STRUCTURAL DESIGN STATEMENT

FOR

PROPOSED MULTI-PURPOSE DEVELOPMENT

AT

277A Grays Inn Road
London
WC1X 8QF

Date: May 2015
Revision: -

Document Record

Job Number	Document Revision	Issue Date
L1706	DRAFT	6th May 2015

CONTENTS

1.0 Introduction

This report outlines the structural proposals for a new eight storey residential-led multi-purpose development at 277A Grays Inn Road, Kings Cross, London. The report has been prepared by Pringuer-James Consulting Engineers (PJCE) on behalf of Eurobuild Properties Co. Ltd. The report is intended to provide sufficient level of information to discharge the planning condition 26 of the Grant of Planning Permission dated, 10th October 2014.

The report is based on the design and discussions held with Eurobuild Properties Co. Ltd, Waugh Thistleton Architects and XCO2 Building Services Engineers. The report should be read in conjunction with the information submitted by associated consultants and the latest Architectural drawings and is to a level of detail equivalent to RIBA Plan of Work 2013 Stage 4.

A topographical survey of the site has been undertaken by Greenhatch Group and is available on request from Regal GI Ltd. A series of additional site surveys to identify the existing site services a currently being undertaken at present and will be available once formally released by the parties undertaking the surveys.

A preliminary geotechnical site investigation and desktop study has been carried out by Herts & Essex Site Investigations Ltd (HESI) in September 2014. A further series of borehole investigations have been undertaken by Soil Consultants Ltd to ascertain the soil conditions beyond the preliminary 15m depth of investigation carried out in the initial site investigation. This additional site investigation has been undertaken in order to identify the soil conditions and capacities for the proposed foundation scheme which is anticipated to extend beyond the scope of the initial site investigation. As part of the initial enabling works undertaken on site a series of trial pits have been excavated across the site to determine the existing boundary conditions and the relationship of the existing adjacent buildings with the proposed development. Details of each site investigation and the trial pits undertaken are included in the appendices of this document.

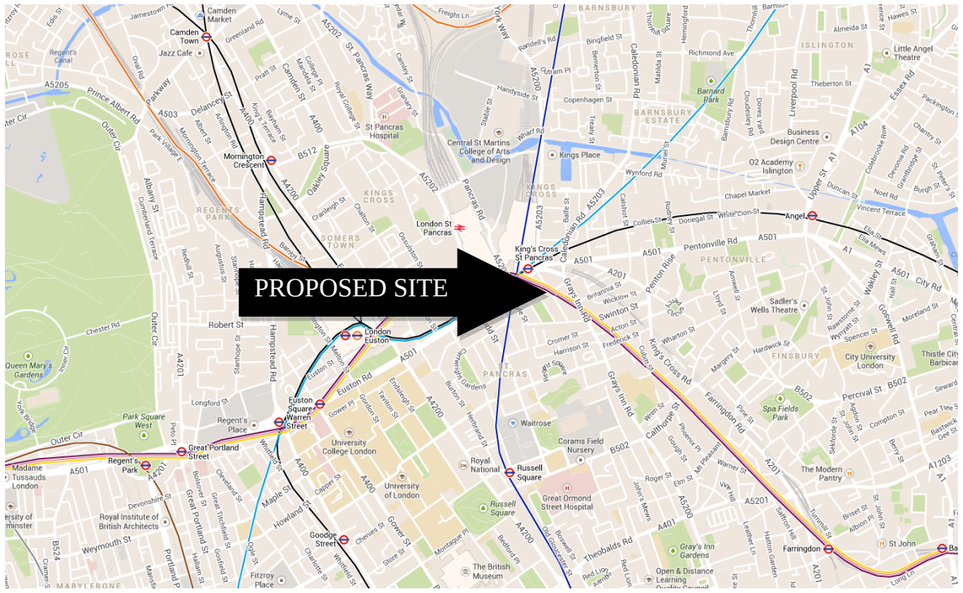

Fig 01 Site Location – Transit Infrastructure

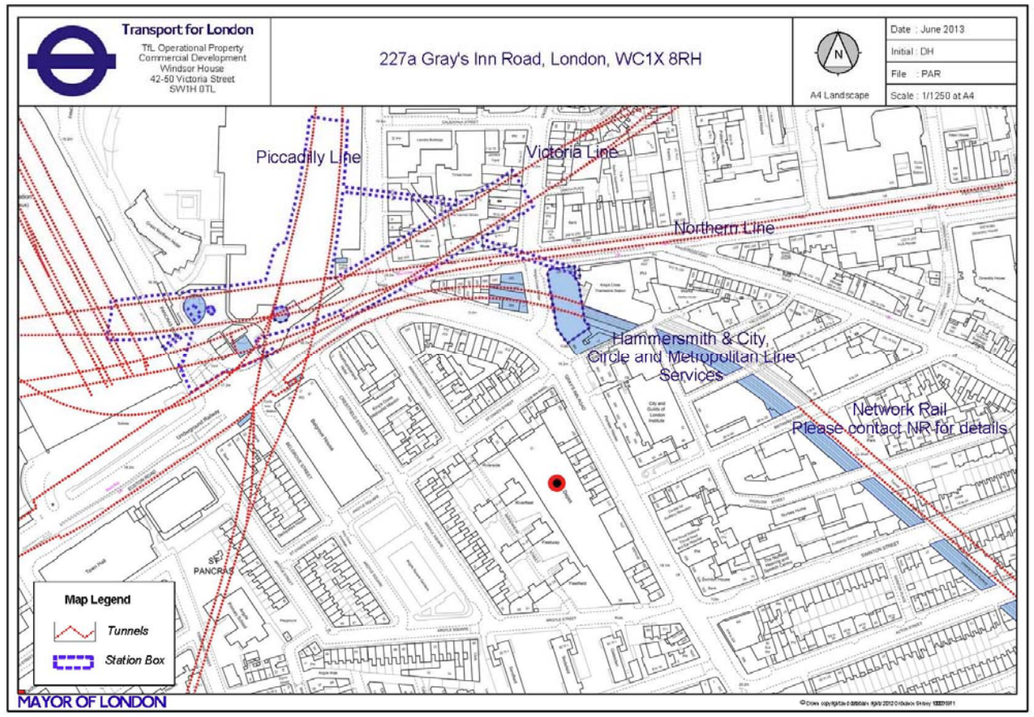

Fig 02 Site Location – Underground Infrastructure

2.0 Existing Buildings & Site

2.1 Site Location

The site is located in the Kings Cross area of Camden at the junction of Grays Inn Road and St. Chads Street. The site faces east towards Grays Inn Road behind a row of street-front properties including 307 Grays Inn Road at the northern extent of the boundary running south as far as 275 Grays Inn Road. To the north the site extends with a portion facing onto St Chads Street. To the south the site is bounded by 55 Argyle Street and to the east the site is bounded by the Birkenhead Estate.

The site is located 150m to the south east of Kings Cross Rail Station. Beyond the immediate boundaries outlined above, the site is also bounded by a number of railway lines and stations, including Kings Cross Station (175m North West), Euston Station (900m East), Euston Square (1100m South West), Russell Square (735m South), Angel Station (1100m East), Caledonian Road & Barnsbury Station (1500m North West).

The site is also bounded by a number of railway lines as indicated on the following plans. With the congested nature of the rail networks in the area a desktop search was undertaken to determine the underground infrastructure locally. This search identified a number of underground rail lines including the Hammersmith & City, Circle, and the Metropolitan lines running south east from the intersection of Grays Inn Road and Euston Road. The lines follow a similar path to that of Grays Inn Road tapering away from the proposed site as they travel south. (See Fig 02)

In addition to the existing infrastructure in the area the Crossrail II High Speed Rail Network has a safeguarding zone in the vicinity to facilitate the proposed Chelsea – Hackney Line. Review of the specified safeguarding zone indicates that the site does not enter into the zone but does run tight up to the proposed safeguarded zone. (See Fig 03)

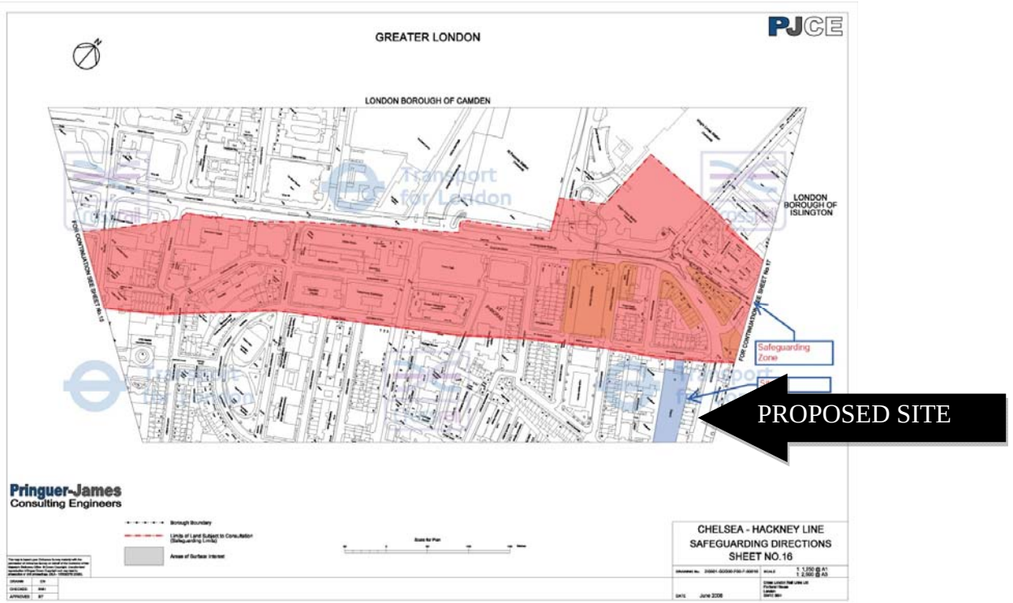

Fig 03 Site Location – Crossrail II Protection Zone

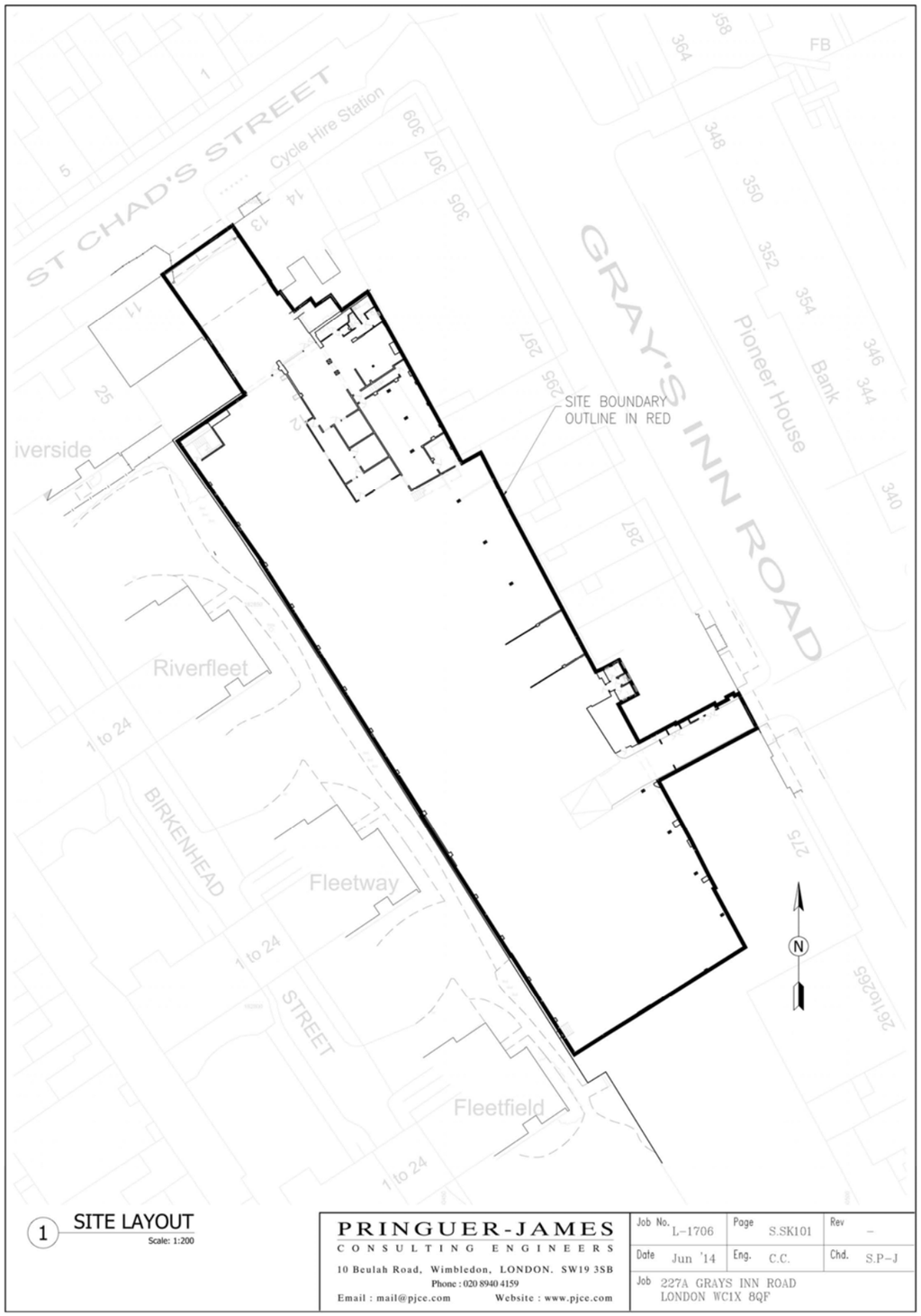

Fig 04 Existing Site

2.2 Existing Site

The site contains an existing steel framed warehouse building currently in use as a car park which extends across a large extent of the site. The car park level is raised relative to the associated road levels servicing the site with an average level of 19.10m AOD across the site compared to a level of 17.5m AOD to the St. Chads Street exit and 18.10m AOD to the Grays Inn Road exit. The difference in levels is overcome by means of access ramps to each access point.

The existing building on the site is formed from a combination of materials, including a steel roof truss and column structure which runs down onto concrete pad footings. The boundary walls between the steel columns are formed of London brickwork and rise up 6.0m to eaves level along the full perimeter of the trussed roof.

Below a section of the ground floor carpark level a basement approximately 8.50m wide exists. This basement area drops down approximately 4.25m to a level of 14.90m AOD. The basement is constructed from a series of brickwork walls supporting brickwork arches overhead which currently support the vehicular loadings generated by the current use of the building. The remainder of the site comprises a single storey steel framed structure.

2.3 Neighbouring Properties

Grays Inn Road

To the eastern boundary along Grays Inn Road, the site is directly adjacent to the residential and commercial properties facing out onto Grays Inn Road. These generally consist of terraced brickwork buildings, a large proportion of which have a rear annex which extends back to the eastern boundary of the proposed site. Further south along the eastern boundary the proposed site is adjacent to number 275 Grays Inn Road.

A number of trial pits have been excavated along the extent of the site boundary to ascertain the depth and extent of the existing footings. These have been incorporated into the proposed boundary design details and considered as part of the temporary works methodologies. Details of the trial pits are provided in the appendices.

Argyle Street

Along the southern boundary, an existing building exists identified as No. 55 Argyle Street which runs along the length of the southern boundary. This property contains an existing lower ground floor level and rises up two stories to the original roof level. A relatively recent extension to the building was undertaken which involved adding an additional storey on top of the original building. As part of the works undertaken the boundary wall was raised to suit the proportion of the new building. The boundary wall now extends to a level approximately 10.5 meters above existing ground level.

Birkenhead Estate

To the western boundary the site is bounded by the Birkenhead Estate which contains four individual multi residential buildings each of which contain a single storey basement. The buildings are located approximately 5.0m from the existing site boundary wall. Surrounding the Birkenhead Estate is a communal green area which has an average level of 18.75m along the boundary with the proposed development site.

St Chads Street

To the northern boundary the site is accessed directly from St. Chads Street with properties each side of the site access. These have been identified as No.11 St. Chads Street and No.13 St. Chads Street. At present, No.11 St. Chads Street is under development with construction of a new lower ground floor basement level nearing completion. The lower ground floor level has been constructed using typical underpinning methods with a reinforced concrete basement box structure forming the permanent structure. No. 13 St. Chads Street comprises an existing end of terrace brickwork building with a single storey lower ground floor level below.

2.4 Site Constraints

Site Access

The site has restricted access given the built up nature of the site boundaries. A minor access entrance below the existing 277 Grays Inn Road property provides single vehicular access from Grays Inn Road and a larger access entrance from St. Chads Street provides greater access to the site running between the adjacent properties of 11 and 13 St Chads Street. The two access locations servicing the site will be maintained as part of the proposed redevelopment of the site. A construction management plan has been developed for the project which proposes utilizing the larger less congested access point from St. Chads Street.

Site Services

The site is serviced by the existing Thames Water drainage infrastructure in the area. An asset search has been carried out and identified the existing network of sewers in the neighbouring roads.

The site contains an existing UKPN sub-station which will be relocated as part of the redevelopment with the relevant permissions, phasing and connections agreed and undertaken by the clients representative. An additional ground penetrating radar (GPR) survey has been commissioned for the site and details of the existing services identified can be made available once the survey is completed.

3.0 Geotechnical Ground Conditions

3.1 Herts & Essex Site Investigation Report

A geotechnical site investigation has been carried out by Herts & Essex Site Investigations (HESI) in May 2014 with further investigation undertaken in September 2014 to determine the existing soil conditions within the site and provide and interpretative report with details of structural design parameters and geotechnical analysis. The site investigation (attached in appendix) has been used to interpret the feasibility of various structural solutions to develop the proposed structure.

Exploratory Work - Fieldwork

Two 15.0m investigation boreholes were carried out at agreed locations within the site. In-situ Standard Penetration Tests [SPT] and soil sampling were carried out at appropriate levels with groundwater monitoring standpipes installed in one borehole. An additional window sample borehole was carried out to a depth of 6.0m providing a broad cross section of the soil profile across the site.

Laboratory Work – Testing

Geotechnical laboratory testing was carried out to establish the following soil characteristics:

- Natural moisture content
- Index properties (Atterberg Limits)
- Particle size distribution tests (wet sieve method)
- Unconsolidated undrained triaxial compression tests

Ground Conditions

The geological sequence beneath the site comprises a predominantly stiff London Clay with no superficial deposits identified. A desk study has identified the site has previously been used as a North London Horse Depository, later used as a Bottling Warehouse. The site is currently used as a warehouse/parking area. The site is overlain by a layer of brick/rubble fill material approximately 2.0-3.0 meters below existing ground level. Details of the investigative boreholes are attached in Appendix E of this document.

Made Ground

The upper levels of the two boreholes undertaken encountered various layers of concrete consistent with the current use of the building. Below the upper layers, the fill material extended to depths of 2.90m and generally consisted of soft sandy clay with brick fragments. Borehole D encountered fill material to a depth of 1.50m with soft peaty clay material identified to a depth of 4.40m. This has the potential to be un-compacted clay material reinstated historically. No obvious visual evidence of contamination was noted.

London Clay

The London Clay was encountered below the fill material and extended to the full depth of each borehole. The formation typically comprised firm becoming stiff brown slightly silty clay to depths of approximately 6.0m to 7.0m. Below the upper firm layers of clay, a stiff grey slightly silty clay was identified in each of the boreholes. This is consistent with the initial desktop study carried out which identified a London Clay Formation underlying the site.

HERTS & ESSEX SITE INVESTIGATIONS

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Telephone: Ware (01920) 822233
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Appendix No. 2
Sheet No. 4
Job No. 12138
Date Aug 2014

277a Grays Inn Road, London WC1X 8QF

Borehole D

Description of Strata	Depth	Thickness (m)	Legend	Installation installed	Water Level	Samples No.	Samples Type	Samples Depth (m)	S.P.T N-Value or Vane Strength	Casing Depth (m)
Cobbles over concrete reinforced	0.20	0.20								
Sandy brick rubble FILL	1.30	1.10		Bentonite Seal						
Soft brown silty slightly peaty CLAY	4.40	3.10		50 mmø Slotted Pipework / Solid Pipework	DRY	1	D	1.50		
						2	D	2.40		
						1	U	3.00		
						2	U	4.00		
Firm becomming stiff brown slightly silty CLAY	6.95	2.55		Response Zone		3	U	5.00		
						4	U	6.50		
Stiff grey slightly silty CLAY		8.05				5	U	8.00		
						6	U	9.50		

Remarks:

Scale 1:50

Key : U–Undisturbed Sample (100mm diameter) B –Bulk Sample ▼–Water Struck D –Disturbed Sample ▽–Water Standing W–Water Sample P–Piston Sample N–S.P.T. N–Value V–Vane Strength (kN/m²)

Fig 05 HESI Borehole Extract

Groundwater

A desktop study identified the subsoil as an unproductive strata with no groundwater source protection zones within the proximity of the site. In each of the 15.0m boreholes and the 6.0m window sample groundwater was not encountered. A groundwater monitoring standpipe has been installed in one of the two boreholes to allow future readings and identification of potential groundwater fluctuations.

Contamination

Initial testing of the existing soil material did not identify any excessive levels of contamination and the site has been categorised as a class 1 in accordance with BRE Digest.

Existing Foundations

An additional scheme of trial pits has been carried out by PJCE in order to evaluate the existing boundary wall conditions and define the typical anticipated foundations which will be encountered during the construction stages. Details of these trial pits are included in Appendix A and have been incorporated into the proposed structural details to each of the site boundaries.

Site & Location: **277A Gray's Inn Road, London WC1X 8QF**

Borehole No: **BH102**

Client: **Regal Homes Ltd**

Coordinates: 530448E, 182853N

Sheet 1 of 3

Engineer: **Pringuer-James Consulting Engineers Ltd**

Ground Level: +19.10mOD

Report No: 9708/MC

Progress & Observations	Samples & Tests Type	Samples & Tests Depth (m)	Field Test Results	Strata Depth (m)	Strata Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH commenced: 02/03/2015				0.25	18.85		MADE GROUND: Concrete slab. [Description from driller's log]	
BH casing diameter: 150mm							MADE GROUND: Soft, brown and orange-brown, slightly gravelly, slightly sandy, silty clay. Gravel is of flint, brick and concrete.	
Inspection pit to 1.20m	D	1.00						1
				1.70	17.40		MADE GROUND: Firm, brown, slightly gravelly clay. Gravel is fragments of brick.	
Casing depth: 2.00m	D	2.00						2
				2.70	16.40		Stiff, becoming very stiff below 5.0m, fissured, thinly laminated, brown and orange-brown, thinly veined blue-grey CLAY, with occasional selenite. Some orange-brown gleying on fissure planes.	
	U	3.00						3
	D	3.50						
	D	4.00						4
	SPT/S	4.00	N=17 Nk=22					
	D	4.50						
	U	5.00						5
	D	5.50						
				6.30	12.80		Very stiff, thinly laminated, fissured, dark grey-brown CLAY, with rare small pockets of light grey-brown silt.	6
	D	6.50						
	SPT/S	6.50	N=17 Nk=22					
	D	7.25						7
	U	8.00						8
	D	8.50						
	D	9.50						9
	SPT/S	9.50	N=23 Nk=29					
				10.00	9.10		Continued on next sheet	10

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone HV = Hand Vane [kPa] PP = Pocket Penetrometer [kg/cm²] PID = Photo Ionisation Detector [ppmv] * = full SPT penetration not achieved - see summary sheet

Borehole type: Cable Percussion

Remarks: 50mm diameter standpipe with gas tap installed on completion. Approximate coordinates interpolated from public domain data. Approximate Ground Level interpolated from Pringuer-James drawing (ref. L1706-03_01, dated May 2014).

Borehole No: **BH102**

Soil Consultants

Fig 06 Soil Consultants Borehole-102 Extract

3.2 Soil Consultants Ltd Report.

An additional site investigation has been commissioned by Regal GI Ltd. and undertaken by Soil Consultants Ltd. in March 2015 to ascertain the soil profile at greater depths below the site. The site investigation carried out three borehole investigations each extending to a depth of 25.0m below ground level and subsequently verified the soil design parameters for adoption in the foundation design for the proposed structural scheme. The results of this site investigation have been issued by Soil Consultants and serve to reinforce the initial findings of the preliminary site investigation undertaken by HESI.

Exploratory Work – Fieldwork

Three boreholes were completed to a depth of 25.0m below ground level with samples taken for environmental and geotechnical testing at various levels. A recording of the gas and groundwater levels recording was made at the time of the investigation and a standpipe was installed in one of the boreholes to facilitate future groundwater monitoring as required.

Laboratory Work – Testing

Geotechnical laboratory testing was carried out to establish the following soil characteristics:

- Natural moisture content and index properties
- Unconsolidated, undrained triaxial compression tests
- Soluble sulphate/pH analyses.

Ground Conditions

The site investigation undertaken confirmed the natural sequence of the soil profile and revealed made ground at surface levels. Information relating to the area indicates that the site is underlain by the London Clay formation above the Lambeth Group, the Thanet Formation and the White Chalk Sub-group. The London Clay is known to extend to depths of 21.0m with the Lambeth Group extending a further 18.0m and the shallow Thanet Formation extending 2.0m deep before the White Chalk Sub-group extends to substantial depths.

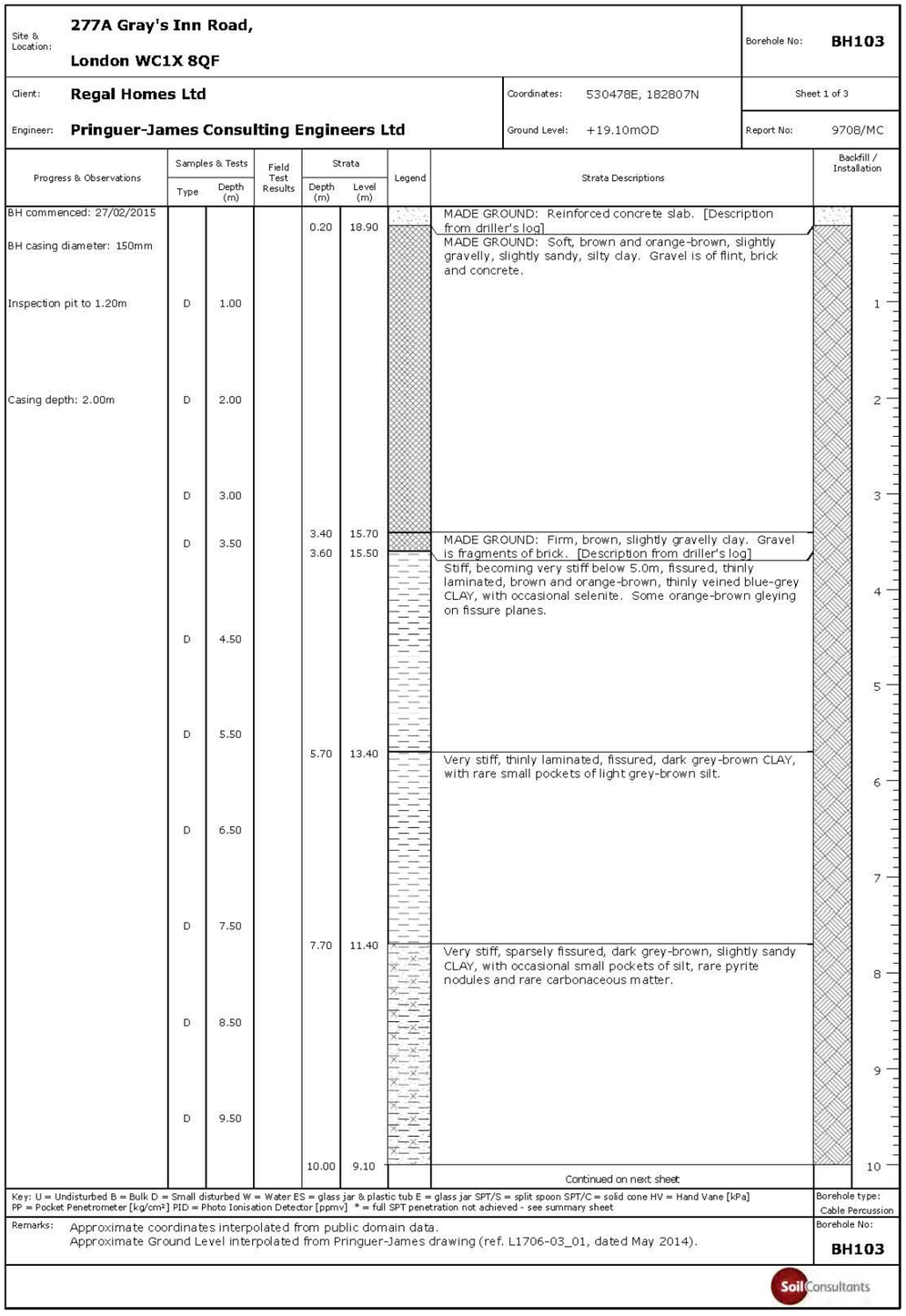
Made Ground

The boreholes undertaken identified made ground extending to depths of between 1.30m and 3.60m below the existing slab warehouse level. The made ground comprised brown, slightly gravelly, slightly sandy, silty clay with elements of flint, brick and concrete intertwined within the material. The made ground was characterised as a fine grained and soft locally firm material.

London Clay

The London Clay Group was encountered at varying depths below the made ground and contained upper layers of brown and orange-brown weathered clay material. Extending down, the clay material was found to be consistent with a typical unweathered grey London Clay with an increase in stiffness and bearing capacity.

The tests carried out indicate that from a depth of 3.0m to 10.5m the clay was considered to be of high to very high shear strength and extending down below 10.5m the clay was determined to have a very high shear strength.



Site & Location: **277A Gray's Inn Road, London WC1X 8QF**

Borehole No: **BH103**

Client: **Regal Homes Ltd**

Coordinates: 530478E, 182807N

Sheet 1 of 3

Engineer: **Pringuer-James Consulting Engineers Ltd**

Ground Level: +19.10mOD

Report No: 9708/MC

Progress & Observations	Samples & Tests Type	Samples & Tests Depth (m)	Field Test Results	Strata Depth (m)	Strata Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH commenced: 27/02/2015				0.20	18.90		MADE GROUND: Reinforced concrete slab. [Description from driller's log]	
BH casing diameter: 150mm							MADE GROUND: Soft, brown and orange-brown, slightly gravelly, slightly sandy, silty clay. Gravel is of flint, brick and concrete.	
Inspection pit to 1.20m	D	1.00						
Casing depth: 2.00m	D	2.00						
	D	3.00						
	D	3.50		3.40	15.70		MADE GROUND: Firm, brown, slightly gravelly clay. Gravel is fragments of brick. [Description from driller's log]	
				3.60	15.50		Stiff, becoming very stiff below 5.0m, fissured, thinly laminated, brown and orange-brown, thinly veined blue-grey CLAY, with occasional selenite. Some orange-brown gleying on fissure planes.	
	D	4.50						
	D	5.50		5.70	13.40		Very stiff, thinly laminated, fissured, dark grey-brown CLAY, with rare small pockets of light grey-brown silt.	
	D	6.50						
	D	7.50		7.70	11.40		Very stiff, sparsely fissured, dark grey-brown, slightly sandy CLAY, with occasional small pockets of silt, rare pyrite nodules and rare carbonaceous matter.	
	D	8.50						
	D	9.50						
				10.00	9.10		Continued on next sheet	

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone HV = Hand Vane [kPa] PP = Pocket Penetrometer [kg/cm²] PID = Photo Ionisation Detector [ppmv] * = full SPT penetration not achieved - see summary sheet

Borehole type: Cable Percussion

Remarks: Approximate coordinates interpolated from public domain data.
Approximate Ground Level interpolated from Pringuer-James drawing (ref. L1706-03_01, dated May 2014).

Borehole No: **BH103**

Soil Consultants

Fig 07 Soil Consultants Borehole-103 Extract

Lambeth Group

The Lambeth group was encountered at depths of approximately 20.90m to 21.50m and was identified to have a very stiff consistency with very high to extremely high shear strength. The soil was also determined to be of a high plasticity when considered in relation to BS5930 parameters.

Groundwater

As per the initial site investigations carried out by HESI, the geotechnical investigation undertaken by Soil Consultants Ltd. did not encounter groundwater in any of the boreholes. A small seepage was identified at 11.1.m bgl which has been attributed to an accumulation of perched water in the silt partings of the clay material. Recent monitoring of the boreholes on site found each borehole to be dry.

4.0 Structural Design Philosophy

4.1 Design Concept

The proposed development will involve the demolition of the existing warehouse buildings and removal of the hardstanding areas and underground services found within the confines of the site. It will be necessary to deconstruct the existing brickwork boundary wall along the length of the western boundary facing out to the Birkenhead Estate in order to safeguard the site and adjacent general access areas. The boundary wall is restrained by the steel columns and piers forming the roof truss supports for the existing building. As part of the demolition works, the existing roof trusses and the associated columns will be removed. In doing so, the long term stability of the wall will be compromised and it is proposed that the wall be rebuilt as part of the proposed works with the long term stability of the wall suitably reinstated in the proposed design.

The redeveloped site will make use of the full area of the site and will provide three readily identifiable structural blocks which rise up from an upper ground floor level of +18.95m AOD. The three blocks will include the low lying residential mews of the “Eastern Block”, the high rise residential “Western Block” and the high rise multi-purpose “Southern Block”. An external central courtyard is proposed between the three proposed blocks running between the site access locations onto St. Chads Street and Grays Inn Road. The central communal areas between the eastern and western blocks will be dropped by approximately 1.35m to a level of +17.60mAOD to form a split level ground floor plate.

The combined floor plates at upper ground level in the residential blocks and across the courtyard and commercial space at ground floor levels will extend across almost the full extent of the site when viewed on plan.

Above upper ground floor level the proposed development extends two storeys above ground level to form the low level “Eastern Block” residential mews properties. Directly across the courtyard, the “Western Block” adopts a stepped form when rising from a minimum of three storeys up to six storeys above ground level with the floor plates stepping as they rise to the top level. The third “Southern Block” will extend from a basement level of +13.455m AOD up seven storeys above ground level. In similar fashion to the “Western Block” the building will step back as it rises up with a considerable reduction (approx 40%) in the overall footprint of the block at first floor level.

Below ground level the lower ground floor and basement level adopt a similar split level alignment which is similar to the ground floor structural arrangement. The various levels will be identified separately as lower ground floor below the residential upper ground floor duplex units, and basement level below the central courtyard area and the full footprint of the southern block. The lower ground floor will be formed at a level of +15.690m AOD with the lower basement levels adopting a level of approximately +13.455m AOD.

4.2 Design Proposals

The structural scheme for the building has looked at adopting various construction methods and materials. Preliminary schemes were carried out for a variety of floor plate configurations including steel beam and columns with precast concrete slabs and also in-situ concrete infill slabs. An alternative concrete framed scheme was subsequently proposed and was identified as the preferred option.

Superstructure

The proposed superstructure for this development will combine a number of construction methods where appropriate but will predominantly consist of a reinforced concrete framed structure with flat slab floors and blade columns forming the larger multi storey blocks. The top two levels of the larger western and southern blocks will form a penthouse duplex residential unit and will comprise structural steel with precast concrete hollowcore floors at intermediate level and a timber metal-web truss ecojoist system forming the roof levels.

The smaller residential building forming part of the western block will be formed using similar methods with a reinforced concrete framed structure up to the top floor and a structural steel beam and column arrangement forming the penthouse structure. The roof of the penthouse will adopt timber metal web truss ecojoists as an infill floor plate.

The residential mews terrace buildings will adopt more traditional residential construction methods with load bearing blockwork walls, precast concrete hollowcore floor slabs and loose steelwork as required transferring the loads down to a reinforced concrete lower ground floor level.

The lone-standing residential unit facing out on to St. Chads Street will be similar to the residential mews with a superstructure formed using load bearing blockwork, precast concrete hollowcore floor slabs and loose steel beams where required. A structural steel framed penthouse structure will be adopted with timber infill wall panels and roof structure.

Substructure

The redevelopment proposes to construct a split-level lower ground floor and basement level substructure across the full extent of the site. The existing site levels are higher than the adjoining road levels and in an effort to make the site more easily accessible to pedestrians and future residents the proposed ground floor level has been chosen to suit the external road levels. This has resulted in an initial 1.65m drop in levels across the site to obtain a ground floor level of approximately +17.40m AOD.

The split-level nature of the residential mews and multi-storey blocks serves to limit the extent of excavation close to the site boundaries by raising the upper ground floor level and the underlying lower ground floor level. For the proposed levels of +15.690mAOD to form the lower ground floor an anticipated excavation of 3.90m is envisaged to reach an appropriate reduced level of +15.150mAOD allowing the lower ground floor slab and associated elements to be cast.