of Southern Testing Laboratories Limited

STL: J12252
25 June 2015

TABLE OF CONTENTS

A INTRODUCTION

1 Authority

Our authority for carrying out this work is contained in a completed Southern Testing project order form, dated 26th April 2015.

2 Location

The site is located approximately 170m south east of Hampstead underground station, in London. The approximate National Grid Reference of the site is TQ 266 857.

3 Proposed Construction

It is proposed to extend the existing basement to the rear boundary wall, and construct a double level extension over the top of it.

4 Object

This is a Phase I Desk Study and Walkover and Phase II geotechnical investigation.

The object of the investigation is to assess foundation bearing conditions and other soil parameters relevant to the proposed development, and to assess the likely nature and extent of soil contamination on the site.

5 Scope

This factual report presents our desk study findings, exploratory hole logs and test results and our interpretation where necessary.

As with any site there may be differences in soil conditions between exploratory hole positions.

This factual report is not an engineering design and the figures and calculations contained in the report should be used by the Engineer, taking note that variations will apply, according to variations in design loading, in techniques used, and in site conditions. Our figures therefore should not supersede the Engineer's design.

The findings and opinions conveyed via this factual report are based on information obtained from a variety of sources as detailed within this report, and which Southern Testing Laboratories Ltd believes are reliable. Nevertheless, Southern Testing Laboratories Ltd cannot and does not guarantee the authenticity or reliability of the information it has obtained from others.

The site investigation was conducted and this report has been prepared for the sole internal use and reliance of Van Bruggen Limited and their appointed Engineers. This report shall not be relied upon or transferred to any other parties without the express written authorization of Southern Testing Laboratories Ltd. If an unauthorised third party comes into possession of this report they rely on it at their peril and the authors owe them no duty of care and skill.

The recommendations contained in this report may not be appropriate to alternative development schemes. The contamination screening values used are valid at the time of writing but may be

subject to change and any such changes will have implications for the assessments based on them. Their validity should be confirmed at the time of site development.

B DESK STUDY & WALKOVER SURVEY

6 Desk Study

A desk study has been carried out. Reference has been made to the following information sources.

- Geological Maps
- Hydrogeological/Groundwater Vulnerability maps
- Aerial Photographs
- Historical Ordnance Survey Maps
- Environmental Databases
- Environment Agency website
- Bomb Maps
- BRE Radon Atlas[1]

The environmental databases search report compiled for this desk study contains site-specific environmental data drawn from data sets that comprise publicly available information together with data from third parties, some of which is under review. Accordingly, Southern Testing Laboratories Limited does not warrant its accuracy, reliability or completeness.

The full report is included in Appendix F; a summary of the salient features is included in the following sections of this report.

6.1 Geology

The British Geological Survey Map No. 256 indicates that the site geology consists of Claygate Member over London Clay, with the Bagshot Formation shown approximately 200m to the west.

Claygate Member

The Claygate Member of the London Clay formation comprises sandy transition beds, about 15 m thick, at the top of the London Clay and consists of alternations of sand and clay. Sand predominates above, and clay below. They were commonly worked for brick making.

London Clay

London Clay is a well-known stiff (high strength) blue-grey, fissured clay, which weathers to a brown colour near the surface. It contains thin layers of nodular calcareous mudstone - "claystone" - from place to place, and crystals of water clear calcium sulphate (selenite) are common. Although slopes will stand in the clay at steep angles in the short term, the long-term stable slope angle is about 7^{o} for grassed, or cleared slopes, and a few degrees more for wooded slopes.

Bagshot Beds

This formation consists of fine white, buff and crimson sands with occasional seams of pipe clay,

[1] BR 211 (2007) 'Radon: guidance on protective measures for new buildings'

silt, and local beds of flint gravel.

The Beds are usually 30-45m in thickness and often have a band of flint pebbles at the base. There is a basal layer of mottled loams and clay, with subordinate amounts of reddish sand that resembles the Reading Beds. The clays are succeeded by more sandy, locally pebbly, yellow or gold coloured strata. These beds produce a marked feature above the loam, and sometimes have been taken as the junction with the underlying London Clay. The uppermost part of the formation is a grey clay and mottled loam, about 6m thick in the type area.

6.2 Hydrology and Hydrogeology

Data from the Environment Agency and other information relating to controlled waters is summarised below.

Data		Remarks	Possible Hazard to/from Site (Y/N)
Aquifer Designation	Superficial Deposits	None mapped	-
	Bedrock	Claygate Member (& Bagshot Beds) - **Secondary A Aquifer** - permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.	Y
		London Clay - **Unproductive Strata**	N
Groundwater Vulnerability		Minor Aquifer – High groundwater vulnerability	Y
Abstractions		The nearest water abstraction is approximately 1.3km to the south; a small abstraction from a groundwater source.	N
Source Protection Zones		The site does not lie within a source protection zone.	N
Surface Water Features		The nearest surface water features are; Whitestone Pond, approximately 650m to the north, and the Hampstead Pond East Chain, approximately 650m to the east.	N
Marine/Fluvial Flood Risk		The "Flood map for planning (Rivers and Sea)" mapping on the Environment Agency website (June 2015) shows that the site is not located within a flood zone, and not at risk.	N
Surface Water Flood Risk		The "Risk of Flooding from Surface Water" mapping on the Environment Agency website (May 2015) shows that the site is located within an area at very low risk.	N
Reservoir Flood Risk		On the basis of the information given on the EA website (May 2015) the site is not located within an area at risk of flooding from Reservoirs.	N
Discharge Consents		The nearest discharge consent is 489m to the east (+/-100m); trade effluent into a stream or river.	N

Given that the Claygate Member is classified as a Secondary A Aquifer, there is a potential for the migration of contaminated groundwater (if present). The groundwater flow direction is most likely to follow the topographic gradient of the area, which falls in an easterly direction.

6.3 Historical Map Search

Copy extracts of historical Ordnance Survey plans dating from 1879 to 1991 were obtained and are presented in Appendix F, together with a summary of the salient features. In brief, the site was mapped as residential gardens until 1896, when it was mapped as containing the present day subject property. The surrounding area was mapped as largely residential, with several historical commercial/ industrial uses, including garages mapped in 1954 and 1966, industrial works buildings from 1934, and public houses.

6.4 Environmental Databases

	Distance (m)	Direction	Details	Possible Hazard to/ from site (Y/N)
Historical Industrial Land Uses	There are 2 No. *Potentially contaminative industrial uses* within 250m of the site.			
	85	SE	Brewing & malting	N
	220	NW	Hospital	N
Current Industrial Land Uses	There are 28 No. *Contemporary trade directory entries* within 250m of the site.			
	43	SE	Domestic cleaning services – active	N
	67	W	Food manufacturers – inactive	N
	109	NW	Ceramic manufacturers - inactive	N
	82	SE	Domestic cleaning services – inactive	N
	93	SE	Plaster manufacturers – active	N
	118	W	Toiletries – inactive	N
	122	NW	Candle manufacturers – active	N
	125	NW	Upholstery cleaning - inactive	N
	133	NW	Domestic cleaning services – active	N
	143	W	Car breakers – active	N
	151	W	Dry cleaners - active	N
	159	SE	Photographic processors – inactive	N
	163	W	Hardware - active	N
	167	NW	Leather products - active	N
	167	W	Electrolysis	N
	179	W	Waste disposal - inactive	N
	182	SE	Car breakers- active	N

	Distance (m)	Direction	Details	Possible Hazard to/ from site (Y/N)
	191	SW	Dry cleaners - inactive	N
	192	SW	Commercial cleaning services - inactive	N
	198	SE	Upholstery cleaners - active	N
	198	SE	Wallpapers - active	N
	201	SW	Garages - inactive	N
	207	W	Dry cleaners – active	N
	208	S	Medical waste disposal – inactive	N
	212	SE	Upholstery cleaners – active	N
	234	NE	Commercial cleaning services – active	N
	242	SE	Electrical goods manufacturing – active	N
	243	NW	Tobacco manufacturing - inactive	N
Potential tanks	There are 5 No. *Potential tanks* within 250m of the site.			
	9	NW	Potential fuel tank	Y
	57	NW	Potential fuel tank	Y
	68	NW	Potential fuel tank	Y
	62	SW	Potential fuel tank	N
	88	E	Potential fuel tank	N
Current and Historical Landfills	-	-	None within 250m radius of the site	-
Fuel Sites	-	-	None within 250m radius of the site	-
Pollution Incidents	-	-	None within 250m radius of the site	-
IPC Part B Authorisations	-	-	None within 250m radius of the site	-
Hazardous Substances Consents	-	-	None within 250m radius of the site	-
Sensitive Land Use Designations	-	-	None noted	-

Only potential sources within a 250m radius of the site have been considered above. While additional sources exist, due to their distance from the site, they are not considered to pose a significant risk.

Additional potential sources of contamination were identified in the historical map search, including the historic garages directly adjacent to the site, and in the surrounding area. Whilst they weren't identified in the environmental database, they could be the location of the "potential fuel tank" entries.

6.5 Geological Hazards and Mining Activities

Data from various sources relating to potential geological hazards at the site are summarized below. The Hazard Potentials listed for the BGS data are as presented in the Envirocheck report, derived from various generic BGS sources, which are not considered as site-specific. It is important that this information is considered in context of the actual site topography, ground conditions encountered during future investigation, and development proposals.

Data Source	Hazard	Hazard Potential to Site	Remarks
BGS	Potential for Collapsible Ground Stability Hazard	Very low	-
	Potential for Compressible Ground Stability Hazard	No hazard	-
	Potential for Ground Dissolution Stability Hazard	No hazard	-
	Potential for Landslide Ground Stability Hazard	Very low	-
	Potential for Running Sand Ground Stability Hazard	Very low	-
	Potential for Swelling or Shrinking Clay Ground Stability Hazard	Moderate	-
	Shallow Mining Hazard	No hazard	-
ARUP	Mining Instability	The nearest mining instability is approximately 5km to the north west.	
CSS/KURG*	Underground openings	With reference to our underground openings database, the nearest record is approximately 1.0km south east of the site; an air raid shelter.	

**Chelsea Spelaeological Society/ Kent Underground Research Group*

6.6 Bomb Maps

With reference to the published bomb map of the area, taken from the London Country Council Bomb Damage Maps (1939-1945), the subject site and its surrounding area are not shown to have suffered any damage.

6.7 Radon Risk

With reference to BRE guidance: no radon protection is required on this site.

7 Walkover Survey

A walkover survey was carried out on 18 May 2015, at the time of the fieldwork.

7.1 General Description and Boundaries

The site is located on the northern boundary of Gayton Road. It is trapezoidal in shape and approximately 60m² in area. The majority of the site is occupied by a 4-storey semi-detached house, including a basement. The remaining area is occupied by an outdoor decking covered area

on the northern side of the site, accessible from Gayton Road by large wooden double doors.

The site is bounded to the south west by 1 Gayton Road; a three-story residential building. The north western and northern boundary of the site is with a car park area, accessed off Gayton Road.

7.2 Topography

Regionally, ground levels fall to the east at about 2°, however, ground levels across the subject site itself are relatively level. Due of the sloping nature of the front pavement, the ground levels on the north east side of the site are slightly raised above the pavement.

7.3 Vegetation

There are several flowerbeds, potted plants and shrubs in the outdoor area of the site.

Gayton Road is lined with several mature trees, the nearest of which is approximately 10m to the south; what appears to be a Ginkgo Tree outside 1 Gayton Road.

C PRELIMINARY CONCEPTUAL MODEL

8 Introduction

In the context of this report, the conceptual model summarises the potential pollutant linkages identified for the site and forms the basis of the risk assessment for the site. The preliminary model comprises the potential sources of contamination, receptors that could be harmed and exposure pathways identified from the desk study and walkover survey. These potential linkages form the basis upon which the investigation is designed and reported.

9 Potential Sources of Contamination

The site was mapped as residential gardens until 1896, when it was mapped as containing the present day subject property. The surrounding area has been largely residential, however, there are a number of commercial/industrial buildings and garages.

A limited number of potentially contaminative uses have been identified, both on site and in the locality.

9.1 On Site Sources

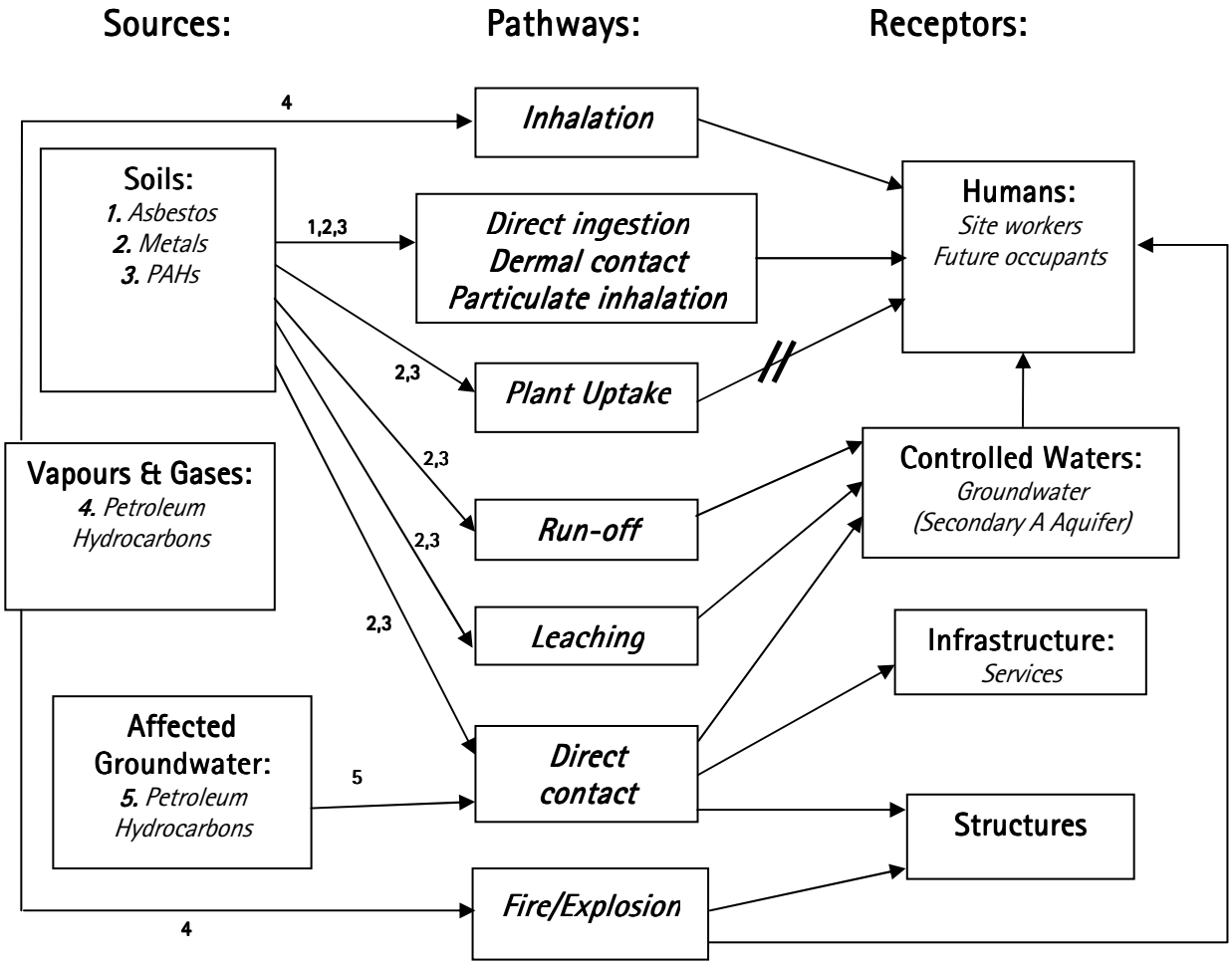
Source	Potential Contaminants
Made Ground	Various but typically metals, asbestos and Polyaromatic Hydrocarbons (PAHs).

9.2 Off Site Sources

The site may be impacted by contamination migrating from beyond the site boundary. Various garages and "potential fuel tanks" have been identified as sources of potential contamination, with the closest located being immediately to the west of the site.

10 Pollutant Linkages and Model Summary

The following diagram shows the potential pollutant linkages identified for the site and summarises the preliminary conceptual model:



// Denotes potential pollutant linkage not complete

D SITE INVESTIGATION

11 Method

The strategy adopted for the intrusive investigation comprised the following:

- 1 No. 6m deep boreholes was drilled using hand held window sampler equipment (WS1).
- A groundwater monitoring well was installed within the borehole WS1 for groundwater monitoring purposes.
- 1 No. inspection pit (TP1) was excavated by hand to establish existing foundation conditions.

Exploratory hole locations are shown on Figure 1 in Appendix A.

12 Weather Conditions

The fieldwork was carried out on the 18 May 2015, at which time it was cloudy and raining. The preceding months of March and April, were significantly drier than average, with approximately 40% of the normal rainfall in the South of England, while February was slightly wetter than average with approximately 110% of the normal rainfall.

13 Soils as Found

The soils encountered are described in detail in the attached exploratory hole logs (Appendix A), but in general comprised a covering of Made Ground over Sandy Clay. A summary is given below.

Depth	Soil Type	Description
GL - 0.25m	Concrete	Hard concrete with reinforcing.
0.25 - 0.8m	Made Ground	Soft to firm, brown silty sandy gravelly CLAY. Gravel is fine to medium brick and concrete, with occasional ash.
0.8 - 6.0m	Sandy Clay	Firm to stiff, medium to high strength light orange brown becoming grey brown, sandy slightly silty CLAY.

13.1 Visual and Olfactory Evidence of Contamination

Other than the presence of made ground, which can sometimes contain elevated levels of metals, PAHs and asbestos, no visual/olfactory signs of significant contamination were noted.

Noting the presence of historical adjacent garages, there was no visual or olfactory evidence of significant oil/fuel hydrocarbon contamination.

14 Groundwater levels and Hydrogeology

Groundwater levels vary considerably from season to season and year to year, often rising close to the ground surface in wet or winter weather, and falling in periods of drought. Long-term monitoring from boreholes or standpipes is required to assess the groundwater regime and this was not possible during the course of this site investigation.

During the course of the investigation groundwater was encountered in the window sample hole; the standing water level in WS1 was recorded at 3.41m (bgl) upon completion.

The standing water levels from the groundwater monitoring visits to date (including the initial readings taken on completion of the borehole) are shown in the table below.

Hole ID	Date	Standing water level (m bgl)
WS1	18/05/2015 (During site works)	3.41
	22/05/2015	3.48
	19/06/2015	3.51

E FIELD TESTING AND SAMPLING

The following in-situ test and sampling methods were employed. Descriptions are given in Appendix B together with the test results.

- Disturbed Samples
- Hand Penetrometer Tests
- Hand shear vane tests

F GEOTECHNICAL LABORATORY TESTS

The following tests were carried out on selected samples. Test method references and results are given in Appendix C.

- Atterberg Limit Tests
- Moisture Content
- Soluble Sulphate and pH

G LAND QUALITY

15 Analytical Framework

There is no single methodology that covers all the various aspects of the assessment of potentially contaminated land and groundwater. Therefore, the analytical framework adopted for this investigation is made up of a number of procedures, which are outlined below. All of these are based on a Risk Assessment methodology centred on the identification and analysis of Source – Pathway – Receptor linkages.

The CLEA model[2] provides a methodology for quantitative assessment of the long term risks posed to human health by exposure to contaminated soils. Toxicological data is used to calculate a Soil Guideline Value (SGV) for an individual contaminant, based on the proposed site use; these represent minimal risk concentrations and may be used as screening values.

In the absence of any published SGVs for certain substances, Southern Testing have derived or adopted Tier 1 screening values for initial assessment of the soil, based on available current UK guidance including the LQM/CIEH[3] S4UL's and CL:AIRE[4] generic assessment criteria. In addition, in March 2014, DEFRA[5] published the results of a research programme to develop screening values to assist decision making under Part 2A of the Environmental Protection Act. Category 4 screening levels were published for 6 substances, with reference to human health risk only. This guidance includes revisions of the CLEA exposure parameters, presenting parameters for public open space land use scenarios, and also of the toxicological approach. The screening levels

[2] Environment Agency Publication SC050021/SR3 'Updated technical background to the CLEA Model' (2009).
[3] The LQM/CIEH S4ULs for Human Health Risk Assessment. (2014).
[4] The EIC/AGS/CL:AIRE Soil Generic Assessment Criteria for Human Health Risk Assessment (2009).
[5] SP1010 Development of Category 4 Screening Levels foe Assessment of Land Affected by Contamination. DEFRA, 2014.

represent a low risk scenario, based on a 'Low Level of Toxicological Concern' rather than the 'Minimal Risk' of CLEA, and the analytical results of this investigation may be considered relative to these levels.

The values used are valid at the time of writing but may be subject to change and any such changes will have implications for the assessments based upon them. Their validity should be confirmed at the time of site development.

Site-specific assessments are undertaken wherever possible and/or applicable.

CLEA requires a statistical treatment of the test results to take into account the normal variations in concentration of potential contaminants in the soil and allow comparisons to be made with published guidance.

16 Site Investigation – Soil

16.1 Sampling Regime

The number of sample locations were limited due to the nature of the site work.

16.2 Testing

The potential for contamination through the presence of made ground was identified in the preliminary conceptual model confirmed by observations made on site. Whilst no obvious evidence of contamination was noted during the fieldwork, these soils along with the underlying natural ground were tested.

No visual or olfactory evidence of significant oil/fuel hydrocarbon contamination was noted during this site investigation, therefore, no hydrocarbon testing was carried out.

Samples from materials likely to be excavated as part of any basement construction were also subject to WAC testing to aid their waste classification.

Test Suite	Number of Samples	Soil Tested
STL Key Contaminant Suite	1 1	Made Ground Natural Soil
Asbestos Identification	1	Made Ground
Waste Acceptance Criteria Tests	1 1	Made Ground Natural Soil

The test results are presented in full in Appendix D. A summary and discussion of the significance of the results and identified contamination sources is given below.

16.3 Test Results and Identified Contamination Sources

16.3.1 General Contaminants

The results of the key contaminant tests have been analysed in accordance with the CLEA methodology. The samples have been grouped into two populations comprising made ground and natural soil. For each parameter in each population the sample value is compared to a Tier 1 screening value. If the sample value exceeds the screening value, the soil may be regarded as

contaminated and further assessment may be required. If the sample value does not exceed the screening value, the soil may be regarded as not contaminated, though further confirmatory assessment may be required.

Summary data is presented in the tables below and the laboratory analysis is included in Appendix D. The screening values and source notes are presented in Table 1 "Tier 1 Screening Values" at the end of Appendix D.

Soil Type: Made Ground

Contaminants	Units	No of Samples Tested	Sample Result	Residential with homegrown produce consumption
Arsenic (As)	mg/kg	1	15	37
Cadmium (Cd)	mg/kg	1	<0.1	11
Total Chromium (Cr)	mg/kg	1	38	910
Hexavalent Chromium (CrVI)	mg/kg	1	<1	6
Lead (Pb)	mg/kg	1	21	200
Mercury (Hg)	mg/kg	1	<1.0	7.6-11
Selenium (Se)	mg/kg	1	<3	250
Nickel (Ni)	mg/kg	1	20	180
Copper (Cu)	mg/kg	1	17	2,400
Zinc (Zn)	mg/kg	1	71	3,700
Phenol	mg/kg	1	<1.0	120-380
Benzo[a]pyrene	mg/kg	1	<0.1	1.7-2.4
Naphthalene	mg/kg	1	<0.1	2.3-13
Total Cyanide (CN)	mg/kg	1	<1	/
Acidity (pH value)	Units	1	7.9	/
Soil Organic Matter	%	1	0.7	/

The made ground soil sample analysed was free from significant contamination relative to the Tier 1 screening values for this land use. This concurs with the visual and olfactory evidence.

Soil Type: Natural Soil

Contaminants	Units	No of Samples Tested	Sample Result	Residential with homegrown produce consumption
Arsenic (As)	mg/kg	1	21	37
Cadmium (Cd)	mg/kg	1	<0.1	11
Total Chromium (Cr)	mg/kg	1	42	910
Hexavalent Chromium (CrVI)	mg/kg	1	<0.1	6
Lead (Pb)	mg/kg	1	18	200

Contaminants	Units	No of Samples Tested	Sample Result	Residential with homegrown produce consumption
Mercury (Hg)	mg/kg	1	<1.0	7.6-11
Selenium (Se)	mg/kg	1	<3	250
Nickel (Ni)	mg/kg	1	25	180
Copper (Cu)	mg/kg	1	21	2,400
Zinc (Zn)	mg/kg	1	70	3,700
Phenol	mg/kg	1	<1.0	120-380
Benzo[a]pyrene	mg/kg	1	<0.1	1.7-2.4
Naphthalene	mg/kg	1	<0.1	2.3-13
Total Cyanide (CN)	mg/kg	1	<1	/
Acidity (pH value)	Units	1	7.7	/
Soil Organic Matter	%	1	0.5	/

The natural soil sample analysed was free from significant contamination relative to the Tier 1 screening values for this land use. This concurs with the visual and olfactory evidence.

16.3.2 Asbestos

No asbestos containing materials were detected in the samples analysed and none were observed in the exploratory holes. However, it should be noted that the exploratory holes are of small diameter and the samples obtained may not reflect the full composition of the soils on the site. Therefore, there is always the potential for pockets of asbestos or for asbestos containing materials to be present, which have not been detected in the sampling.

16.3.3 Waste Acceptance Criteria (WAC) Tests

As an initial assessment of the soils for waste disposal purposes WAC testing was undertaken on 1 No. sample of the shallow made ground (TP1 at 0.4m) and 1 No. sample of the natural soil (WS1 at 1.0m) to assist with the classification of the materials (see Appendix D).

17 Risk Evaluation

The object of the risk evaluation is to assess the pollution linkages for specific contaminant groups considered in the conceptual model, identify any unacceptable risks and, therefore establish whether there is a need for further investigation and/or remedial action.

The risks are considered in the context of the specific development proposals for the site and, therefore, the conclusions may not be appropriate for alternative schemes.

17.1 Revised Conceptual Model

The preliminary site model has been refined in light of the findings of this investigation and is summarised below.

Metals	*Polyaromatic Hydrocarbons*	*Asbestos*	PATHWAYS	RECEPTORS
N	N	N	Ingestion and inhalation of contaminated soil and dust	Human Health
N	N	n/a	Dermal contact with contaminated soil and dust	
n/a	N	n/a	Inhalation of vapours or gases	
N	N	n/a	Uptake into edible fruit and vegetables	
n/a	n/a	n/a	Surface water run-off into surface water features	Water Environment
N	N	n/a	Migration through ground into surface water or groundwater	
N	N	n/a	Off-site migration of contaminated groundwater	
N	N	n/a	Vegetation on site growing in contaminated soil	Flora and Fauna
n/a	n/a	n/a	Aquatic life in affected waters	
N	N	n/a	Contact with contaminated soil	Building materials/ buried services
n/a	n/a	n/a	Fire or explosion	

Key:

Y	Pollutant linkage likely
N	Pollutant linkage not likely
P	Pollutant linkage possible
n/a	Pathway not applicable to contaminant

17.2 Relevant Pollutant Linkages

No Relevant Pollutant Linkages for which remedial action will be required have been identified during our investigation works.

18 Discussion and Conclusions

Based on the investigation and laboratory testing carried out to date, no obvious contamination has been identified and the soils are considered suitable to remain on site. Given the presence of made ground on site, (as with any site) areas of contamination not identified during site investigation works may come to light in the course of redevelopment. Accordingly, a discovery strategy must be in place during the redevelopment to ensure that any unknown contamination is identified and dealt with in an appropriate manner. Depending on the nature of any such contamination, it may prove necessary to implement a remedial strategy for the site.

If necessary, a formal remediation strategy and verification plan may need to be agreed with the regulatory authorities prior to commencement of any remedial works.

19 Comments on Waste Disposal

Some soils are likely to require removal from site as part of the redevelopment. The contamination laboratory test results (including Waste Acceptance Criteria tests) obtained to date indicate that the soils are likely to be classified as inert waste, although the final classification ultimately lies within the receiving tip and additional sampling and analysis may be necessary to classify this material. The identification of any more significant contamination during construction may, however, change the waste classification.

20 General Guidance

It may be that specific local requirements apply to this site, of which we are not aware at this time.

In general terms, the workforce and general public should be protected from contact with contaminated material (if present). There is a range of relevant documents published by the Health and Safety Executive, and organisations such as CIRIA, and the BRE.

Some soils will require removal from site and disposal to suitably licensed landfills. Different guidelines and charges will apply to different waste classification. As waste producers, the Developer holds responsibilities under the various governing regulations. The chemical analyses appended to this report should be forwarded to tip operators for their own assessment, to confirm classification of the soils for offsite disposal, and whether they can accept the material. Waste Acceptance Criteria (WAC) testing may be requested for confirmation of the material's classification.

All hazardous and non-hazardous soils leaving site will need to be pre-treated. Waste minimisation by selective excavation is a recognised form of pre-treatment.

Many water supply companies now require higher specification pipe on contaminated sites, even following remediation.