Geotechnical Interpretive Report

in connection with proposed development at

Nos. 155 – 157 Regent's Park Road
Camden
London
NW1 8BB

for

Uchaux Ltd

LBH4540GIR Ver 1.0

July 2019

LBH WEMBLEY ENGINEERING

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Foreword-Guidance Notes

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1. Introduction

1.1 Background

Following demolition of the existing building at Nos. 155 – 157 Regent's Park Road, it is proposed to construct an eight storey hotel with a two storey basement extending to an approximate depth of 7m below ground level.

1.2 Brief

LBH WEMBLEY have been appointed by Uchaux Ltd to prepare an interpretive geotechnical report on the basis of factual information obtained from a recent ground investigation, in order to assist the structural design of the new hotel.

1.3 Report Structure

This report initially describes the site and the details of the proposed development. A summary of the findings of the ground investigation are then presented and a ground model is developed.

A discussion of the geotechnical issues associated with the proposed development is then discussed, which includes an appraisal of the potential construction methodologies and foundation solutions that could be implemented in the design of the new building.

The report then concludes with an assessment of the potential ground movements arising from the proposed solutions.

1.4 Documents Consulted

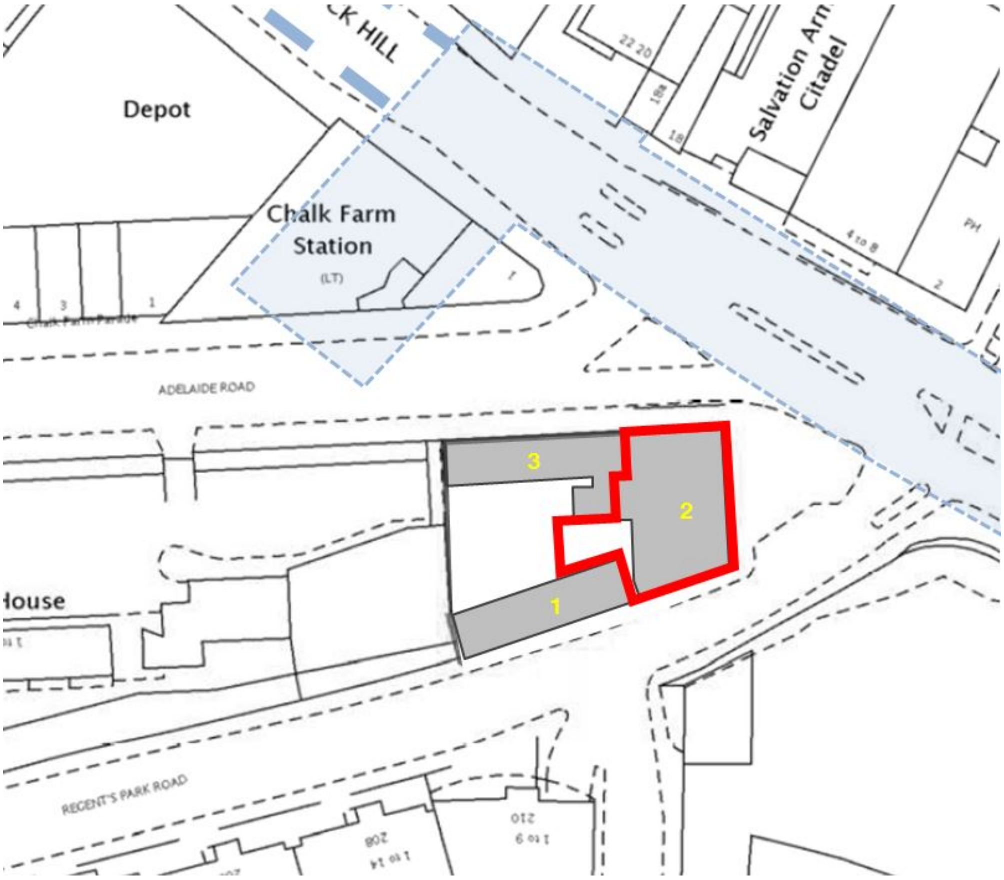
- 2019 Structural Engineering Report, by Heyne Tillett Steel, dated 18th July 2019, ref: 1827 rev A
- 2019 Design & Access Statement by Piercy & Company, dated July 2019, ref: 13545
- 2019 Proposed Drawings by Piercy & Company, dated 12th July 2019
- 2018 Factual SI report by ST Consult, dated 30th July 2018, ref: JN1143SMS

2. The Site

2.1 Site Location

The site is situated at the junction of Regent's Park Road, Haverstock Hill and Adelaide Road, approximately 15m to the south of Chalk Farm underground station.

The site may be located approximately by postcode NW1 8BB or by National Grid Reference 528155, 184380.



Location plan (Chalk Farm Underground Station shaded blue)

1: Nos. 151 – 153 Regent's Park Road
2: Nos. 155 – 157 Regent's Park Road
3: Nos. 1 – 13 Adelaide Road

2.2 Topographical Setting

The site lies on a lower slope of Hampstead Hill that is gently falling to the southeast, towards a culverted tributary of the River Fleet. The street levels around the site fall from a maximum of around +32m OD on Regent's Park Road in the southwestern corner of the site to around +31m OD on Haverstock Hill.

2.3 Site Description

The site is occupied by a four storey terraced building with mansard roof at Nos. 155 – 157 Regent's Park Road.

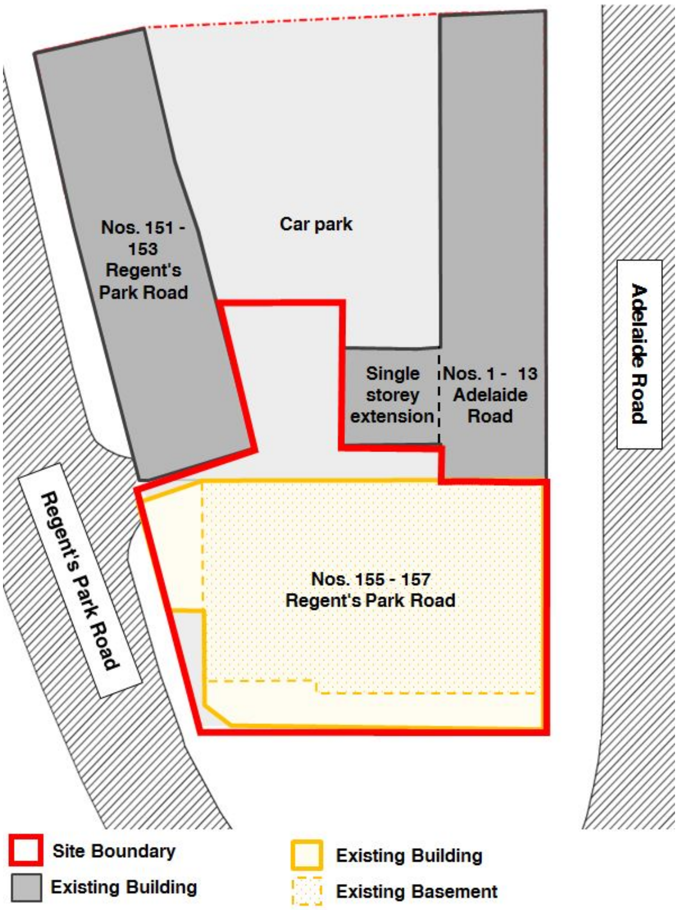
Nos. 1 – 13 Adelaide Road and Nos. 151 – 153 Regent's Park Road, both similar four storey terraces, adjoin the site to the north.

Nos. 1 – 13 Adelaide Road is connected to 155 – 157 Regent's Park Road, while Nos. 151 – 153 forms a separate row.

Nos. 1 – 13 also has a single storey extension to the rear of the terraced row.

Street level immediately on the corner of Regent's Park Road and Adelaide Road is situated at approximately +31m OD. The natural ground level appears to rise by some 2m towards the rear end of Nos. 151 – 153.

Nos. 155 – 157 comprises a single storey basement that occupies most of the building footprint. It appears that the basement extends to approximately 3.5m depth below ground level.



Plan showing existing features

The adjoining building at Nos. 1 – 13 also appears to comprise a basement that extends to a similar depth. The single storey extension does not appear to have a basement.

Front elevation of Nos. 155 – 157 Regent's Park Road

It is understood that Nos. 151 – 153 does not comprise a basement.

Retail units are located on ground and basement floors to Nos. 155 – 157, with the upper floors (including mansard roof) occupied by flats.

Similarly, retail units are located on ground floor to Nos. 1 – 13, with upper floors also occupied by flats. Nos. 151 – 153 is occupied by flats at ground floor level and above.

The site is entirely hard surfaced and a car park is enclosed by the three terraced buildings, which is accessed from Regent's Park Road.

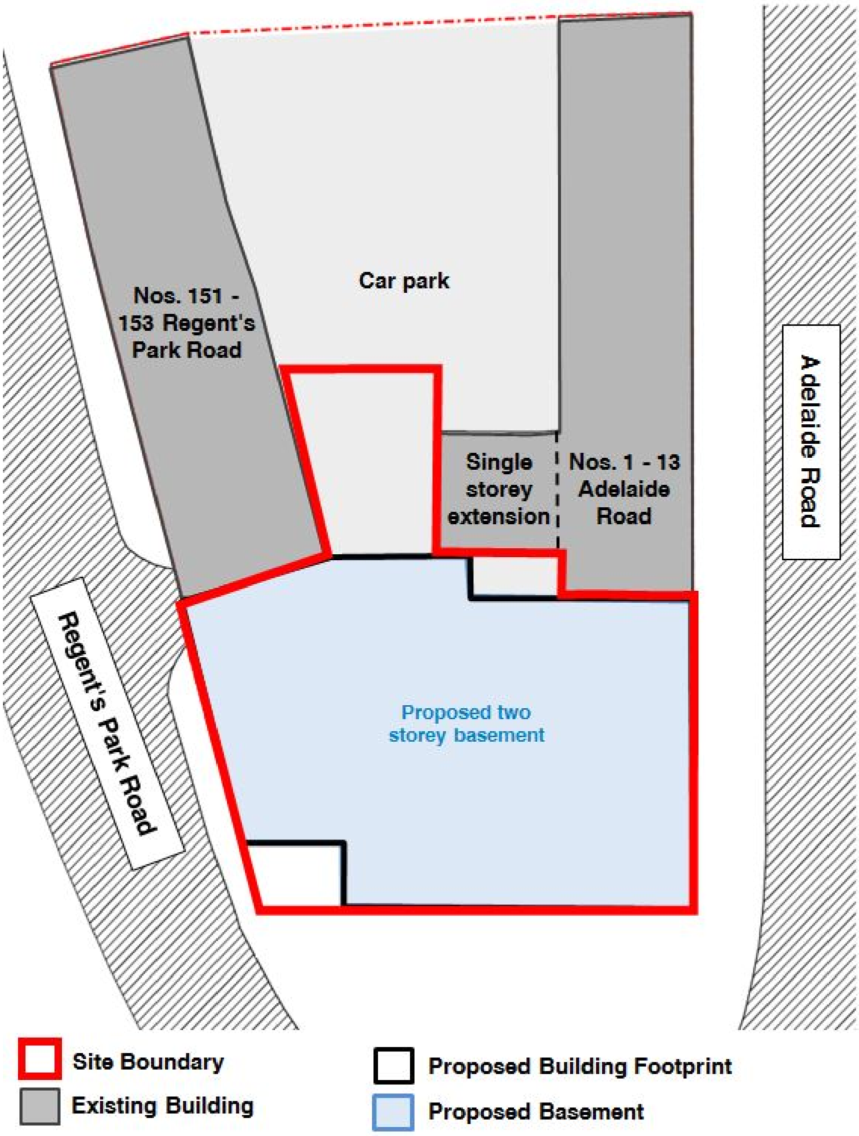
Chalk Farm Underground Station lies beneath Haverstock Hill, at the closest approximately 8m laterally to the northeast of the site.

The crowns of the tunnels at the station are understood to be situated at approximately 8m below existing street level (+23m OD) with an estimated diameter of roughly 7m.

2.4 Proposed Development

It is proposed to construct an eight storey hotel including a two storey basement.

The proposed development includes demolition of the existing four storey building at Nos. 155 – 157 Regent's Park Road. This will be followed by excavation, in order to allow the construction of a two storey basement to an approximate depth of 7m (+24m OD) below existing ground level. The basement is to cover the entire building footprint aside from a small area in the southern corner, as shown on the plan below.



Plan showing proposed development

3. Ground Model

A ground model has been developed on the basis of an intrusive site investigation undertaken in July 2018 by ST Consult and from other nearby boreholes.

The plan below indicates the approximate exploratory positions.

3.1 Made Ground

Outside of any existing or former basement areas there appears to be approximately 1m of made ground beneath the car park, consisting of dark brown sandy clay with extraneous fragments of brick and concrete.

3.2 London Clay Formation

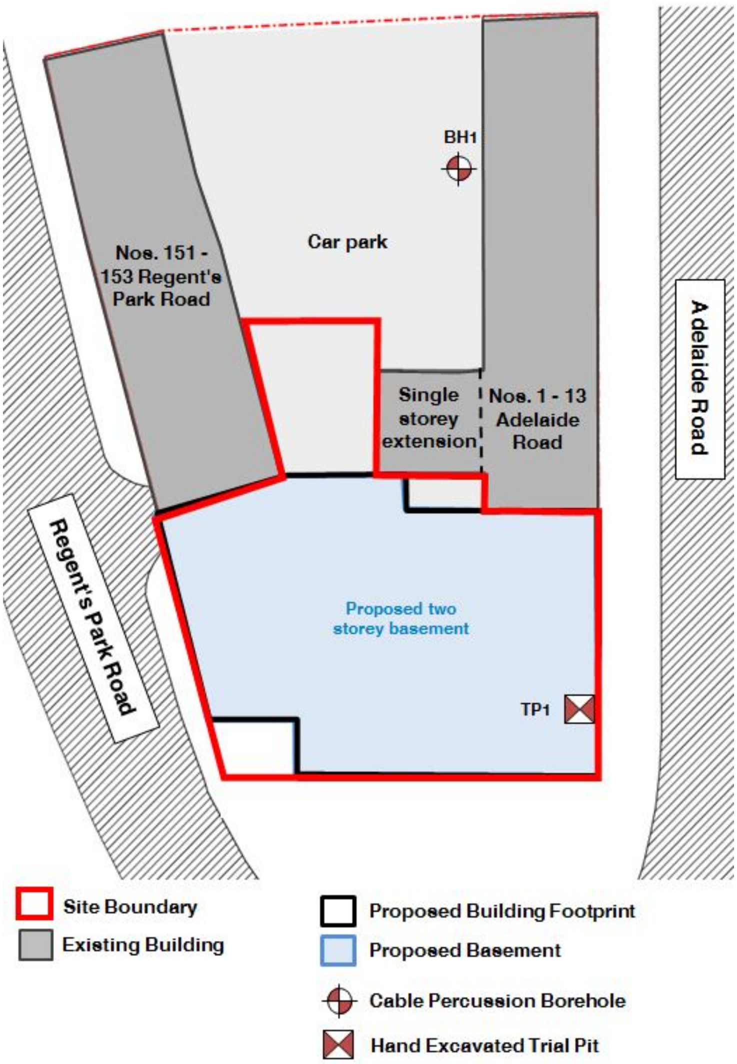
The London Clay underlies the made ground and consists of typical firm becoming stiff, grey fissured silty clay with occasional claystones.

3.3 Groundwater

No shallow groundwater table is present beneath the site.

3.4 Existing Foundations

The basement perimeter walls appear to be supported by shallow concrete strip foundations that extend to around 0.3m depth below existing basement level.



4. Discussion of Geotechnical Issues

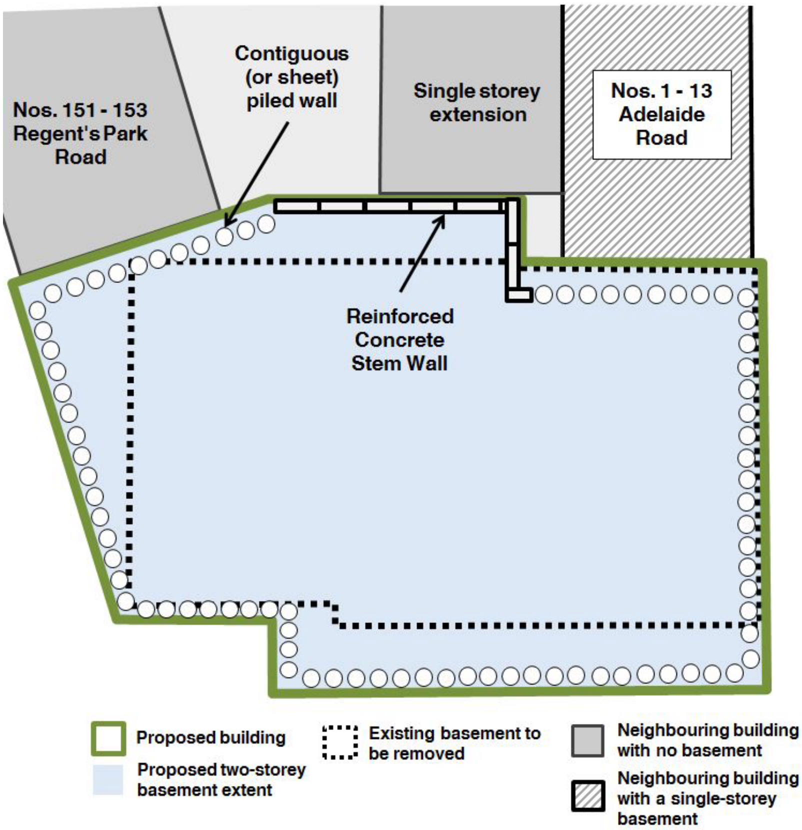
4.1 Basement Construction

Following demolition of the entirety of the existing building, it is proposed to construct a new eight storey hotel.

The hotel will comprise a two storey basement, which will extend to an approximate depth of 7m below ground level (approximately +24m OD) and will be present beneath the entire footprint of the new structure.

Temporary lateral support will be required in order to maintain the stability of the adjacent ground and neighbouring buildings.

Due to the scale of the proposed basement and proximity of the neighbouring buildings, it is suggested that a piled retaining wall is utilised to form the entirety of the basement perimeter and is designed to be maintained in as rigid state as is possible.



Plan showing the proposed basement structure

This may be achieved through top-down excavation, supported laterally by a contiguous bored or sheet pile retaining wall with secondary propping.

4.1.1 Basement Retaining Wall

Given the relatively small plan area of the building it may be possible to install propping that spans horizontally across the full site rather than to have to resort to raked propping.

A contiguous bored pile retaining wall would be expected to provide the stiffest solution and multilevel propping could be introduced to limit the required pile size for retention purposes.

It is envisaged that the new building will be supported by a perimeter contiguous bored pile retaining wall, located 1m or so away from the adjacent buildingsin conjunction with a section of underpinning to for the reinforced concrete stem wall section as shown on the plan above, where the adjacent buildings and internal piles are closer. This would be undertaken in two stages and result in a section of 250mm thick reinforced stem wall.

A steel sheet pile solution may be considered as an alternative to the bored pile wall. This would require more robust propping than a contiguous bored pile wall but would present a thinner wall and offer a better structural connection for a potential raft foundation.

4.2 Foundations

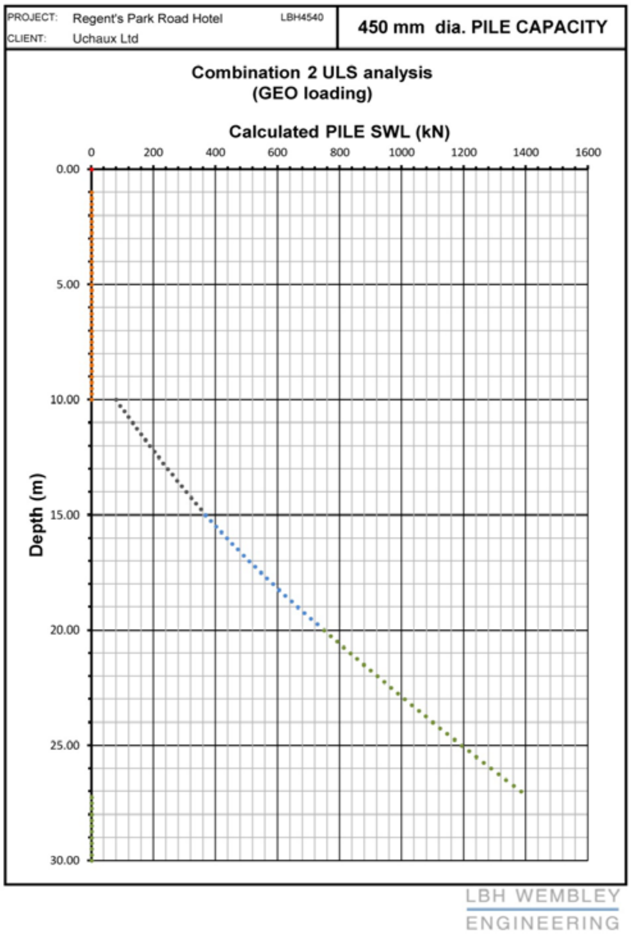
4.2.1 Bored Piled Foundations

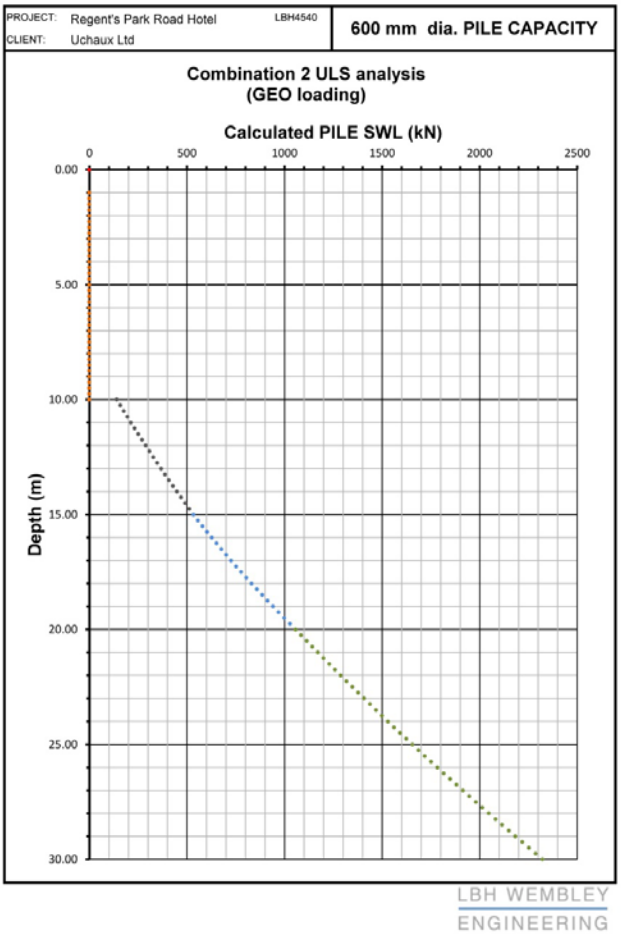
In view of the high structural loading, it is suggested contiguous bored piled retaining wall may be used as piled foundations to transfer the loading down into the London Clay Formation at depth, together with piled foundations to support the internal columns.

To assist the initial assessment of pile foundations capacity, a preliminary graph of Pile Safe Working Load (SWL) based on Combination 2 ULS GEO is shown for 450mm and 600mm diameter piles. The graphs are based upon an α-value of 0.5, N_c of 9 and the adopted design strength profile.

The advice of a specialist piling contractor should be sougth both in the selection of pile type and to provide a suitable pile design for the proposed scheme.

It should be noted that the charts include an allowance for no load shedding in the top 10m of the pile in order to avoid loading the nearby London Underground tunnels.



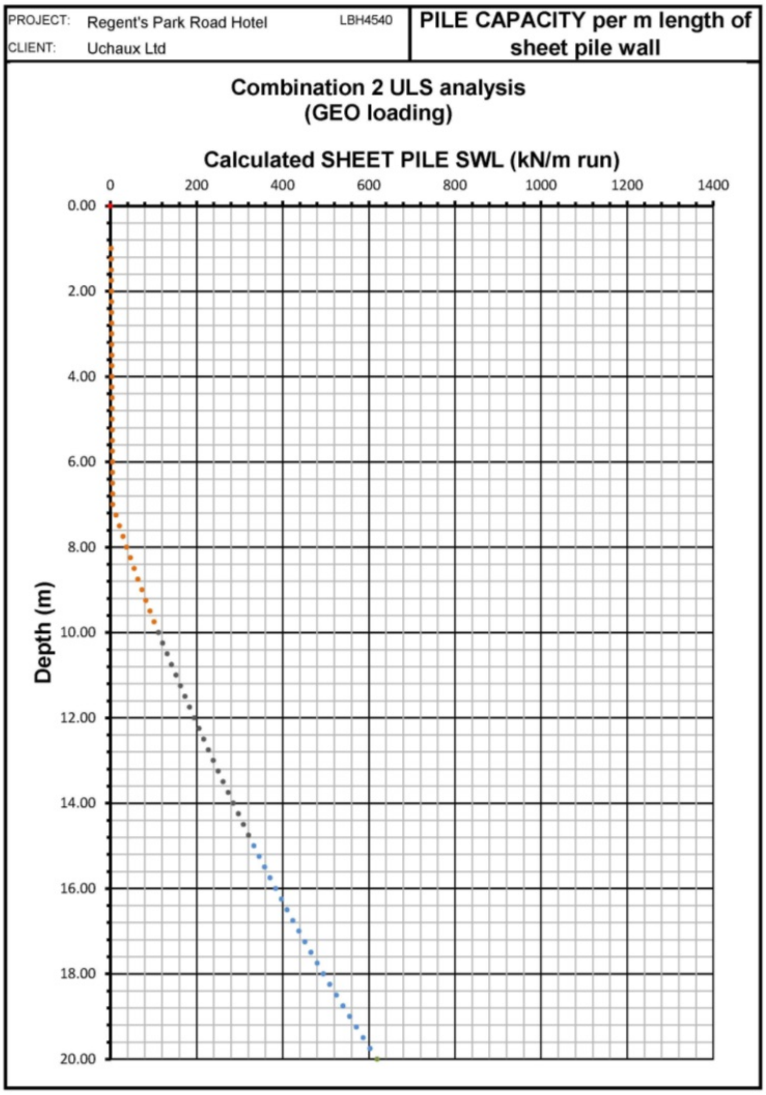


4.2.2 Sheet Piled Foundations

Conventional pile design allows the consideration of both shaft frictional resistance and end bearing. However, shaft resistance is only allowable below the base of the excavation and is also only allowable on both sides of the wall below the depth of any zone of theoretical passive resistance.

For practical purposes, the latter depth has been assessed as the depth of embedment that would have been required for retaining wall design without vertical loading, and to a first approximation this may be taken as 1.5 times the retained height.

The following chart shows the theoretical allowable vertical loading per metre run of sheet piling, which suggests that 250kN/m run should be theoretically achievable to piles to approximately 12m depth and that 600kN/m run should be theoretically achievable to piles to approximately 20m depth.



4.2.3 Raft Foundation

Given the limited scale of expected post-construction soil heave movements, it is possible that the proposed building may be supported on a raft foundation, which will distribute the structural loads from the internal columns and the stair & lift core across the entire basement footprint.

While it may prove a challenge to satisfactorily connect a basement raft to a contiguous bored pile wall, the use of a sheet pile wall may provide scope for a cast-in situ reinforced concrete liner wall to transfer the new structural loads to the raft more easily.

The raft would need to be designed as a rigid monolithic concrete basement, such that the structure responds uniformly to any heave movements without distortion.

The structural loading of the new hotel could potentially be then shared between the perimeter walls and raft. The raft thickness would need to be large enough to accommodate the necessary reinforcement to distribute the high column loads. A localised thicker section of the raft may be designed in the high loaded area of the lift & stair core.

A multi-stage, detailed raft settlement analysis would need to be undertaken to resolve the feasibility of this foundation solution in terms of the potential settlement pattern.

4.2.4 Retaining Walls

The retaining walls should be designed to prevent any significant lateral movement in both the temporary and permanent situations. It will be imported to design for k_0 rather than conventional k_a conditions, in order to preserve in-situ stress conditions and to limit movements behind the walls.

This may be achieved through the provision of continuous positive propping throughout a top-down excavation and construction.

The following parameters may be considered in the design of the retaining walls:-

Suggested Retaining Wall Design Parameters			
Stratum	**Bulk Unit Weight**	**Effective Cohesion**	**Effective Friction Angle**
	(kN/m^3)	(c' - kN/m^2)	(ϕ'- degrees)
London Clay	20	Zero	25

4.3 Basement Heave

Up to approximately 10mm of short term soil heave, due to soil unloading, is predicted at the centre of the new basement excavation, albeit these movement are expected to be confined to the piled excavation area, with negligible influence outside of it.

The post construction ground movement, may amount to an additional 10mm soil heave; however, this will be largely dependent upon the selected foundation solution.

4.4 London Underground

A key factor for the proposed development is the need to avoid any undue loading of London Underground infrastructure.

Should piled foundations be adopted, they will need to be designed to transfer the structural loading to the soil at depth and not to shed any appreciable load within the zones of soil that might transfer this loading to the tunnel structure.

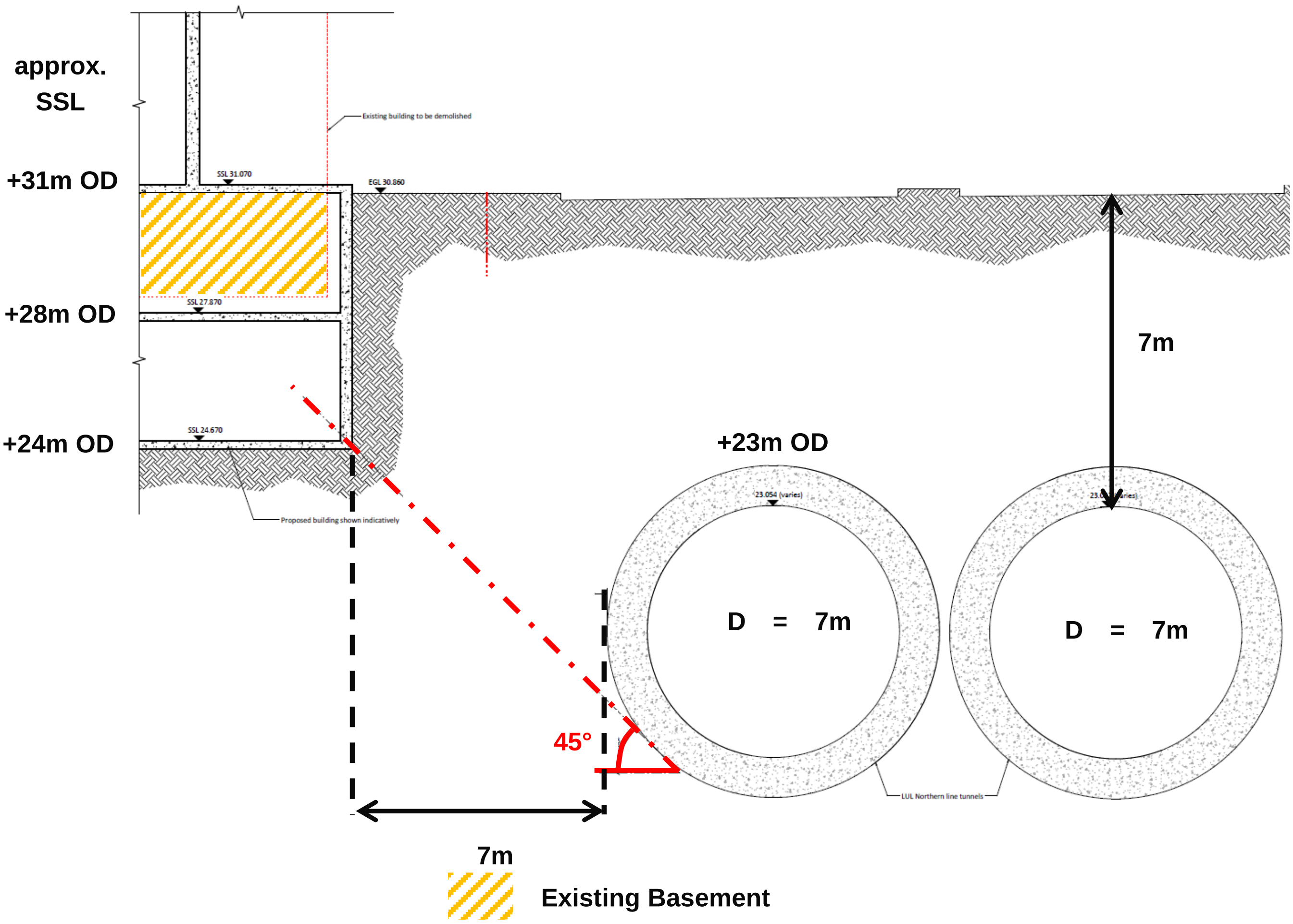
As a first approximation, these zones may be assessed as that soil lying above a line rising at 45° away from the edge of the tunnel.

The section presented below indicates that the proposed basement lies just within the zone of influence of soils associated with the tunnel.

The piles would need to be designed to shed loading to the soil through shaft friction only commencing at just below the proposed basement depth, in order to ensure that no discernible load will be shed upon the tunnel.

Similarly, in the case of a raft foundation, the imposed loading may marginally be transferred to the tunnel.

An assessment of the ground movements that can be expected to occur at the tunnels at the station as a result of the various construction stages (i.e. demolition, basement excavation and structural loading) is to be undertaken as part of the separate Asset Impact Assessment.



Section showing proposed basement and LUL tunnel stations
(Drwg. No. 1872/P200 by HTS dated 26/07/18)

5. Ground Movement Assessment

An analysis has been undertaken to provide an approximation of the potential ground movements associated with the basement development.

5.1 Ground Model

The analysis uses classic modified Boussinesq elastic theory, assuming a fully flexible foundation applying a uniform loading to a semi-infinite elastic half-space, using the above parameters for stratified homogeneity and with the introduction of an assumed rigid boundary at approximately 30m depth (approx. -5m OD).

Stratum:	**Undrained Elastic Modulus Eu (kN/m^2)**	**Drained Elastic Modulus E' (kN/m^2)**
London Clay Formation	79,500kN/m^2 at existing basement level increasing linearly to 259,500kN/m^2 at 30m depth	53,000kN/m^2 at existing basement level increasing linearly to 173,000kN/m^2 at 30m depth

Poisson's Ratios of 0.5 and 0.1 have been used for short term (undrained) and long term (drained) conditions respectively.

5.2 Excavation Unloading

The basement excavation will extend to approximately 7m depth below the existing ground level over the entire building footprint. The excavation depth will, however, be limited to approximately 3.5m within the footprint of the existing single storey basement.

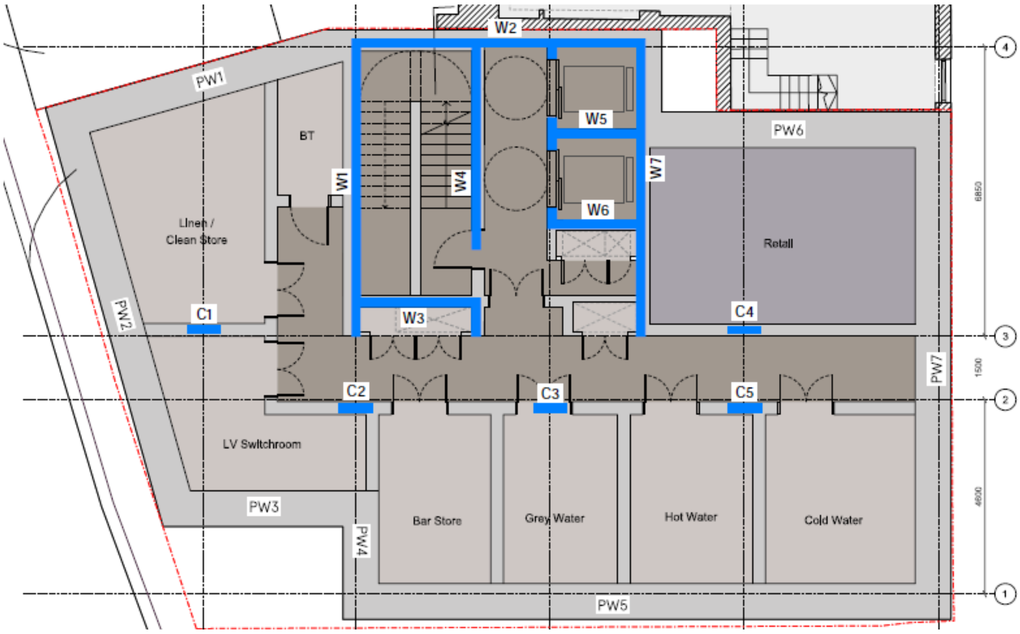
The potential effect of the excavation may be considered by unloading of -70kN/m^2 due to soil excavation within the existing basement area, increasing to -140kN/m^2 outside of this.

5.3 Structural Loading

Loading information has been provided by HTS, in the form of column and wall loading at the proposed basement level. This was provided by means of the following drawing and load schedule:

- 1872-SK21-P1 – Proposed Structural GA, dated June 2019
- 2170-Sheet 1-P1 – Column & Wall Load Summary, dated June 2019

For the purpose of the Ground Movement Assessment, the column and wall loads bearing directly on the proposed piled foundations (Ref. C6 – C19 and PW1 – PW7 on the schedule) at the perimeter of the proposed basement are assumed to be transferred to the underlying soil at depth and therefore not interacting with the resultant movements at basement level.



Proposed lower basement plan showing the column and wall loads references

Column Schedule

Ref	Bearing Level	Description	Self Weight (kN)	SDL (kN)	Live (kN)	Live % Red (kN)	Total G (kN)	Total Q (kN)
C1	B2	Column Total Load	784	162	518	311	946	311
C2	B2	Column Total Load	735	224	451	271	959	271
C3	B2	Column Total Load	923	209	627	376	1132	376
C4	B2	Column Total Load	764	166	498	299	930	299
C5	B2	Column Total Load	959	218	656	394	1177	394
C6	Piled Wall	Column Total Load	226	455	97	58	681	58
C7	Piled Wall	Column Total Load	314	518	161	97	832	97
C8	Piled Wall	Column Total Load	301	505	152	91	806	91
C9	Piled Wall	Column Total Load	416	412	232	139	829	139
C10	Piled Wall	Column Total Load	171	233	52	31	404	31
C11	Piled Wall	Column Total Load	163	293	59	35	456	35
C12	Piled Wall	Column Total Load	385	626	198	119	1011	119
C13	Piled Wall	Column Total Load	667	740	397	238	1407	238
C14	Piled Wall	Column Total Load	469	548	279	168	1017	168
C15	Piled Wall	Column Total Load	581	737	366	219	1318	219
C16	Piled Wall	Column Total Load	338	670	179	108	1009	108
C17	Piled Wall	Column Total Load	424	522	245	147	946	147
C18	Piled Wall	Column Total Load	424	522	245	147	946	147
C19	Piled Wall	Column Total Load	343	711	183	110	1054	110
Total		**Total Column Loads**	**9386**	**8473**	**5596**	**3358**	**17859**	**3358**

Wall Schedule

Ref	Bearing Level	Description	Length (m)	Self Weight (kN)	SDL (kN)	Live (kN)	Live % Red (kN)	Total G (kN/m)	Total Q (kN/m)
W1	B2	Column Total Load	6.9	2326	549	850	510	417	74
W2	B2	Column Total Load	7	1946	900	238	143	407	20
W3	B2	Column Total Load	2.8	720	59	178	107	278	38
W4	B2	Column Total Load	6.9	2370	306	921	553	388	80
W5	B2	Column Total Load	2.1	738	53	167	100	376	48
W6	B2	Column Total Load	2.1	738	53	167	100	376	48
W7	B2	Column Total Load	6.9	2055	677	672	403	396	58
Total		**Total Wall Load**	**35**	**10892**	**2597**	**3193**	**1916**	**2638**	**366**

Piled Wall Schedule

Ref	Bearing Level	Description	Length (m)	Self Weight (kN)	SDL (kN)	Live (kN)	Live % Red (kN)	Total G (kN/m)	Total Q (kN/m)
PW1	B2	B1 + B2 + Columns	6.9	1128	903	422	253	294	37
PW2	B2	B1 + B2 + Columns	10.3	1100	1020	352	211	206	20
PW3	B2	B1 + B2 + Columns	4.6	553	557	168	101	241	22
PW4	B2	B1 + B2 + Columns	2.2	312	319	118	71	287	32
PW5	B2	B1 + B2 + Columns	14.4	2477	2203	1127	676	650	94
PW6	B2	B1 + B2 + Columns	7.2	1033	905	433	260	269	36
PW7	B2	B1 + B2 + Columns	12	1862	1775	788	473	303	39
Total		**Total Piled Wall Load**	**58**	**8464**	**7682**	**3408**	**2045**	**2250**	**281**

Total

Ref	Bearing Level	Description	Self Weight (kN)	SDL (kN)	Live (kN)	Live % Red (kN)	Total G (kN)	Total Q (kN)
Total	B2	Total Column Loads	23521	11258	9353	5612	34779	5612
							40391	

Schedule of structural loads provided by HTS

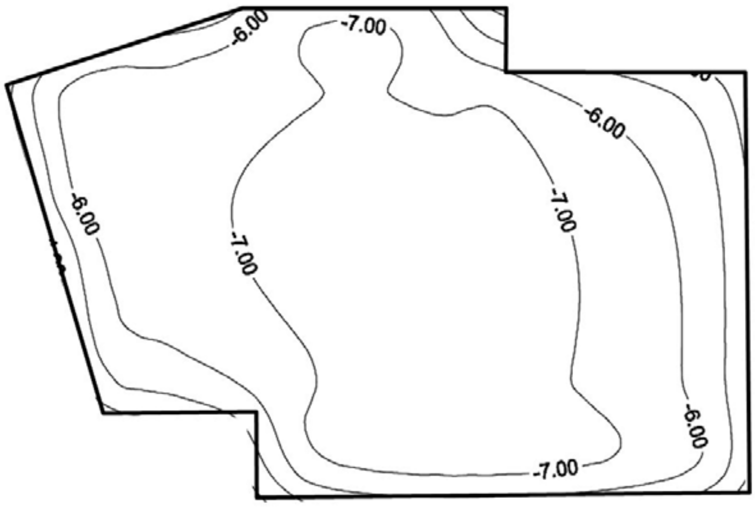
5.4 Predicted Movements

5.4.1 Short Term Heave

Up to approximately 8mm of short heave is theoretically expected in the centre of the basement excavation, reducing to 6mm at the perimeter retaining walls.

The ground heave movements due to soil unloading are not expected to have any discernible impact on the neighbouring structures as the heave movements will confined by the perimeter retaining walls.

An exception is the single storey extension to Nos. 1 – 13 Adelaide Road, where theoretical movement heave of 6mm could affect the perimeter wall.



Predicted theoretical short term ground movement at lower basement level (values in mm)

5.4.2 Post-Construction Ground Movement

Following the reapplication of structural loading, as described in section 5.3, initial modelling suggests that a raft foundation would counteract the potential heave movements due to soil unloading.

However, should a piled foundation solution be adopted, the analysis indicates that an additional 10mm of heave may theoretically be expected, albeit this will in practice be restricted by the presence of internal piling.

Nevertheless, both pile caps and the suspended basement floor will be required to be provided with an appropriate thickness of heave protection material to accommodate these movements.