Garden as a series of rooms

Camden Road itself is a busy Red Route thoroughfare with several bus routes (including night buses). Consequently it suffers from very poor air quality and noise disturbance. The existing trees provide some relief from both, but clearly any new development on the site will need to address the considerable threat to public health presented by traffic.

In contrast the gardens to the rear of the homes along Camden Road are relatively peaceful, shielded from the worst of the noise and some of the pollution by the large mass of the buildings themselves. The gardens, although in most cases small, provide an invaluable sanctuary away from the busy street.

The pattern of development which has emerged along Camden Road and Camden Mews appears to have involved the later construction of new homes on the rear gardens of the larger houses along Camden Road. Thus these gardens are small in proportion to the size of the houses themselves (although many of these properties have subsequently been divided up into flats). Although at first the gardens appear as a green band running between Camden Road and Camden Mews, in actual fact most of these space comprise small courtyard gardens separated by high fences.

In contrast the existing garden to the rear of the 248-250 Camden Road comprises a large area of open lawn, with a rubber play area and overgrowth towards the rear boundary. Due to the size of the garden, the sense of exposure and the lack of variety of the space, it is seldom used by residents.

We propose creating a series of “garden rooms” through the introduction of single-storey pavilions within the rear garden. These spaces will provide shelter, variety and privacy with shared accommodation, such as residents’ lounge, opening onto them. These courtyards are also framed around the existing trees to provide additional shelter. The sequence of diagrams below show how the design for the rear garden has developed from a large, open space to modest courtyards which are more sympathetic in scale with the neighbouring properties. These rooms will be formed by the introduction of new single-storey garden pavilions which contain a variety of uses including accommodation and communal space. Because of the sunken level described above, these buildings will have no impact on neighbours, and each will have a green roof so that when viewed from the upper floors of neighbouring buildings their visual impact is reduced.

Summary

- Retention and extension of existing building could not offer sufficient number of new rooms of appropriate quality
- A choice must be made between retaining existing trees and reestablishing the prevailing building line. We consider that the trees should take precedence.
- Consolidation of site to a single level helps create an accessible landscape and provides the opportunity to conceal from view new structure in the garden from neighbouring gardens
- Existing garden is large and rarely used, and unlike neighbouring gardens which are compact and intensely used. The introduction of a similar pattern allows the introduction of “rooms” within a landscaped courtyard.

Above Existing pattern of development with large rear garden to 248-250 Camden Road

Above Proposed breaking down of this garden space to smaller, intimate “rooms”

Above Introduction of green roofs to garden pavilions reinforces patchwork character and scale of adjacent gardens

Design Development

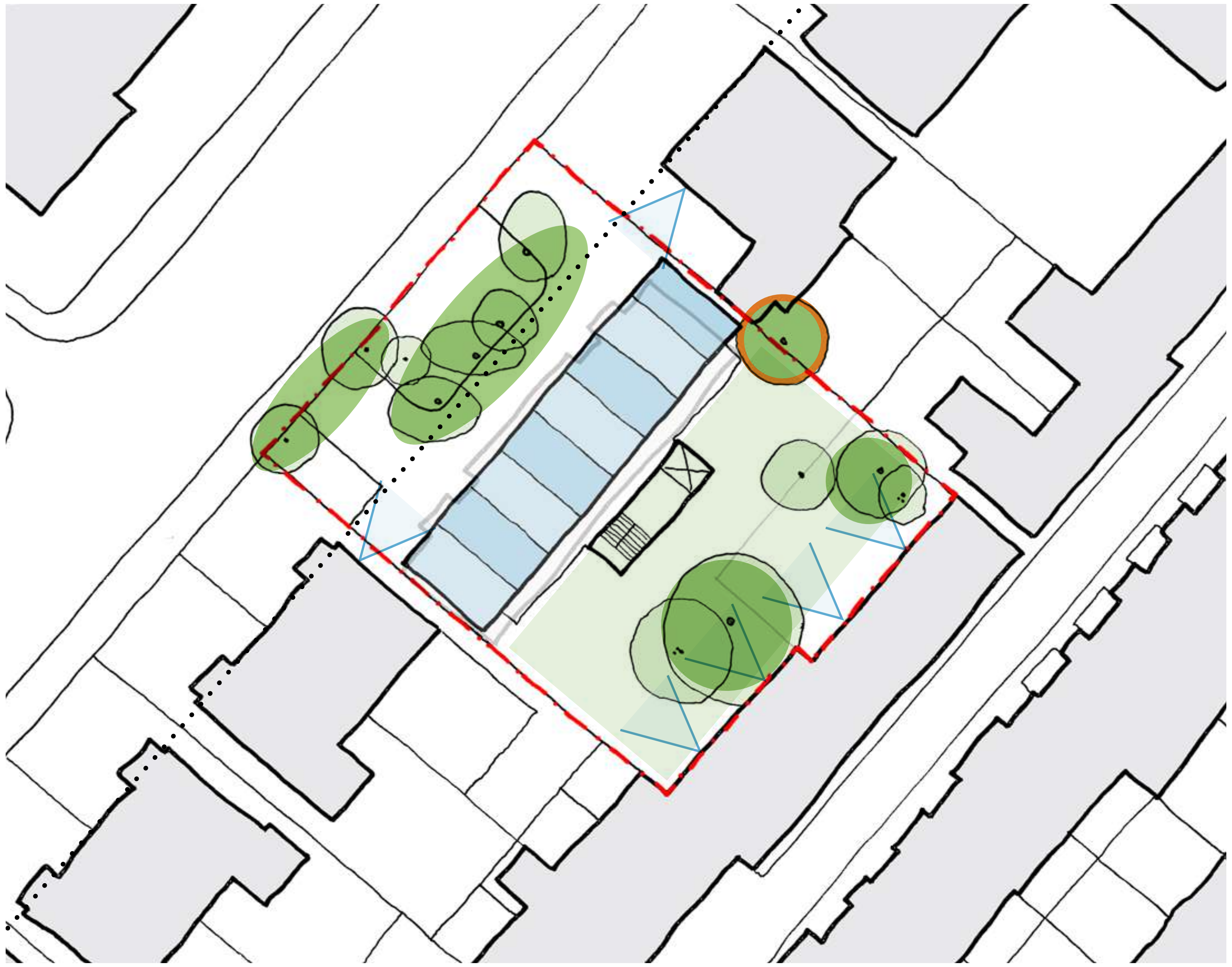
In response to the constraints and opportunities outlined above we explored a series of options for the potential development of the site. These are explained on the following pages.

Double-stached corridor

This option proposes a single replacement block with a central corridor accessed via a single core in the middle of the plan, providing eight apartments per floor.

Whilst the arrangement is reasonably efficient, all of the apartments would be single aspect which would limit the penetration of natural daylight (particular on the north-west elevation facing the trees) and cross-ventilation. Those apartments facing Camden Road would suffer from noise and pollution from the road, and opportunities for engagement between residents would be limited. The long central corridor would be an unpleasant space to inhabit, with limited natural daylight except at the two ends.

The block would need to be deeper than existing building, and to avoid blocking the windows to adjacent homes would need to be pushed further back into the site, and into the roof protection area of the neighbouring tree in the rear garden of 246 Camden Road.



Staggered blocks

Adopting a similar arrangement as the previous option, shifting one half of the main block closer to the street. Whilst this would help articulate the larger mass of the building to a scale similar to that of neighbouring homes, many of the apartments would still be single aspect and therefore suffer from the problems raised previously.

The building would also encroach into the tree protection areas of the trees at the front and within the rear garden of 246 Camden Road, and block the side windows of 252 Camden Road.

This arrangement would also introduce additional complexity in construction which would increase cost and compromise financial viability.

Gallery access

A simple arrangement of dual-aspect apartments accessed from a gallery would enable a modest reduction in the depth of the new block, allowing all apartments to be dual-aspect. This is an efficient layout which lends itself to modular construction. The shallow depth avoids the root protection areas of front and rear trees and avoids obscuring neighbouring windows.

The gallery access arrangement encourages social interaction between residents and makes the building feel less 'bulky' at the rear, reducing the perceived size of the footprint.

This is the option which we believe is the best for the site and the one which has been further developed for the purposes of this document.

Gallery access

We have previously deployed a gallery access arrangement within a specialist housing scheme in Seaford, East Sussex. These modest apartments are all dual-aspect, allowing the penetration of daylight deep into the plan and long views through the home, as well as providing the opportunity for cross-ventilation (above left). These apartments open onto a shared gallery which provides a space for informal meeting and social interaction between neighbours (above right).

This project was recipient of 2019 Housing Design Award.

HOUSING DESIGN AWARDS
COMPLETED WINNER 2019

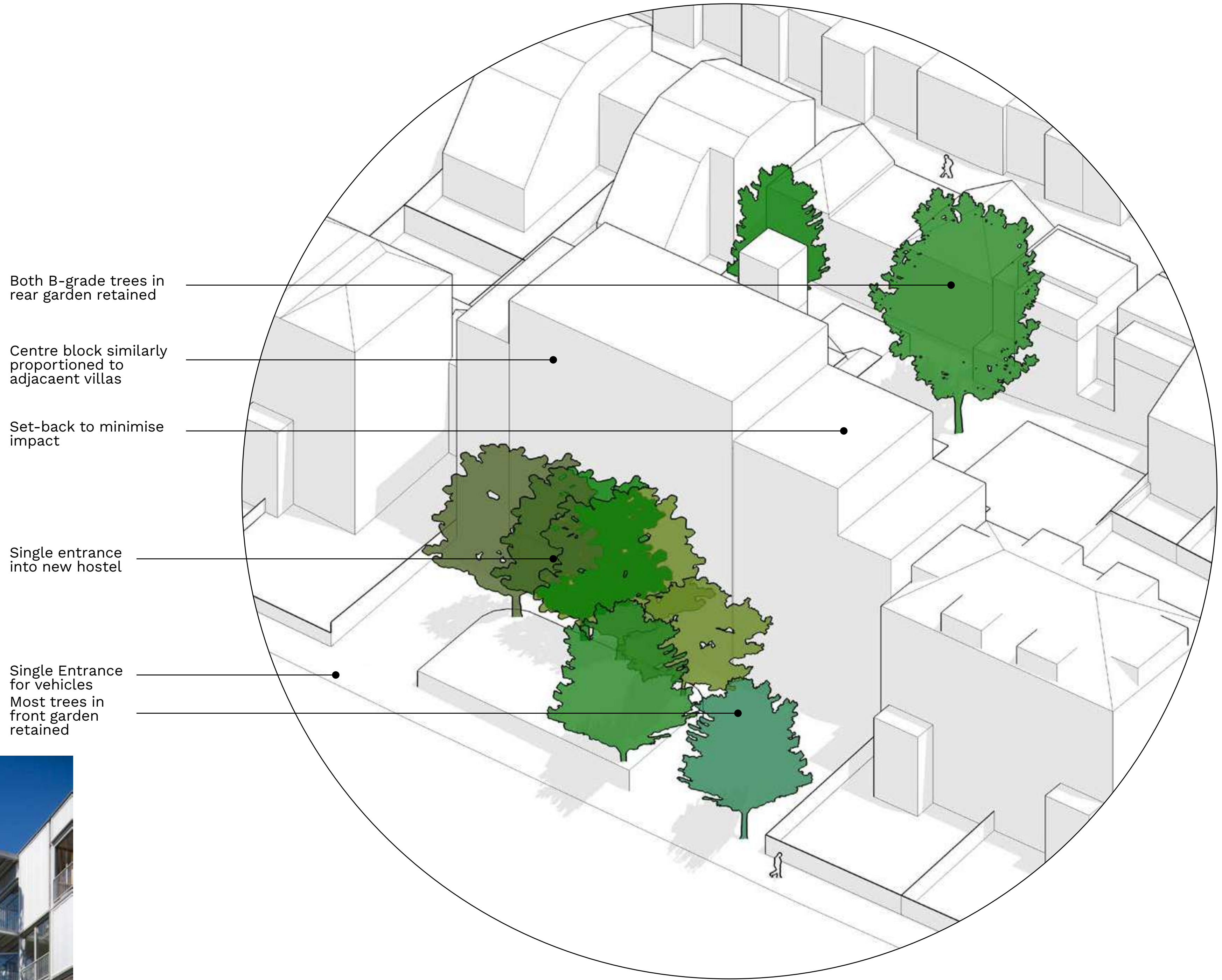
Proposed Massing

There are two competing objectives with regards to the position of the front of the replacement building: the presence of several large, mature trees; and the prevailing building line established by adjacent Victorian villas. It is not possible to position the new building in line with its neighbours without removing the trees. Our priority has therefore been to retain as many of the trees as possible and to align the new building with the existing structure (this also may allow some reuse of existing foundations, an option which is currently being explored by our engineer). The proposed massing is located generally on the footprint of the existing building, with both front and rear elevations pushing very slightly forward towards Camden Road.

The established set-back provides an opportunity to create a taller building than its neighbours: given that the site is typically viewed from an oblique angle from either direction along Camden Road, the set-back allows additional height to be achieved without significantly compromising the prevailing height of the street (in fact, the large numbers of dormer windows within the roofs, and the dominant chimney stacks of the Victorian villas create an undulating and inconsistent roofline). The large trees at the front of the site reinforce the prominance of the site within the streetscape.

Our proposal is for a six storey building (ground plus five floors) with the top floor inset from either side. The side set-backs are assymmetrical, responding to adjacent windows and large trees to the front. Although we have not yet designed the elevations in detail, we propose that the facade treatment will emphasise the central volume, which has a similar proportion to the adjacent villas.

Whilst gaps between buildings is identified as a positive characteristic of the street, our proposed scheme fills the width of the site to maximise the number of new rooms delivered. This is justified by the existing set-back wing of 252 Camden Road which already provides this gap, and between the application site and 246 Camden Road where there is already considerable difference between the front plane of the two buildings and the fact that no gap currently exists. This has a secondary benefit of allowing the site to be fully secured with no means of access to the rear garden and the circulation spaces without passing through a secure area.



Streetscape

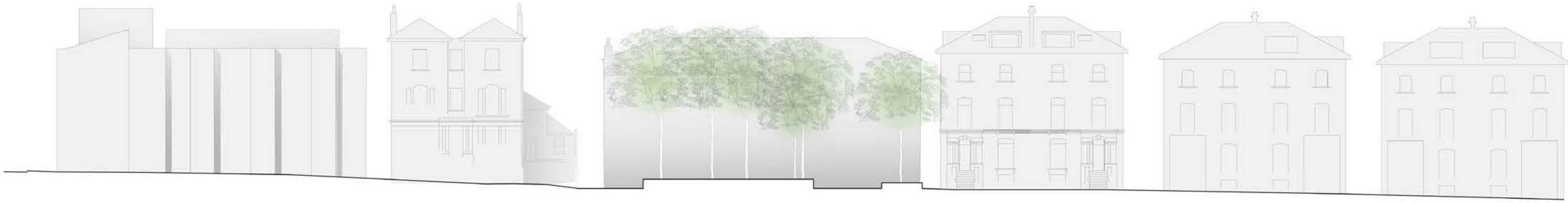
The chimneys of the existing vilas along Camden Road are a dominant feature of the skyline, especially when viewed obliquely from either direction.

From these positions the scale of the proposed development appears appropriate and commensurate with its location within the street.

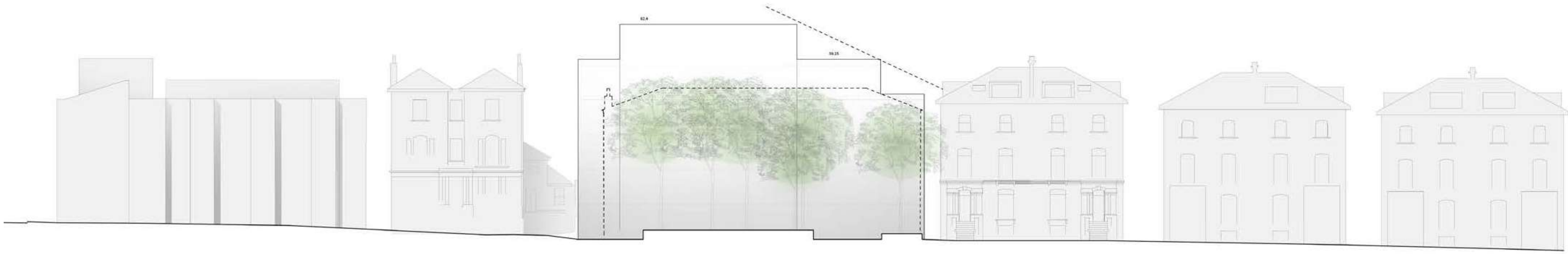
Above Composite sketch showing proposed massing within streetscape, when viewed from Camden Road looking north east

Front Elevation

- The existing building appears similar in height to the adjacent villas when viewed in elevation, however, when viewed obliquely it appears far lower.
- A taller building in this location, set back from the prevailing building line, is appropriate when viewed from along the street.
- The proportion of the central part of the elevation is similar to that of the adjacent villas, and reintroduces a vertical emphasis missing from the existing building on the site.



Above Long elevation of street in existing condition



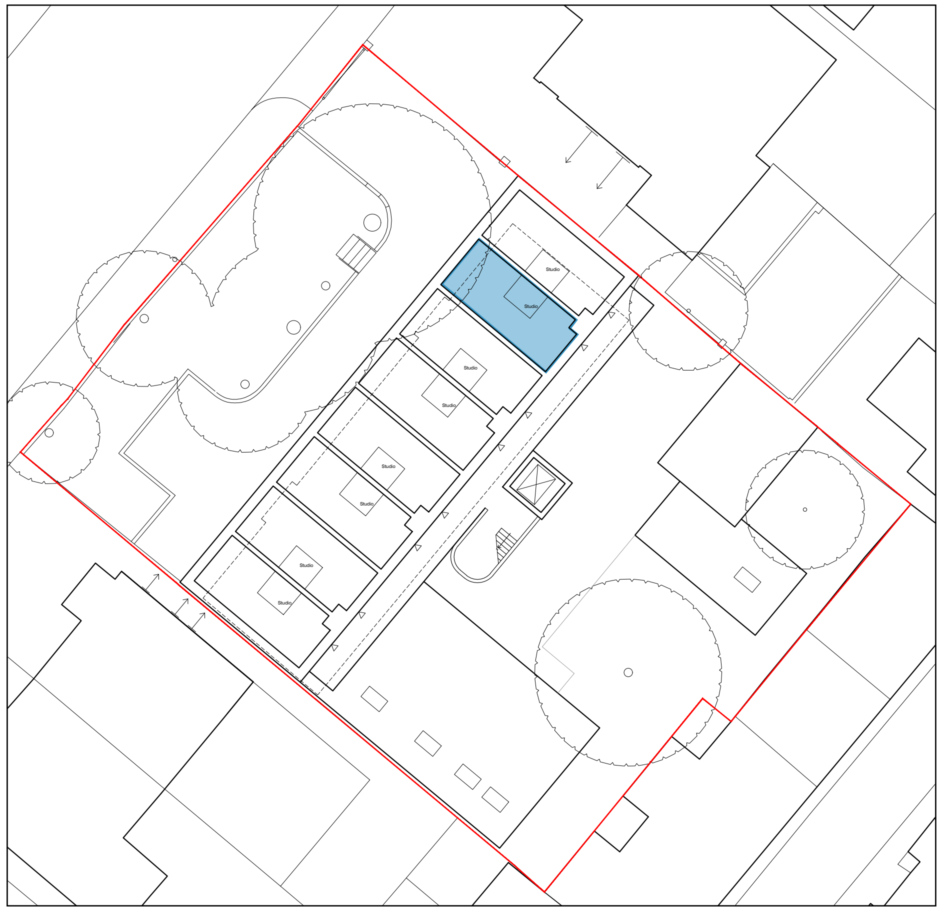
Above Long elevation of street in proposed condition with the outline of the existing building shown dotted

Accommodation

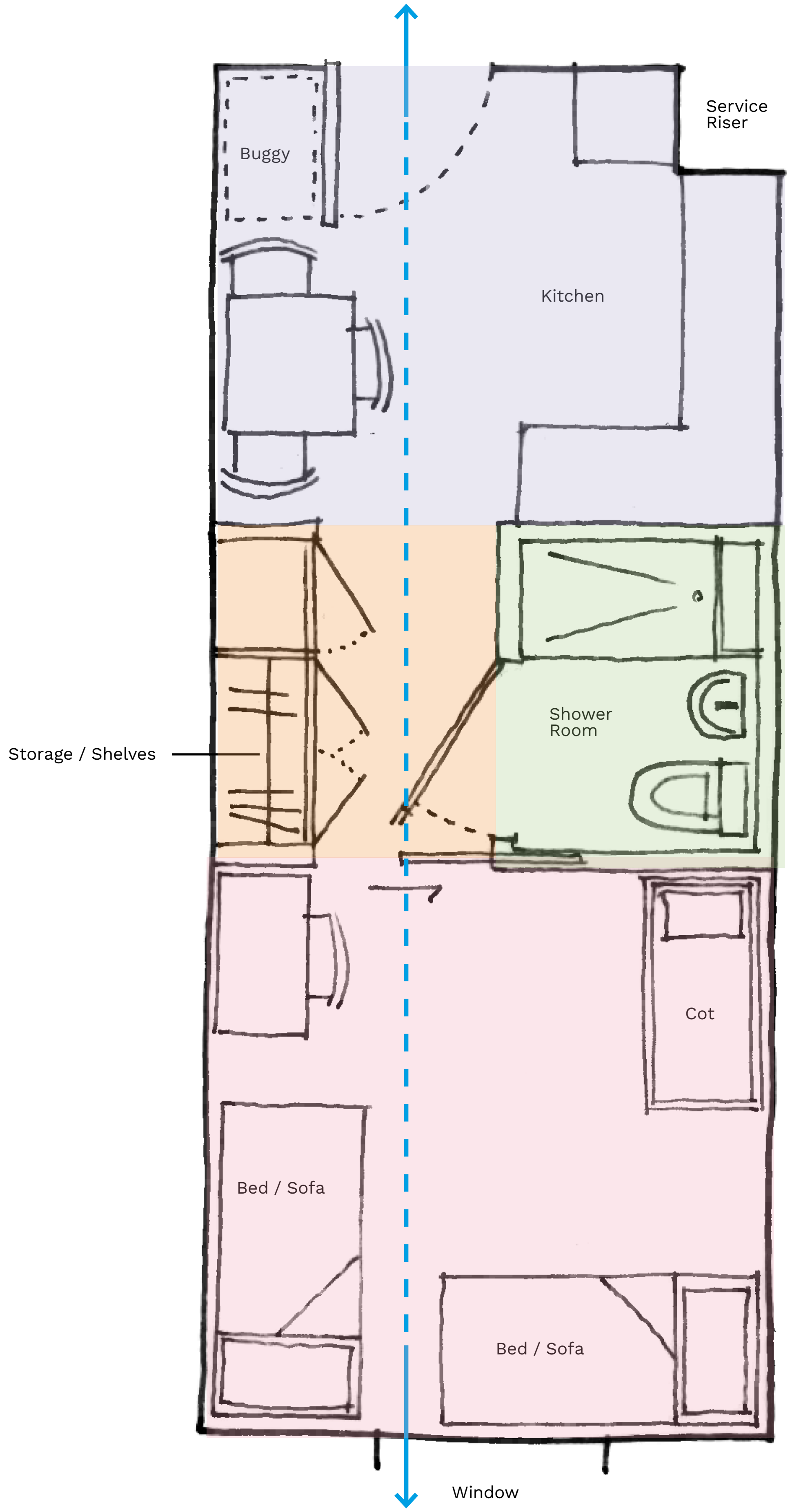
Learning from the work that has been undertaken by Bell Phillips at Chester Road we have developed a standardised apartment type which enables an efficient dual-aspect apartment to be accessed from a gallery overlooking the rear garden. We have previously described the benefits of a dual-aspect arrangement, and the efficiencies which this arrangement presents.

With this arrangement a typical apartment is approximately 8 metres deep and just over 3 metres wide. An apartment such as this allows for a family of three people to be housed. The front door opens into a small kitchen and dining area, with storage for a buggy behind the door. The centre of the plan is occupied by a shower room and storage. Beyond that is a sleeping area with space for three beds. This can be screened off from the rest of the apartment, allowing adults to leave and enter the apartment, watch television, and so on, whilst children are asleep. This arrangement also allows for a clear view from the front door through to the windows at the far end.

This layout follows a similar arrangement to those proposed at the forthcoming Chester Road site to create further efficiencies for construction and ongoing maintenance.



Above Typical upper floor plan showing extent of single apartment unit



Ground Floor

- The ground floor layout is conceived as a series of internal and external 'rooms' within a landscaped setting. We have appointed a landscape architect, Camlins, to develop the proposals for the external areas.
- A single entry/exit point from the building improves management of the hostel and creates a protected garden space. Safeguarding is of upmost importance, so providing a place of sanctuary and security is an importance priority. A central staff area provides views throughout the ground floor, ensuring security.
- The existing garden is currently underused due to its large size and relative inaccessibility from the rest of the accommodation. By creating actively used spaces across the rear, the residents will more easily engage with this valuable amenity.
- Each of these 'rooms' will have different character, engaging with varying levels and uses, whether for play, engaging in growing or quiet respite.
- By consolidating the level of the site so that level access is achieved from the hostel entrance to individual front doors, the garden buildings become nestled behind the existing garden walls.
- Bikes will be stored in secure shelter within the front garden.
- Bin storage needs to be accessible from the secure part of the site so that residents can access this without leaving. Waste can be collected by operatives from the front elevation without having to come through the secure line.
- The stair and lift provide convenient access to the rear garden without having to leave the secure part of the site.

Key

- Studio (26 sqm)
- Communal Area
- Staff Area
- Utilities

Upper Floors (Storeys 1-3)

- The upper storeys follow a simple arrangement of paired apartments. Eight studios per floor are accessed via a rear gallery.
- The gallery, stair and lift enclosure will be formed from lightweight materials to reduce the visual mass.
- Green roofs to the accommodation to the rear space will maintain the appearance of the garden when viewed from above.

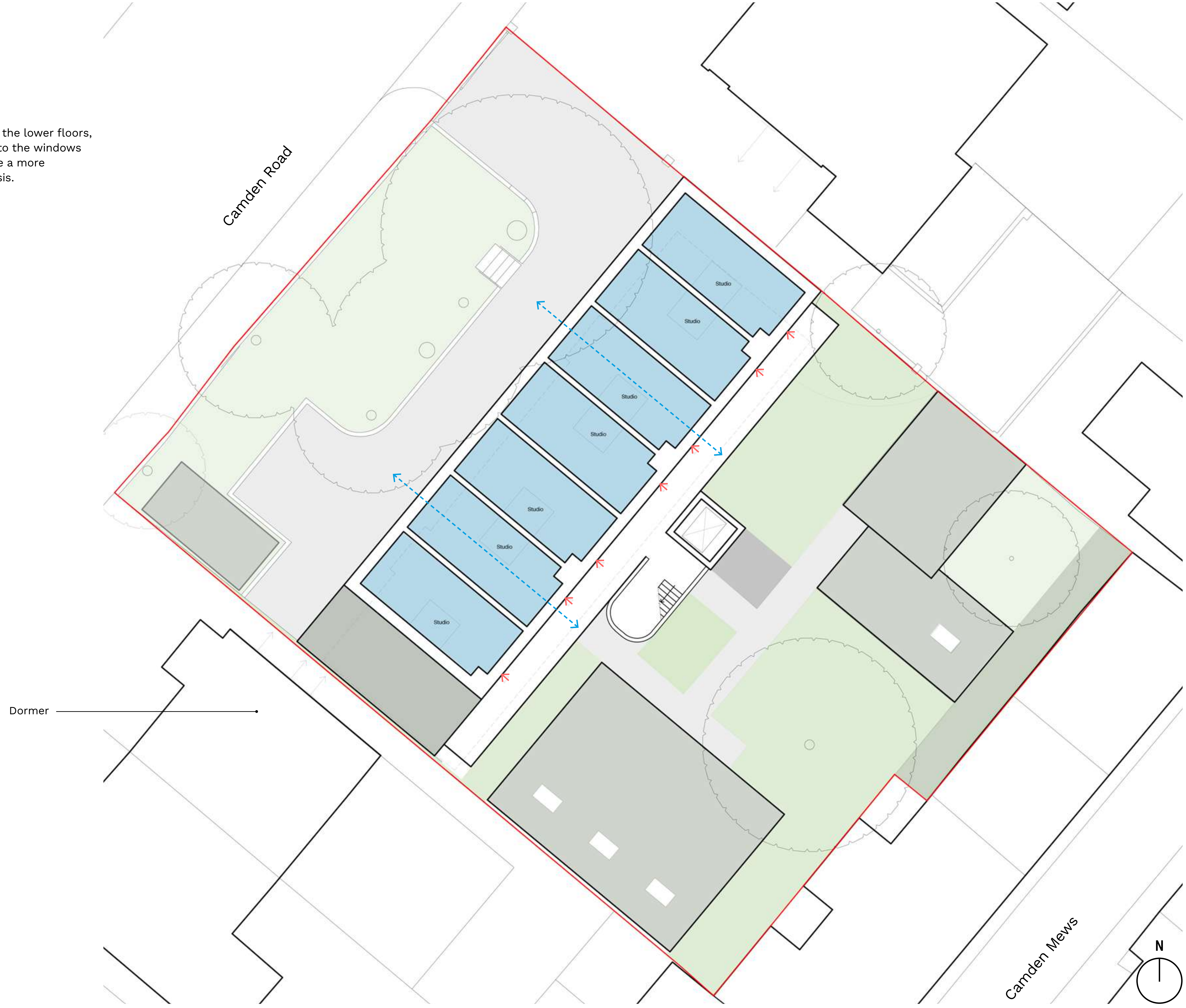
Key

Studio (26m2)

Roof

Fourth Floor

- The fourth floor plan follows a similar rhythm to the lower floors, but is set back from either side to provide relief to the windows within dormers of the adjacent roof and to create a more interesting front elevation with a vertical emphasis.



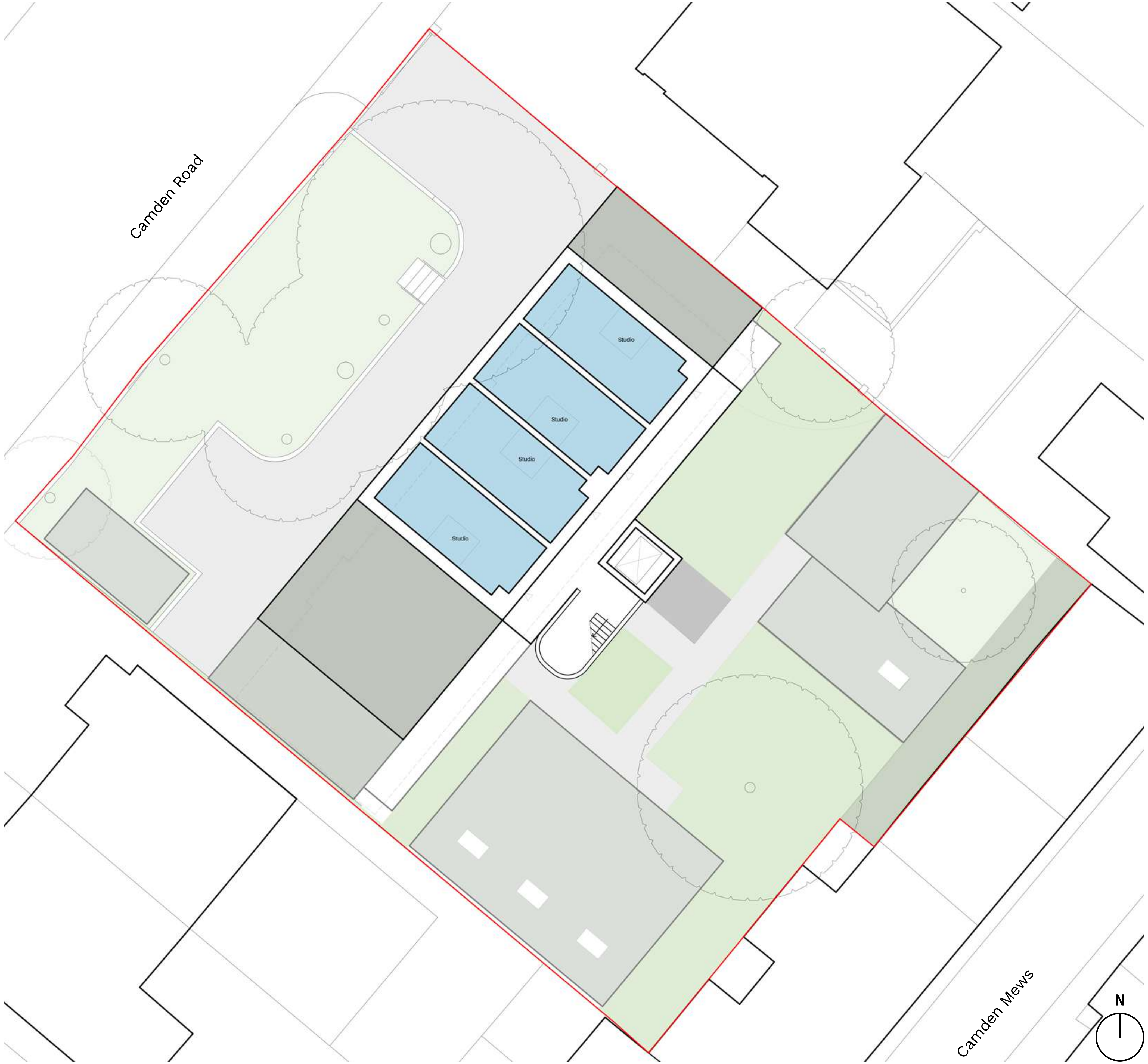
Key

Studio (26m2)

Roof

Fifth Floor

- The top floor consists of two pairs of studio apartments



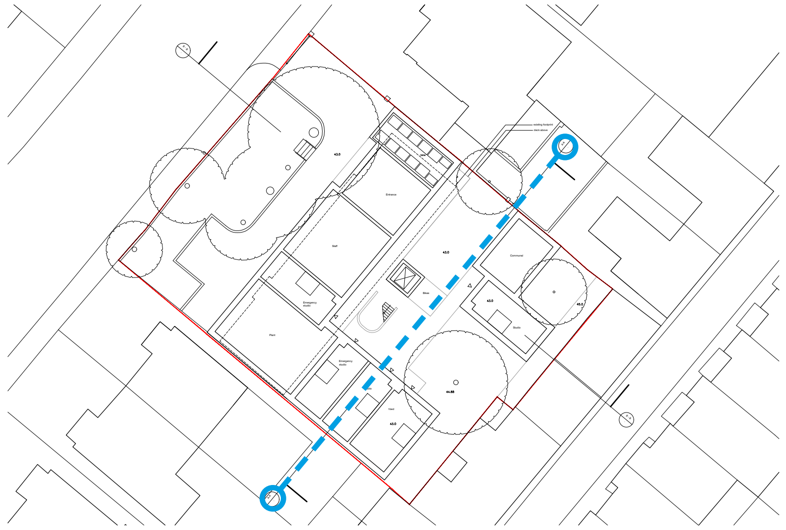
Key

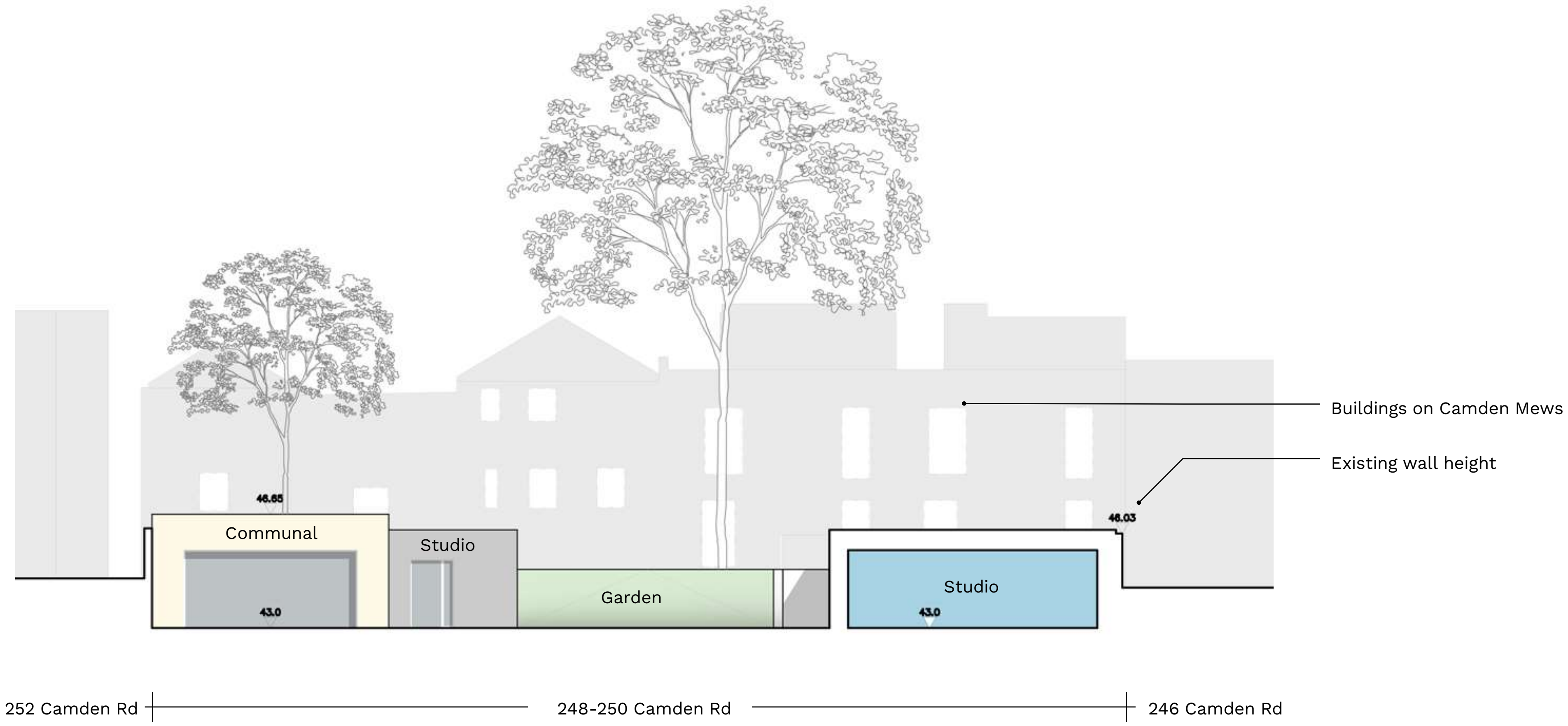
Studio (26m2)

Roof

Section A-A

- This section shows how by lowering the level of the garden, structures can be hidden behind the neighbouring garden walls.
- The elevation of the properties on Camden Road in the background show how new structures will have minimal impact on exsisting windows.



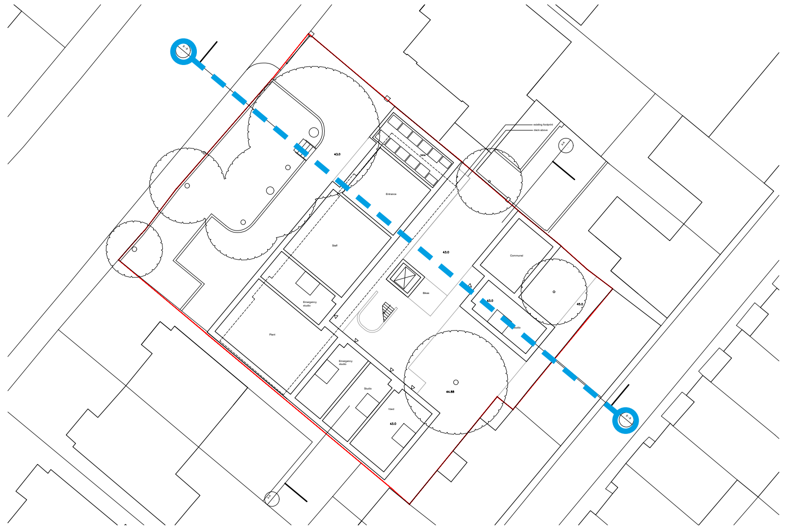


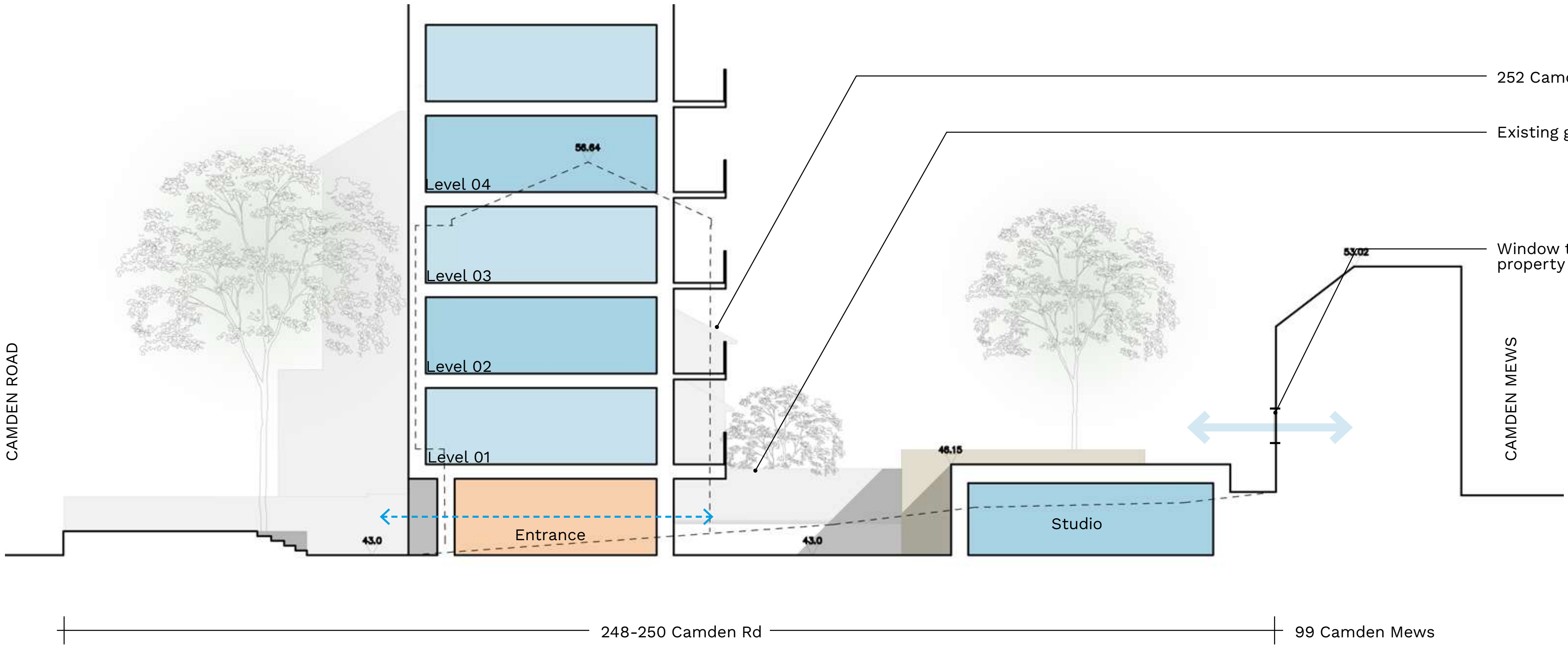
Scale 1:200

0 1m 4m 8m 12m 20m

Section B-B

- This section further shows the minimal impact of the addition of structures within the garden.
- The main building is located broadly on top of the existing footprint. The gallery access breaks down the massing to the rear, minimising the impact of the building.





Key

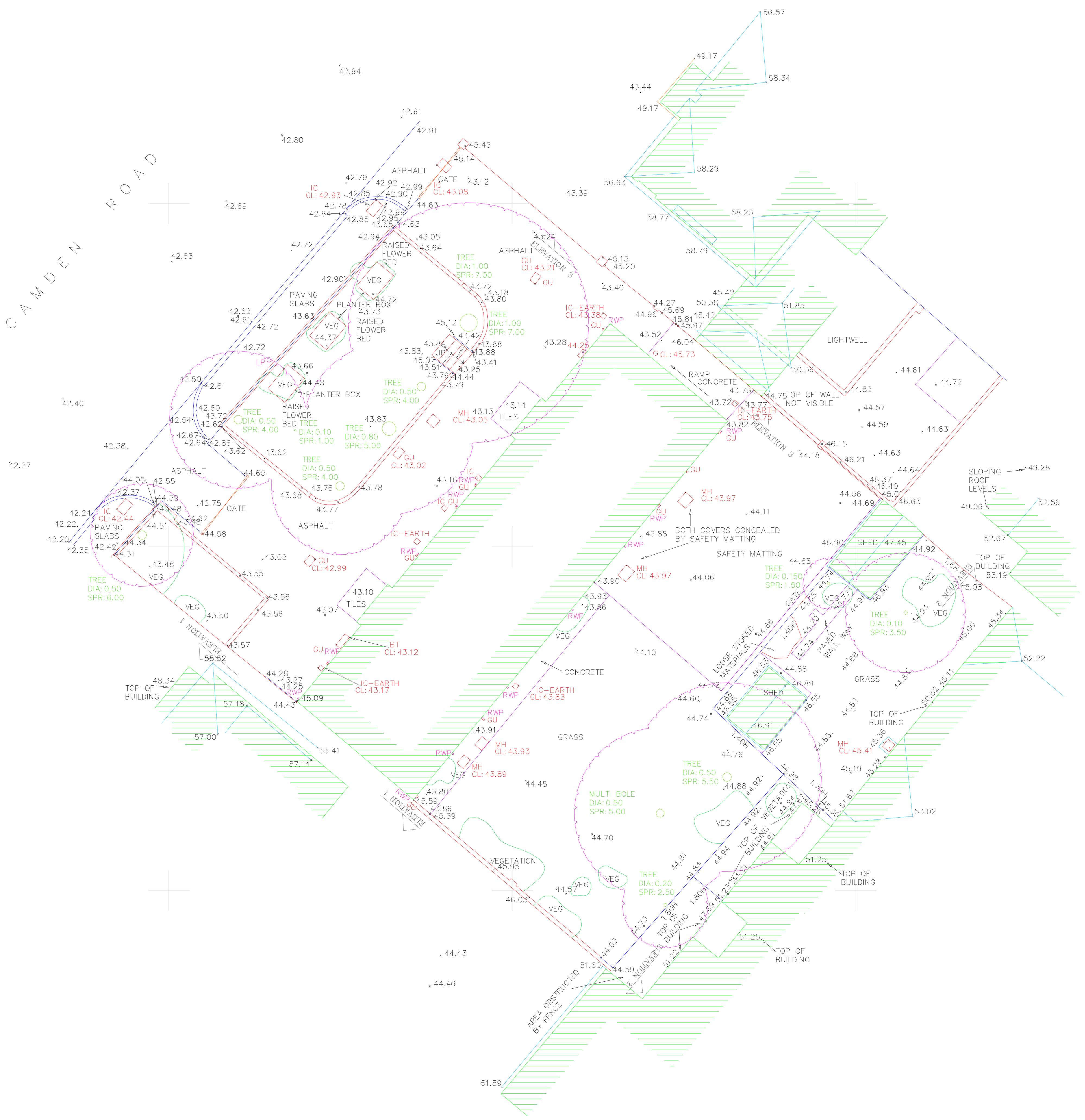
Studio (26m2)

Communal Area

Next Steps

- Design Review Panel - 22 November 2019
- Facade studies
- Exploration of materials
- Fire engineering
- Coordinated design development
- Landscape design
- Home Quality Mark pre-assessment
- Pre-application submission no. 3 - 9 January 2020
- Planning application end of January

rcka



OS NORTH

Building Abbreviations

BL	Basement Level	RWP	Rain Water Pipe
BSL	Beam Soffit Level	SL	Soffit Level
HD	Heating Duct	SVP	Soil and Vent Pipe
DP	Down Pipe	VP	Vent Pipe
DPC	Damp Proof Course	C	Cill Height from FFL
FFL	Finished Floor Level	W	Window Height from Cill
FCL	Finished Ceiling Level	H	Door Height
2.10	Floor to Ceiling Height		Direction of Floor Joist Span

Topographical Abbreviations

A/R	Assumed Route	MKR	Marker
BH	Borehole	MT	Mercury Telecom Cover
BOL	Bollard	OHC	Overhead Cable
BT	British Telecom Cover	OHP	Overhead Pipe
BW	Barbed Wire Fence	OSBM	Ordnance Survey Bench Mark
BWK	Brickwork	PB	Post Box
CATV	Cable TV Cover	PGM	Permanent Ground Marker
CB	Close Boarded Fence	PR	Post & Rail Fence
CCTV	Closed Circuit TV	PW	Post & Wire Fence
CHLK	Chainlink Fence	PWM	Post & Wire Mesh Fence
CHPL	Chestnut Paling Fence	RE	Rodding Eye
CL	Cover Level	RG	Road Gully
CM	Cable Marker	RN	Road Name
CP	Catch Pit	RS	Road Sign
CPL	Catch Pit Base Level	RW	Retaining Wall
DIA	Diameter	RWP	Rain Water Pipe
DK	Drop Kerb	SAP	Sapling
DP	Down Pipe	SC	Stop Cock
EJB	Electricity Junction Box	SPR	Spread
EC	Electricity Cover	STA	Traverse Station
EP	Electricity Pole	SV	Stop Valve
ER	Earthing Rod	SVP	Soil Vent Pipe
FCL	Finished Ceiling Level	SW	Storm Water
FH	Fire Hydrant	TB	Telephone Box
FIG	Feed Into Ground	TBM	Temporary Bench Mark
FW	Foul Water	TFR	Taken From Records
GU	Gully	TJB	Telephone Junction Box
GV	Gas Valve	TPT	Trial Pit
H	Height	TL	Traffic Light
IC	Inspection Cover	TP	Telephone Pole
IL	Invert Level	UTL	Unable To Lift
IR	Iron Railing Fence	UTT	Unable To Trace
KO	Kerb Outlet	VEG	Vegetation
LB	Litter Bin	VP	Vent Pipe
LC	Lamp Column	WKH	Water Key Hole
LP	Lamp Post	WM	Water Meter
MH	Manhole	WV	Water Valve

Notes

The survey has been oriented to Ordnance Survey (OS) National Grid (OSGB36) using Industry Standard Network RTK GPS equipment utilising the OS Active Network (OS Net).

A true OSGB36 coordinate has been established on site using the OSTN15 (transformation) & OSGB15 (geoid) models.

The survey detail has been correlated to this point and a further one (or more) OSGB36 points established to produce a true OS bearing for angle orientation.

Scale factor 1.0 has been applied therefore the survey coordinates are shown on a pseudo OS grid.

All levels are in metres unless otherwise specified

All heights are in millimetres unless otherwise specified

D Deduced

Rev	Svyr	QA Check	Description	Date
5	-	-	-	-
4	-	-	-	-
3	-	-	-	-
2	MW	MW	Utility Services Survey Added	27/06/2019
1	JW	AM	Outlines of Surrounding Buildings Added	25/06/2019
0	JW	AM	First Complete Issue	17/06/2019
Prelim	JW	AM	Preliminary - Not Complete	17/06/2019

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DRAWN	KJA	
SCALE	1:200	

248 – 250 CAMDEN ROAD

TOPOGRAPHICAL SURVEY

JOB No	DRAWING NUMBER
LT319/0532	LT319/0532/P0001

A1 Sheet - 841mm X 594mm

Appendix II – Calculations

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Sam Lee
Site name:	Camden Road
Site location:	

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	51.54714° N
Longitude:	0.13108° W
Reference:	1776275198
Date:	Apr 30 2020 17:26

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 0.1286

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	629	629
Hydrological region:	6	6
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	0.55	0.55
1 in 1 year (l/s):	0.47	0.47
1 in 30 years (l/s):	1.26	1.26
1 in 100 year (l/s):	1.75	1.75
1 in 200 years (l/s):	2.05	2.05

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	49.249	0.249	33.3	0.4	O K
30 min Summer	49.228	0.228	29.0	0.4	O K
60 min Summer	49.187	0.187	20.9	0.3	O K
120 min Summer	49.138	0.138	13.4	0.2	O K
180 min Summer	49.120	0.120	10.2	0.2	O K
240 min Summer	49.109	0.109	8.2	0.2	O K
360 min Summer	49.093	0.093	6.0	0.1	O K
480 min Summer	49.082	0.082	4.8	0.1	O K
600 min Summer	49.075	0.075	4.0	0.1	O K
720 min Summer	49.070	0.070	3.5	0.1	O K
960 min Summer	49.062	0.062	2.8	0.1	O K
1440 min Summer	49.053	0.053	2.0	0.1	O K
2160 min Summer	49.045	0.045	1.5	0.1	O K
2880 min Summer	49.040	0.040	1.2	0.0	O K
4320 min Summer	49.034	0.034	0.8	0.0	O K
5760 min Summer	49.029	0.029	0.7	0.0	O K
7200 min Summer	49.026	0.026	0.6	0.0	O K
8640 min Summer	49.024	0.024	0.5	0.0	O K
10080 min Summer	49.022	0.022	0.4	0.0	O K
15 min Winter	49.250	0.250	33.6	0.4	O K
30 min Winter	49.208	0.208	25.1	0.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	98.681	0.0	13.0	9
30 min Summer	64.789	0.0	17.0	17
60 min Summer	40.510	0.0	21.3	32
120 min Summer	24.461	0.0	25.7	62
180 min Summer	17.964	0.0	28.3	92
240 min Summer	14.342	0.0	30.1	122
360 min Summer	10.418	0.0	32.8	182
480 min Summer	8.302	0.0	34.9	244
600 min Summer	6.956	0.0	36.5	300
720 min Summer	6.017	0.0	37.9	360
960 min Summer	4.784	0.0	40.2	482
1440 min Summer	3.456	0.0	43.5	712
2160 min Summer	2.493	0.0	47.1	1084
2880 min Summer	1.975	0.0	49.8	1428
4320 min Summer	1.421	0.0	53.7	2204
5760 min Summer	1.124	0.0	56.6	2888
7200 min Summer	0.936	0.0	59.0	3632
8640 min Summer	0.806	0.0	60.9	4240
10080 min Summer	0.710	0.0	62.6	4952
15 min Winter	98.681	0.0	14.5	10
30 min Winter	64.789	0.0	19.0	17

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	49.159	0.159	16.4	0.3	O K
120 min Winter	49.119	0.119	10.1	0.2	O K
180 min Winter	49.105	0.105	7.4	0.2	O K
240 min Winter	49.093	0.093	6.0	0.1	O K
360 min Winter	49.078	0.078	4.3	0.1	O K
480 min Winter	49.070	0.070	3.5	0.1	O K
600 min Winter	49.064	0.064	2.9	0.1	O K
720 min Winter	49.059	0.059	2.5	0.1	O K
960 min Winter	49.053	0.053	2.0	0.1	O K
1440 min Winter	49.045	0.045	1.5	0.1	O K
2160 min Winter	49.038	0.038	1.1	0.0	O K
2880 min Winter	49.034	0.034	0.8	0.0	O K
4320 min Winter	49.027	0.027	0.6	0.0	O K
5760 min Winter	49.024	0.024	0.5	0.0	O K
7200 min Winter	49.022	0.022	0.4	0.0	O K
8640 min Winter	49.020	0.020	0.4	0.0	O K
10080 min Winter	49.019	0.019	0.3	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	40.510	0.0	23.8	32
120 min Winter	24.461	0.0	28.8	60
180 min Winter	17.964	0.0	31.7	94
240 min Winter	14.342	0.0	33.7	122
360 min Winter	10.418	0.0	36.8	184
480 min Winter	8.302	0.0	39.1	242
600 min Winter	6.956	0.0	40.9	300
720 min Winter	6.017	0.0	42.5	366
960 min Winter	4.784	0.0	45.0	498
1440 min Winter	3.456	0.0	48.8	714
2160 min Winter	2.493	0.0	52.8	1092
2880 min Winter	1.975	0.0	55.8	1432
4320 min Winter	1.421	0.0	60.2	2180
5760 min Winter	1.124	0.0	63.4	2832
7200 min Winter	0.936	0.0	66.1	3624
8640 min Winter	0.806	0.0	68.3	4296
10080 min Winter	0.710	0.0	70.2	5248

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.070

Time From:	(mins) To:	Area (ha)
0	4	0.070

Time Area Diagram

Total Area (ha) 0.000

Time From:	(mins) To:	Area (ha)
0	4	0.000

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Model Details

Storage is Online Cover Level (m) 50.000

Pipe Structure

Diameter (m)	0.225	Length (m)	5.000
Slope (1:X)	80.000	Invert Level (m)	49.000

Pipe Outflow Control

Diameter (m)	0.225	Entry Loss Coefficient	0.500
Slope (1:X)	80.0	Coefficient of Contraction	0.600
Length (m)	5.000	Upstream Invert Level (m)	49.000
Roughness k (mm)	0.600		

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Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	100	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	40	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.500
Ratio-R	0.400	Preferred Cover Depth (m)	0.600
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	4.00	Enforce best practice design rules	✓

Circular Link Type

Shape	Circular	Barrels	1	Auto Increment (mm)	75	Follow Ground	x

Available Diameters (mm)

100	150

Nodes

	Name	Area (ha)	T of E (mins)	Cover Level (m)	Node Type	Manhole Type	Diameter (mm)	Depth (m)
✓	3			43.500	Manhole	Adoptable	1200	0.919
✓	Underground Tank			43.250	Junction			1.850
✓	External Paved Areas	0.099	4.00	43.500	Manhole	Adoptable	1200	0.500
✓	2			43.000	Manhole	Adoptable	1200	1.700

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Links

	Name	US Node	DS Node	Length (m)	ks (mm) / n	Velocity Equation	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	Link Type	T of C (mins)	Rain (mm/hr)
?	1.001	3	Underground Tank	5.000	0.600	Colebrook-White	42.581	42.519	0.062	80.0	225	Circular	4.08	50.0
?	1.000	External Paved Areas	3	5.000	0.600	Colebrook-White	43.000	42.581	0.419	11.9	225	Circular	4.02	50.0
?	1.002	Underground Tank	2	5.000	0.600	Colebrook-White	41.400	41.300	0.100	50.0	225	Circular	4.12	50.0

	Name	US Node	DS Node	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Minimum Depth (m)	Maximum Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
?	1.001	3	Underground Tank	1.463	58.2	18.8	0.694	0.506	0.506	0.694	0.099	0.0	87	1.306
?	1.000	External Paved Areas	3	3.808	151.4	18.8	0.275	0.694	0.275	0.694	0.099	0.0	53	2.613
?	1.002	Underground Tank	2	1.854	73.7	18.8	1.625	1.475	1.475	1.625	0.099	0.0	77	1.552

Simulation Settings

Rainfall Methodology	FSR	Summer CV	0.750	Drain Down Time (mins)	1440
FSR Region	England and Wales	Winter CV	0.840	Additional Storage (m³/ha)	0.0
M5-60 (mm)	20.000	Analysis Speed	Normal	Check Discharge Rate(s)	x
Ratio-R	0.400	Skip Steady State	x	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0	100	0	0	0
30	0	0	0	100	40	0	0

Node Underground Tank Online Hydro-Brake® Control

Flap Valve	x	Design Flow (l/s)	1.4
Downstream Link	1.002	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	41.400	Product Number	CTL-SHE-0050-1400-1600-1400
Design Depth (m)	1.600	Min Outlet Diameter (m)	0.075

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Node Underground Tank Online Hydro-Brake® Control

Min Node Diameter (mm) 1200

Node Underground Tank Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	41.400
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	344

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	40.0	0.0	1.600	40.0	0.0	1.601	0.0	0.0

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
1 year 15 minute summer	109.521	30.991	1 year 720 minute winter	5.513	2.199
1 year 15 minute winter	76.857	30.991	1 year 960 minute summer	6.768	1.782
1 year 30 minute summer	71.439	20.215	1 year 960 minute winter	4.483	1.782
1 year 30 minute winter	50.133	20.215	1 year 1440 minute summer	4.949	1.326
1 year 60 minute summer	48.435	12.800	1 year 1440 minute winter	3.326	1.326
1 year 60 minute winter	32.179	12.800	30 year 15 minute summer	268.706	76.035
1 year 120 minute summer	30.053	7.942	30 year 15 minute winter	188.566	76.035
1 year 120 minute winter	19.966	7.942	30 year 30 minute summer	174.929	49.499
1 year 180 minute summer	23.233	5.979	30 year 30 minute winter	122.757	49.499
1 year 180 minute winter	15.102	5.979	30 year 60 minute summer	116.589	30.811
1 year 240 minute summer	18.475	4.882	30 year 60 minute winter	77.459	30.811
1 year 240 minute winter	12.274	4.882	30 year 120 minute summer	70.438	18.615
1 year 360 minute summer	14.169	3.646	30 year 120 minute winter	46.797	18.615
1 year 360 minute winter	9.210	3.646	30 year 180 minute summer	53.298	13.715
1 year 480 minute summer	11.185	2.956	30 year 180 minute winter	34.645	13.715
1 year 480 minute winter	7.431	2.956	30 year 240 minute summer	41.604	10.995
1 year 600 minute summer	9.182	2.511	30 year 240 minute winter	27.641	10.995
1 year 600 minute winter	6.274	2.511	30 year 360 minute summer	31.221	8.034
1 year 720 minute summer	8.203	2.199	30 year 360 minute winter	20.295	8.034

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Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year 480 minute summer	24.324	6.428	100 year 720 minute winter	15.089	6.017
30 year 480 minute winter	16.160	6.428	100 year 960 minute summer	18.166	4.784
30 year 600 minute summer	19.756	5.404	100 year 960 minute winter	12.033	4.784
30 year 600 minute winter	13.498	5.404	100 year 1440 minute summer	12.896	3.456
30 year 720 minute summer	17.490	4.687	100 year 1440 minute winter	8.667	3.456
30 year 720 minute winter	11.754	4.687	100 year +40% CC 15 minute summer	488.233	138.153
30 year 960 minute summer	14.215	3.743	100 year +40% CC 15 minute winter	342.620	138.153
30 year 960 minute winter	9.416	3.743	100 year +40% CC 30 minute summer	320.551	90.705
30 year 1440 minute summer	10.161	2.723	100 year +40% CC 30 minute winter	224.948	90.705
30 year 1440 minute winter	6.829	2.723	100 year +40% CC 60 minute summer	214.603	56.713
100 year 15 minute summer	348.738	98.681	100 year +40% CC 60 minute winter	142.577	56.713
100 year 15 minute winter	244.728	98.681	100 year +40% CC 120 minute summer	129.587	34.246
100 year 30 minute summer	228.965	64.789	100 year +40% CC 120 minute winter	86.094	34.246
100 year 30 minute winter	160.677	64.789	100 year +40% CC 180 minute summer	97.729	25.149
100 year 60 minute summer	153.288	40.510	100 year +40% CC 180 minute winter	63.526	25.149
100 year 60 minute winter	101.841	40.510	100 year +40% CC 240 minute summer	75.977	20.078
100 year 120 minute summer	92.562	24.461	100 year +40% CC 240 minute winter	50.477	20.078
100 year 120 minute winter	61.496	24.461	100 year +40% CC 360 minute summer	56.677	14.585
100 year 180 minute summer	69.806	17.964	100 year +40% CC 360 minute winter	36.841	14.585
100 year 180 minute winter	45.376	17.964	100 year +40% CC 480 minute summer	43.979	11.622
100 year 240 minute summer	54.269	14.342	100 year +40% CC 480 minute winter	29.219	11.622
100 year 240 minute winter	36.055	14.342	100 year +40% CC 600 minute summer	35.604	9.738
100 year 360 minute summer	40.484	10.418	100 year +40% CC 600 minute winter	24.327	9.738
100 year 360 minute winter	26.315	10.418	100 year +40% CC 720 minute summer	31.433	8.424
100 year 480 minute summer	31.414	8.302	100 year +40% CC 720 minute winter	21.125	8.424
100 year 480 minute winter	20.871	8.302	100 year +40% CC 960 minute summer	25.432	6.697
100 year 600 minute summer	25.431	6.956	100 year +40% CC 960 minute winter	16.847	6.697
100 year 600 minute winter	17.376	6.956	100 year +40% CC 1440 minute summer	18.055	4.839
100 year 720 minute summer	22.452	6.017	100 year +40% CC 1440 minute winter	12.134	4.839

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Results for 1 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
15 minute winter	3	10	42.663	0.082	14.8	0.0929	0.0000	OK
120 minute winter	Underground Tank	96	41.631	0.231	4.6	8.7671	0.0000	SURCHARGED
15 minute summer	External Paved Areas	10	43.047	0.047	14.8	0.0536	0.0000	OK
15 minute summer	2	1	41.300	0.000	0.9	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m^3)	Discharge Vol (m^3)
15 minute winter	3	1.001	Underground Tank	14.8	1.179	0.254	0.0628	
120 minute winter	Underground Tank	Hydro-Brake®	2	1.0				13.2
15 minute summer	External Paved Areas	1.000	3	14.8	1.575	0.098	0.0479	

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Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
15 minute summer	3	10	42.721	0.140	36.2	0.1582	0.0000	OK
180 minute winter	Underground Tank	176	42.086	0.686	8.0	26.0549	0.0000	SURCHARGED
15 minute summer	External Paved Areas	9	43.081	0.081	36.2	0.0912	0.0000	OK
15 minute summer	2	1	41.300	0.000	1.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m^3)	Discharge Vol (m^3)
15 minute summer	3	1.001	Underground Tank	36.2	1.472	0.622	0.1230	
180 minute winter	Underground Tank	Hydro-Brake®	2	1.0				34.2
15 minute summer	External Paved Areas	1.000	3	36.2	1.877	0.239	0.0967	

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Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	3	10	42.749	0.168	47.0	0.1904	0.0000	OK
240 minute winter	Underground Tank	232	42.337	0.937	8.3	35.6122	0.0000	SURCHARGED
15 minute winter	External Paved Areas	9	43.096	0.096	47.0	0.1087	0.0000	OK
15 minute summer	2	1	41.300	0.000	1.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	3	1.001	Underground Tank	47.0	1.554	0.808	0.1511	
240 minute winter	Underground Tank	Hydro-Brake®	2	1.1				47.7
15 minute winter	External Paved Areas	1.000	3	47.0	1.946	0.310	0.1200	

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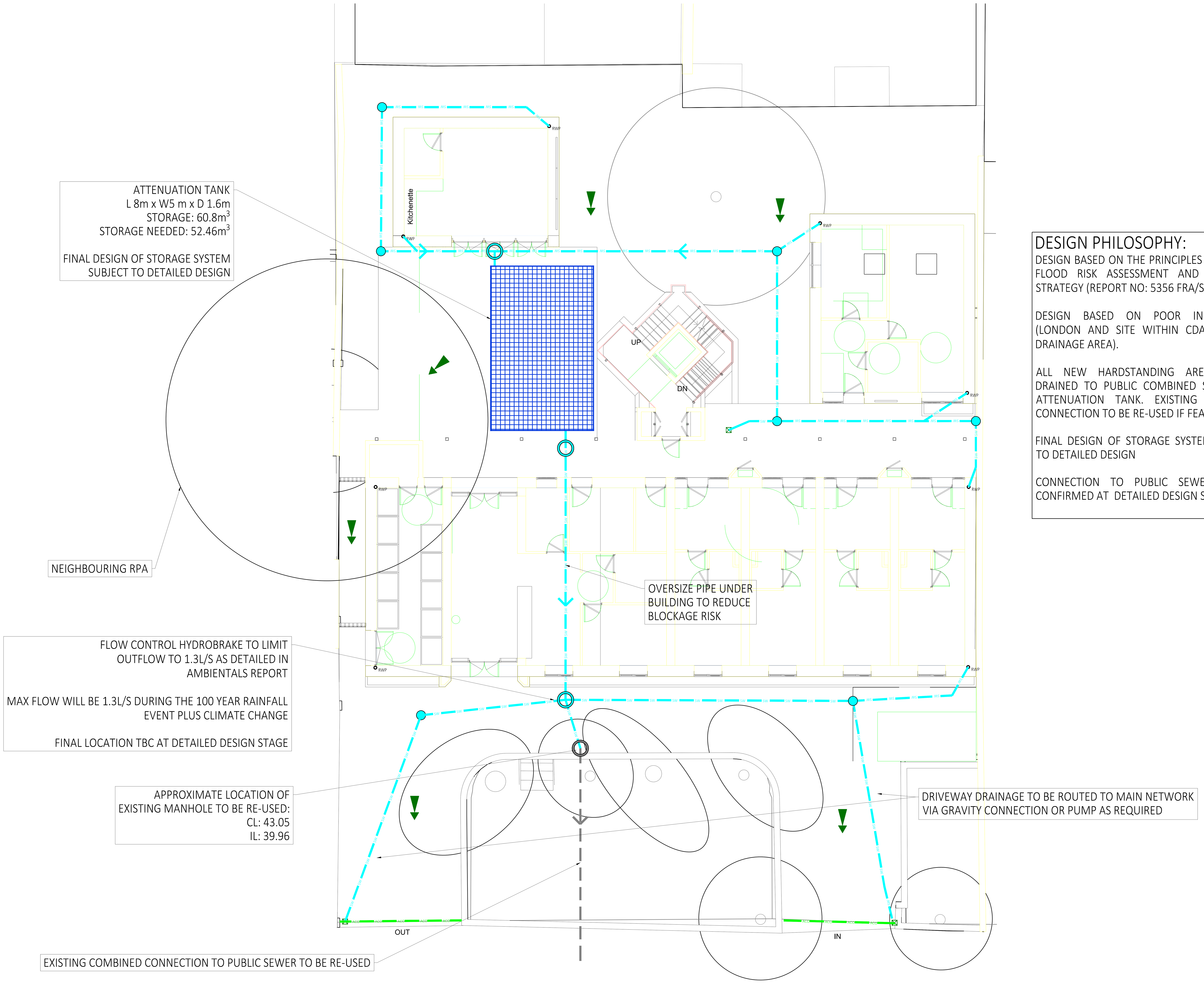
Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	3	10	42.848	0.267	65.8	0.3017	0.0000	SURCHARGED
240 minute winter	Underground Tank	232	42.781	1.381	11.7	52.4611	0.0000	SURCHARGED
15 minute winter	External Paved Areas	10	43.131	0.131	65.8	0.1477	0.0000	OK
15 minute summer	2	1	41.300	0.000	1.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	3	1.001	Underground Tank	65.8	1.655	1.131	0.1947	
240 minute winter	Underground Tank	Hydro-Brake®	2	1.3				66.8
15 minute winter	External Paved Areas	1.000	3	65.8	1.979	0.435	0.1591	

Appendix III – Proposed Drawing

Ambiental Environmental Assessment
Sussex Innovation Centre,
Science Park Square,
Brighton, BN1 9SB



DESIGN PHILOSOPHY:

DESIGN BASED ON THE PRINCIPLES SET IN THE FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY (REPORT NO: 5356 FRA/SWDS).

DESIGN BASED ON POOR INFILTRATION (LONDON AND SITE WITHIN CDA (CRITICAL DRAINAGE AREA).

ALL NEW HARDSTANDING AREA TO BE DRAINED TO PUBLIC COMBINED SEWER VIA ATTENUATION TANK. EXISTING DRAINAGE CONNECTION TO BE RE-USED IF FEASIBLE.

FINAL DESIGN OF STORAGE SYSTEM SUBJECT TO DETAILED DESIGN

CONNECTION TO PUBLIC SEWER TO BE CONFIRMED AT DETAILED DESIGN STAGE

1. GENERAL
a. THIS DRAWING IS NOT TO BE SCALED, WORK TO FIGURED DIMENSIONS ONLY, CONFIRMED ON SITE.
b. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL DRAWINGS, DETAILED SPECIFICATIONS WHERE APPLICABLE AND ALL ASSOCIATED DRAWINGS IN THIS SERIES.
c. ANY DISCREPANCY ON THIS DRAWING IS TO BE REPORTED IMMEDIATELY TO THE PARTNERSHIP FOR CLARIFICATION.
d. THE CONTRACTOR IS RESPONSIBLE FOR ALL TEMPORARY WORKS AND FOR THE STABILITY OF THE WORKS IN PROGRESS.
e. CDM REGULATIONS 2015. ALL CURRENT DRAWINGS AND SPECIFICATIONS MUST BE READ IN CONJUNCTION WITH THE DESIGNER'S HAZARD RISK AND ENVIRONMENT ASSESSMENT RECORD. DESIGN HAS BEEN PRODUCED BASED ON INFORMATION PROVIDED BY THE CLIENT/PRINCIPLE DESIGNER AVAILABLE AT TIME OF ISSUE. CONTRACTOR TO REVIEW DRAWING AND SPECIFICATION IN CONTEXT WITH THE WIDER SITE AND SPECIFIC SITE INVESTIGATION, CONTAMINATION ASSESSMENT, ASBESTOS SURVEY, ENVIRONMENTAL SURVEY, UXO SURVEY AND ANY OTHER RELEVANT INFORMATION AND MANAGE RISKS RELATING TO THE WORKS OUTLINED IN THE DRAWINGS AND SPECIFICATION. PRINCIPLE CONTRACTOR TO MAKE DESIGNER AND CLIENT AWARE OF SITE SPECIFIC RISKS THAT MAY AFFECT THE DRAWING AND SPECIFICATION.
f. CDM REGULATIONS 2015. FOR GENERIC MAINTENANCE AND MANAGEMENT RISKS REFER TO CHAPTER 36 OF CIRIA 752 SUDS MANUAL. FOR PROPRIETARY SYSTEMS SEE MANUFACTURER'S MANAGEMENT AND MAINTENANCE DETAILS AND RISK ASSESSMENT WITH REGARDS TO MAINTENANCE OF PROPRIETARY SYSTEMS.

2. CONSTRUCTION NOTE
a. THE MAIN CONTRACTOR IS RESPONSIBLE FOR THE DESIGN OF ALL TEMPORARY WORKS, AND IS ALSO RESPONSIBLE FOR THE SAFE MAINTENANCE AND STABILITY OF EXISTING BUILDINGS AT ALL TIMES.
b. THE MAIN CONTRACTOR IS RESPONSIBLE FOR ALL OCCURRENCES OF GROUND WATER DURING THE CONSTRUCTION PERIOD.
c. ANY INFORMATION GIVEN REGARDING EXISTING UNDERGROUND SERVICES IS GIVEN IN GOOD FAITH AFTER CONSULTATION WITH THE RELEVANT AUTHORITY, HOWEVER ACCURACY IS NOT CERTAIN. THE MAIN CONTRACTOR IS RESPONSIBLE FOR CHECKING ALL INFORMATION ON SITE PRIOR TO WORK COMMENCING AND TAKING DUE CARE AND ATTENTION WHILST UNDERTAKING THE WORKS.
d. THE CONTRACTOR MUST COMPLY WITH ALL CURRENT LEGISLATION RELATING TO HEALTH & SAFETY.
e. ALL PRODUCTS SPECIFIED SHALL BE INSTALLED IN STRICT ACCORDANCE WITH THE MANUFACTURERS RECOMMENDATIONS AND INSTRUCTIONS. IF THERE ARE DISCREPANCIES BETWEEN THAT INFORMATION AND THE DETAILS ON ANY AMBIENTAL DRAWINGS, THE MANUFACTURERS INSTRUCTIONS MUST BE USED

3. BELOW GROUND DRAINAGE
a. PIPEWORK TO BE UPVC-U PIPES TO BS 4660 : 2000 AND INSPECTION CHAMBERS TO BS 7158 : 2001.
b. ALL ADOPTABLE DRAINAGE TO BE CONSTRUCTED IN ACCORDANCE WITH 'SEWERS FOR ADOPTION' 7TH EDITION AND THE RELEVANT COUNCIL DESIGN GUIDE.
c. ALL PRIVATE SURFACE WATER SEWERS TO BE LAID AT 1 IN 100 UNLESS OTHERWISE STATED ON THE DRAWING.
d. ALL PRIVATE FOUL WATER SEWERS TO BE LAID AT 1 IN 40 AT THE HEAD OF PIPE RUNS AND 1 IN 80 ELSEWHERE UNLESS OTHERWISE STATED.
e. ALL PRIVATE FOUL SEWER PIPES TO BE 150MM DIAMETER UNLESS OTHERWISE STATED ON THE DRAWING. ALL PRIVATE SURFACE WATER SEWER PIPES TO BE 100MM DIAMETER FROM DOWNPIPES AND 150MM DIAMETER ELSEWHERE UNLESS OTHERWISE STATED ON THE DRAWING.
f. ALLOW FOR RODDING ACCESS ABOVE GROUND WHERE RAINWATER DOWNPIPES DO NOT HAVE A DIRECT CONNECTION TO AN INSPECTION CHAMBER. EXISTING SEWER PIPE TO BE RE-USED TO BE SURVEYED AND LEVELLED PRIOR TO COMMENCEMENT OF THE DRAINAGE WORKS AND REFURBISHED IF NECESSARY.
g. CONNECTIONS TO AN ADOPTED SEWER ONLY TO BE MADE FOLLOWING APPROVAL FROM THE RELEVANT ADOPTING AUTHORITY.
h. ALL DRAINS, SEWER PIPES AND MANHOLES TO BE CLEANED AND TESTED FOR WATER TIGHTNESS ON COMPLETION OF CONSTRUCTION.

4. MANHOLE COVERS AND FRAMES
a. MANHOLE COVERS TO BE CLASS D400 IN HIGHWAYS, CLASS B125 IN FOOTWAYS AND VERGES, CLASS A15 IN NON-TRAFFICKED AREAS.
b. MANHOLE COVER AND FRAME TO BE BEDDED AND SURROUNDED IN 1:3 MORTAR.

LEGEND

- PRIVATE SURFACE WATER DRAIN
- EXISTING SURFACE WATER DRAIN
- EXISTING MANHOLE
- TYPE 3 INSPECTION CHAMBER
- TREE RPA
- RWP RAIN WATER PIPE
- BOTTLE GULLY
- ATTENUATION SYSTEM
- OVERLAND FLOW
- TYPE 4 INSPECTION CHAMBER

##	XX.XX.XX	...	...	...	
REV	DATE	BY	CKD	APPD	DESCRIPTION

PRELIMINARY DRAWING
FOR INFORMATION ONLY. NOT FOR CONSTRUCTION.

Client
RCKa Architects

AMBIENTAL
ENVIRONMENTAL ASSESSMENT
a company of Royal HaskoningDHV

Project
248-250 CAMDEN ROAD
LONDON NW1 9HE

Drawing
GROUND FLOOR LAYOUT
SURFACE WATER DRAINAGE STRATEGY

Drawn by: SL
Date: 01/05/2020

Drawing No. 5356_DR02
Revision A

Drawing Scale: 1:100 @ A1
0 1m 2m 3m 4m 5m

Appendix IV – Thames Water Sewer Asset Plan

Asset location search

Thames Water Property Searches

Ambiental
Sussex Innovation Centre
Science Park Square
BRIGHTON
BN1 9SB

Search address supplied	248-250 Camden Road London NW1 9HE
Your reference	5356
Our reference	ALS/ALS Standard/2020_4182760
Search date	20 April 2020

Knowledge of features below the surface is essential for every development

The benefits of this knowledge not only include ensuring due diligence and avoiding risk, but also being able to ascertain the feasibility of any development.

Did you know that Thames Water Property Searches can also provide a variety of utility searches including a more comprehensive view of utility providers' assets (across up to 35-45 different providers), as well as more focused searches relating to specific major utility companies such as National Grid (gas and electric).

Contact us to find out more.

Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13

searches@thameswater.co.uk
www.thameswater-propertysearches.co.uk

0845 070 9148

Asset location search

Thames Water Property Searches

Search address supplied: 248-250, Camden Road, London, NW1 9HE

Dear Sir / Madam

An Asset Location Search is recommended when undertaking a site development. It is essential to obtain information on the size and location of clean water and sewerage assets to safeguard against expensive damage and allow cost-effective service design.

The following records were searched in compiling this report: - the map of public sewers & the map of waterworks. Thames Water Utilities Ltd (TWUL) holds all of these.

This searchprovides maps showing the position, size of Thames Water assets close to the proposed development and also manhole cover and invert levels, where available.

Please note that none of the charges made for this report relate to the provision of Ordnance Survey mapping information. The replies contained in this letter are given following inspection of the public service records available to this company. No responsibility can be accepted for any error or omission in the replies.

You should be aware that the information contained on these plans is current only on the day that the plans are issued. The plans should only be used for the duration of the work that is being carried out at the present time. Under no circumstances should this data be copied or transmitted to parties other than those for whom the current work is being carried out.

Thames Water do update these service plans on a regular basis and failure to observe the above conditions could lead to damage arising to new or diverted services at a later date.

Contact Us

If you have any further queries regarding this enquiry please feel free to contact a member of the team on 0845 070 9148, or use the address below:

Thames Water Utilities Ltd
Property Searches
PO Box 3189
Slough
SL1 4WW

Email: searches@thameswater.co.uk
Web: www.thameswater-propertysearches.co.uk

Waste Water Services

Please provide a copy extract from the public sewer map.

Enclosed is a map showing the approximate lines of our sewers. Our plans do not show sewer connections from individual properties or any sewers not owned by Thames Water unless specifically annotated otherwise. Records such as "private" pipework are in some cases available from the Building Control Department of the relevant Local Authority.

Where the Local Authority does not hold such plans it might be advisable to consult the property deeds for the site or contact neighbouring landowners.

This report relates only to sewerage apparatus of Thames Water Utilities Ltd, it does not disclose details of cables and or communications equipment that may be running through or around such apparatus.

The sewer level information contained in this response represents all of the level data available in our existing records. Should you require any further Information, please refer to the relevant section within the 'Further Contacts' page found later in this document.

For your guidance:

- The Company is not generally responsible for rivers, watercourses, ponds, culverts or highway drains. If any of these are shown on the copy extract they are shown for information only.
- Any private sewers or lateral drains which are indicated on the extract of the public sewer map as being subject to an agreement under Section 104 of the Water Industry Act 1991 are not an 'as constructed' record. It is recommended these details be checked with the developer.

Clean Water Services

Please provide a copy extract from the public water main map.

Enclosed is a map showing the approximate positions of our water mains and associated apparatus. Please note that records are not kept of the positions of individual domestic supplies.

For your information, there will be a pressure of at least 10m head at the outside stop valve. If you would like to know the static pressure, please contact our Customer Centre on 0800 316 9800. The Customer Centre can also arrange for a full flow and pressure test to be carried out for a fee.

For your guidance:

- Assets other than vested water mains may be shown on the plan, for information only.
- If an extract of the public water main record is enclosed, this will show known public water mains in the vicinity of the property. It should be possible to estimate the likely length and route of any private water supply pipe connecting the property to the public water network.

Payment for this Search

A charge will be added to your suppliers account.

Further contacts:

Waste Water queries

Should you require verification of the invert levels of public sewers, by site measurement, you will need to approach the relevant Thames Water Area Network Office for permission to lift the appropriate covers. This permission will usually involve you completing a TWOSA form. For further information please contact our Customer Centre on Tel: 0845 920 0800. Alternatively, a survey can be arranged, for a fee, through our Customer Centre on the above number.

If you have any questions regarding sewer connections, budget estimates, diversions, building over issues or any other questions regarding operational issues please direct them to our service desk. Which can be contacted by writing to:

Developer Services (Waste Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

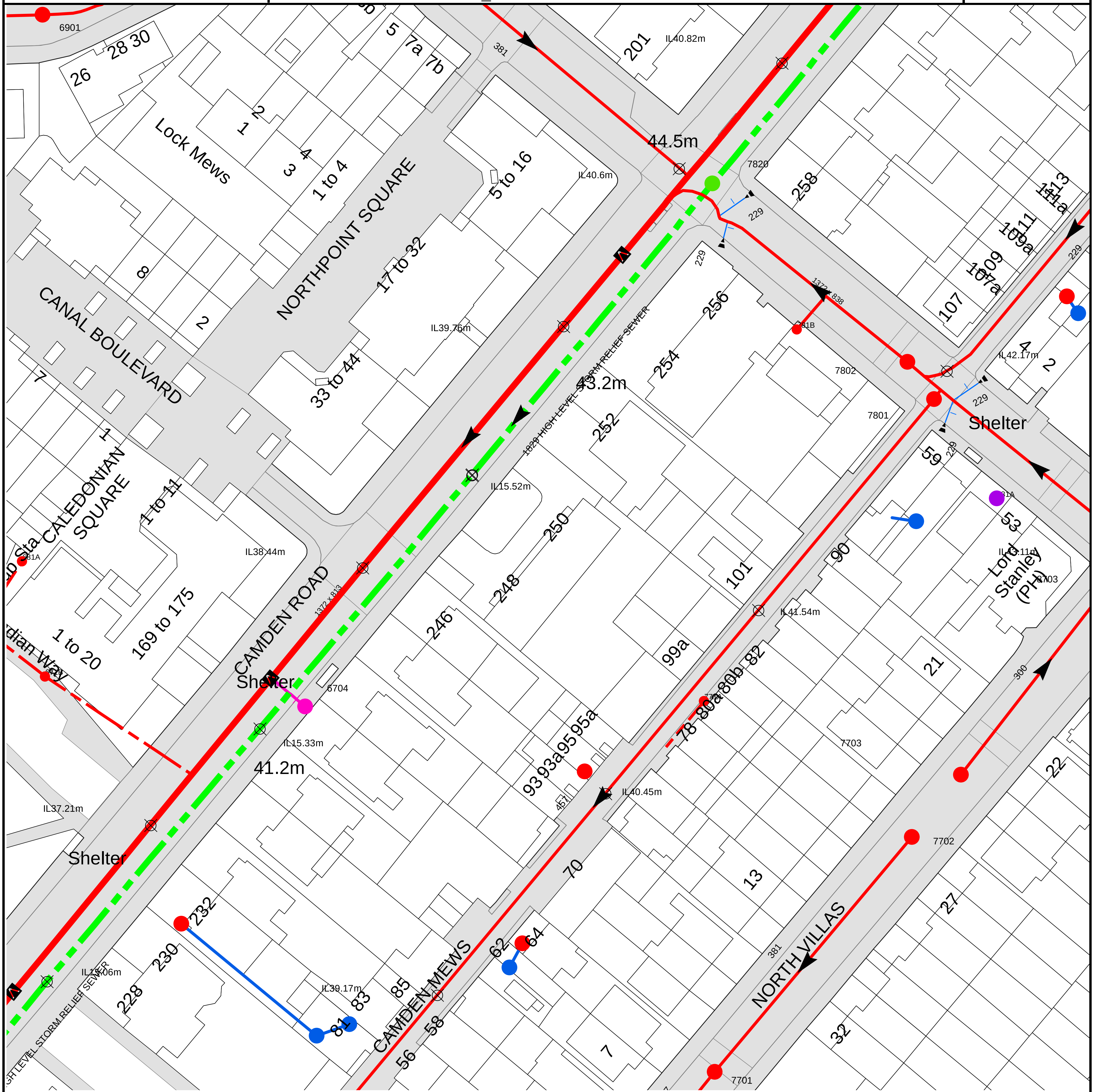
Clean Water queries

Should you require any advice concerning clean water operational issues or clean water connections, please contact:

Developer Services (Clean Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

Asset Location Search Sewer Map - ALS/ALS Standard/2020_4182760



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 529700,184804

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Based on the Ordnance Survey Map with the Sanction of the controller of H.M. Stationery Office, License no. 100019345 Crown Copyright Reserved.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
6901	43.68	n/a
681A	n/a	n/a
671B	n/a	n/a
67BE	n/a	n/a
6704	41.74	n/a
67BD	n/a	n/a
67BC	n/a	n/a
67AG	n/a	n/a
67AH	n/a	n/a
77AH	n/a	n/a
771A	n/a	n/a
7820	n/a	15.75
7701	45.43	42
781B	n/a	n/a
7802	45.68	41.73
7702	46.92	42.98
78DA	n/a	n/a
7801	45.85	42.88
7703	47.12	43.49
781A	n/a	n/a
78CD	n/a	n/a
78CC	n/a	n/a

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

Foul: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

Surface Water: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

Combined: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

Trunk Surface Water

Trunk Foul

Storm Relief

Trunk Combined

Vent Pipe

Bio-solids (Sludge)

Proposed Thames Surface Water Sewer

Proposed Thames Water Foul Sewer

Gallery

Foul Rising Main

Surface Water Rising Main

Combined Rising Main

Sludge Rising Main

Proposed Thames Water Rising Main

Vacuum

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

Air Valve

Dam Chase

Fitting

Meter

Vent Column

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

Control Valve

Drop Pipe

Ancillary

Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol, Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

Outfall

Undefined End

Inlet

Other Symbols

Symbols used on maps which do not fall under other general categories

Public/Private Pumping Station

Change of characteristic indicator (C.O.C.I.)

Invert Level

Summit

Areas

Lines denoting areas of underground surveys, etc.

Agreement

Operational Site

Chamber

Tunnel

Conduit Bridge

Other Sewer Types (Not Operated or Maintained by Thames Water)

Foul Sewer

Surface Water Sewer

Combined Sewer

Gulley

Culverted Watercourse

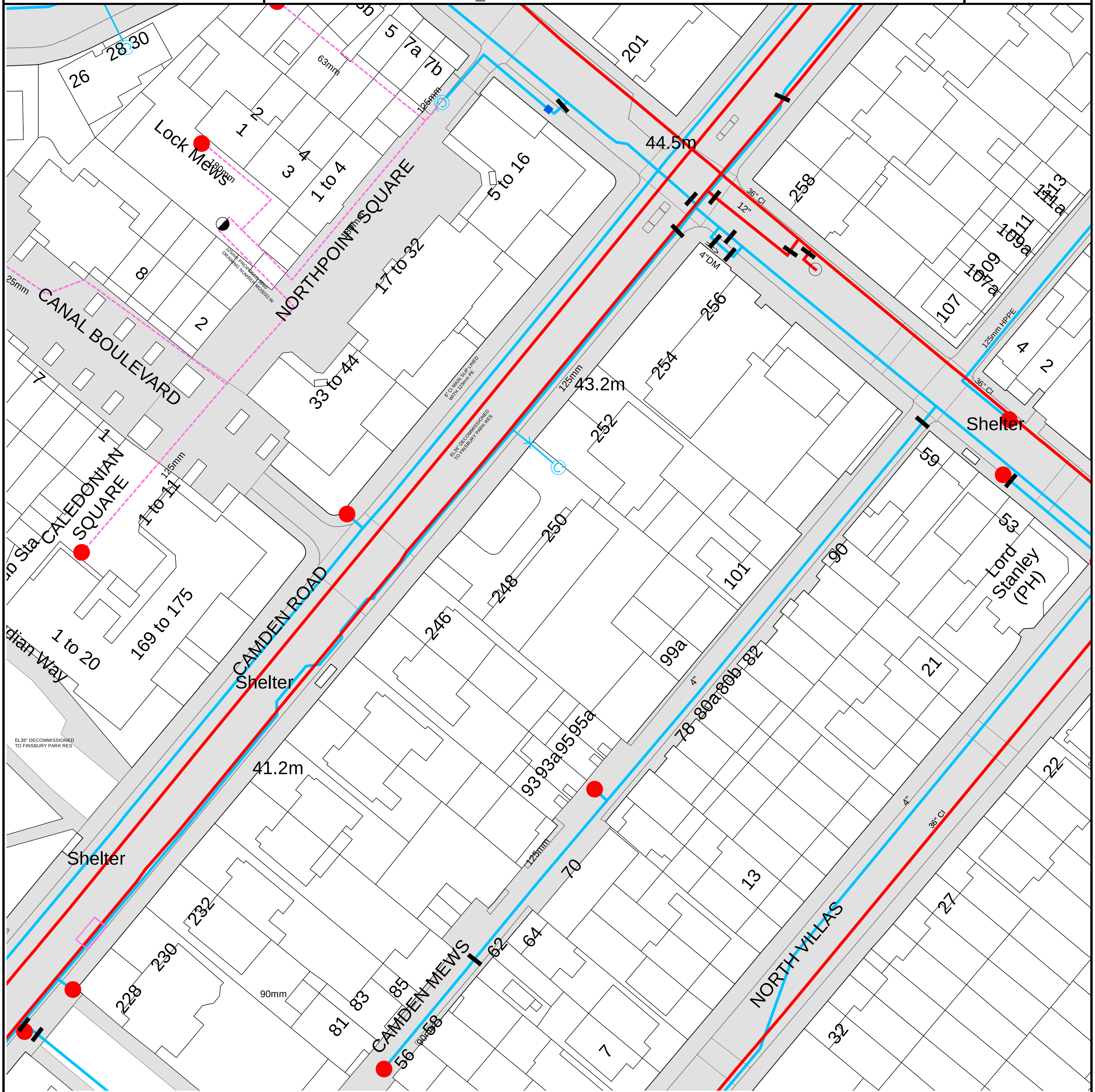
Proposed

Abandoned Sewer

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.
2) All measurements on the plans are metric.
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.
4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
5) 'na' or '0' on a manhole level indicates that data is unavailable.
6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Insight on 0845 070 9148.

Asset Location Search Water Map - ALS/ALS Standard/2020_4182760



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 529700, 184804.

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

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ALS Water Map Key

Water Pipes (Operated & Maintained by Thames Water)

4"

Distribution Main: The most common pipe shown on water maps. With few exceptions, domestic connections are only made to distribution mains.

16"

Trunk Main: A main carrying water from a source of supply to a treatment plant or reservoir, or from one treatment plant or reservoir to another. Also a main transferring water in bulk to smaller water mains used for supplying individual customers.

3" SUPPLY

Supply Main: A supply main indicates that the water main is used as a supply for a single property or group of properties.

3" FIRE

Fire Main: Where a pipe is used as a fire supply, the word FIRE will be displayed along the pipe.

3" METERED

Metered Pipe: A metered main indicates that the pipe in question supplies water for a single property or group of properties and that quantity of water passing through the pipe is metered even though there may be no meter symbol shown.

Transmission Tunnel: A very large diameter water pipe. Most tunnels are buried very deep underground. These pipes are not expected to affect the structural integrity of buildings shown on the map provided.

Proposed Main: A main that is still in the planning stages or in the process of being laid. More details of the proposed main and its reference number are generally included near the main.

PIPE DIAMETER	DEPTH BELOW GROUND
Up to 300mm (12")	900mm (3')
300mm - 600mm (12" - 24")	1100mm (3' 8")
600mm and bigger (24" plus)	1200mm (4')

Valves

General Purpose Valve

Air Valve

Pressure Control Valve

Customer Valve

Hydrants

Single Hydrant

Meters

Meter

End Items

Symbol indicating what happens at the end of a water main.

Blank Flange

Capped End

Emptying Pit

Undefined End

Manifold

Customer Supply

Fire Supply

Operational Sites

Booster Station

Other

Other (Proposed)

Pumping Station

Service Reservoir

Shaft Inspection

Treatment Works

Unknown

Water Tower

Other Symbols

Data Logger

Other Water Pipes (Not Operated or Maintained by Thames Water)

Other Water Company Main: Occasionally other water company water pipes may overlap the border of our clean water coverage area. These mains are denoted in purple and in most cases have the owner of the pipe displayed along them.

Private Main: Indiates that the water main in question is not owned by Thames Water. These mains normally have text associated with them indicating the diameter and owner of the pipe.

Terms and Conditions

All sales are made in accordance with Thames Water Utilities Limited (TWUL) standard terms and conditions unless previously agreed in writing.

1. All goods remain in the property of Thames Water Utilities Ltd until full payment is received.
2. Provision of service will be in accordance with all legal requirements and published TWUL policies.
3. All invoices are strictly due for payment 14 days from due date of the invoice. Any other terms must be accepted/agreed in writing prior to provision of goods or service, or will be held to be invalid.
4. Thames Water does not accept post-dated cheques-any cheques received will be processed for payment on date of receipt.
5. In case of dispute TWUL`s terms and conditions shall apply.
6. Penalty interest may be invoked by TWUL in the event of unjustifiable payment delay. Interest charges will be in line with UK Statute Law 'The Late Payment of Commercial Debts (Interest) Act 1998'.
7. Interest will be charged in line with current Court Interest Charges, if legal action is taken.
8. A charge may be made at the discretion of the company for increased administration costs.

A copy of Thames Water's standard terms and conditions are available from the Commercial Billing Team (cashoperations@thameswater.co.uk).

We publish several Codes of Practice including a guaranteed standards scheme. You can obtain copies of these leaflets by calling us on 0800 316 9800

If you are unhappy with our service you can speak to your original goods or customer service provider. If you are not satisfied with the response, your complaint will be reviewed by the Customer Services Director. You can write to her at: Thames Water Utilities Ltd. PO Box 492, Swindon, SN38 8TU.

If the Goods or Services covered by this invoice falls under the regulation of the 1991 Water Industry Act, and you remain dissatisfied you can refer your complaint to Consumer Council for Water on 0121 345 1000 or write to them at Consumer Council for Water, 1st Floor, Victoria Square House, Victoria Square, Birmingham, B2 4AJ.

Ways to pay your bill

Credit Card	BACS Payment	Telephone Banking	Cheque
Call **0845 070 9148** quoting your invoice number starting CBA or ADS / OSS	Account number **90478703** Sort code **60-00-01** A remittance advice must be sent to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW.** or email **ps.billing@thameswater.co.uk**	By calling your bank and quoting: Account number **90478703** Sort code **60-00-01** and your invoice number	Made payable to '**Thames Water Utilities Ltd**' Write your Thames Water account number on the back. Send to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW** or by DX to **151280 Slough 13**

Thames Water Utilities Ltd Registered in England & Wales No. 2366661 Registered Office Clearwater Court, Vastern Rd, Reading, Berks, RG1 8DB.

Appendix V – Thames Water Sewer Capacity Check

Mr Max Brambani
Ambiental
max.brambani@rhdhv.com

Wastewater pre-planning
Our ref DS6078800-DTS **66860**

25 November 2020

Pre-planning enquiry: 248-250 Camden Road Hostel, Camden Road, London, NW1 9HE - Confirmation of sufficient capacity

Dear Max,

Thank you for providing information on your development and proposed drainage strategy**: Redevelopment of the site to include demolition of existing 27 bed hostel. Construction of 30 bed hostel, 28 Studio flats and 2x 1bed flat. Surface water (1000sqm impervious) restricted to 1.3l/s (currently unrestricted). All flows to be discharged by gravity using existing connection into combined sewer in Camden Rd.**

We have completed the assessment of the foul and surface water flows based on the information submitted in your application with the purpose of assessing sewerage capacity within the existing Thames Water sewer network.

Foul Water

If your proposals progress in line with the details you've provided, we're pleased to confirm that there will be sufficient sewerage capacity in the adjacent foul sewer network to serve your development.

This confirmation is valid for 12 months or for the life of any planning approval that this information is used to support, to a maximum of three years.

You'll need to keep us informed of any changes to your design – for example, an increase in the number or density of homes. Such changes could mean there is no longer sufficient capacity.

Surface Water

When developing a site, policy 5.13 of the London Plan and Policy 3.4 of the Supplementary Planning Guidance (Sustainable Design And Construction) states that every attempt should be made to use flow attenuation and SuDS/Storage to reduce the surface water discharge from the site as much as possible.

In accordance with the Building Act 2000 Clause H3.3, positive connection of surface water to a public sewer will only be consented when it can be demonstrated that the hierarchy of disposal methods have been examined and proven to be impracticable. Before we can consider your surface water needs, you'll need written approval from the lead local flood authority that you have followed the sequential approach to the disposal of surface water and considered all practical means.

The disposal hierarchy being:

1. store rainwater for later use.
2. use infiltration techniques where possible.
3. attenuate rainwater in ponds or open water features for gradual release.
4. attenuate rainwater by storing in tanks or sealed water features for gradual release.
5. discharge rainwater direct to a watercourse.
6. discharge rainwater to a surface water sewer/drain.
7. discharge rainwater to the combined sewer.
8. discharge rainwater to the foul sewer

Where connection to the public sewerage network is still required to manage surface water flows we will accept these flows at a discharge rate in line with CIRIA's best practice guide on SuDS or that stated within the sites planning approval.

If the above surface water hierarchy has been followed and if the flows are restricted to a total of 1.3 l/s then Thames Water would not have any objections to the proposal.

Please see the attached 'Planning your wastewater' leaflet for additional information.

What happens next?

Please make sure you submit your connection application, giving us at least 21 days' notice of the date you wish to make your new connection/s.

If you've any further questions, please contact me on the number in the signature.

Yours sincerely

Jose Varela

Developer Services – Adoptions Engineer

Mobile 0756 424 7625

jose.varela@thameswater.co.uk

Get advice on making your sewer connection correctly at connectright.org.uk

Please send all emails to developer.services@thameswater.co.uk quoting the application reference and full site address

Clearwater Court, Vastern Road, Reading, RG1 8DB

Find us online at developers.thameswater.co.uk

Appendix VI – Supplementary Document

Geotechnical Survey Report

FSI Ref:	20269
Issue Date:	December 2019
Risk Address:	248-250 Camden Road Camden London NW1 9HE
Engineer:	Carl Bauer
Company:	Rodrigues Associates

Managing Director:	Martin Rush MSc FGS
Finance Director:	Louise Ayres BSc (Hons)
Geotechnical Compliance & Logistics Supervisor:	Perry Martin MCIHT
Laboratory Supervisor:	Jade McLellan
Assistant Geologists:	George Baron BSc (Hons) FGS Scott Parker BSc (Hons) FGS

248-250 Camden Road, Camden, London NW1 9HE

1.0 INTRODUCTION

In accordance with instructions by Rodrigues Associates, 24/10/2019, we visited the site occupied by 248-250 Camden Road, Camden, London NW1 9HE, on 25/10/2019-27/10/2019. The purpose of our visit was to carry out an investigation into the ground conditions, with a view to foundation design for a proposed development. It is our understanding that the existing four-story unit on site is to be demolished and a new six-story commercial/residential property with basement is proposed to be developed in its place.

The exploratory holes carried out during the fieldwork, which investigate only a small volume of the ground in relation to the size of the site, can only provide general indication of site conditions. The comments and opinions expressed within this report are based on the ground conditions revealed by the site works, together with information contained within the desk study provided and of laboratory test results. There may be exceptional ground conditions elsewhere on the site which have not been disclosed by this investigation and which therefore have not been taken into account in this report.

All ground water readings relate to short term observations and do not allow for variations due to seasonal or other effects. Monitoring wells have been installed, to allow for groundwater samples and also to assess groundwater levels.

All depths stated within this report and on the borehole logs are depths below the ground level surrounding the borehole locations.

2.0 SITE SETTING

i. Location

The site is located at approximate grid reference 529700 184800, the site is situated in Camden on the South-Eastern side of Camden Road, approximately 50m South of the junction between Camden Park Road, Torriano Avenue and Camden Road. The site slopes downwards from South-East to North-West towards the front of the property and Camden Road, and lies approximately 46-47m above sea level.

ii. Description

The area of the whole site is approximately 0.11ha and is currently occupied by a detached, four-story hostel. There is a tarmac/soft landscape garden area to the South-East (rear) of the site, with a tarmac pavement and soft landscape planter located immediately to the North-West (front), which leads directly onto Camden Road. The North-East, South-East and South-West boundaries are made up of neighbouring residential properties. The majority of the surrounding area is residential housing although a parade of commercial units is noted on York Way approximately 190m to the North-East. There is also an Esso petrol garage and railway line running to the North-West, approximately 220m South-West and 200m South-West respectively.

iii. Geology

Reference to the 1:50,000 scale geological map of the area (Sheet No.256, North London) shows the site to be underlain by the London Clay Formation. The London Clay Formation is a sedimentary bedrock comprised of Clay, Silt and Sand which formed approximately 48 to 56 million years ago in the Palaeogene Period, in a local environment previously dominated by deep seas. The London Clay Formation here is not noted to be overlain by a superficial deposit.

iv. Hydrogeology

The hydrogeology of the area is not dealt with within the Desk Study and as such we have no information on the likely depth of the water table beneath the site. The boreholes on site were taken to a maximum depth of 15.00m and no groundwater was noted within any of the three boreholes carried out. The groundwater table is therefore assumed to be located at a depth greater than 15.00m. The site is not located within a groundwater source protection zone as defined within the Environment Agency website. It is also not noted to be situated above an aquifer within the London Clay bedrock.

v. Hydrology

There are no water courses located within close proximity of the site. The nearest watercourse on the relevant 1:25,000 OS map is shown to be Regents Canal noted approximately 0.80km to the South-West of the site. According to the Environment Agency Website the likelihood of flooding in this area is 1 in 1000 or less, this is based on current best information on the extent of the extreme flood from rivers or the sea that would occur without the presence of flood defences.

The risk of flooding due to surface water is also noted to be Very Low. Very low risk means that each year this area has a chance of flooding of less than 0.1%. Flooding from surface water is difficult to predict as rainfall location and volume are difficult to forecast. In addition, local features can greatly affect the chance and severity of flooding.

3.0 FIELDWORK

The site investigation work was carried out on 25/10/2019-27/10/2019 and comprised of the digging of 8No. trial pits and drilling of 3No. boreholes across the site to a maximum depth of 15.00m. Monitoring wells were also installed within boreholes 1 and 3 to provide groundwater readings. The locations of the boreholes carried out are marked on the site plan within Appendix 1 and the borehole logs included as Appendix 2.

Within the boreholes, disturbed samples were taken at 0.50m and 1.00m intervals. Insitu strength tests, in the form of SPT-tests were also performed within the Sub soil at appropriate intervals. The results of all insitu strength tests are recorded on the borehole logs within Appendix 2.

4.0 TRIAL PIT FINDINGS

i. Foundation Details

Trial pit 1 notes two different foundation constructions; the Boundary Wall foundations are shown to be Concrete foundations seated into Brick/Concrete Rubble FILL at a depth of 1.60m. The top of the Concrete footing is noted at 1.50m and attains a thickness of 100mm with a projection of 160mm. The top of the Front Projection foundations is noted at a depth of 1.70m, it was however not possible to locate the underside due to excessive depth of footings and the presence of Brick/Concrete Rubble FILL to depth.

The foundations of trial pit 2, are shown to be Concrete foundations seated into MADE GROUND at a depth of 0.36m. The top of the Concrete footing is noted at 0.16m and attains a thickness of 200mm with a projection of 180mm.

The foundations of trial pit 3, are shown to be Brick and Concrete foundations seated into Silty CLAY at a depth of 0.50m. The top of the Concrete footing is noted at 0.16m and attains a thickness of 160mm and a projection of 220mm onto Brick, 200mm thick with no further projection.

The top of the foundations within trial pit 4 are noted at a depth of 1.40m with a projection of 340mm, it was however not possible to locate the underside due to the excessive depth of footings.

The foundations of trial pit 5, are shown to be Concrete foundations seated into Silty CLAY at a depth of 0.50m. The top of the Concrete footing is noted at 0.10m and attains a thickness of 400mm with a projection of 70mm.

The foundations of trial pit 6, are shown to be Concrete foundations seated into Silty CLAY at a depth of 0.32m. The top of the Concrete footing is noted at 0.27m and attains a thickness of 50mm with a projection of 230mm.

Trial pit 7 notes two different foundation constructions; the Boundary Wall foundations are shown to be Concrete foundations seated into MADE GROUND at a depth of 1.00m. The top of the Concrete footing is noted at 0.60m and attains a thickness of 400mm with a projection of 220mm. The top of the Rear Projection foundations is noted at a depth of 1.80m, it was however not possible to locate the underside due to excessive depth of footings and the presence of MADE GROUND containing Brick/Concrete Rubble fill to depth.

The foundations of trial pit 8, are shown to be Concrete foundations seated into Silty CLAY at a depth of 0.82m. The top of the Concrete footing is noted at 0.07m and contains two step-outs attaining thicknesses of 250mm & 500mm; with projections of 0mm & 110mm respectively.

Locations of the trial pits can be seen on the site plan in appendix 1 and the trial pit logs can be seen in appendix 2.

5.0 BOREHOLE FINDINGS

i. Overview

Three boreholes were carried out on site, to establish the geology across the site as a whole. The boreholes were drilled to a maximum depth of 15.00m and all encountered very similar profiles which matched the expected underlying geology of London Clay bedrock with no superficial deposits. All boreholes were drilled utilising a shell and auger drilling rig to provide details on the geology beneath the site and also allowed monitoring wells to be installed within boreholes 1 & 3.

The strata encountered within each of the boreholes drilled, along with their depth is recorded below:

Stratum	BH1	BH2	BH3
TARMAC onto Type 1 FILL	G.L. – 0.20m	G.L. – 0.20m	–
Grass onto Topsoil/MADE GROUND	–	–	G.L. – 0.50m
Brick/Concrete FILL	0.20m – 2.10m	0.20m – 2.00m	–
Silty CLAY	2.10m – 12.50m	2.00m – 12.00m	0.50m – 13.00m
Blue/Grey CLAY	12.50m – 15.00m	12.00 – 15.00m	13.00m – 15.00m

ii. Made Ground/Topsoil

Made Ground was encountered to a maximum depth of 2.10m within boreholes 1 & 2 and consisted of Brick/Concrete FILL. The area from which boreholes 1 & 2 were drilled was covered with Tarmac onto Type 1 FILL noted to be 0.20m thick. Within borehole 3, Grass onto Topsoil/MADE GROUND containing Brick was observed to 0.50m, with no further fill material beneath.

iii. Silty CLAY

Below the MADE GROUND, Mid Brown Silty CLAY was recorded; this stratum was proved to a depth of 13.00m and is recognised as the weathered upper London Clay bedrock. Within borehole 3, two claystone horizons were also noted from 6.40m-7.00m and 11.50m-12.00m.

Insitu SPT testing within this stratum found it to be Firm-Stiff to Stiff (N Value = 14-22).

iv. Blue/Grey CLAY

Blue/Grey CLAY was noted to the base of all boreholes, a maximum depth of 15.00m and is recognised as a continuation of the London Clay bedrock.

Insitu SPT testing within this stratum found it to be Stiff (N Value = 22-24).

v. Insitu testing

Insitu strength tests, in the form of Standard Penetration Tests (SPTs), were carried out at appropriate intervals throughout the boreholes. The results of all insitu strength tests are recorded on the borehole logs within Appendix 2.

The Standard Penetration Test measures the number of blows taken to drive a probe 300mm into the soil using the drop of a 63.5kg hammer over a distance of 0.76m. The SPT-test gives an indication of soil density.

vi. Root Activity

No roots below grass level were observed within any of the boreholes.

vii. Groundwater

None of the boreholes encountered water strikes during drilling, in the short term this suggests that the groundwater lies at a depth greater than 15.00m below ground level. Monitoring wells were installed in boreholes 1 to 3 to allow groundwater levels to be monitored**. During a revisit on 16/01/2020 the monitoring wells were still noted to be dry showing that there is no elevated groundwater.**

It should be noted that comments on groundwater conditions are based on observations made at the time of the investigation (October 2019) and that changes in groundwater levels are likely to arise due to seasonal affects and changes in drainage conditions.

6.0 GEOTECHNICAL TESTING

All samples were tested in accordance with BS 1377 1990: method of test of soils for Civil Engineering purposes, the results of which are discussed within Chapter 7 and recorded as test sheets and summaries within Appendix 3.

The laboratory testing conducted on the samples taken during this investigation comprised of, natural moisture contents (39No.), classification testing using Atterberg limits testing to determine the plasticity of the fine soils encountered (14No.), Triaxial testing (6No.), odometer testing (2No.), Waste Acceptance Criteria (WAC) testing (3No.) and sulphate content and pH (6No.).

7.0 GEOTECHNICAL TEST RESULTS

i. Moisture Contents and Atterberg Limit Tests

Atterberg Limits Testing found that the London Clay falls into soil class CV and CH of the British Soil Classification System. The results show the samples to be high-very high plasticity. The plastic indices were found to range from 32-54%, this indicates that the Clay is of generally intermediate to high susceptibility to shrinkage and swelling with changes in moisture content.

Borehole	Depth	MC	LL	PL	PI	CLASS
BH1	3.00m	28.9	76	28	48	CV
	3.50m	29.0	76	26	50	CV
	5.00m	28.8	75	28	47	CV
	7.00m	28.5	71	27	44	CV
BH2	1.20m	29.0	60	24	36	CH
	2.00m	25.9	56	24	32	CH
	2.50m	29.9	75	28	47	CV
	4.00m	30.7	75	32	43	CV
	5.50m	28.4	73	29	44	CV
	8.00m	27.9	72	28	44	CV
BH3	3.00m	26.0	82	28	54	CV
	3.50m	29.8	72	27	45	CV
	5.50m	30.5	69	31	38	CH
	7.50m	30.0	70	28	42	CH/CV

ii. Sulphate and pH Tests

Six soil samples were tested for sulphate and pH from the area in which the new commercial/residential unit is proposed to be built. The soil samples tested gave water soluble sulphate 2:1 results ranging from a minimum of 0.09g/l to a maximum of 2.67g/l. The samples ranged from a pH of 8.1 to a pH of 10.2. Using the BRE digest SD1 (2005) - concrete in Aggressive Ground, the design sulphate class for this site is DS-3, with an ACEC class of AC-3 (Natural Soil - Mobile Water).

iii. Triaxial Tests

Triaxial testing was carried out on six samples, these samples were from borehole 1 at 2.23m, 4.10m & 6.08m and borehole 3 at 2.10m, 4.07m and 6.05m. The results can be seen in the table below and in appendix 3.

Triaxial test results: Lowest shear stress taken from each test of three

Depth (m)	BH1	BH2
~2.00	100kPa	180kPa
~4.00	85kPa	79kPa
~6.00	127Kpa	105kPa

iv. CBR Tests

CBR tests were carried out at three locations across the site at a depth of 0.45m. These tests were carried out to test the strength of the substrata beneath the proposed pavement area. CBR tests 1 and 3 had values of 2.9% and 1.4% respectively. The results of test 3 had a value of 29%. The following table gives guidance on what the CBR values mean.

This table is only for guidance, you should refer to a design document for specific information.

CBR VALUE	SUBGRADE STRENGTH	COMMENTS
3% and less	Poor	" Capping “ is required
3% - 5%	Normal	Widely encountered CBR range capping considered according to road category
5% - 15%	Good	"Capping" normally unnecessary except on very heavily trafficked roads.

The results can be seen in appendix 3 and the test locations are marked on the site plan in appendix 1.

8.0 GEOTECHNICAL RECOMMENDATIONS AND CONCLUSIONS

i. Subsoil Profile

The subsoil profile encountered across the site was generally consistent with the geological survey map of the area, which suggested the site to be underlain by London Clay bedrock, with no superficial deposits. Made Ground was encountered across the site to a maximum depth of approximately 2.10m with Silty CLAY underlying the Made Ground.

ii. Foundation Options

It is understood that the proposed development is for the demolition of the existing four-story unit on site and the construction of a new six-story commercial/residential property with basement in its place. We would note that we have no information regarding the construction of these buildings or possible loadings and therefore, our comments are general comments based on assumed ‘normally’ loaded residential building, with no significant point loadings.

The main factors which will control the type of foundation used on this site will be the thickness of Made Ground present across this site and the bearing capacity of the underlying London Clay. Made Ground is an inherently variable material and foundations should not be based in this material as the composition of the soil may vary wildly across the site. The Made Ground was encountered to a maximum depth of 2.10m, and foundations should be taken at least 300mm past this to ensure natural ground is encountered, which means a minimum depth of 2.40m.

The underlying London Clay Deposits were found to be reasonably competent and would normally be adequate to support normal strip foundations. However, the main economical factor will be the depth at which any strip footings would have to be based to remove the risk of any movements, associated with clay shrinkage or heave, causing future damage to the new development. Seasonal variations in moisture content can cause significant movements over time, therefore it would be prudent to found the new building at a depth which would not be affected by any shrinkage or heave of the clay. A useful guide to foundation depths is given by the NHBC Guidelines – Chapter 4.2: building near trees, which provides suggested founding depths based on type, size and distance of trees within either a low, moderate or highly shrinkable soil. In addition to this, allowances will need to be made over any new planting, which may affect foundations in the future.

Therefore, in summary, we would suggest that conventional strip foundations could be utilised but are likely to be economically unviable due to shoring and health & safety risks. Therefore the most suitable alternative foundation for this site would be a piled foundation taken down further into the London Clay, this will also mitigate any risk of differential settlement between the basement and groundfloor footings. The borehole data contained within this report will be sufficient for a piling contractor to carry out a pile design.

As fill material was noted to a depth of 2.10m below ground level, as well as the existing foundations requiring removal for the new construction; we would recommend that a suspended groundfloor slab would be most suitable for this site.

iii. Bearing Capacity Assessment

For preliminary design purposes, BS8004 gives presumed bearing values which are the pressures which would normally result in an adequate factor of safety against shear failure for particular soil types, but without consideration of settlement.

These values are as follows:

Category	Types of rocks and soils	Presumed bearing value
Non-cohesive soils	Dense gravel or dense sand and gravel	>600 kN/m²
	Medium dense gravel, or medium dense sand and gravel	<200 to 600 kN/m²
	Loose gravel, or loose sand and gravel	<200 kN/m²
	Compact sand	>300 kN/m²
	Medium dense sand	100 to 300 kN/m²
	Loose sand	<100 kN/m² *depends on degree of looseness*

Cohesive soils	Very stiff bolder clays & hard clays	300 to 600 kN/m²
	Stiff clays	150 to 300 kN/m²
	Firm clay	75 to 150 kN/m²
	Soft clays and silts	< 75 kN/m²
	Very soft clay	Not applicable
Peat		Not applicable
Made ground		Not applicable

Within the boreholes at 2.50m-5.50m depth, the ground was found to be Silty CLAY with an SPT reading of N=15-18, indicating the material at 2.50m to 5.50m to be Stiff with a bearing capacity of 150-300kN/m².

For calculation of the bearing capacities available at 2.50m to 5.50m, we have used the lowest SPT reading at each depth. Based on Hansen (1968) and Tomlinson (2001), which assumes groundwater will not impact upon the foundations (i.e. groundwater will not be present within the width of the foundation below the foundation) the bearing capacities for each depth are shown below. The calculated bearing capacities allow for settlements up to 25mm.

Depth	2.50m	3.50m	4.00m	5.50m
N-Value	N = 15	N = 15	N = 16	N = 17
Bearing capacity	213kN/m²	233kN/m²	238kN/m²	243kN/m²

Soil properties for the Silty CLAY soil are as follows:

The shearing angle is 20°
Coefficient of compressibility Mv – 0.10-0.30
Stiffness Modulus E - 150MPa
Poisson's Ratio – 0.10-0.30

iv. Ground Conditions & Construction

The three boreholes drilled on this site were all found to be dry on completion of drilling, but water monitoring standpipes were installed to assess long term groundwater levels. However, in the short term this would indicate that excavations on this site are likely to be unaffected by water inflows, with the groundwater levels likely to be at a depth greater than 15.00m.

The material encountered on this site was found to be of a generally cohesive nature, which would indicate that sides of excavations are likely to be self-supporting, certainly in the short term. However, temporary support should be considered for all excavations where collapse is to be avoided, with heavy duty closed shoring in excavations below 1.20m where construction workers access is required.

With regard to desiccation, Driscoll (1983) gives two fairly crude guidelines relating to highly plastic clays at shallow depths (3.00m). The first of these is that desiccation is significant when the natural moisture content is less than or equal to 0.40 times the liquid limit. The second indicates that desiccation is significant when the moisture content is equal to or less than the plastic limit plus 2%. Driscoll's relationships can be used to give guidance on the presence of significantly desiccated clay. These relationships can sometimes give spurious results, especially when applied to clays of lower plasticity as the relationships were devised for highly plastic clays. Therefore, we would recommend that they should be used in conjunction with moisture content profiles, shear strength profiles and field descriptions. The moisture content profiles of the boreholes highlighted desiccation of the underlying clay sub soil at 3.00m, 3.50m & 5.00m in BH1, 2.50m, 4.00m, 5.50m & 8.00m in BH2 and 3.00m & 5.50m in BH3. This desiccation is likely natural due to overburden pressures compressing the clay. Due to desiccation at depth there is likely to be heave when the overburden is removed, therefore we would recommend heave protection when the basement is constructed.

9.0 SOAK AWAY TESTING

Two soakaway tests were carried out on this site, one at the front of the property and one at the rear of the property. The test pits were 300mm x 300mm and 1000mm deep. Soakaway test pit 1 (SW1) shows that the water drained from 75% full to 25% full in approximately 20,000 seconds. Using this time, a soil infiltration rate of 32.61×10^{-7} m/s is calculated for this location. Soakaway test pit 2 (SW2) shows that the water drained from 75% full to 25% full in approximately 16,000 seconds. Using this time, a soil infiltration rate of 40.76×10^{-7} m/s is calculated for this location. Given the slow rate of infiltration within the London Clay we would suggest that this site is not suitable for a soakaway system. The calculation can be seen in appendix 3 and the test pit locations can be seen on the site plan in appendix 1.

10.0 CERTIFICATION

Although the boreholes were positioned to give a spread across the site, it is impossible to give total coverage across a site, especially one which contains buildings, hard standings and obstructions. Therefore, areas exist on the site where investigations were not carried out. Such areas are generally only exposed during the construction stage. Should any areas of potential contamination be identified during construction, further testing may be required.

Responsibility cannot be accepted for variation in ground conditions between and around exploratory points not revealed by the data or at the time of the investigation. The report may suggest an opinion on the nature of the strata or conditions between exploratory points and below the maximum depth of investigation. However, this is for guidance only and no liability can be accepted for its accuracy.

The conclusions and recommendations given within this report are based upon the stated development plans for the site. If the site is to be developed for a more or less sensitive use then a different interpretation may be appropriate. This report relies upon the co-operation of other organisations and the free availability of information and total access. No responsibility can therefore, be accepted for conditions arising from information, which was not available to the investigation team as a result of information being withheld or access prevented.

This report is for the sole use of "the client" and/or their professional advisors. It must not be reproduced or transferred to any third party without prior written permission of the author. We will consider the reissue of the report in its original form to a third party for an administrative fee (currently £100). We reserve the right to refuse copies of the report to any third party (other than those named above). We reserve the right to amend our pinions in the event that additional information is made available. If any unauthorised third party makes use of the report they do so at their own risk and Fastrack™ Site Investigations Limited owes them no duty of care or skill.

We hope that this is satisfactory for your requirements. If you have any queries, please do not hesitate from contacting us.

Yours faithfully

George Baron
For and on behalf of
FASTRACK SITE INVESTIGATIONS LTD

APPENDIX I
Site Plan

FASTRACK

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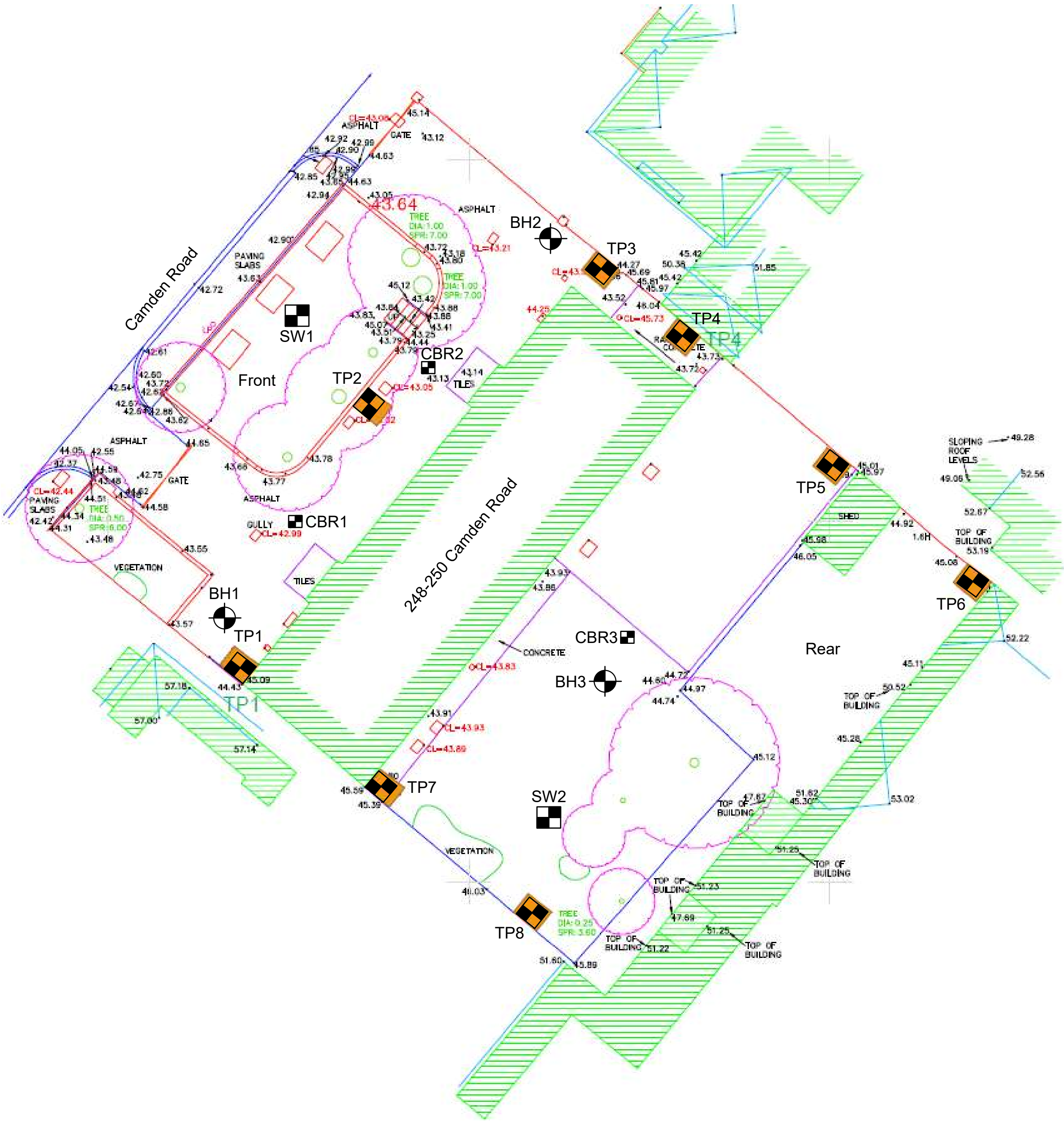
Appendix No: 1
FSI Ref: 20269

SITE PLAN

Property Address: 248-250 Camden Road, Camden, London NW1 9HE

Survey date: 25-27/10/2019 **Operative:** SE1



Scale:	**Drawn by:**	**Key:**
NTS	GB	Trial Pit; Borehole; Manholes; Rain Water Pipe; Soil & Vent Pipe; Surface Water Gully; Foul Water Gully; Shrub; Tree (Conifer); Tree (Deciduous)

APPENDIX II
Trial Pit and Borehole Findings

FASTRACK	Fastrack Site Investigations Ltd Unit 9, Tyndales Farm Southend Road Maldon CM9 6TQ	Borehole Log	Borehole No. **BH1** Sheet 1 of 1
Project Name: 248-250 Camden Road	Project No. 20269	Site Date: 25/10/2019	Hole Type: BH
Location: Camden, London NW1 9HE			Scale: 1:75
Client: Rodrigues Associates			Logged By: SE1

Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Stratum Description
				0.10	TARMAC
				0.20	Type 1 FILL
					Brick/Concrete FILL
	1.00	D			
	1.20	D			
		SPT	N = 17		
	2.00	U			
				2.10	Mid Brown Silty CLAY containing Blue Mottling
	3.00	D			
	3.50	D			
		SPT	N = 15		
	4.00	U			
	5.00	D			
	5.50	D			
		SPT	N = 17		
	6.00	U			
	7.00	D			
	7.50	D			
		SPT	N = 18		
	8.50	D			
	9.00	D			
		SPT	N = 19		
	10.00	D			
	10.50	D			
		SPT	N = 20		
	11.50	D			
	12.00	D			
		SPT	N = 21		
				12.50	Blue/Grey CLAY
	13.00	D			
	13.50	D			
		SPT	N = 22		
	14.25	D			
	14.55	D			
		SPT	N = 23		
				15.00	End of Borehole at 15.000m

Key: D - Disturbed Sample V - Insitu Vane Test MP - Mackintosh Probe Test

Remarks: Borehole closed at 15.00m. Standpipe installed to 10.00m.
Borehole noted to be dry on completion. No Roots noted.

AGS

FASTRACK	Fastrack Site Investigations Ltd Unit 9, Tyndales Farm Southend Road Maldon CM9 6TQ	Borehole Log	Borehole No. **BH2** Sheet 1 of 1
Project Name: 248-250 Camden Road	Project No. 20269	Site Date: 26/10/2019	Hole Type BH
Location: Camden, London NW1 9HE			Scale 1:75
Client: Rodrigues Associates			Logged By SE1

Water Strikes	Sample and In Situ Testing			Depth (m)	Legend	Stratum Description
	Depth (m)	Type	Results			
				0.10		TARMAC
				0.20		Type 1 FILL
						Brick/Concrete FILL
	1.20	D SPT	N = 11			
	2.00	D		2.00		Mid Brown Silty CLAY containing Blue Mottling
	2.50	D SPT	N = 15			
	3.50	D				
	4.00	D SPT	N = 16			
	5.00	D				
	5.50	D SPT	N = 18			
	6.50	D				
	7.00	D SPT	N = 17			
	8.00	D				
	8.50	D SPT	N = 19			
	9.50	D				
	10.00	D SPT	N = 19			
	11.00	D				
	11.50	D SPT	N = 20			
				12.00		Blue/Grey CLAY
	12.50	D				
	13.00	D SPT	N = 22			
	14.00	D				
	14.55	D SPT	N = 22			
				15.00		End of Borehole at 15.000m

Key: D - Disturbed Sample V - Insitu Vane Test MP - Mackintosh Probe Test

Remarks: Borehole closed at 15.00m.
Borehole noted to be dry on completion. No Roots noted.

AGS

FASTRACK

Fastrack Site Investigations Ltd
Unit 9, Tyndales Farm
Southend Road
Maldon CM9 6TQ

Borehole Log

Borehole No.	**BH3**	Sheet 1 of 1	
Project Name: 248-250 Camden Road	Project No. 20269	Site Date: 27/10/2019	Hole Type BH
Location:	Camden, London NW1 9HE		Scale 1:75
Client:	Rodrigues Associates		Logged By SE1

Water Strikes	Sample and In Situ Testing			Depth (m)	Stratum Description
	Depth (m)	Type	Results		
					Grass onto Dark Brown Silty Topsoil/MADE GROUND containing Brick
				0.50	Mid Brown Silty CLAY
	1.00	D			
	1.20	D			
		SPT	N = 14		
	2.00	U			
	3.00	D			
	3.50	D			
		SPT	N = 15		
	4.00	U			
	5.00	D			
	5.50	D			
		SPT	N = 18		
	6.00	U			
				6.40	CLAYSTONE
	7.00	D		7.00	Mid Brown Silty CLAY
	7.50	D			
		SPT	N = 19		
	8.50	D			
	9.00	D			
		SPT	N = 20		
	10.00	D			
	10.50	D			
		SPT	N = 21		
	11.50	D		11.50	CLAYSTONE
	12.00	D		12.00	Mid Brown Silty CLAY
		SPT	N = 22		
	13.00	D		13.00	Blue/Grey CLAY
	13.50	D			
		SPT	N = 24		
	14.25	D			
	14.55	D			
		SPT	N = 24		
				15.00	End of Borehole at 15.000m

Key: D - Disturbed Sample V - Insitu Vane Test MP - Mackintosh Probe Test

Remarks: Borehole closed at 15.00m. Standpipe installed to 10.00m.
Borehole noted to be dry on completion. No Roots noted.

AGS

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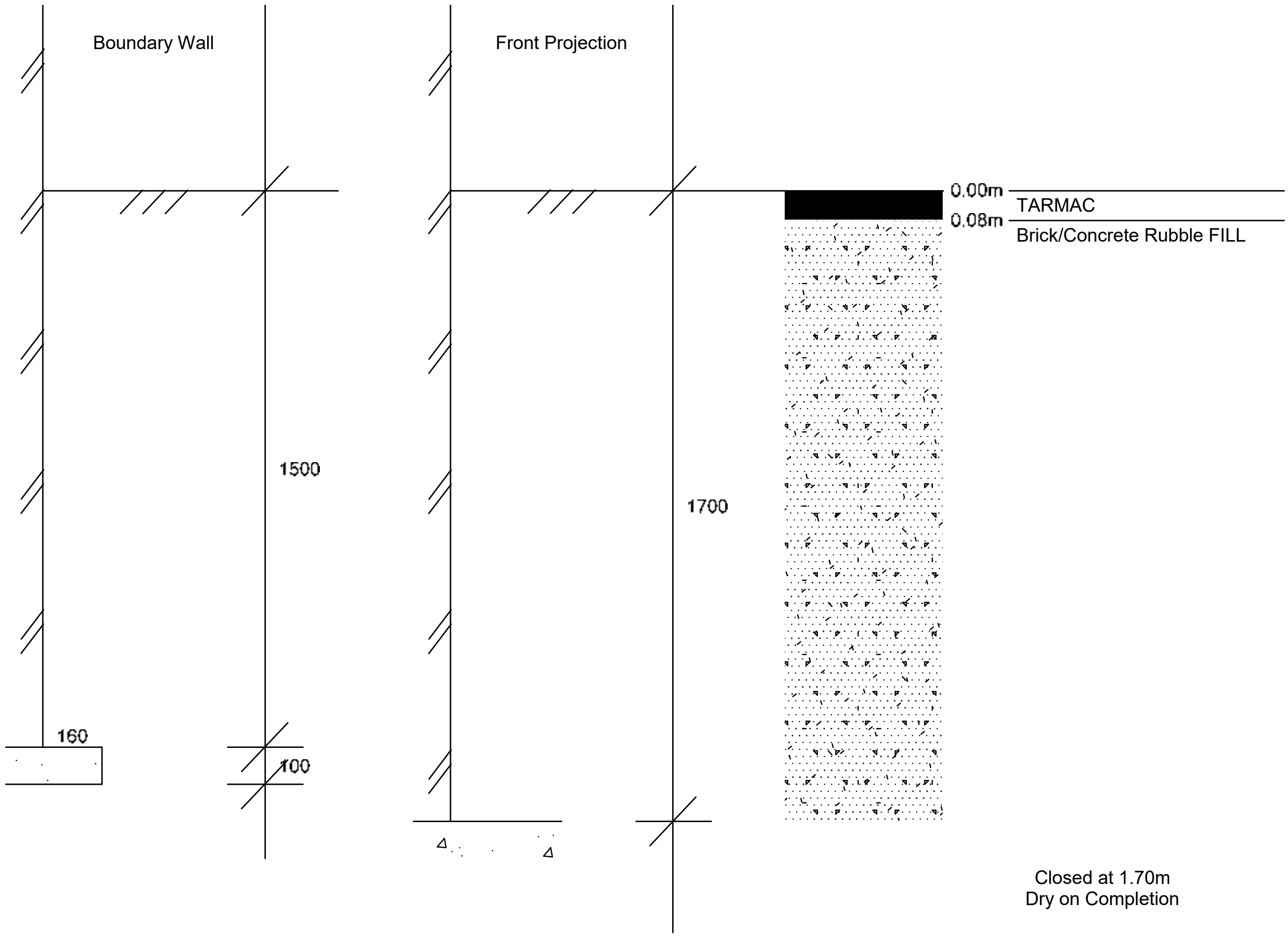
Appendix No: 2
FSI Ref: 20269

TRIAL PIT 1

Property Address: 248-250 Camden Road, Camden, London NW1 9HE

Survey date:25-27/10/2019 **Operative:** SE1

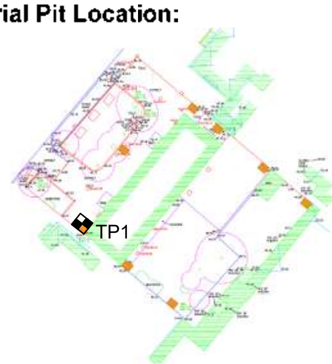


Unable to locate underside
due to excessive depth of footing
and Brick/Concrete Rubble FILL

D1 @ F.L. (1.60m)
V = 92-98kPa
Founding strata: Brick/Concrete Rubble FILL

D= small disturbed sample, B= large bulk sample, U= undisturbed sample,
MP= mackintosh proble blow counts, V= shear vane reading (kPa)

Trial Pit Location:



Drawn by: GB

Scale: 1:20

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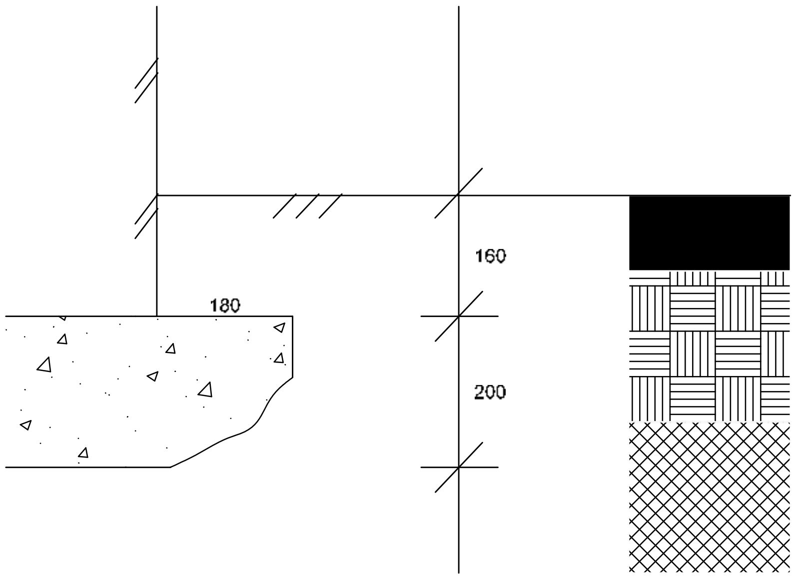
FSI Ref: 20269

TRIAL PIT 2

Property Address: 248-250 Camden Road, Camden, London NW1 9HE

Survey date:25-27/10/2019 **Operative:** SE1



0.00m TARMAC

0.10m Dark Brown Sandy Silty TOPSOIL containing Brick/Hardcore Fill

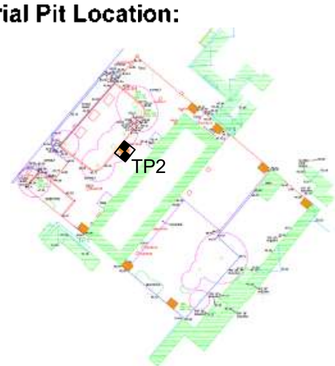
0.30m Dark Brown Silty Sandy Clayey MADE GROUND containing Brick and Gravel

Closed at Underside (0.36m)
Dry on Completion

D1 @ F.L. (0.36m)
Mp = 2-2-1-3 /75mm
Founding strata: Dark Brown Silty Sandy Clayey MADE GROUND containing Brick and Gravel

D= small disturbed sample, B= large bulk sample, U= undisturbed sample, MP= mackintosh proble blow counts, V= shear vane reading (kPa)

Trial Pit Location:



Drawn by: GB

Scale: 1:10

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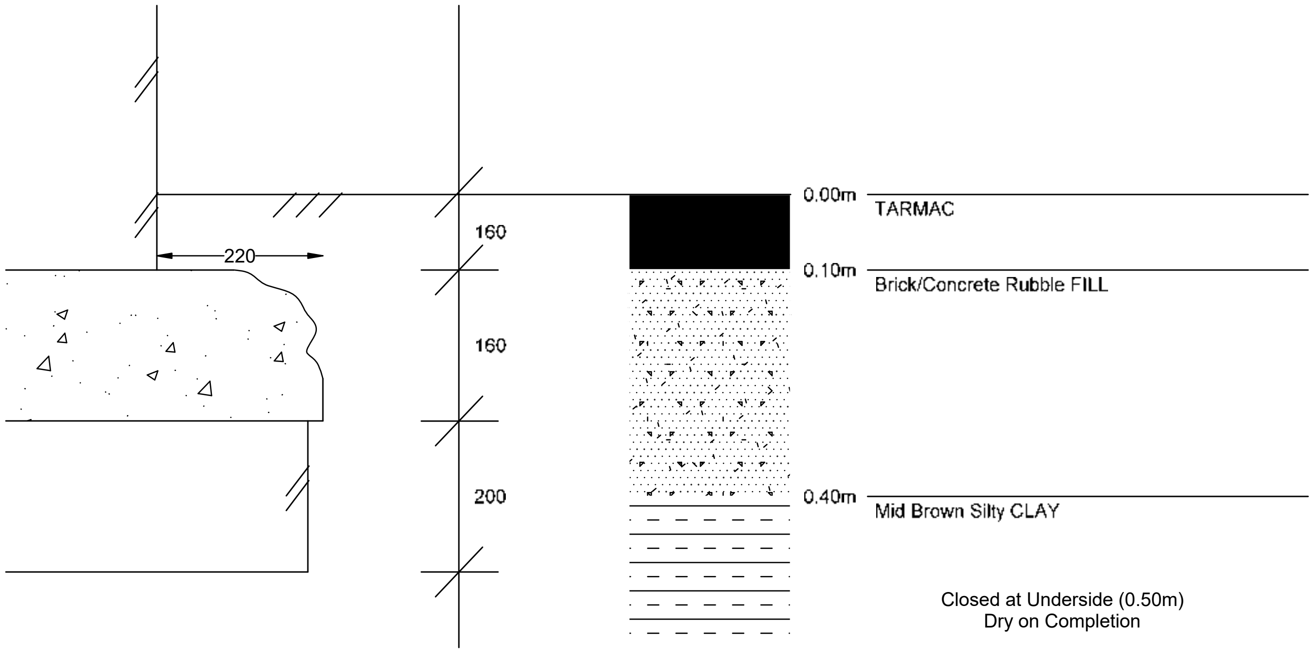
TRIAL PIT 3

Property Address: 248-250 Camden Road, Camden, London NW1 9HE
Survey date:25-27/10/2019 **Operative:** SE1

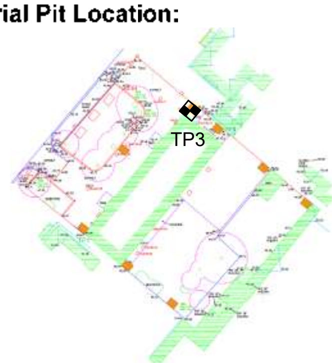


Closed at Underside (0.50m)
Dry on Completion

D1 @ F.L. (0.50m)
V = 70-72kPa
Founding strata: Mid Brown Silty CLAY

D= small disturbed sample, B= large bulk sample, U= undisturbed sample,
MP= mackintosh proble blow counts, V= shear vane reading (kPa)

Trial Pit Location:



Drawn by: GB

Scale: 1:10

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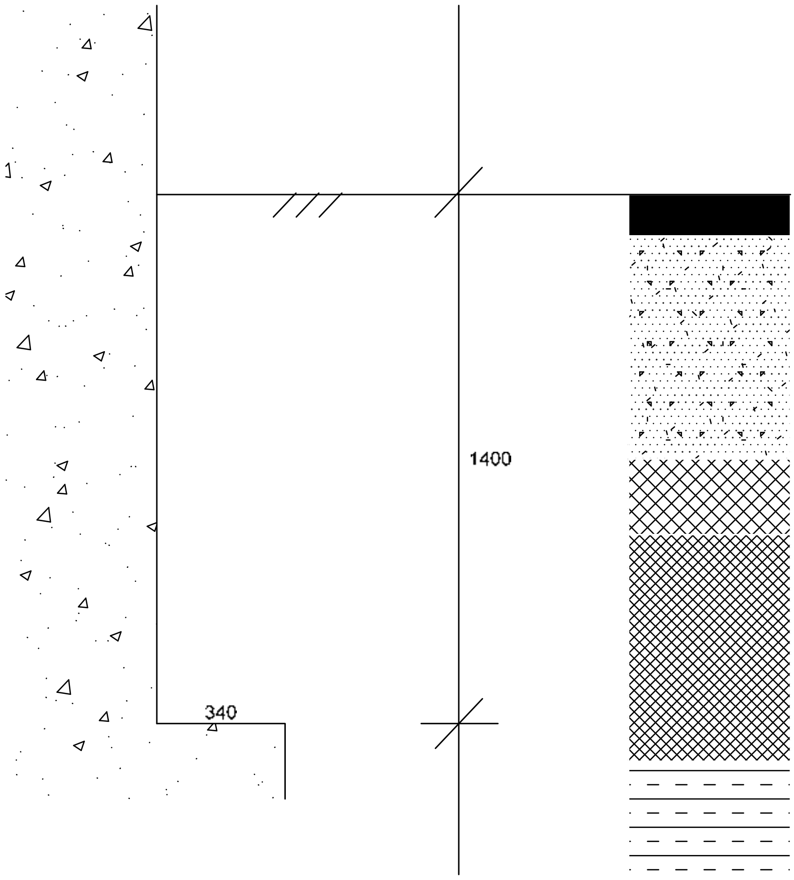
TRIAL PIT 4

Property Address: 248-250 Camden Road, Camden, London NW1 9HE

Survey date:25-27/10/2019 **Operative:** SE1



0.00m	TARMAC
0.11m	Brick/Concrete Rubble FILL
0.30m	Orange Sand & Gravel FILL
0.70m	Orange Sandy Gravelly Clayey MADE GROUND containing Brick/Hardcore Fill
0.90m	Dark Brown Sandy MADE GROUND containing Brick/Hardcore Fill and Gravel
1.50m	Mid Brown Silty CLAY containing Grey Mottling

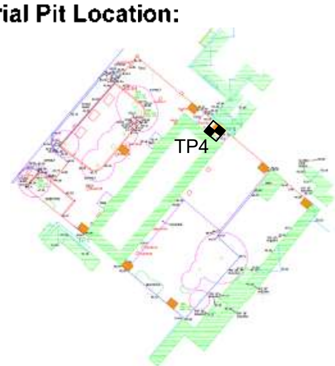
Closed at 1.60m
Dry on Completion

Unable to locate underside
due to excessive depth of footing

D1 @ (1.60m)
V = 88-94kPa
Founding strata: Mid Brown Silty CLAY containing Grey Mottling

D= small disturbed sample, B= large bulk sample, U= undisturbed sample,
MP= mackintosh proble blow counts, V= shear vane reading (kPa)

Trial Pit Location:



Drawn by: GB

Scale: 1:20

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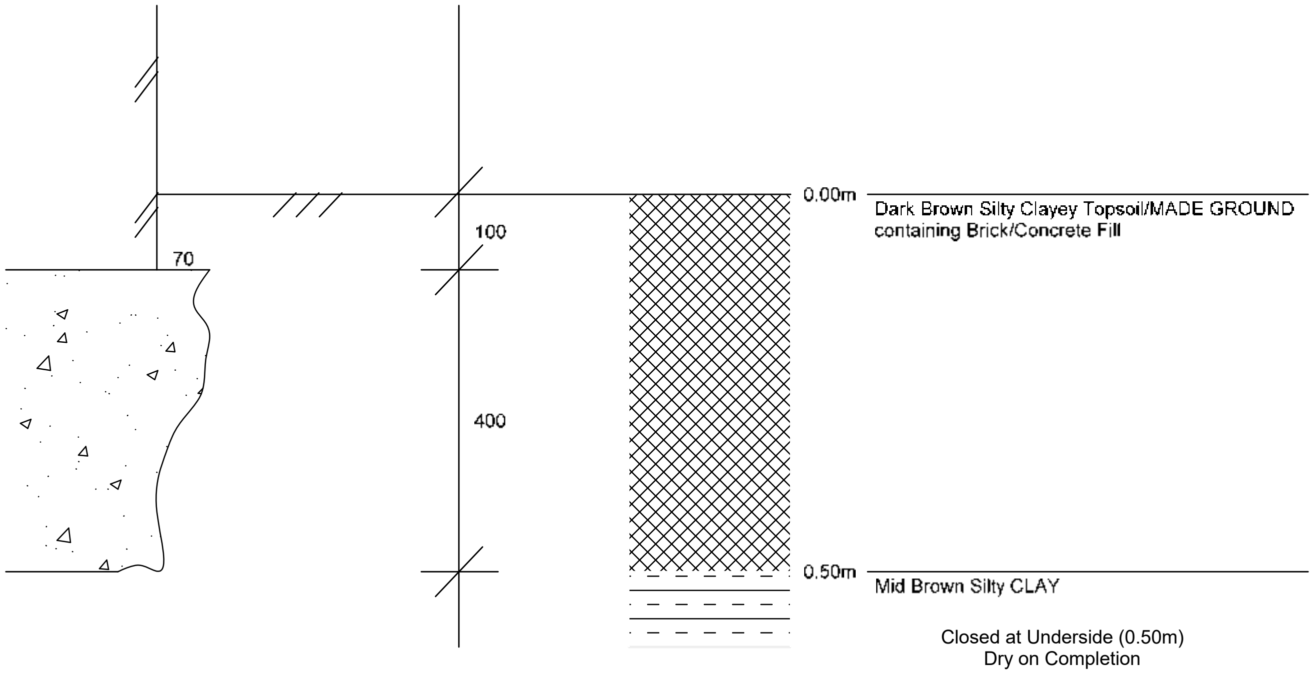
FSI Ref: 20269

TRIAL PIT 5

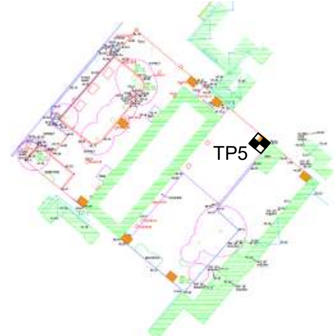
Property Address: 248-250 Camden Road, Camden, London NW1 9HE
Survey date:25-27/10/2019 **Operative:** SE1



D1 @ F.L. (0.50m)
V = 80-84kPa
Founding strata: Mid Brown Silty CLAY

D= small disturbed sample, B= large bulk sample, U= undisturbed sample, MP= mackintosh proble blow counts, V= shear vane reading (kPa)

Trial Pit Location:



Drawn by: GB

Scale: 1:10

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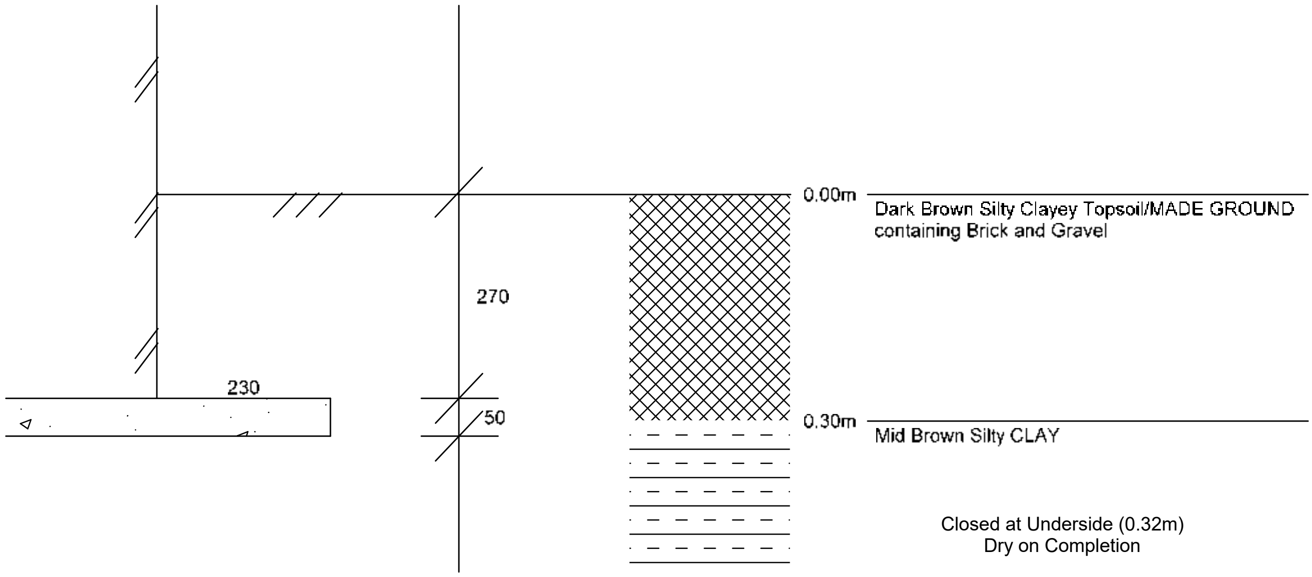
TRIAL PIT 6

Property Address: 248-250 Camden Road, Camden, London NW1 9HE

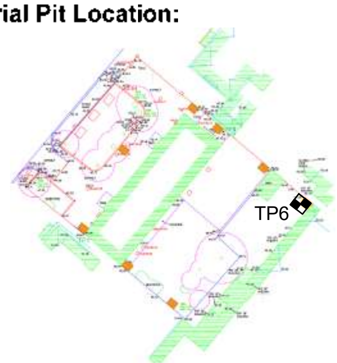
Survey date:25-27/10/2019 **Operative:** SE1



D1 @ F.L. (0.32m)
V = 90-94kPa
Founding strata: Mid Brown Silty CLAY

D= small disturbed sample, B= large bulk sample, U= undisturbed sample, MP= mackintosh proble blow counts, V= shear vane reading (kPa)

Trial Pit Location:



Drawn by: GB

Scale: 1:10

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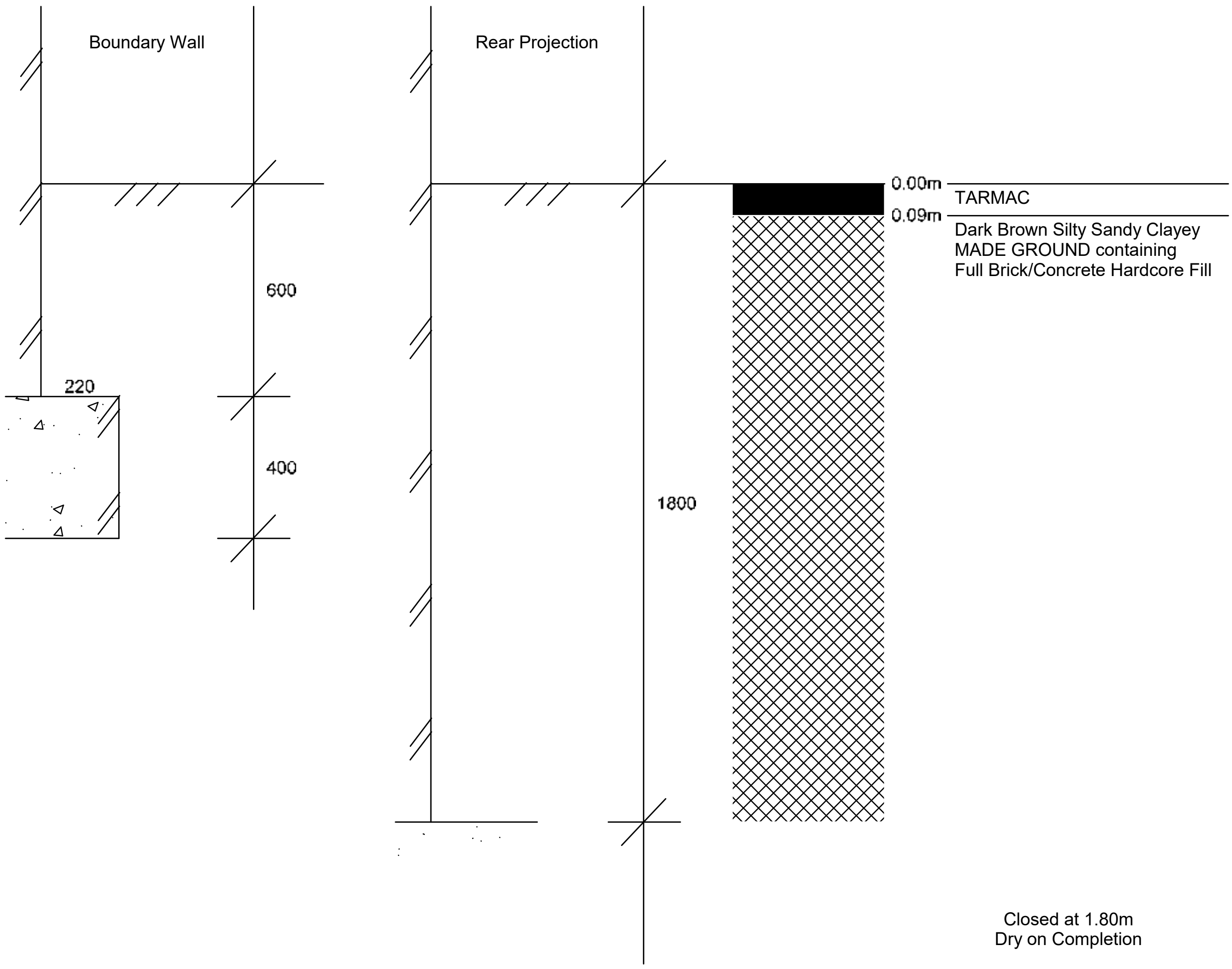
TRIAL PIT 7

Property Address: 248-250 Camden Road, Camden, London NW1 9HE

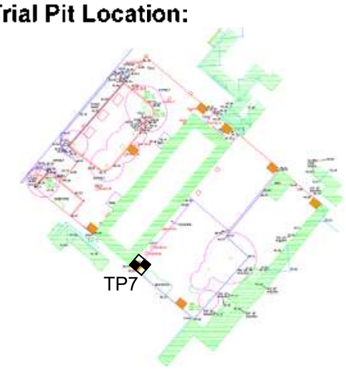
Survey date:25-27/10/2019 **Operative:** SE1



Unable to locate underside
due to excessive depth of footing
and Brick/Concrete Rubble FILL

D1 @ F.L. (1.00m)
Founding strata: Dark Brown Silty Sandy Clayey
MADE GROUND containing
Full Brick/Concrete Hardcore Fill

Trial Pit Location:



Drawn by: GB

Scale: 1:20

D= small disturbed sample, B= large bulk sample, U= undisturbed sample,
MP= mackintosh proble blow counts, V= shear vane reading (kPa)

FASTRACK
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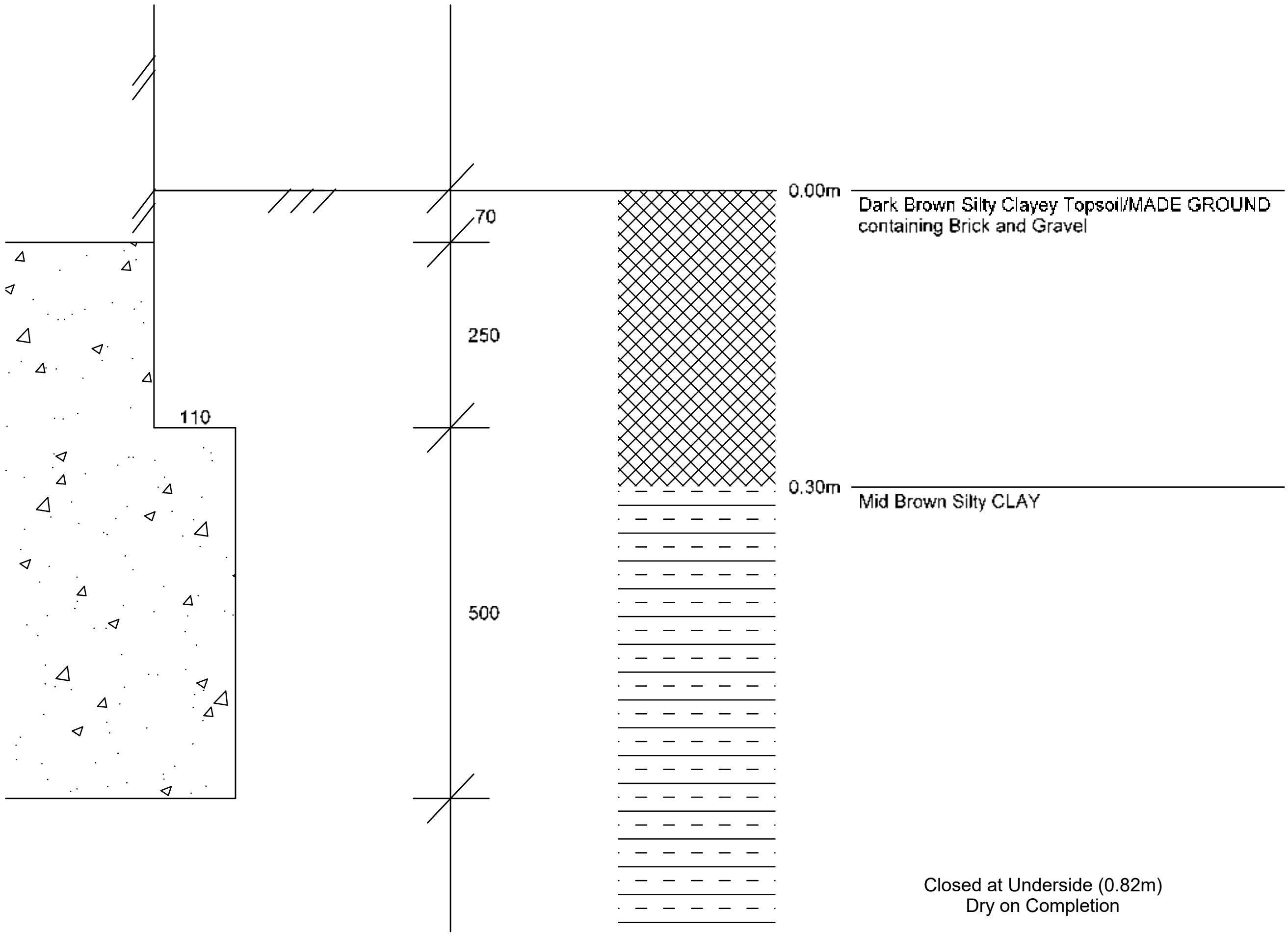
Appendix No: 2
FSI Ref: 20269

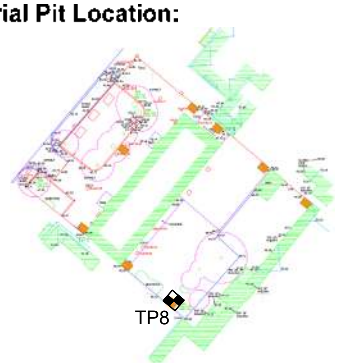
TRIAL PIT 8

Property Address: 248-250 Camden Road, Camden, London NW1 9HE
Survey date:25-27/10/2019 **Operative:** SE1



D1 @ F.L. (0.82m)
V = 80-82kPa
Founding strata: Mid Brown Silty CLAY

Trial Pit Location:

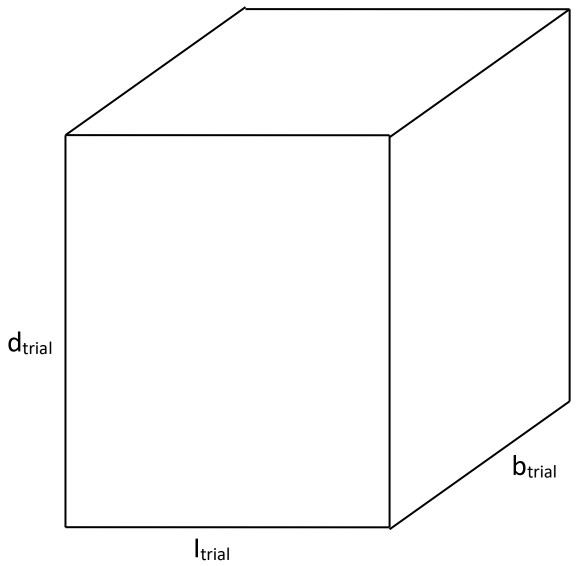


Drawn by: GB

Scale: 1:10

D= small disturbed sample, B= large bulk sample, U= undisturbed sample, MP= mackintosh proble blow counts, V= shear vane reading (kPa)

Soil Infiltration Rate (BRE Digest 365)



0.00m – Decorative SHINGLE

0.20m – Dark Brown Sandy Clayey Topsoil/MADE GROUND containing Full Brick/Hardcore Rubble Fill

0.60m – Mid-Light Brown Silty Sandy Clayey MADE GROUND containing Brick/Hardcore Fill and Gravel

SOAK AWAY TEST NO: 1

Length of Trial Pit l_{trial} = **0.30m**
Width of Trial Pit b_{trial} = **0.30m**
Depth of Trial Pit d_{trial} = **1.00m**
Free Volume (if fill used) V_{trial} = 35%

75% depth of pit: d_{75}: (d_{trial} x 0.75) = **0.75m**
50% depth of pit: d_{50}: (d_{trial} x 0.50) = **0.50m**
25% depth of pit: d_{25}: (d_{trial} x 0.25) = **0.25m**

Test 1 – time to fall from 75% depth to 25% depth = T1 = **20,000 Seconds**

Longest time to fall from 75% depth to 25% depth = T_{lg} = Max(T1, T2, T3) = **20,000 Seconds**

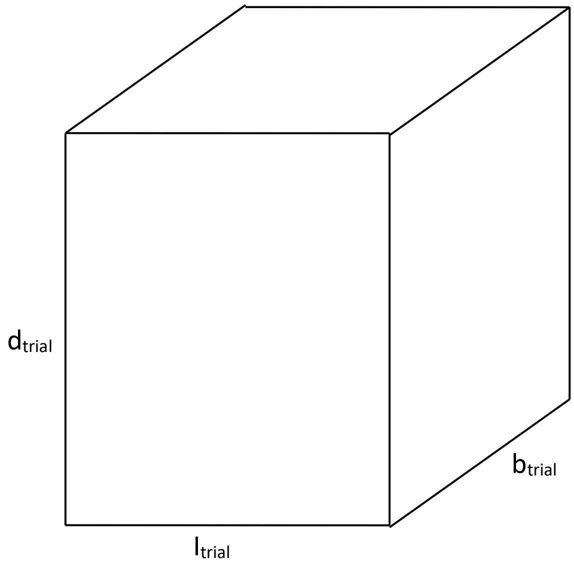
Storage Volume from 75% depth to 25% depth = V_{p75_25} = (l_{trial} x b_{trial} x (d_{75} – d_{25})) x V_{trial} = **0.045m^3**

Internal surface area to 50% depth = A_{p50} = ((l_{trial} x b_{trial}) + (l_{trial} + b_{trial}) x 2 x d_{50}) = **0.69m^2**

Surface area of soakaway to 50% storage depth A_{s50} = 2 x (l_{trial} + b_{trial}) x d_{trial} / 2 = **0.60m^2**

Soil infiltration rate = F = V_{p75_25} / (A_{p50} x T_{lg}) = **<u>32.61 x 10^{-7} m/s</u>**

Soil Infiltration Rate (BRE Digest 365)



0.00m – Grass onto Dark Brown Silty TOPSOIL

0.10m – Dark Brown Sandy Clayey Topsoil/MADE GROUND containing Full Brick/Hardcore Rubble Fill

0.40m – Dark Brown Silty Clayey MADE GROUND containing Brick and Gravel

0.60m – Mid-Dark Brown Silty CLAY

SOAK AWAY TEST NO: 2

Length of Trial Pit l_{trial} = **0.30m**
Width of Trial Pit b_{trial} = **0.30m**
Depth of Trial Pit d_{trial} = **1.00m**
Free Volume (if fill used) V_{trial} = 35%

75% depth of pit: d_{75}: (d_{trial} x 0.75) = **0.75m**
50% depth of pit: d_{50}: (d_{trial} x 0.50) = **0.50m**
25% depth of pit: d_{25}: (d_{trial} x 0.25) = **0.25m**

Test 1 – time to fall from 75% depth to 25% depth = T1 = **16,000 Seconds**

Longest time to fall from 75% depth to 25% depth = T_{lg} = Max(T1, T2, T3) = **16,000 Seconds**

Storage Volume from 75% depth to 25% depth = $V_{p75\_25} = (l_{trial} \times b_{trial} \times (d_{75} - d_{25})) \times V_{trial}$ = **0.045m³**

Internal surface area to 50% depth = $A_{p50} = ((l_{trial} \times b_{trial}) + (l_{trial} + b_{trial}) \times 2 \times d_{50})$ = **0.69m²**

Surface area of soakaway to 50% storage depth $A_{s50} = 2 \times (l_{trial} + b_{trial}) \times d_{trial} / 2$ = **0.60m²**

Soil infiltration rate = $F = V_{p75\_25} / (A_{p50} \times T_{lg})$ = **<u>40.76×10^{-7} m/s</u>**

APPENDIX III
Geotechnical Test Results

FASTRACK
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Appendix No: 3
FSI Ref: 20269

LABORATORY RESULTS

Property Address: 248-250 Camden Road, Camden, London, London, NW1 9HE
Client Claim Ref: N/A
Client: Rodrigues Associates

SAMPLE DETAILS

Investigation date:	**25-24/10/2019**
Sample details:	**Bags as received**
Samples received:	**04/12/2019**
Schedule recieved:	**04/12/2019**
Samples tested:	**04/12/19-17/12/19**
Results reported:	**17/12/2019**

ANALYSIS REQUESTED

Moisture Content	☑	PSD	☐
Liquid Limit	☑	Soil Suction	☐
Plastic Limit	☑	Shear Strength	☐
Plasticity Index	☑	Contamination	☐
Root ID	☐	Root/Tree DNA	☐
Other (please state)			☐

TEST DETAILS

General

Sample descriptions were written in accordance with BS 5930:1999.

Samples were prepared in accordance with BS 1377: Part 1: 1990, section 7

Samples from this contract will be retained for 1 calender month following the issue of this report unless otherwise notified

Written approval is required from Fastrack Site Investigations Limited to reproduce report in full. The results shown within this report only relate to the samples tested

Moisture Content

Samples were tested in accordance with BS 1377: Part 2: 1990, section 3.2 (Oven drying method)

In accordance with Note 1 to paragraph 3.2.4 of BS 1377 Part 2 1990; these moisture contents have been corrected to give the equivalent moisture content of the fraction passing the 425µm sieve, to enable comparison with the liquid & plastic limits. (If condition of test is 'natural' the retained percentage is an estimated value, if condition is 'washed' the percentage is a measured value).

Samples are dried at 105-110^{o}C unless otherwise stated.

Atterberg Limits

Samples were tested in accordance with BS 1377: Part 2: 1990, section 4.3 (4 drop LL), 4.4 (1 drop LL), 5.3 (PL) and 5.4 (PI)
Test results on samples with a sand content, may show less accurate results. If condition of test is 'washed' results relate to the fraction passing the 425µm sieve only.

* *Driscoll's rules deem the soil to be desicated where the moisture content is less than the value calculated using driscoll's rule 1 and/or 2*

Particle Size Distribution

Samples were tested in accordance with BS 1377: Part 2: 1990 section 9.2 (Wet sieving method)

Undrained Shear Stength

Samples were prepared in accordance with BS 1377: Part 7: 1990 section 8.3 and testing in accordance with BS 1377: Part 7: 1990: section 8.4 (undrained shear strength in triaxial compression without measurement of pore pressure (UU))

Soil Suction

Samples were prepared and tested based on the BRE digest No:IP4/93 (Corrected). 'A method of determining the state of desiccation in clay soils.' (Filter paper method).

Test results on samples with a sand or silt content, may show less accurate results. Deviation to standard procedure - Polythene bags are not used from weighing filter papers.

FASTRACK
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Email: enquiries@fastrackgroup.co.uk

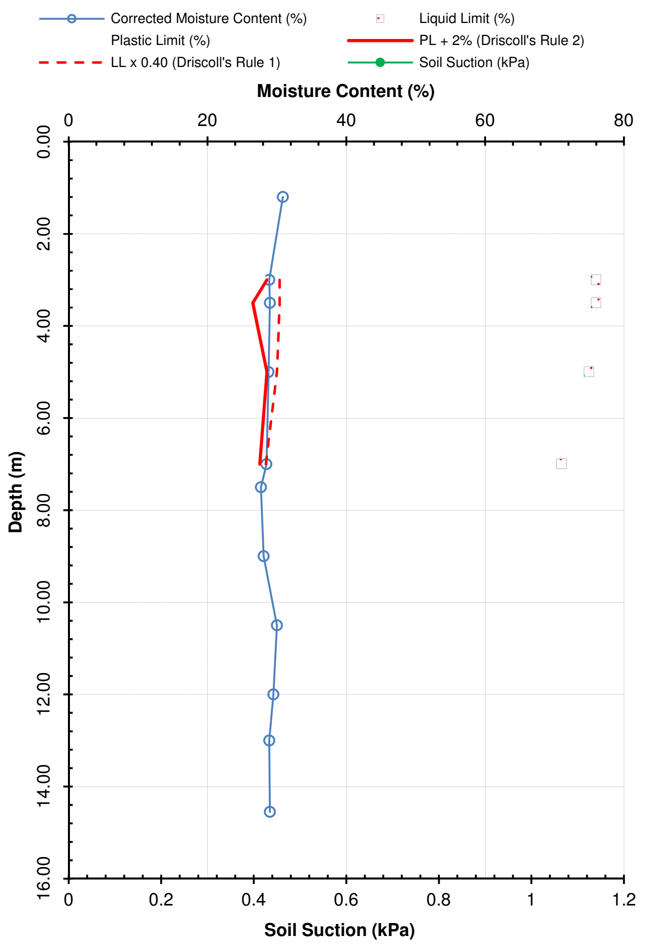
Appendix No: 3
FSI Ref: 20269

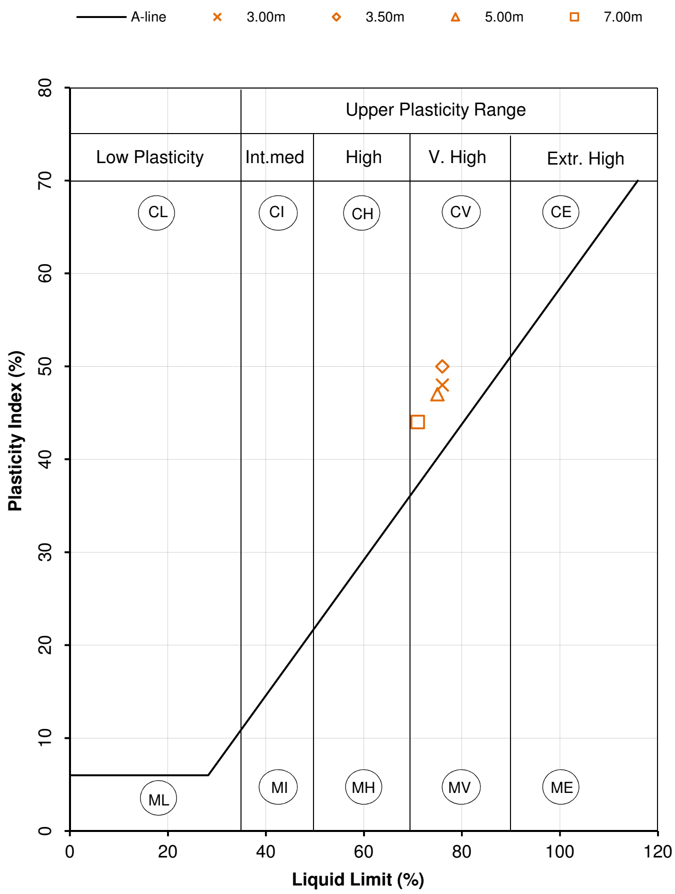
LABORATORY RESULTS

Property Address: 248-250 Camden Road, Camden, London, London, NW1 9HE
Client Claim Ref: N/A

BOREHOLE 1

Depth (m)	MC (%)	Corr. MC (%)	LL (%)	PL	PI (%)	Class	% Retained (425µm)	Soil Suction (kPa)	Condition of test	Soil Description
1.20	21.6	30.86					30		Natural	Brown/red gravelley SAND
3.00	28.9	28.9	76	28	48	CV	0		Natural	Brown silty CLAY containing grey mottle
3.50	29	29	76	26	50	CV	0		Natural	Brown silty CLAY containing grey mottle
5.00	28.8	28.8	75	28	47	CV	0		Natural	Brown silty CLAY
7.00	28.5	28.5	71	27	44	CV	0		Natural	Brown silty CLAY containing grey mottle and gypsum
7.50	27.7	27.7					0		Natural	Brown silty CLAY containing grey mottle
9.00	28.1	28.1					0		Natural	Brown silty CLAY containing grey mottle
10.50	30	30					0		Natural	Brown silty CLAY containing grey mottle
12.00	29.5	29.5					0		Natural	Brown silty CLAY containing grey mottle
13.00	28.9	28.9					0		Natural	Brown silty CLAY containing grey mottle
14.55	29	29					0		Natural	Brown silty CLAY containing grey mottle





Comments: Unable to perform atterberg limits on BH1@1.20m due to sample being sand. Samples tested in 75° oven due to the presnece of gypsum

Issued by: ☑ Jade McLellan (Laboratory Manager)
☐ (Laboratory Technician)

Signed: J McLellan

FASTRACK
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Email: enquiries@fastrackgroup.co.uk

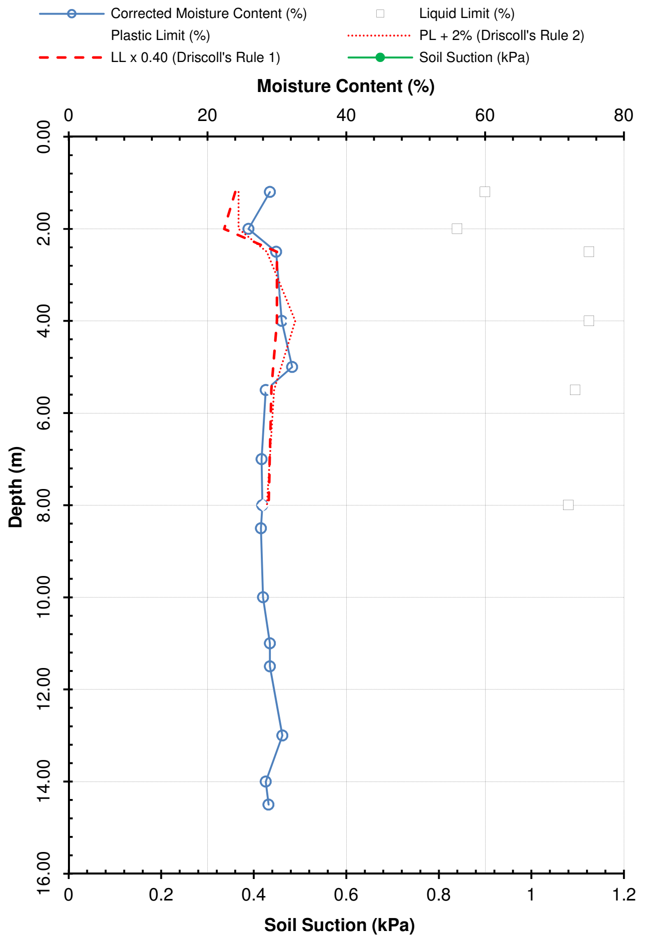
Appendix No: 3
FSI Ref: 20269

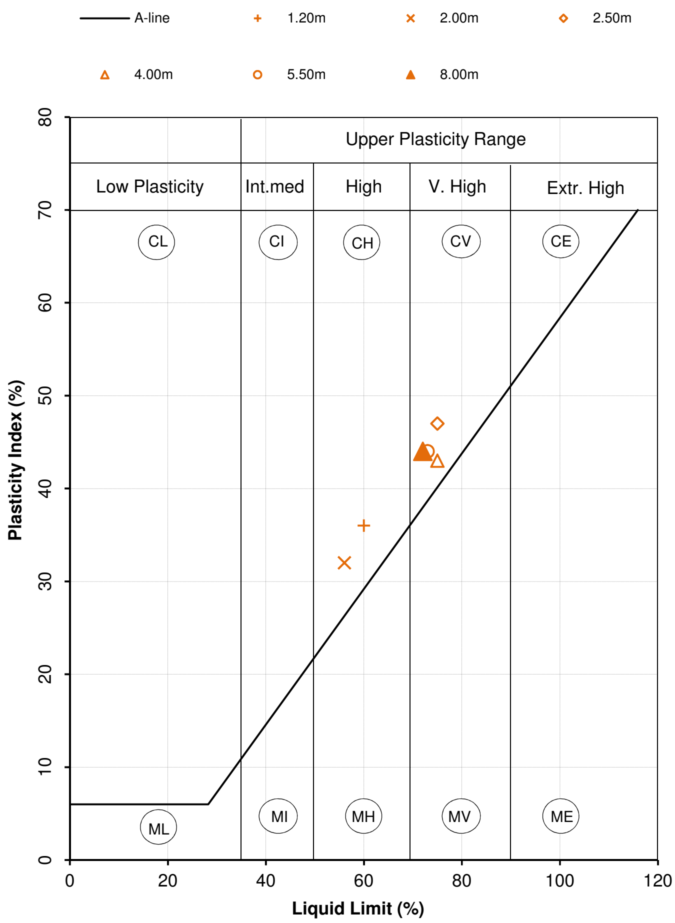
LABORATORY RESULTS

Property Address: 248-250 Camden Road, Camden, London, London, NW1 9HE
Client Claim Ref: N/A

BOREHOLE 2

Depth (m)	MC (%)	Corr. MC (%)	LL (%)	PL	PI (%)	Class	% Retained (425µm)	Soil Suction (kPa)	Condition of test	Soil Description
1.20	29	29	60	24	36	CH	0		Natural	Brown silty, sandy CLAY
2.00	25.9	25.9	56	24	32	CH	0		Natural	Light brown silty CLAY
2.50	29.9	29.9	75	28	47	CV	0		Natural	Brown silty CLAY containing grey mottle
4.00	30.7	30.7	75	32	43	CV	0		Natural	Brown silty CLAY containing grey mottle
5.00	32.2	32.2					0		Natural	Brown silty CLAY containing grey mottle
5.50	28.4	28.4	73	29	44	CV	0		Natural	Brown silty CLAY
7.00	27.8	27.8					0		Natural	Brown silty CLAY
8.00	27.9	27.9	72	28	44	CV	0		Natural	Brown silty CLAY containing gypsum
8.50	27.7	27.7					0		Natural	Brown silty CLAY containing gypsum
10.00	28	28					0		Natural	Brown silty CLAY containing gypsum
11.00	29	29					0		Natural	Brown silty CLAY
11.50	29	29					0		Natural	Brown silty CLAY
13.00	30.8	30.8					0		Natural	Brown silty CLAY
14.00	28.4	28.4					0		Natural	Brown silty CLAY
14.50	28.8	28.8					0		Natural	Brown silty CLAY





Comments: Samples tested in 75º oven due to the presence of gypsum

Issued by:
☑ Jade McLellan (Laboratory Manager)
☐ (Laboratory Technician)

Signed: J McLellan

FASTRACK
Tel: 0844 3358908
Email: enquiries@fastrackgroup.co.uk

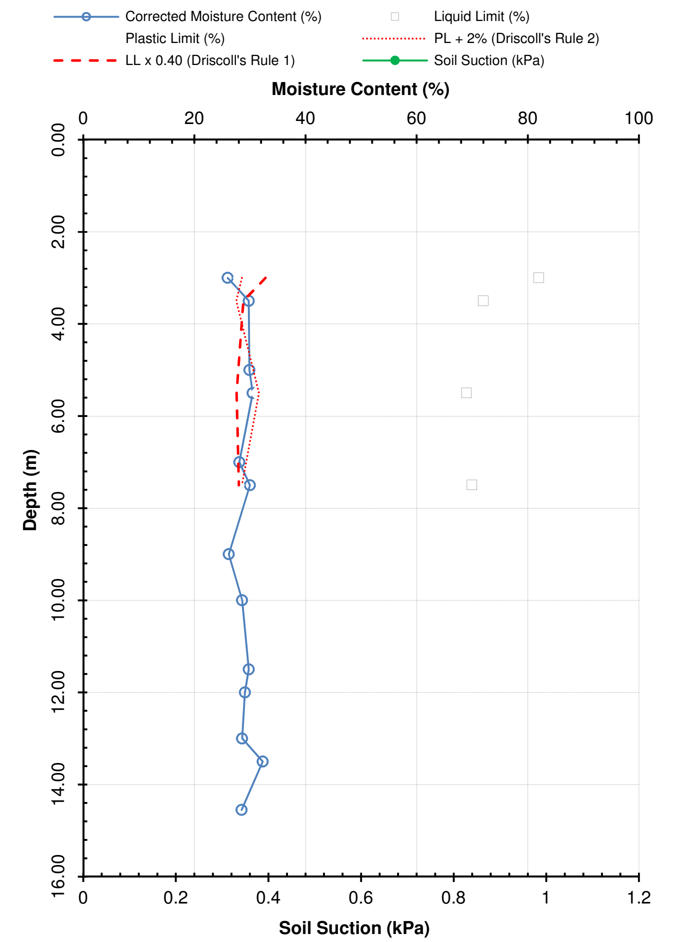
Appendix No: 3
FSI Ref: 20269

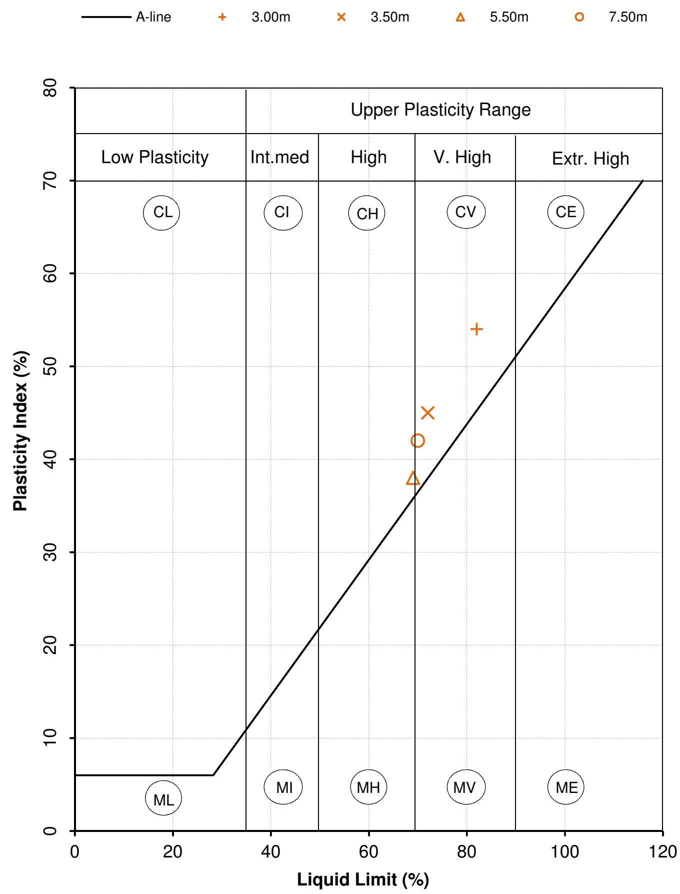
LABORATORY RESULTS

Property Address: 248-250 Camden Road, Camden, London, London, NW1 9HE
Client Claim Ref: N/A

BOREHOLE 3

Depth (m)	MC (%)	Corr. MC (%)	LL (%)	PL (%)	PI (%)	Class	% Retained (425µm)	Soil Suction (kPa)	Condition of test	Soil Description
3.00	26	26	82	28	54	CV	0		Natural	Brown silty CLAY
3.50	29.8	29.8	72	27	45	CV	0		Natural	Brown silty CLAY containing gypsum
5.00	29.9	29.9					0		Natural	Brown silty CLAY
5.50	30.5	30.5	69	31	38	CH	0		Natural	Brown silty CLAY
7.00	28.1	28.1					0		Natural	Brown silty CLAY
7.50	30	30	70	28	42	CH/V	0		Natural	Brown silty CLAY
9.00	26.2	26.2					0		Natural	Brown silty CLAY
10.00	28.6	28.6					0		Natural	Brown silty CLAY
11.50	29.8	29.8					0		Natural	Brown silty CLAY
12.00	29.1	29.1					0		Natural	Brown silty CLAY containing gypsum
13.00	28.6	28.6					0		Natural	Brown silty CLAY
13.50	32.3	32.3					0		Natural	Brown silty CLAY
14.55	28.5	28.5					0		Natural	Brown silty CLAY containing gypsum





Comments: Samples tested in 75º oven due to the presence of gypsum

Issued by:
☑ Jade McLellan (Laboratory Manager)
☐ (Laboratory Technician)

Signed: J McLellan

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THE ENVIRONMENTAL LABORATORY LTD

Analytical Report Number:	19-26156
Issue:	1
Date of Issue:	13/12/2019
Contact:	Martin Rush
Customer Details:	Fastrack Site Investigations Ltd Unit 9 Tyndales Farm Southend Road Woodham Mortimer EssexCM9 6TO
Quotation No:	Q19-01629
Order No:	5000/20269
Customer Reference:	20269
Date Received:	10/12/2019
Date Approved:	13/12/2019
Details:	248-250 Camden Road, Camden, London, NW1 9HE
Approved by:	

Mike Varley, Technical Manager

Any comments, opinions or interpretations expressed herein are outside the scope of UKAS accreditation (Accreditation Number 2683

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ELAB

Sample Summary

Report No.: 19-26156, issue number 1

Elab No.	Client's Ref.	Date Sampled	Date Scheduled	Description	Deviations
191875	BH1 1.20 - 1.65	25/10/2019	10/12/2019	Sandy silty loam	fg
191876	BH1 3.00	25/10/2019	10/12/2019	Silty clayey loam	fg
191877	BH2 1.20 - 1.65	25/10/2019	10/12/2019	Silty clayey loam	fg
191878	BH2 4.00 - 4.45	25/10/2019	10/12/2019	Clayey loam	fg
191879	BH3 3.00	25/10/2019	10/12/2019	Silty clayey loam	fg
191880	BH3 5.00	25/10/2019	10/12/2019	Silty clayey loam	fg

Results Summary

Report No.: 19-26156, issue number 1

			ELAB Reference	191875	191876	191877	191878	191879
			Customer Reference					
			Sample ID					
			Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL
			Sample Location	BH1	BH1	BH2	BH2	BH3
			Sample Depth (m)	1.20 - 1.65	3.00	1.20 - 1.65	4.00 - 4.45	3.00
			Sampling Date	25/10/2019	25/10/2019	25/10/2019	25/10/2019	25/10/2019
Determinand	**Codes**	**Units**	**LOD**					
Soil sample preparation parameters								
Material removed	N	%	0.1	38.7	< 0.1	29.3	< 0.1	< 0.1
Description of Inert material removed	N		0	Stones,Brick	None	Stones	None	None
Anions								
Water Soluble Sulphate	M	g/l	0.02	fg 0.90	fg 2.67	fg 0.28	fg 0.10	fg 0.09
Miscellaneous								
pH	M	pH units	0.1	fg 10.2	fg 8.3	fg 8.3	fg 8.5	fg 8.1

Tests marked N are not UKAS accredited.

ELAB

UKAS TESTING 2683

MCERTS

Results Summary

Report No.: 19-26156, issue number 1

			ELAB Reference	191880
			Customer Reference	
			Sample ID	
			Sample Type	SOIL
			Sample Location	BH3
			Sample Depth (m)	5.00
			Sampling Date	25/10/2019
Determinand	**Codes**	**Units**	**LOD**	
Soil sample preparation parameters				
Material removed	N	%	0.1	< 0.1
Description of Inert material removed	N		0	None
Anions				
Water Soluble Sulphate	M	g/l	0.02	fg 0.48
Miscellaneous				
pH	M	pH units	0.1	fg 8.2

Method Summary

Report No.: 19-26156, issue number 1

Parameter	Codes	Analysis Undertaken On	Date Tested	Method Number	Technique
Soil					
pH	M	Air dried sample	13/12/2019	113	Electromeric
Water soluble anions	M	Air dried sample	11/12/2019	172	Ion Chromatography

Report Information

Report No.: 19-26156, issue number 1

Key

U	hold UKAS accreditation
M	hold MCERTS and UKAS accreditation
N	do not currently hold UKAS accreditation
^	MCERTS accreditation not applicable for sample matrix
*	UKAS accreditation not applicable for sample matrix
S	Subcontracted to approved laboratory UKAS Accredited for the test
SM	Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test
NS	Subcontracted to approved laboratory. UKAS accreditation is not applicable.
I/S	Insufficient Sample
U/S	Unsuitable sample
n/t	Not tested
<	means "less than"
>	means "greater than"

Soil sample results are expressed on an air dried basis (dried at < 30°C), and are uncorrected for inert material removed.

ELAB are unable to provide an interpretation or opinion on the content of this report.

The results relate only to the sample received.

PCB congener results may include any coeluting PCBs

Uncertainty of measurement for the determinands tested are available upon request

Unless otherwise stated, sample information has been provided by the client. This may affect the validity of the results.

Deviation Codes

a	No date of sampling supplied
b	No time of sampling supplied (Waters Only)
c	Sample not received in appropriate containers
d	Sample not received in cooled condition
e	The container has been incorrectly filled
f	Sample age exceeds stability time (sampling to receipt)
g	Sample age exceeds stability time (sampling to analysis)

Where a sample has a deviation code, the applicable test result may be invalid.

Sample Retention and Disposal

All soil samples will be retained for a period of one month

All water samples will be retained for 7 days following the date of the test report

Charges may apply to extended sample storage

TEST REPORT

ISSUED BY SOIL PROPERTY TESTING LTD

DATE ISSUED: 20/12/2019

0998

Contract	**248-260 Camden Road, Camden, London, NW1 9HE**
Serial No.	**36274**

Client:

Fastrack Site Investigations Limited

Unit 9 Tyndales Farm
Southend Road
Woodham Mortimer
Maldon
Essex
CM9 6TQ

Soil Property Testing Ltd

15, 16, 18 Halcyon Court, St Margaret's Way,
Stukeley Meadows, Huntingdon,
Cambridgeshire, PE29 6DG

Tel: 01480 455579
Email: enquiries@soilpropertytesting.com
Website: www.soilpropertytesting.com

Samples Submitted By:

Fastrack Site Investigations Limited

Samples Labelled:

248-260 Camden Road, Camden,
London, NW1 9HE

Approved Signatories:

- [ ] **J.C. Garner B.Eng (Hons) FGS**
  Technical Director & Quality Manager
- [ ] **S.P. Townend FGS**
  Chairman
- [ ] **W. Johnstone**
  Materials Lab Manager
- [x] **D. Sabnis**
  Operations Manager

Dinker Sabnis

Date Received: 11/12/2019 **Samples Tested Between:** 11/12/2019 **and** 20/12/2019

Remarks:

For the attention of Martin Rush
Your Reference No: 20269

Notes:

1 All remaining samples or remnants from this contract will be disposed of after 21 days from today, unless we are notified to the contrary.

2 (a) UKAS - United Kingdom Accreditation Service.
(b) Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

3 Tests marked "NOT UKAS ACCREDITED" in this test report are not included in the UKAS Accreditation Schedule for this testing laboratory.

4 This test report may not be reproduced other than in full except with the prior written approval of the issuing laboratory.

TEST REPORT

ISSUED BY SOIL PROPERTY TESTING LTD

DATE ISSUED: 20/12/2019

0998

Contract	**248-260 Camden Road, Camden, London, NW1 9HE**		
Serial No.	**36274**	**Target Date**	23/12/2019
Scheduled By	Fastrack Site Investigations Limited		

SCHEDULE OF LABORATORY TESTS

Schedule Remarks

Bore Hole No.	Type	Sample Ref.	Top Depth	Triaxial Test	One Dimensional Consolidation	Sample Remarks
BH1	U	-	2.00	1	1	
BH1	U	-	4.00	1	1	
BH1	U	-	6.00	1		
BH3	U	-	2.00	1		
BH3	U	-	4.00	1		
BH3	U	-	6.00	1		
Totals				**6**	**2**	**End of Schedule**

TEST REPORT

ISSUED BY SOIL PROPERTY TESTING LTD

DATE ISSUED: 20/12/2019

0998

Contract	**248-260 Camden Road, Camden, London, NW1 9HE**
Serial No.	**36274**

DETERMINATION OF DENSITY, WATER CONTENT AND UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASURMENT OF PORE PRESSURE

Borehole /Pit No.	Depth (m)	Type	Reference	Water Content (%)	Bulk Density (Mg/m³)	Dry Density (Mg/m³)	Lateral Pressure (kPa)	Deviator Stress (kPa)	Shear Stress (kPa)	Mohrs Circle Analysis		Description
										Cu (kPa)	Ø degrees	
BH1	2.23	U	-	30.2	1.98	1.52	41	200	100			Stiff (high strength) fissured orangish brown CLAY with occasional reddish yellow mottling, rare grey mottling, and orange fine sand pockets.
BH1	4.10	U	-	27.1	1.99	1.57	78	170	85			Stiff (high strength) fissured reddish yellow CLAY with rare grey mottling, and selenite crystals.
BH1	6.08	U	-	27.0	2.02	1.59	119	254	127			Stiff (high strength) slightly fissured yellowish brown CLAY with occasional selenite crystals, and rare shell fragments.
BH3	2.10	U	-	21.9	1.95	1.60	41	359	180			Very stiff (very high strength) yellowish brown CLAY with rare orange silt pockets.
BH3	4.07	U	-	28.2	2.00	1.56	82	157	79			Stiff (high strength) slightly fissured yellowish brown CLAY with rare selenite crystals.
BH3	6.05	U	-	26.4	1.97	1.56	118	209	105			Stiff (high strength) slightly fissured yellowish brown CLAY with rare selenite crystals.

Method of Preparation:	BS 1377: Part 1: 1990: 7.4.2 & 8, Part 2: 1990: 7.2, Part 7: 1990: 8.3
Method of Test:	BS 1377: Part 2: 1990:3 Determination of Moisture Content, Part2: 1990:7 Determination of Density, Part 7: 1990: 8 Undrained Shear Strenth, 9 Multistage Loading
Type of Sample Key:	U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter
Comments:	
Remarks to Include:	Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample, oven drying temperature if not 105-110°C

TEST REPORT

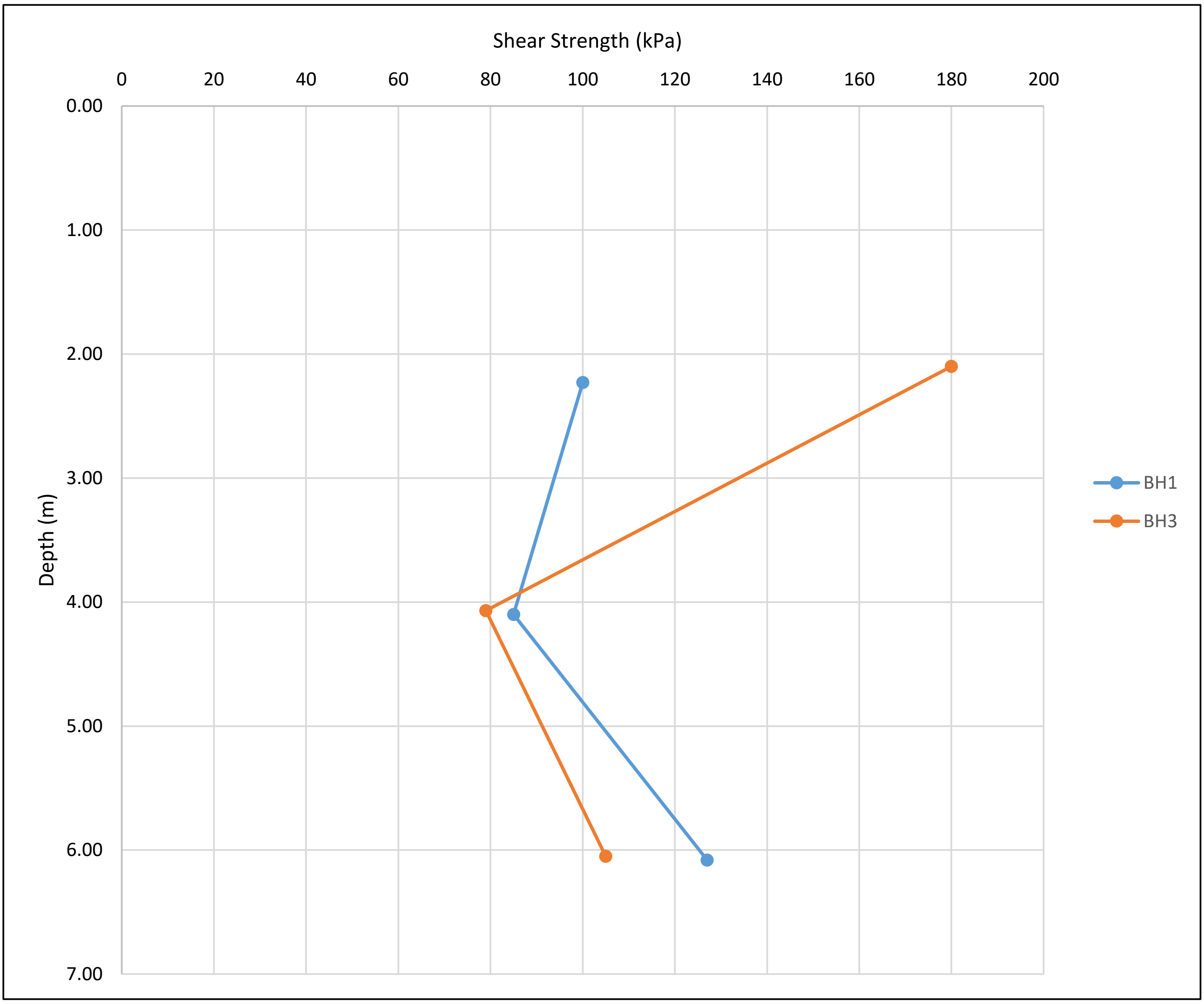
ISSUED BY SOIL PROPERTY TESTING LTD

DATE ISSUED: 20/12/2019

0998

Contract	**248-260 Camden Road, Camden, London, NW1 9HE**
Serial No.	**36274**

SHEAR STRENGTH VS DEPTH BELOW GROUND LEVEL



Method of Preparation:	BS 1377: Part 1: 1990
Method of Test:	BS 1377: Part7: 1990:8 Definitive Method, 1990:9 Multi-stage loading
Type of Sample Key:	U - Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter
Comments:	
Remarks to Include:	Sample disturbance, loss of water, variation from test procedure, location and origin of test specimen within original sample, oven drying temperature if not 105-110°C

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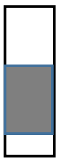
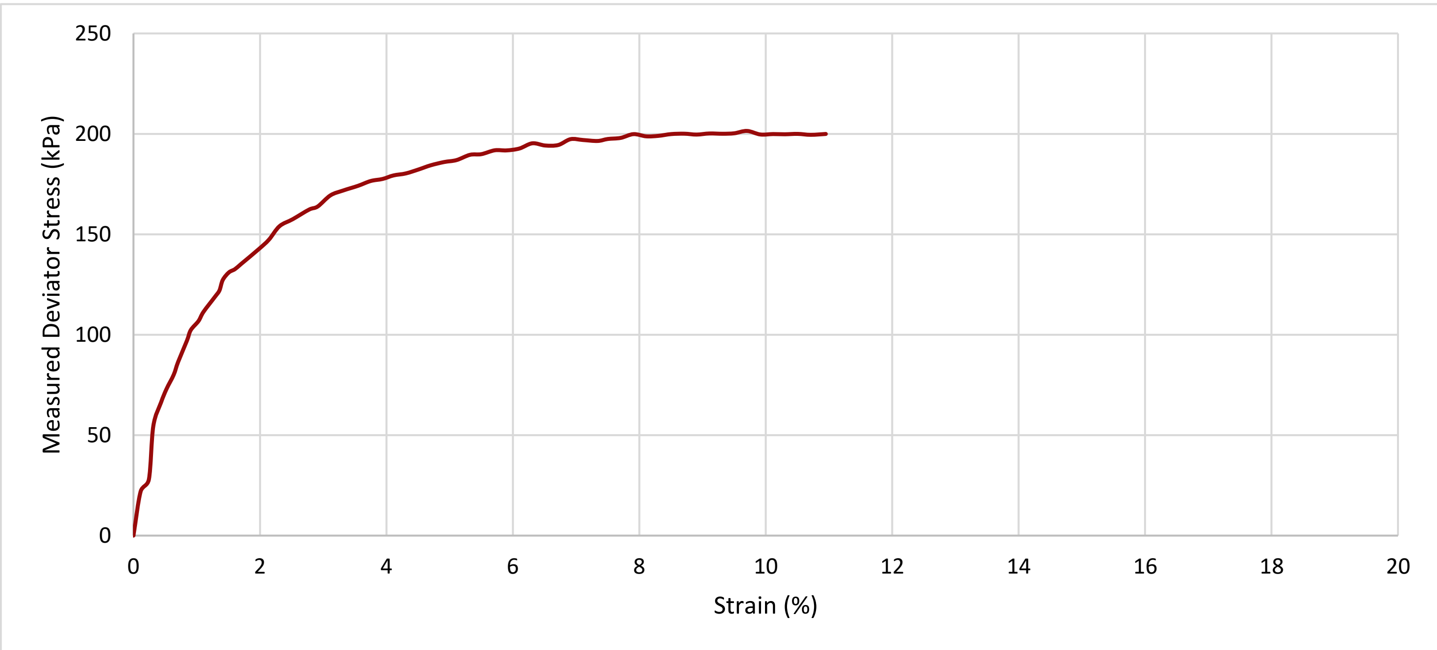
Contract	**248-260 Camden Road, Camden, London, NW1 9HE**
Serial No.	**36274**

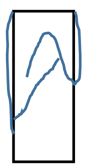
DETERMINATION OF UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole /Pit No.	Depth (m)	Type	Reference	Description	Remarks
BH1	2.00	U	-	Stiff (high strength) fissured orangish brown CLAY with occasional reddish yellow mottling, rare grey mottling, and orange fine sand pockets.	

Initial Specimen		Height (mm)	Diameter (mm)	Weight (g)	Water Content (%)	Bulk Density (Mg/m³)	Dry Density (Mg/m³)
	Depth of Top of Specimen (m) 2.23	153.7	102.7	2520	30.2	1.98	1.52

TEST INFORMATION Rate of Strain 1.0 % per Min | Rubber Membrane Thickness 0.3 mm



Specimen at failure	Measured Cell Pressure, σ3 (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress, (σ1-σ3)f (kPa)	Shear Stress Cu, ½(σ1-σ3)f (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI (degrees)
	41	9.7	0.6	\	200	100		

Method of Preparation:	BS 1377: Part 1: 1990
Method of Test:	BS 1377: Part 7: 1990: 8 Definitive Method, 1990: 9 Multi-stage loading
Type of Sample Key:	U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter
Comments:	Tested in Vertical Condition
	UKAS Calibration - loads from 0.2 to 10kN
Remarks to Include:	Sample disturbance, loss of moisture, variation form test procedure, location and origin of test specimen within original sample, oven drying temperature if not 105-110°C

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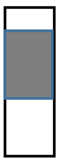
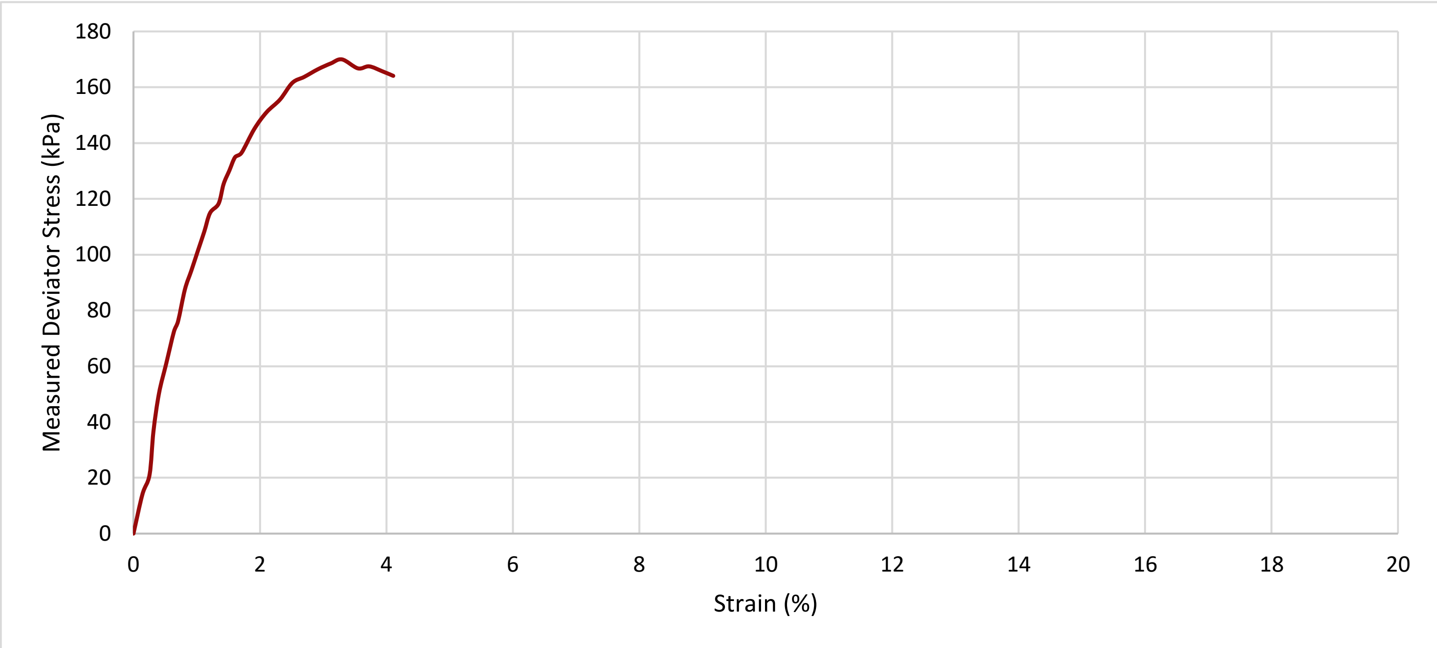
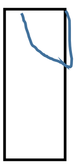
DETERMINATION OF UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole /Pit No.	Depth (m)	Type	Reference	Description	Remarks
BH1	4.00	U	-	Stiff (high strength) fissured reddish yellow CLAY with rare grey mottling, and selenite crystals.	Premature failure at 3.3% strain. Specimen oven dried at 80°C due to the presence of selenite.

Initial Specimen		Height (mm)	Diameter (mm)	Weight (g)	Water Content (%)	Bulk Density (Mg/m³)	Dry Density (Mg/m³)
	Depth of Top of Specimen (m) 4.10	199.2	102.7	3276	27.1	1.99	1.57

TEST INFORMATION	Rate of Strain	1.0	% per Min	Rubber Membrane Thickness	0.3	mm



Specimen at failure	Measured Cell Pressure, σ3 (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress, (σ1-σ3)f (kPa)	Shear Stress Cu, ½(σ1-σ3)f (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI (degrees)
	78	3.3	0.3	\	170	85		

Method of Preparation:	BS 1377: Part 1: 1990
Method of Test:	BS 1377: Part 7: 1990: 8 Definitive Method, 1990: 9 Multi-stage loading
Type of Sample Key:	U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter
Comments:	Tested in Vertical Condition UKAS Calibration - loads from 0.2 to 10kN
Remarks to Include:	Sample disturbance, loss of moisture, variation form test procedure, location and origin of test specimen within original sample, oven drying temperature if not 105-110°C

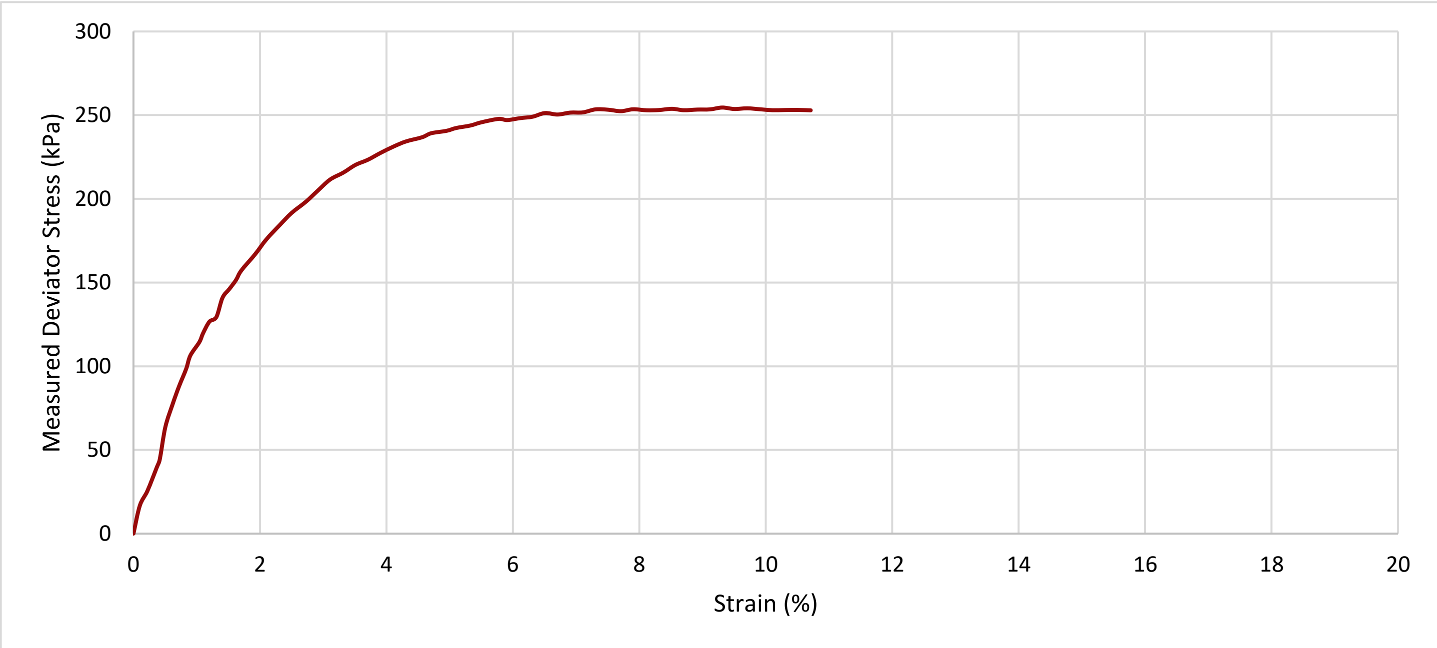
Contract	**248-260 Camden Road, Camden, London, NW1 9HE**
Serial No.	**36274**

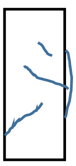
DETERMINATION OF UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole /Pit No.	Depth (m)	Type	Reference	Description	Remarks
BH1	6.00	U	-	Stiff (high strength) slightly fissured yellowish brown CLAY with occasional selenite crystals, and rare shell fragments.	Specimen oven dried at 80°C due to the presence of selenite.

Initial Specimen	Depth of Top of Specimen (m)	Height (mm)	Diameter (mm)	Weight (g)	Water Content (%)	Bulk Density (Mg/m³)	Dry Density (Mg/m³)
	6.08	199.4	101.1	3233	27.0	2.02	1.59

TEST INFORMATION — Rate of Strain 1.0 % per Min — Rubber Membrane Thickness 0.3 mm



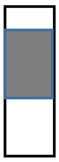
Specimen at failure	Measured Cell Pressure, σ3 (kPa)	Strain at Failure (%)	Stress Corrections (kPa) Rubber Membrane	Stress Corrections (kPa) Piston Friction	Corrected Max. Deviator Stress, (σ1-σ3)f (kPa)	Shear Stress Cu, ½(σ1-σ3)f (kPa)	Mohrs Circle Analysis Cu (kPa)	Mohrs Circle Analysis PHI (degrees)
	119	9.3	0.6	\	254	127		

Method of Preparation:	BS 1377: Part 1: 1990
Method of Test:	BS 1377: Part 7: 1990: 8 Definitive Method, 1990: 9 Multi-stage loading
Type of Sample Key:	U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter
Comments:	Tested in Vertical Condition
	UKAS Calibration - loads from 0.2 to 10kN
Remarks to Include:	Sample disturbance, loss of moisture, variation form test procedure, location and origin of test specimen within original sample, oven drying temperature if not 105-110°C

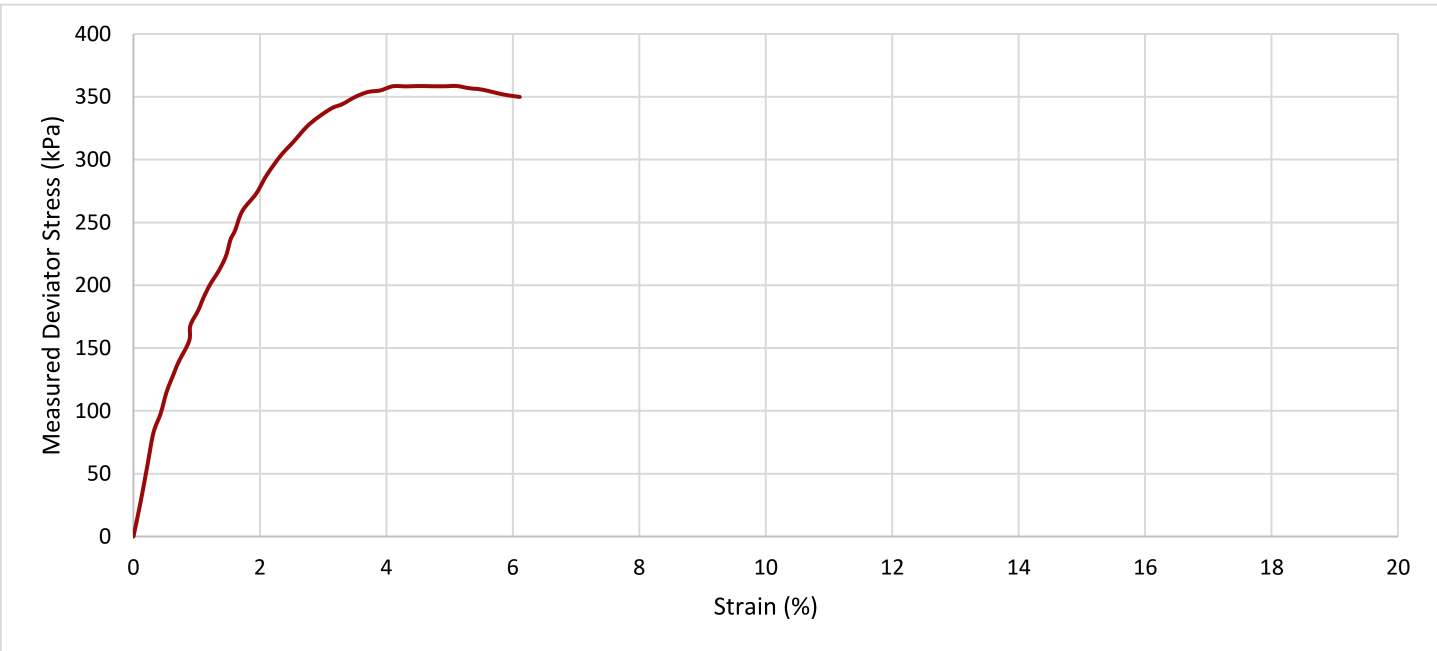
Contract	**248-260 Camden Road, Camden, London, NW1 9HE**
Serial No.	**36274**

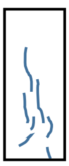
DETERMINATION OF UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole /Pit No.	Depth (m)	Type	Reference	Description	Remarks
BH3	2.00	U	-	Very stiff (very high strength) yellowish brown CLAY with rare orange silt pockets.	

Initial Specimen		Height (mm)	Diameter (mm)	Weight (g)	Water Content (%)	Bulk Density (Mg/m³)	Dry Density (Mg/m³)
	Depth of Top of Specimen (m) 2.10	199.4	102.5	3213	21.9	1.95	1.60

TEST INFORMATION	Rate of Strain	0.9	% per Min	Rubber Membrane Thickness	0.3	mm



Specimen at failure	Measured Cell Pressure, σ3 (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress, (σ1-σ3)f (kPa)	Shear Stress Cu, ½(σ1-σ3)f (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI (degrees)
	41	5.1	0.4	\	359	180		

Method of Preparation:	BS 1377: Part 1: 1990
Method of Test:	BS 1377: Part 7: 1990: 8 Definitive Method, 1990: 9 Multi-stage loading
Type of Sample Key:	U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter
Comments:	Tested in Vertical Condition
	UKAS Calibration - loads from 0.2 to 10kN
Remarks to Include:	Sample disturbance, loss of moisture, variation form test procedure, location and origin of test specimen within original sample, oven drying temperature if not 105-110°C

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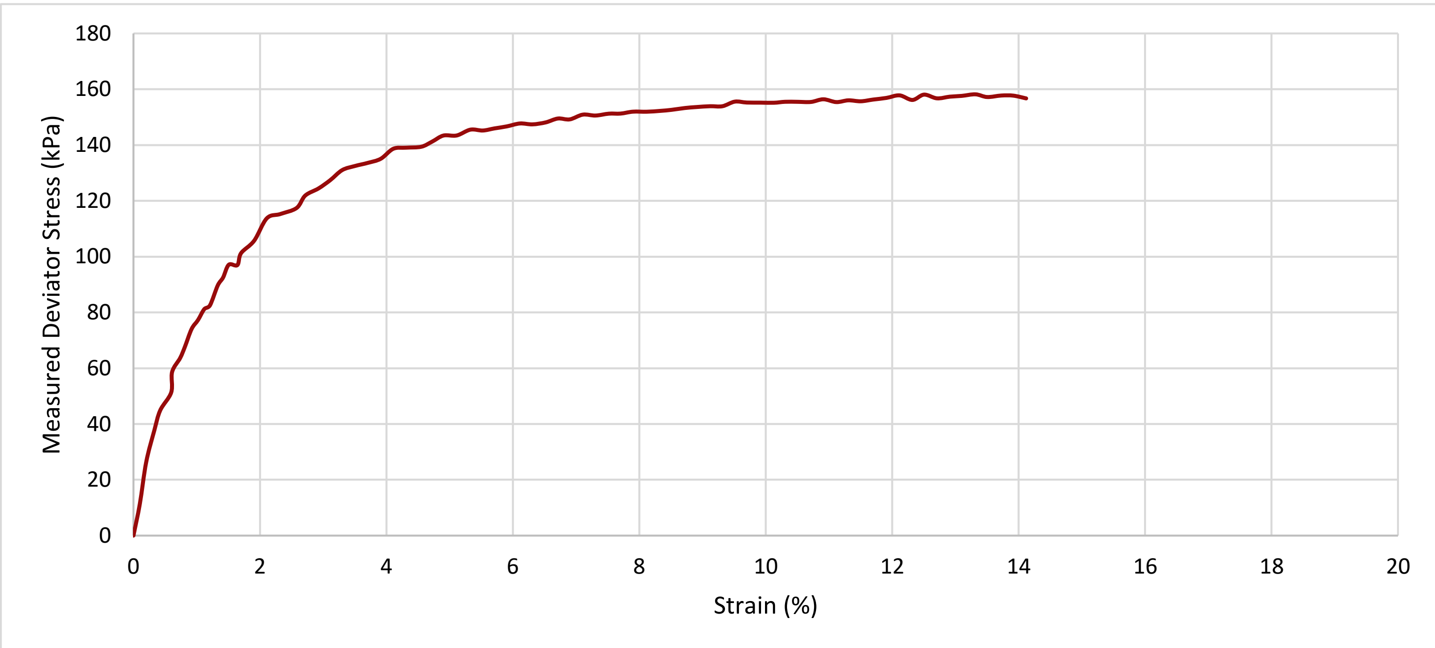
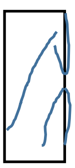
DETERMINATION OF UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole /Pit No.	Depth (m)	Type	Reference	Description	Remarks
BH3	4.00	U	-	Stiff (high strength) slightly fissured yellowish brown CLAY with rare selenite crystals.	Specimen oven dried at 80°C due to the presence of selenite.

Initial Specimen	Height (mm)	Diameter (mm)	Weight (g)	Water Content (%)	Bulk Density (Mg/m³)	Dry Density (Mg/m³)
Depth of Top of Specimen (m) 4.07	199.5	101.8	3252	28.2	2.00	1.56

TEST INFORMATION	Rate of Strain	1.0	% per Min	Rubber Membrane Thickness	0.3	mm



Specimen at failure	Measured Cell Pressure, σ3 (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress, (σ1-σ3)f (kPa)	Shear Stress Cu, ½(σ1-σ3)f (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI (degrees)
	82	13.3	0.8	\	157	79		

Method of Preparation:	BS 1377: Part 1: 1990
Method of Test:	BS 1377: Part 7: 1990: 8 Definitive Method, 1990: 9 Multi-stage loading
Type of Sample Key:	U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter
Comments:	Tested in Vertical Condition
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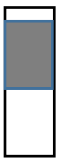
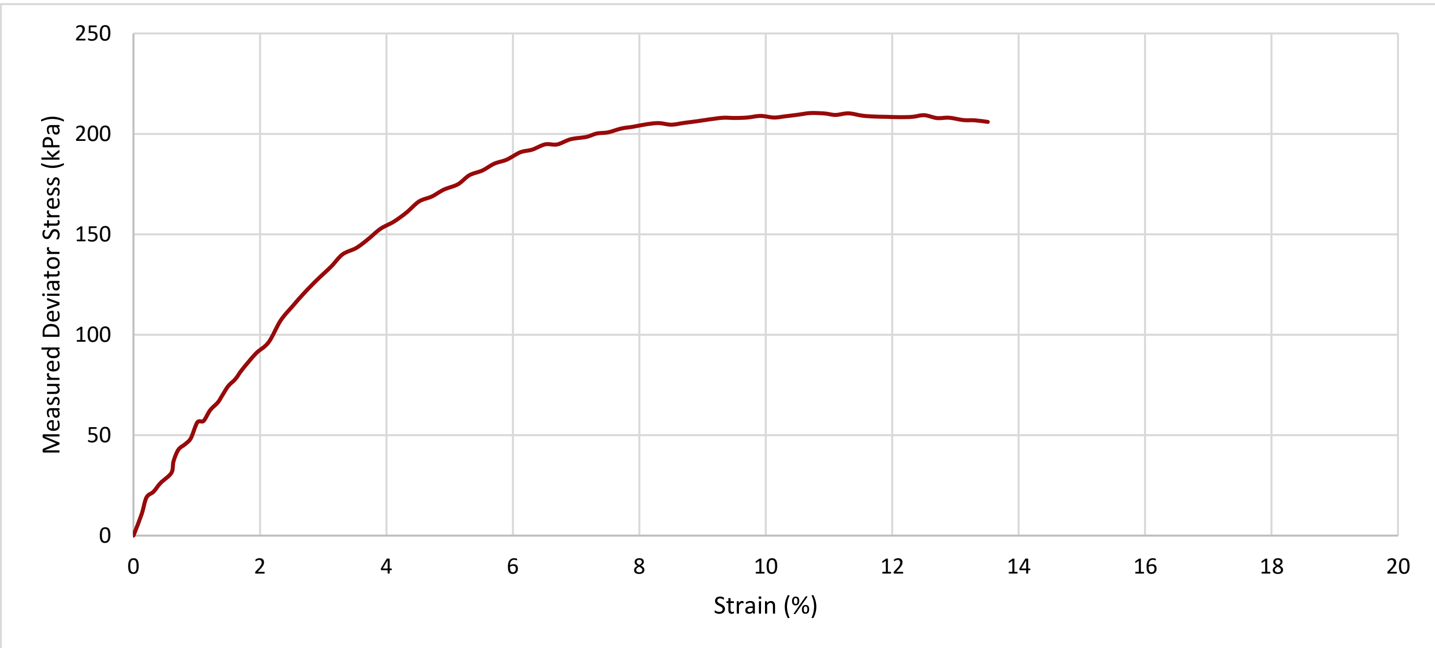
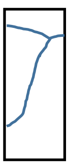
Borehole /Pit No.	Depth (m)	Type	Reference	Description	Remarks
BH3	6.00	U	-	Stiff (high strength) slightly fissured yellowish brown CLAY with rare selenite crystals.	Short sample recovery - short specimen tested. Specimen oven dried at 80°C due to the presence of selenite.

Initial Specimen		Height (mm)	Diameter (mm)	Weight (g)	Water Content (%)	Bulk Density (Mg/m³)	Dry Density (Mg/m³)
	Depth of Top of Specimen (m) 6.05	150.6	102.0	2420	26.4	1.97	1.56

TEST INFORMATION	Rate of Strain	1.0	% per Min	Rubber Membrane Thickness	0.3	mm	



Specimen at failure	Measured Cell Pressure, σ3 (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress, (σ1-σ3)f (kPa)	Shear Stress Cu, ½(σ1-σ3)f (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI (degrees)
	118	10.7	0.7	\	209	105		

Method of Preparation:	BS 1377: Part 1: 1990
Method of Test:	BS 1377: Part 7: 1990: 8 Definitive Method, 1990: 9 Multi-stage loading
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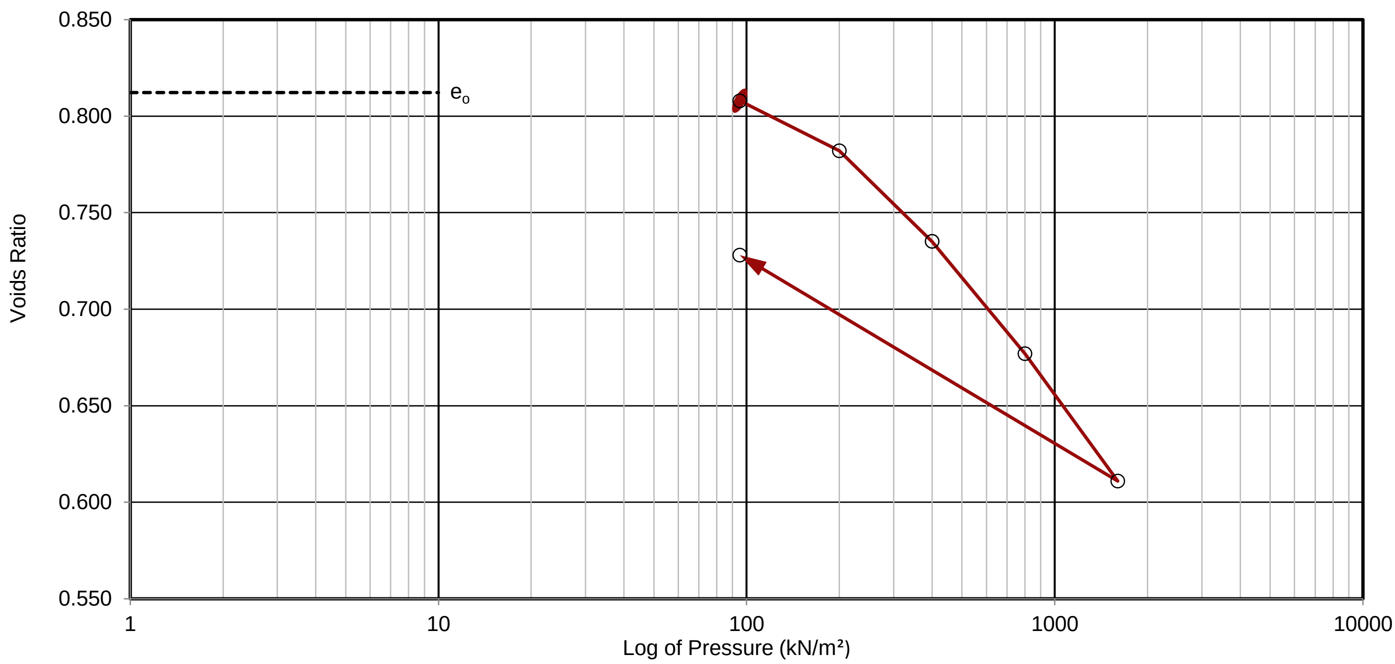
Contract	248-260 Camden Road, Camden, London, NW1 9HE
Serial No.	36274

DETERMINATION OF THE ONE-DIMENSIONAL CONSOLIDATION PROPERTIES

Borehole/ Pit No.	Depth (m)	Type	Ref.	Specimen Depth (m) and Orientation	Water Content (%)	Description	Remarks
BH1	2.00	U	-	2.20 Horizontal	28.6	Stiff (high strength) fissured orangish brown CLAY with occasional reddish yellow mottling, rare grey mottling, and orange fine sand pockets.	

Initial Conditions			Increment No.	Load (kN/m²)	Change in Height (mm)	Void Ratio	Cv (m²/yr)	Mv (m²/MN)	Temp (°C)	Corrected Cv
Height	mm	18.79	1	95	0.047	0.808			22	
Diameter	mm	74.99	2	200	0.313	0.782	0.21	0.14	22	0.20
Wet Weight	g	164.86	3	400	0.799	0.735	0.15	0.13	22	0.14
Water Content	%	28.6	4	800	1.404	0.677	0.14	0.08	22	0.13
Bulk Density	Mg/m³	1.99	5	1600	2.085	0.611	0.14	0.05	22	0.13
Particle Density		Assumed 2.80	6	95	0.875	0.728		0.05	22	
Voids Ratio		0.812								
Degree of Saturation	%	99								
Swelling Pressure	kN/m²	95								
Dry Density	Mg/m³	1.55								



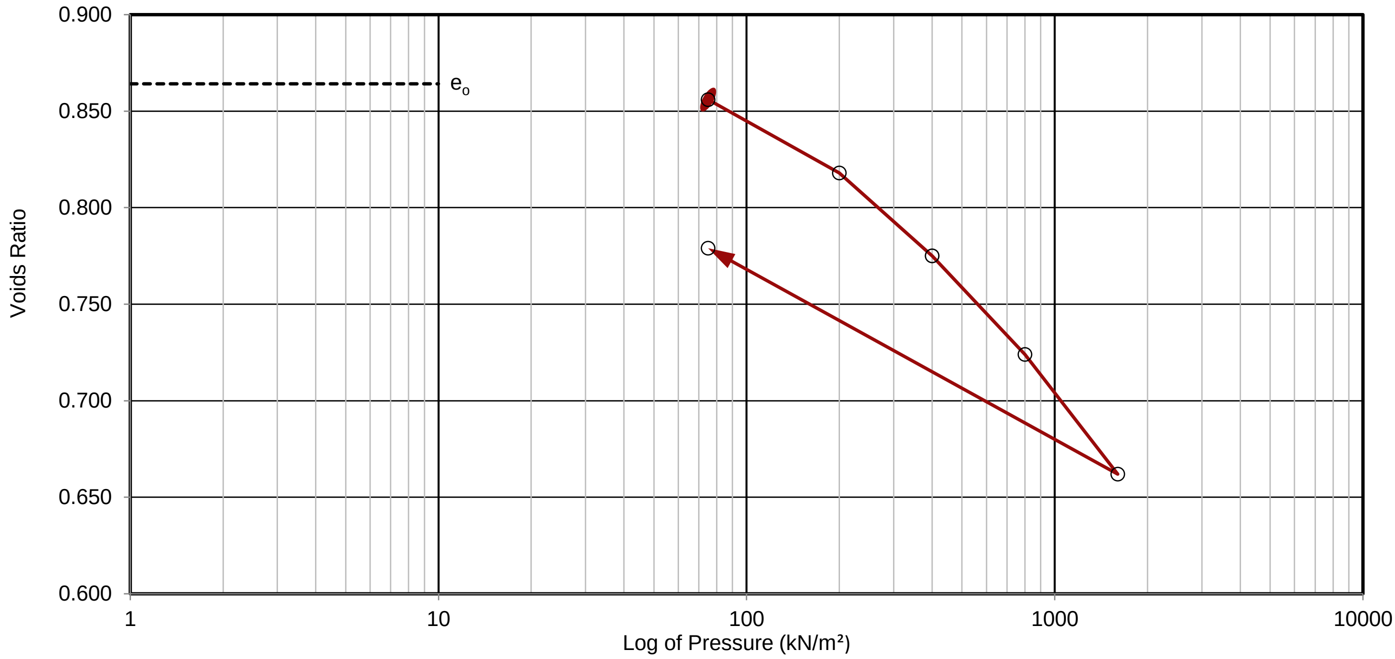
Method of Preparation:	BS 1377: Part 5: 1990: 3.3 & 3.4
Method of Test:	BS 1377: Part 5: 1990: 3.5
Method of Time Fitting Used:	Square root
Type of Sample Key:	U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter
Comments:	
Remarks to Include:	Sample disturbance, loss of water, variation from test procedure, location and origin of test specimen within original sample, oven drying temperature if not 105-110 °C.

Contract	248-260 Camden Road, Camden, London, NW1 9HE
Serial No.	36274

DETERMINATION OF THE ONE-DIMENSIONAL CONSOLIDATION PROPERTIES

Borehole/ Pit No.	Depth (m)	Type	Ref.	Specimen Depth (m) and Orientation	Water Content (%)	Description	Remarks
BH1	4.00	U	-	4.07 Horizontal	29.1	Stiff (high strength) fissured reddish yellow CLAY with rare grey mottling, and selenite crystals.	Specimen dried at 80°C due to the presence of selenite.

Initial Conditions			Increment No.	Load (kN/m²)	Change in Height (mm)	Void Ratio	Cv (m²/yr)	Mv (m²/MN)	Temp (°C)	Corrected Cv
Height	mm	18.93	1	75	0.078	0.856			22	
Diameter	mm	75.02	2	200	0.472	0.818	0.50	0.17	22	0.47
Wet Weight	g	161.03	3	400	0.910	0.775	0.50	0.12	22	0.47
Water Content	%	29.1	4	800	1.421	0.724	0.38	0.07	22	0.36
Bulk Density	Mg/m³	1.92	5	1600	2.049	0.662	0.31	0.05	22	0.29
Particle Density		Assumed 2.78	6	75	0.867	0.779		0.05	22	
Voids Ratio		0.864								
Degree of Saturation	%	94								
Swelling Pressure	kN/m²	75								
Dry Density	Mg/m³	1.49								



Method of Preparation:	BS 1377: Part 5: 1990: 3.3 & 3.4
Method of Test:	BS 1377: Part 5: 1990: 3.5
Method of Time Fitting Used:	Square root
Type of Sample Key:	U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter
Comments:	
Remarks to Include:	Sample disturbance, loss of water, variation from test procedure, location and origin of test specimen within original sample, oven drying temperature if not 105-110 °C.

	In Situ California Bearing Ratio (CBR)			Job Ref	27485
				CBR No.	CBR1
Site Name	248-250 Camden Road, London NW1 9HE			Depth m	0.45
Project No.	-	Client	FASTRACK	Date of Test	27/11/2019
Soil Description	Greyish brown sandy gravelly CLAY with occasional fm brick fragments (gravel is fmc and sub-angular to sub-rounded)				
Test Method	BS1377 : Part 9 : 1990, clause 4.3			CBR Test Number	1

Note: Test only applicable when maximum particle size beneath the plunger does not exceed 20mm

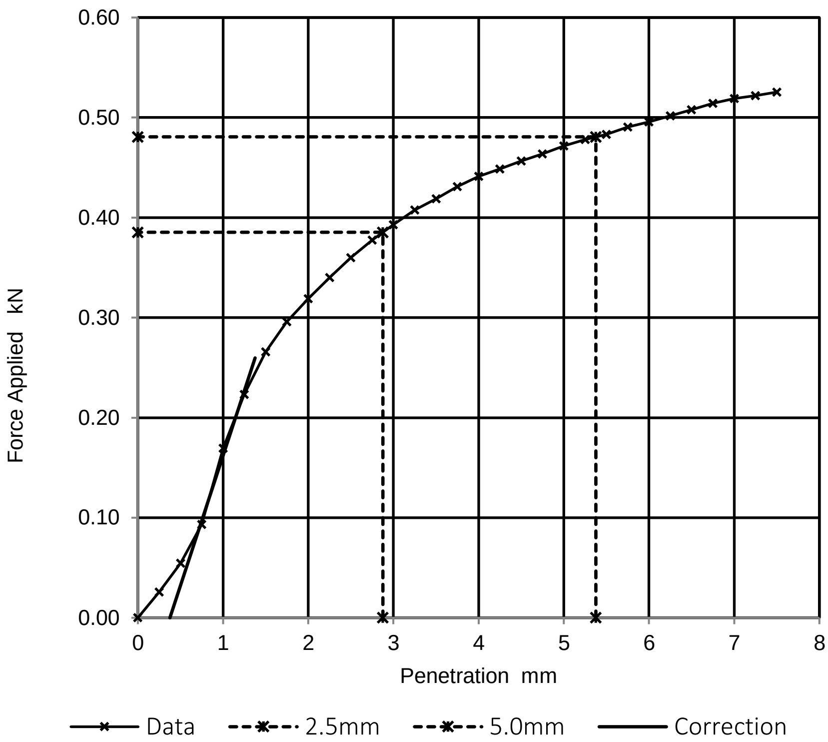
Rate if Strain	1.00	mm/min
Mass of Surcharge		kg
Proving Ring Factor	0.43	N/div

Temperature	11	0C
Environmental Conditions	Overcast with shawers	

Readings

Penetration of Plunger mm	Force on Plunger Dial Reading	Load kN
0.00	0	0.00
0.25	60	0.03
0.50	127	0.05
0.75	217	0.09
1.00	394	0.17
1.25	519	0.22
1.50	618	0.27
1.75	688	0.30
2.00	742	0.32
2.25	791	0.34
2.50	837	0.36
2.75	878	0.38
3.00	914	0.39
3.25	948	0.41
3.50	974	0.42
3.75	1002	0.43
4.00	1026	0.44
4.25	1043	0.45
4.50	1062	0.46
4.75	1078	0.46
5.00	1097	0.47
5.25	1112	0.48
5.50	1124	0.48
5.75	1141	0.49
6.00	1153	0.50
6.25	1167	0.50
6.50	1181	0.51
6.75	1196	0.51
7.00	1207	0.52
7.25	1214	0.52
7.50	1222	0.53

Force versus Penetration Plot



Remarks

Results

Curve correction applied	CBR Values, % Penetration 2.5mm	5mm	CBR Value	Moisture Content %
Yes	2.9	2.4	**2.9**	26

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

Tel: 01923 711 288
Email: James@k4soils.com

Checked and Approved

Initials: **J.P**

Date: 29/11/2019

UKAS TESTING 2519

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

K4 SOILS	In Situ California Bearing Ratio (CBR)			Job Ref	27485
				CBR No.	CBR2
Site Name	248-250 Camden Road, London NW1 9HE			Depth m	0.45
Project No.	-	Client	FASTRACK	Date of Test	27/11/2019
Soil Description	Brown slightly clayey sandy GRAVEL (gravel consists of fmc brick fragments)				
Test Method	BS1377 : Part 9 : 1990, clause 4.3			CBR Test Number	2

Note: Test only applicable when maximum particle size beneath the plunger does not exceed 20mm

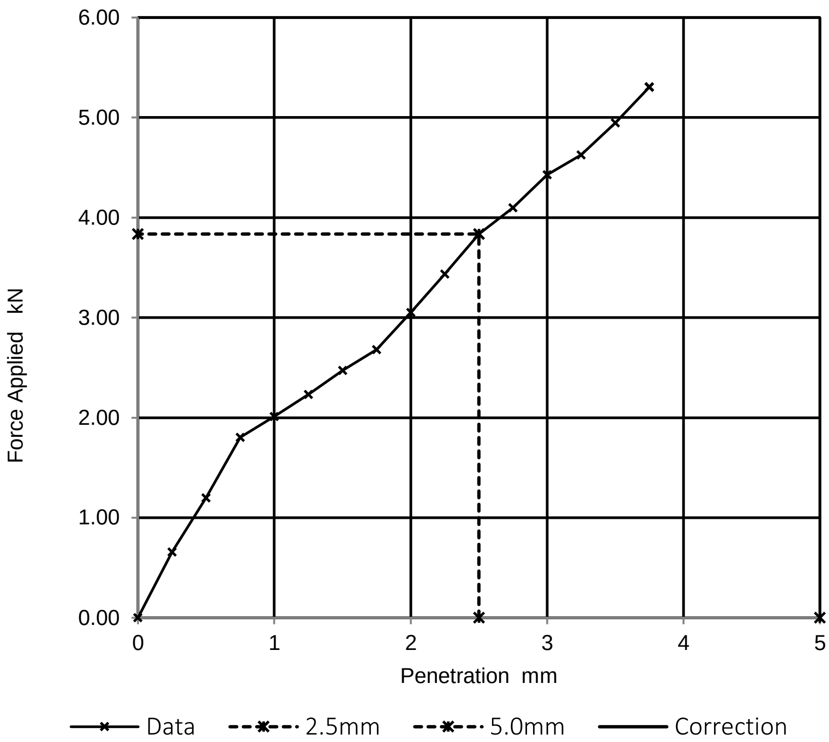
Rate if Strain	1.00	mm/min
Mass of Surcharge		kg
Proving Ring Factor	7.13	N/div

Temperature	11	0C
Environmental Conditions	Overcast with shawers	

Readings

Penetration of Plunger	Force on Plunger	
	Dial Reading	Load
mm		kN
0.00	0	0.00
0.25	92	0.66
0.50	168	1.20
0.75	253	1.80
1.00	282	2.01
1.25	313	2.23
1.50	347	2.47
1.75	376	2.68
2.00	428	3.05
2.25	482	3.44
2.50	538	3.84
2.75	575	4.10
3.00	621	4.43
3.25	649	4.63
3.50	694	4.95
3.75	744	5.30
4.00		
4.25		
4.50		
4.75		
5.00		
5.25		
5.50		
5.75		
6.00		
6.25		
6.50		
6.75		
7.00		
7.25		
7.50		

Force versus Penetration Plot



Remarks

Maximum kentledge reached

Results

Curve correction applied	CBR Values, %			Moisture Content
	Penetration		CBR Value	
	2.5mm	5mm		%
No	29	-	**29**	21

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

Tel: 01923 711 288
Email: James@k4soils.com

UKAS TESTING 2519

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

Checked and Approved

Initials: J.P

Date: 29/11/2019

MSF-5-R16

	In Situ California Bearing Ratio (CBR)			Job Ref	27485
				CBR No.	CBR3
Site Name	248-250 Camden Road, London NW1 9HE			Depth m	0.45
Project No.	-	Client	FASTRACK	Date of Test	27/11/2019
Soil Description	Brown slightly gravelly slightly sandy silty CLAY (gravel is fm and sub-angular to sub-rounded)				
Test Method	BS1377 : Part 9 : 1990, clause 4.3			CBR Test Number	3

Note: Test only applicable when maximum particle size beneath the plunger does not exceed 20mm

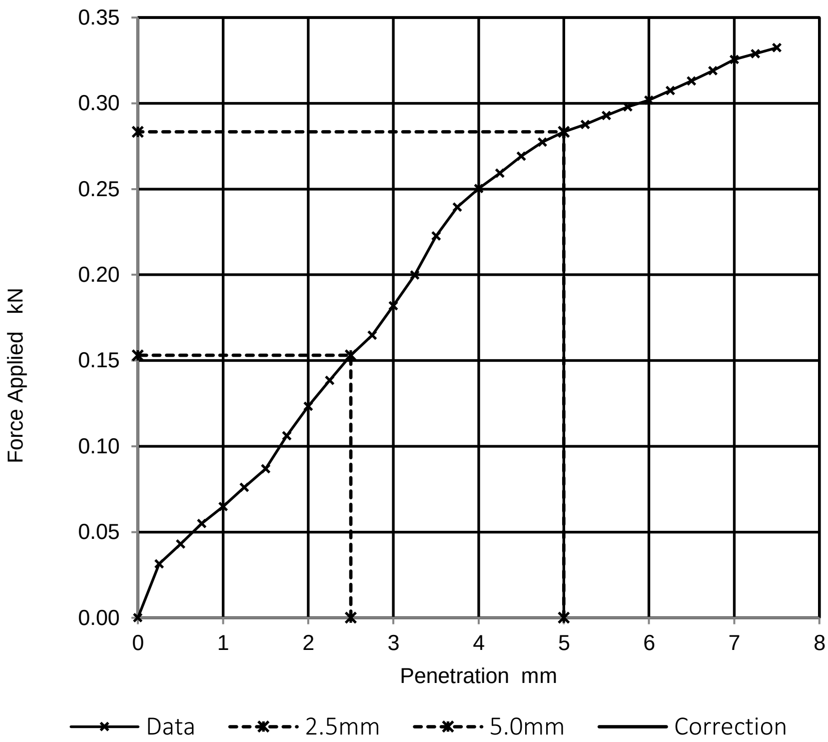
Rate if Strain	1.00	mm/min
Mass of Surcharge		kg
Proving Ring Factor	0.43	N/div

Temperature	11	0C
Environmental Conditions	Overcast with shawers	

Readings

Penetration of Plunger mm	Force on Plunger: Dial Reading	Force on Plunger: Load kN
0.00	0	0.00
0.25	73	0.03
0.50	100	0.04
0.75	128	0.06
1.00	151	0.06
1.25	177	0.08
1.50	202	0.09
1.75	247	0.11
2.00	287	0.12
2.25	322	0.14
2.50	356	0.15
2.75	383	0.16
3.00	423	0.18
3.25	465	0.20
3.50	518	0.22
3.75	557	0.24
4.00	582	0.25
4.25	603	0.26
4.50	626	0.27
4.75	645	0.28
5.00	659	0.28
5.25	669	0.29
5.50	681	0.29
5.75	693	0.30
6.00	702	0.30
6.25	715	0.31
6.50	728	0.31
6.75	742	0.32
7.00	757	0.33
7.25	765	0.33
7.50	773	0.33

Force versus Penetration Plot



Remarks

Results

Curve correction applied	CBR Values, % Penetration 2.5mm	CBR Values, % Penetration 5mm	CBR Value	Moisture Content %
No	1.2	1.4	**1.4**	39

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

Tel: 01923 711 288
Email: James@k4soils.com

Checked and Approved
Initials: J.P
Date: 29/11/2019

UKAS TESTING 2519

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info@elab-uk.co.uk

THE ENVIRONMENTAL LABORATORY LTD

Analytical Report Number:	19-25967
Issue:	1
Date of Issue:	04/12/2019
Contact:	Peter George
Customer Details:	GO Contaminated Land Solutions Ltd 4 De Frene Road Sydenham London SE26 4AB
Quotation No:	Q14-00029
Order No:	1772
Customer Reference:	1772
Date Received:	27/11/2019
Date Approved:	04/12/2019
Details:	Camden Road
Approved by:	

John Wilson, Quality Manager

Any comments, opinions or interpretations expressed herein are outside the scope of UKAS accreditation (Accreditation Number 2683

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Sample Summary

Report No.: 19-25967, issue number 1

Elab No.	Client's Ref.	Date Sampled	Date Scheduled	Description	Deviations
190782	TP1 0.50	25/11/2019	27/11/2019	Loamy sand	
190783	TP5 0.50	25/11/2019	27/11/2019	Sandy silty loam	
190784	BH3 2.00	25/11/2019	27/11/2019	Silty clayey loam	

Results Summary

2683

Report No.: 19-25967, issue number 1

			ELAB Reference	190782	190783	190784
			Customer Reference			
			Sample ID			
			Sample Type	SOIL	SOIL	SOIL
			Sample Location	TP1	TP5	BH3
			Sample Depth (m)	0.50	0.50	2.00
			Sampling Date	25/11/2019	25/11/2019	25/11/2019
Determinand	**Codes**	**Units**	**LOD**			
Soil sample preparation parameters						
Material removed	N	%	0.1	38.0	11.3	< 0.1
Description of Inert material removed	N		0	Stones	Stones	None
Miscellaneous						
Acid Neutralisation Capacity	N	mol/kg	0.1	< 0.1	< 0.1	< 0.1
Loss On Ignition (450°C)	M	%	0.01	2.98	7.34	4.04
pH	M	pH units	0.1	9.6	9.2	8.6
Total Organic Carbon	N	%	0.01	1.2	1.7	0.39
Polyaromatic hydrocarbons						
Total PAH (Including Coronene GC-FID)	N	mg/kg	2	5	< 2	< 2
BTEX						
Total BTEX	N	mg/kg	0.01	< 0.01	< 0.01	< 0.01
Total Petroleum Hydrocarbons						
Mineral Oil	M	mg/kg	5	^ 48	^ < 5	^ 13
PCB (ICES 7 congeners)						
PCB (Total of 7 Congeners)	M	mg/kg	0.03	< 0.03	< 0.03	< 0.03

Results Summary

2683

Report No.: 19-25967, issue number 1

WAC Analysis								
Elab Ref:	190784					**Landfill Waste Acceptance Criteria Limits***		
Sample Date:	25/11/2019					**Inert Waste Landfill**	**Stable Non-reactive Hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Sample ID:	BH3							
Depth (m)	2							
Site:	Camden Road							
Determinand		**Code**	**Units**					
Total Organic Carbon		N	%		0.39	3	5	6
Loss on Ignition		M	%		4.0	--	--	10
Total BTEX		M	mg/kg		< 0.01	6	--	--
Total PCBs (7 congeners)		M	mg/kg		< 0.03	1	--	--
TPH Total WAC		M	mg/kg		13	500	--	--
Total (of 17) PAHs		N	mg/kg		< 2	100	--	--
pH		M			8.6	--	>6	--
Acid Neutralisation Capacity		N	mol/kg		< 0.1	--	To evaluate	To evaluate
Eluate Analysis			**10:1**		**10:1**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
			mg/l		**mg/kg**			
Arsenic		N	< 0.005		< 0.05	0.5	2	25
Barium		N	< 0.005		< 0.05	20	100	300
Cadmium		N	< 0.001		< 0.01	0.04	1	5
Chromium		N	< 0.005		< 0.05	0.5	10	70
Copper		N	< 0.005		< 0.05	2	50	100
Mercury		N	< 0.005		< 0.01	0.01	0.2	2
Molybdenum		N	< 0.005		< 0.05	0.5	10	30
Nickel		N	< 0.001		< 0.05	0.4	10	40
Lead		N	< 0.001		< 0.05	0.5	10	50
Antimony		N	< 0.005		< 0.05	0.06	0.7	5
Selenium		N	< 0.005		< 0.05	0.1	0.5	7
Zinc		N	< 0.005		< 0.05	4	50	200
Chloride		N	6		58.00	800	15000	25000
Fluoride		N	< 5		16.00	10	150	500
Sulphate		N	33		331.00	1000	20000	50000
Total Dissolved Solids		N	109		1090.00	4000	60000	100000
Phenol Index		N	< 0.01		< 0.10	1	-	-
Dissolved Organic Carbon		N	9.570		96.00	500	800	1000
Leach Test Information								
pH		N	7.7					
Conductivity (uS/cm)		N	163					
Dry mass of test portion (g)			101.000					
Dry Matter (%)			83					
Moisture (%)			21					
Eluent Volume (ml)			966					

Results are expressed on a dry weight basis, after correction for moisture content where applicable

* Stated limits are for guidance only, and not for conformity assessment.

Results Summary

2683

Report No.: 19-25967, issue number 1

WAC Analysis								
Elab Ref:	190783					**Landfill Waste Acceptance Criteria Limits***		
Sample Date:	25/11/2019					**Inert Waste Landfill**	**Stable Non-reactive Hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Sample ID:	TP5							
Depth (m)	0.5							
Site:	Camden Road							
Determinand		**Code**	**Units**					
Total Organic Carbon		N	%		1.70	3	5	6
Loss on Ignition		M	%		7.3	--	--	10
Total BTEX		M	mg/kg		< 0.01	6	--	--
Total PCBs (7 congeners)		M	mg/kg		< 0.03	1	--	--
TPH Total WAC		M	mg/kg		< 5	500	--	--
Total (of 17) PAHs		N	mg/kg		< 2	100	--	--
pH		M			9.2	--	>6	--
Acid Neutralisation Capacity		N	mol/kg		< 0.1	--	To evaluate	To evaluate
Eluate Analysis			**10:1**		**10:1**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
			mg/l		**mg/kg**			
Arsenic		N	0.008		0.08	0.5	2	25
Barium		N	0.010		0.10	20	100	300
Cadmium		N	< 0.001		< 0.01	0.04	1	5
Chromium		N	0.015		0.15	0.5	10	70
Copper		N	0.023		0.23	2	50	100
Mercury		N	< 0.005		< 0.01	0.01	0.2	2
Molybdenum		N	0.011		0.11	0.5	10	30
Nickel		N	0.003		< 0.05	0.4	10	40
Lead		N	0.041		0.41	0.5	10	50
Antimony		N	< 0.005		< 0.05	0.06	0.7	5
Selenium		N	< 0.005		< 0.05	0.1	0.5	7
Zinc		N	0.013		0.13	4	50	200
Chloride		N	10		98.00	800	15000	25000
Fluoride		N	< 5		12.00	10	150	500
Sulphate		N	54		540.00	1000	20000	50000
Total Dissolved Solids		N	117		1170.00	4000	60000	100000
Phenol Index		N	< 0.01		< 0.10	1	-	-
Dissolved Organic Carbon		N	22.100		221.00	500	800	1000
Leach Test Information								
pH		N	7.5					
Conductivity (uS/cm)		N	175					
Dry mass of test portion (g)			101.000					
Dry Matter (%)			76					
Moisture (%)			32					
Eluent Volume (ml)			941					

Results are expressed on a dry weight basis, after correction for moisture content where applicable

* Stated limits are for guidance only, and not for conformity assessment.

2683

Results Summary

Report No.: 19-25967, issue number 1

WAC Analysis

Elab Ref:	190782					**Landfill Waste Acceptance Criteria Limits***		
Sample Date:	25/11/2019							
Sample ID:	TP1							
Depth (m)	0.5							
Site:	Camden Road							
Determinand		**Code**	**Units**			**Inert Waste Landfill**	**Stable Non-reactive Hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon		N	%		1.20	3	5	6
Loss on Ignition		M	%		3.0	--	--	10
Total BTEX		M	mg/kg		< 0.01	6	--	--
Total PCBs (7 congeners)		M	mg/kg		< 0.03	1	--	--
TPH Total WAC		M	mg/kg		48	500	--	--
Total (of 17) PAHs		N	mg/kg		5.0	100	--	--
pH		M			9.6	--	>6	--
Acid Neutralisation Capacity		N	mol/kg		< 0.1	--	To evaluate	To evaluate
Eluate Analysis			**10:1**		**10:1**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
			mg/l		**mg/kg**			
Arsenic		N	< 0.005		< 0.05	0.5	2	25
Barium		N	0.027		0.27	20	100	300
Cadmium		N	< 0.001		< 0.01	0.04	1	5
Chromium		N	0.007		0.07	0.5	10	70
Copper		N	0.008		0.08	2	50	100
Mercury		N	< 0.005		< 0.01	0.01	0.2	2
Molybdenum		N	< 0.005		< 0.05	0.5	10	30
Nickel		N	0.001		< 0.05	0.4	10	40
Lead		N	0.012		0.12	0.5	10	50
Antimony		N	< 0.005		< 0.05	0.06	0.7	5
Selenium		N	< 0.005		< 0.05	0.1	0.5	7
Zinc		N	0.007		0.07	4	50	200
Chloride		N	< 5		< 50	800	15000	25000
Fluoride		N	< 5		< 10	10	150	500
Sulphate		N	14		137.00	1000	20000	50000
Total Dissolved Solids		N	75		748.00	4000	60000	100000
Phenol Index		N	< 0.01		< 0.10	1	-	-
Dissolved Organic Carbon		N	6.600		66.00	500	800	1000
Leach Test Information								
pH		N	7.9					
Conductivity (uS/cm)		N	112					
Dry mass of test portion (g)			104.000					
Dry Matter (%)			81					
Moisture (%)			23					
Eluent Volume (ml)			989					

Results are expressed on a dry weight basis, after correction for moisture content where applicable
* Stated limits are for guidance only, and not for conformity assessment.

Method Summary

Report No.: 19-25967, issue number 1

Parameter	Codes	Analysis Undertaken On	Date Tested	Method Number	Technique
Leachate					
Arsenic	N		03/12/2019	101	ICPMS
Cadmium	N		03/12/2019	101	ICPMS
Chromium	N		03/12/2019	101	ICPMS
Lead	N		03/12/2019	101	ICPMS
Nickel	N		03/12/2019	101	ICPMS
Copper	N		03/12/2019	101	ICPMS
Zinc	N		03/12/2019	101	ICPMS
Mercury	N		03/12/2019	101	ICPMS
Selenium	N		03/12/2019	101	ICPMS
Antimony	N		03/12/2019	101	ICPMS
Barium	N		03/12/2019	101	ICPMS
Molybdenum	N		03/12/2019	101	ICPMS
pH Value	N		03/12/2019	113	Electrometric
Electrical Conductivity	N		03/12/2019	136	Probe
Dissolved Organic Carbon	N		03/12/2019	102	TOC analyser
Chloride	N		03/12/2019	131	Ion Chromatography
Fluoride	N		03/12/2019	131	Ion Chromatography
Sulphate	N		03/12/2019	131	Ion Chromatography
Total Dissolved Solids	N		03/12/2019	144	Gravimetric
Phenol index	N		03/12/2019	121	HPLC
WAC Solids analysis	N				
pH Value	M	Air dried sample	02/12/2019	113	Electrometric
Total Organic Carbon	N	Air dried sample	02/12/2019	210	IR
Loss on Ignition	M	Air dried sample	29/11/2019	129	Gravimetric
Acid Neutralization Capacity to pH 7	N	Air dried sample	02/12/2019	NEN 737	Electrometric
Total BTEX	N	As submitted sample	02/12/2019	181	GCMS
Mineral Oil	M	As submitted sample	29/11/2019	117	GCFID
Total PCBs (7 congeners)	M	Air dried sample	29/11/2019	120	GCMS
Total PAH (17)	N	As submitted sample	04/12/2019	133	GCFID

Tests marked N are not UKAS accredited

Report Information

Report No.: 19-25967, issue number 1

Key

U	hold UKAS accreditation
M	hold MCERTS and UKAS accreditation
N	do not currently hold UKAS accreditation
^	MCERTS accreditation not applicable for sample matrix
*	UKAS accreditation not applicable for sample matrix
S	Subcontracted to approved laboratory UKAS Accredited for the test
SM	Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test
NS	Subcontracted to approved laboratory. UKAS accreditation is not applicable.
I/S	Insufficient Sample
U/S	Unsuitable sample
n/t	Not tested
<	means "less than"
>	means "greater than"

Soil sample results are expressed on an air dried basis (dried at < 30°C), and are uncorrected for inert material removed.

ELAB are unable to provide an interpretation or opinion on the content of this report.

The results relate only to the sample received.

PCB congener results may include any coeluting PCBs

Uncertainty of measurement for the determinands tested are available upon request

Unless otherwise stated, sample information has been provided by the client. This may affect the validity of the results.

Deviation Codes

a	No date of sampling supplied
b	No time of sampling supplied (Waters Only)
c	Sample not received in appropriate containers
d	Sample not received in cooled condition
e	The container has been incorrectly filled
f	Sample age exceeds stability time (sampling to receipt)
g	Sample age exceeds stability time (sampling to analysis)

Where a sample has a deviation code, the applicable test result may be invalid.

Sample Retention and Disposal

All soil samples will be retained for a period of one month

All water samples will be retained for 7 days following the date of the test report

Charges may apply to extended sample storage

Appendix VII – SuDS Proforma

Ambiental Environmental Assessment
Sussex Innovation Centre,
Science Park Square,
Brighton, BN1 9SB

Camden GREATERLONDONAUTHORITY LoDEG

1. Project & Site Details

Project / Site Name (including sub-catchment / stage / phase where appropriate)	248-250 Camden Road Hostel
Address & post code	248-250 Camden Road Hostel NW1 9HE
OS Grid ref. (Easting, Northing)	E 529703 N 184808
LPA reference (if applicable)	
Brief description of proposed work	Demolition of existing hostel building and erection of new 4-6 storey plus basement hostel building.
Total site Area	1569 m^2
Total existing impervious area	700 m^2
Total proposed impervious area	987 m^2
Is the site in a surface water flood risk catchment (ref. local Surface Water Management Plan)?	No
Existing drainage connection type and location	Combined sewer on site
Designer Name	Sam Lee
Designer Position	Flood risk & drainage engineer
Designer Company	Ambiental Environmental Assessment

2. Proposed Discharge Arrangements

2a. Infiltration Feasibility

Superficial geology classification	N/A
Bedrock geology classification	London Clay
Site infiltration rate	32.61*10-7 m/s
Depth to groundwater level	N/A m below ground level
Is infiltration feasible?	No

2b. Drainage Hierarchy

	Feasible (Y/N)	*Proposed (Y/N)*
1 store rainwater for later use	N	N
2 use infiltration techniques, such as porous surfaces in non-clay areas	N	N
3 attenuate rainwater in ponds or open water features for gradual release	N	N
4 attenuate rainwater by storing in tanks or sealed water features for gradual release	N	N
5 discharge rainwater direct to a watercourse	N	N
6 discharge rainwater to a surface water sewer/drain	N	N
7 discharge rainwater to the combined sewer.	Y	Y

2c. Proposed Discharge Details

Proposed discharge location	Existing drainage on site
Has the owner/regulator of the discharge location been consulted?	Y

3. Drainage Strategy

3a. Discharge Rates & Required Storage				
	Greenfield (GF) runoff rate (l/s)	*Existing discharge rate (l/s)*	*Required storage for GF rate (m^3)*	*Proposed discharge rate (l/s)*
Qbar	0.42			
1 in 1	0.37		N/A	1
1 in 30	0.98		N/A	1
1 in 100	1.36	33.6	N/A	1.1
1 in 100 + CC			N/A	1.3
Climate change allowance used		40%		
3b. Principal Method of Flow Control		Hydrobrake		

3c. Proposed SuDS Measures			
	Catchment area (m^2)	*Plan area (m^2)*	*Storage vol. (m^3)*
Rainwater harvesting	0		0
Infiltration systems	0		0
Green roofs	0	0	0
Blue roofs	0	0	0
Filter strips	0	0	0
Filter drains	0	0	0
Bioretention / tree pits	0	0	0
Pervious pavements	0	0	0
Swales	0	0	0
Basins/ponds	0	0	0
Attenuation tanks	987		52.5
Total	987	0	52.5

4. Supporting Information

4a. Discharge & Drainage Strategy	*Page/section of drainage report*
Infiltration feasibility (2a) – geotechnical factual and interpretive reports, including infiltration results	Appendix V - Supplementary Docs
Drainage hierarchy (2b)	23
Proposed discharge details (2c) – utility plans, correspondence / approval from owner/regulator of discharge location	23 / Appendix IV
Discharge rates & storage (3a) – detailed hydrologic and hydraulic calculations	Appendix II
Proposed SuDS measures & specifications (3b)	Appendix III

4b. Other Supporting Details	*Page/section of drainage report*
Detailed Development Layout	Appendix I
Detailed drainage design drawings, including exceedance flow routes	Appendix III
Detailed landscaping plans	Appendix I
Maintenance strategy	28
Demonstration of how the proposed SuDS measures improve:	
a) water quality of the runoff?	27
b) biodiversity?	N/A
c) amenity?	N/A

APPENDIX E

Construction methodology and engineering statement drawings and calculations

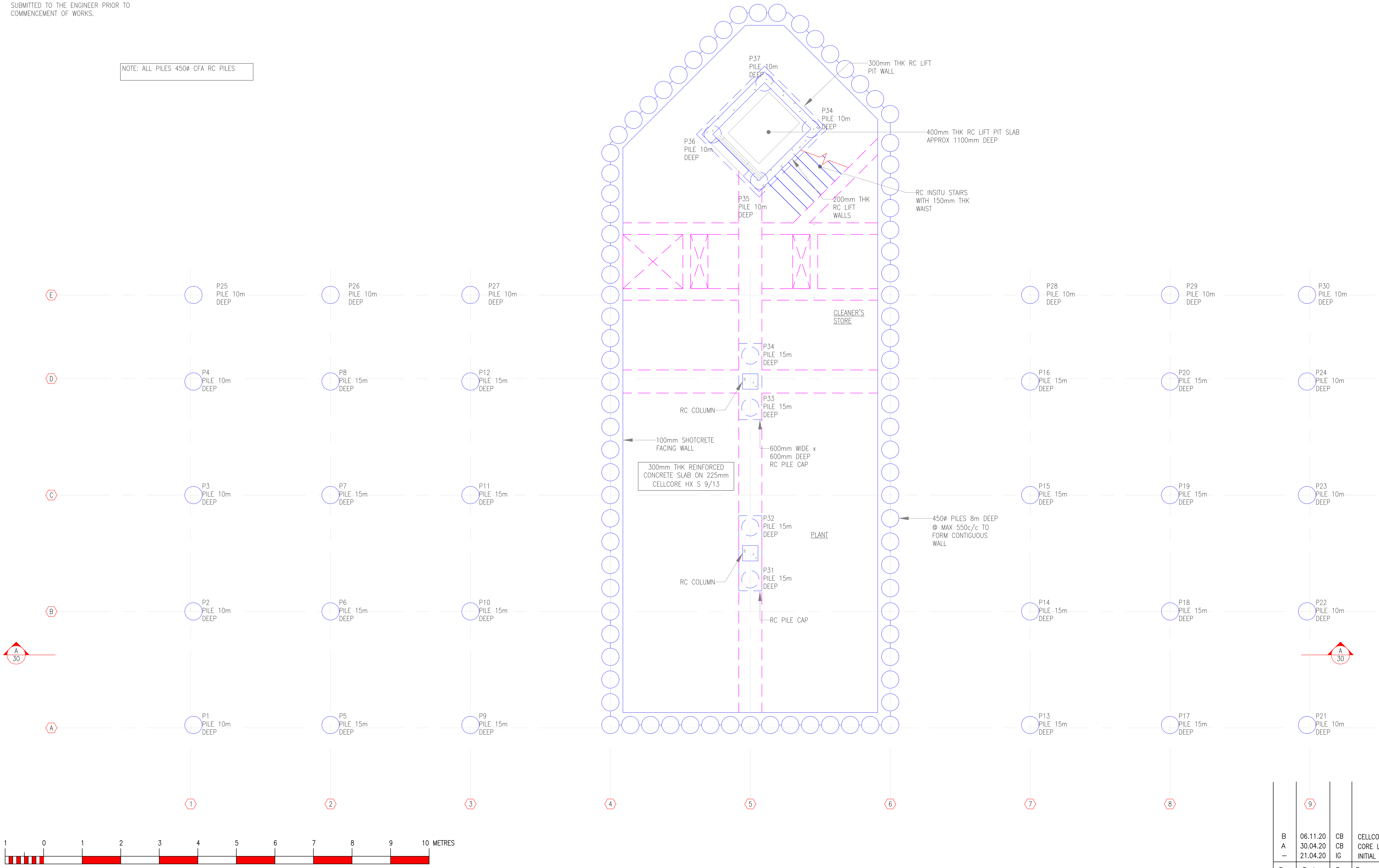
NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECT'S, ENGINEER'S AND SPECIALISTS DRAWINGS AND SPECIFICATIONS.

2. DO NOT SCALE FROM THIS DRAWING IN EITHER PAPER OR DIGITAL FORM. USE WRITTEN DIMENSIONS ONLY. TO CHECK THAT THE DRAWING HAS BEEN PRINTED TO THE INTENDED SCALE USE THE SCALE BAR IN THE ABSENCE OF WRITTEN DIMENSIONS.

3. ALL TEMPORARY WORKS TO BE DESIGNED BY THE CONTRACTOR AND METHODS STATEMENTS TO BE SUBMITTED TO THE ENGINEER PRIOR TO COMMENCEMENT OF WORKS.

NOTE: ALL PILES 450ø CFA RC PILES



Rev	Date	By	Rev
B	06.11.20	CB	CELLCORE ADDED
A	30.04.20	CB	CORE LAYOUT CHANGE
–	21.04.20	IG	INITIAL DRAFT

CDM STATEMENT
ANY INFORMATION GIVEN ON THIS DRAWING MUST BE USED IN CONJUNCTION WITH THE CONSTRUCTION HEALTH AND SAFETY PLAN PREPARED BY THE PRINCIPAL CONTRACTOR.
ANY CHANGES IN DESIGN, OR CONDITIONS ARISING OR INFORMATION BECOMING KNOWN AT A LATER DATE, WHICH MAY IMPACT UPON THE DESIGN, CONSTRUCTION OR USE OF THE BUILDING, MUST BE NOTIFIED TO THE PRINCIPAL CONTRACTOR AND PRINCIPAL DESIGNER IMMEDIATELY.

DRAWING STATUS: SCHEME

CLIENT: LONDON BOROUGH OF CAMDEN, 5 PANCRAS SQUARE, KINGS CROSS, LONDON, N1C 4AG

DRAWING TITLE: PROPOSED BASEMENT PLAN

JOB TITLE: CAMDEN ROAD HOSTEL, 248–250 CAMDEN ROAD, LONDON, NW1 9HE

rodriguesassociates
1 Amwell Street
London EC1R 1UL
020-7837-1133 (Phone)
www.rodriguesassociates.com

DATE	SCALE	
17-04-2020	A1 – 1:50 A3 – 1:100	DRAWN IG CHECKED CB
JOB No. 1858	DRG No. 02	REVISION B

NOTES

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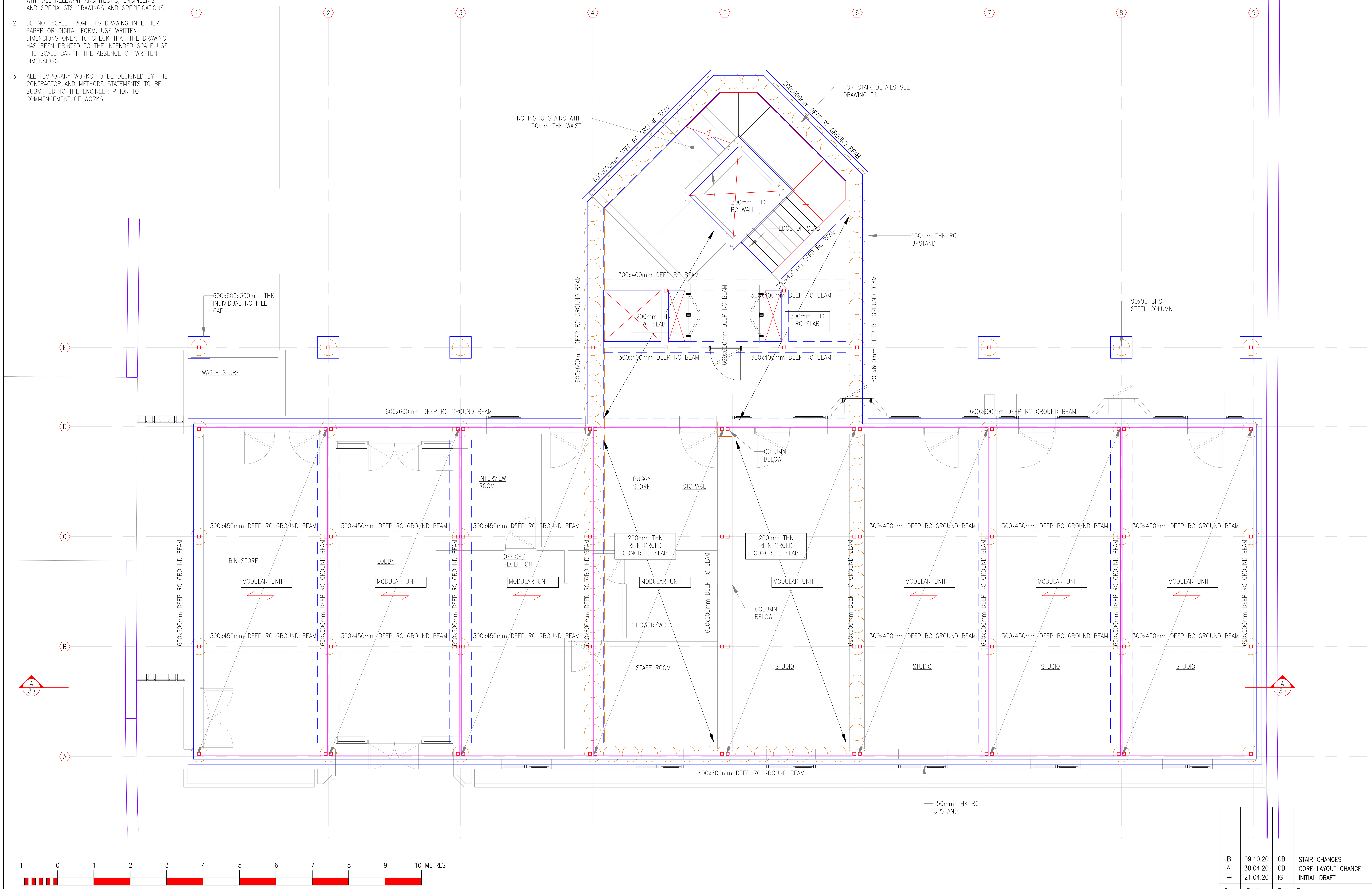

Rev	Date	By	Rev
B	09.10.20	CB	STAIR CHANGES
A	30.04.20	CB	CORE LAYOUT CHANGE
–	21.04.20	IG	INITIAL DRAFT

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DRAWING STATUS: SCHEME

CLIENT: LONDON BOROUGH OF CAMDEN, 5 PANCRAS SQUARE, KINGS CROSS, LONDON, N1C 4AG

DRAWING TITLE: PROPOSED GROUND FLOOR PLAN

JOB TITLE: CAMDEN ROAD HOSTEL, 248–250 CAMDEN ROAD, LONDON, NW1 9HE

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DATE	SCALE	
17–04–2020	A1 – 1:50 A3 – 1:100	DRAWN IG CHECKED CB
JOB No. 1858	DRG No. 03	REVISION B

NOTES

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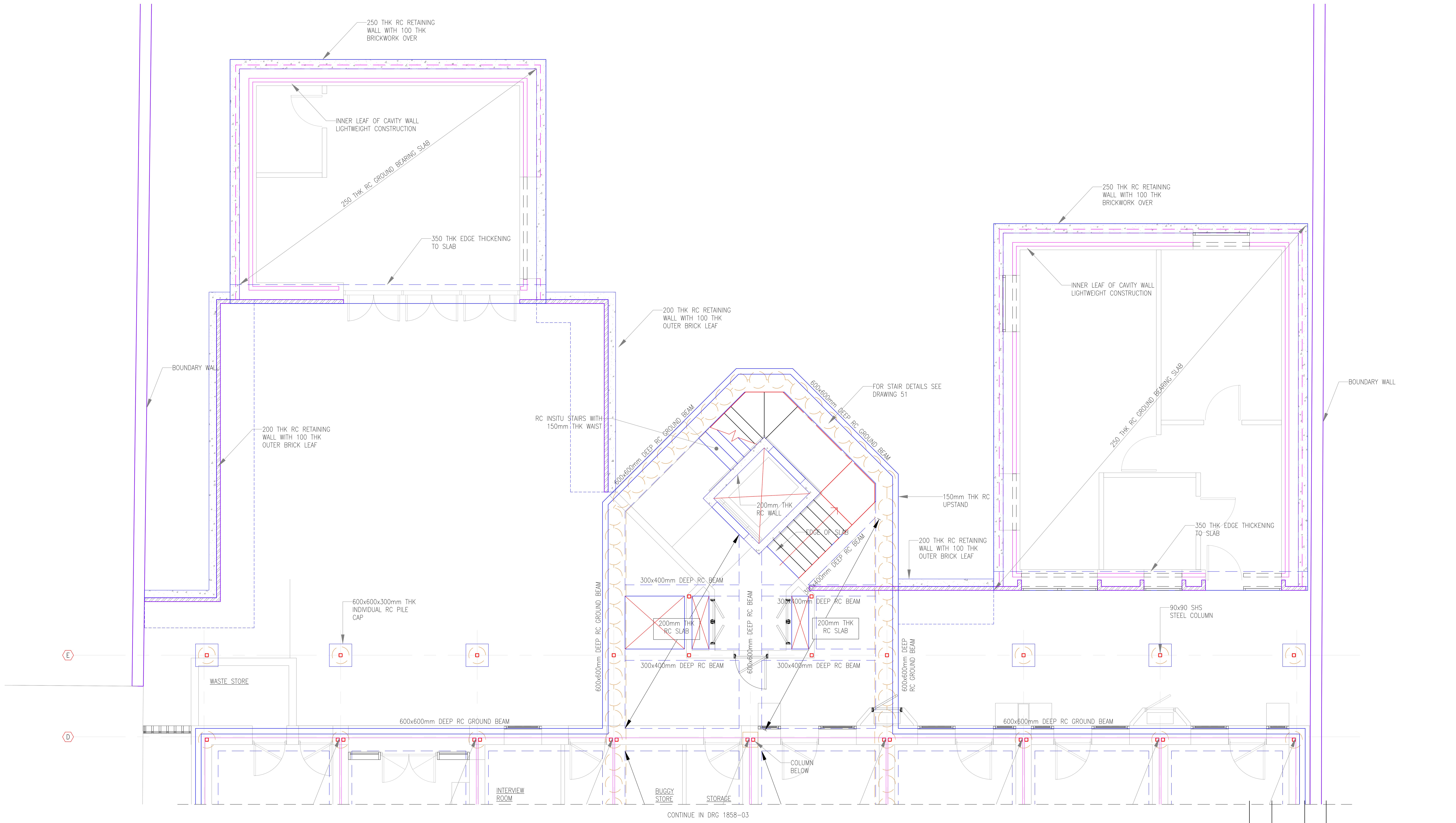

1 0 1 2 3 4 5 6 7 8 9 10 METRES

Rev	Date	By	Rev
A	06.11.20	CB	UPDATED
–	26.10.20	AB	SCHEME

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DRAWING STATUS: SCHEME

CLIENT: LONDON BOROUGH OF CAMDEN, 5 PANCRAS SQUARE, KINGS CROSS, LONDON, N1C 4AG

DRAWING TITLE: PROPOSED GROUND FLOOR PLAN COMMUNITY & WHEELCHAIR ACCESSIBLE BUILDING

JOB TITLE: CAMDEN ROAD HOSTEL 248–250 CAMDEN ROAD LONDON, NW1 9HE

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DATE	SCALE	DRAWN AB
26-10-2020	A1 – 1:50 A3 – 1:100	CHECKED CB
JOB No. 1858	DRG No. 05	REVISION A

NOTES

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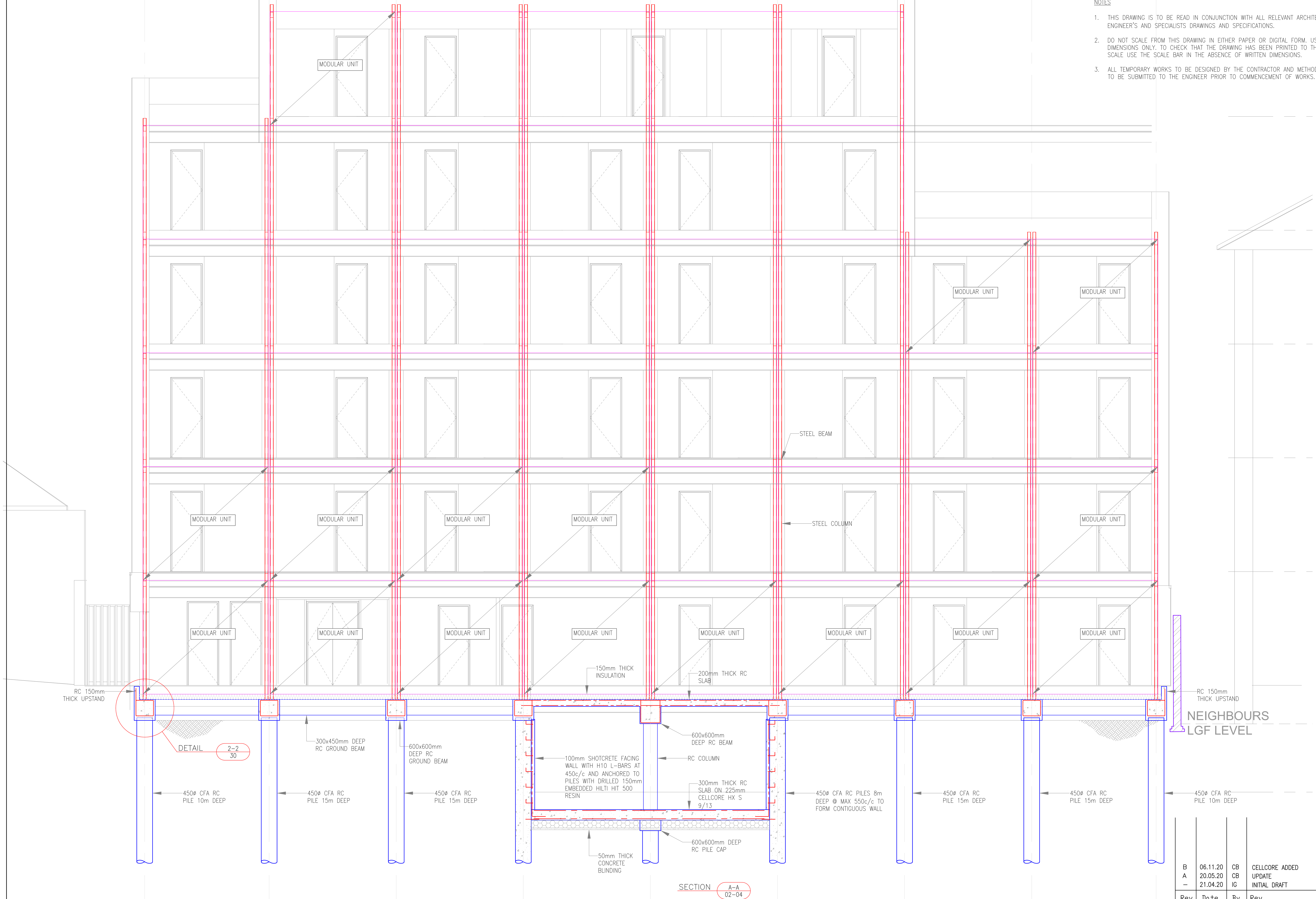

SECTION A-A 02-04

Rev	Date	By	Rev
B	06.11.20	CB	CELLCORE ADDED
A	20.05.20	CB	UPDATE
–	21.04.20	IG	INITIAL DRAFT

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DRAWING STATUS SCHEME

CLIENT LONDON BOROUGH OF CAMDEN
5 PANCRAS SQUARE, KINGS CROSS
LONDON, N1C 4AG

DRAWING TITLE
PROPOSED SECTION A-A

JOB TITLE
CAMDEN ROAD HOSTEL
248-250 CAMDEN ROAD
LONDON, NW1 9HE

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DATE 17-04-2020
SCALE A1 – 1:50 A3 – 1:100
DRAWN IG
CHECKED CB
JOB No. 1858
DRG No. 30
REVISION B

NOTES

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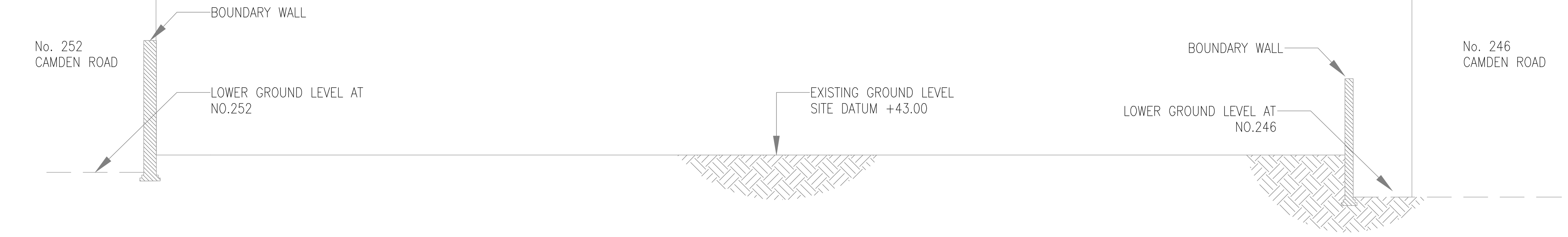
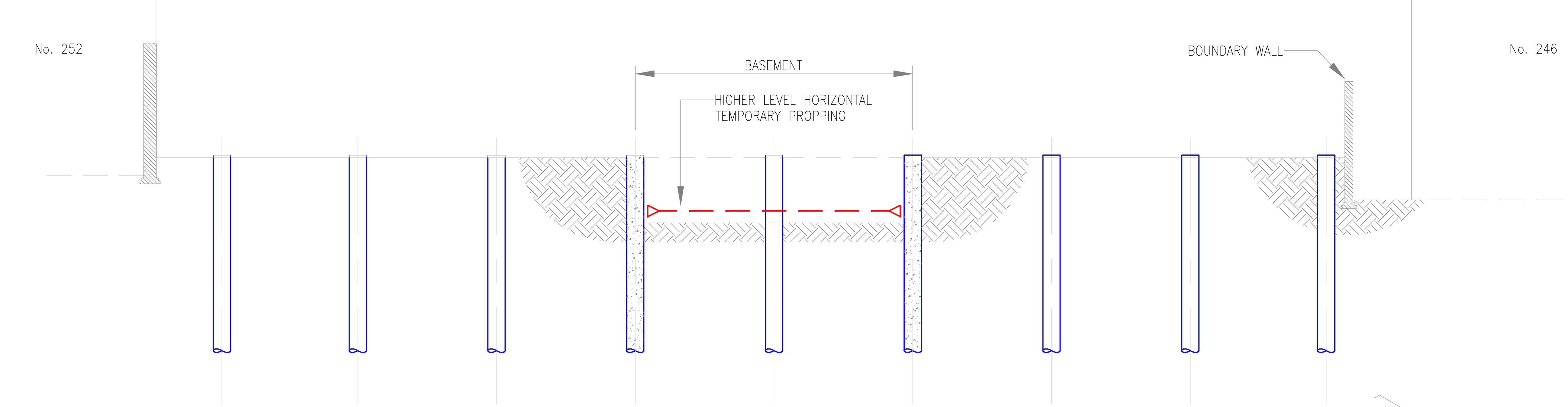
STAGE 1

- DEMOLISH EXISTING BUILDING;
- PREPARE CONSTRUCTION SITE WITH PILING MAT TO ALLOW NEW PILING AND BUILDING WORKS.



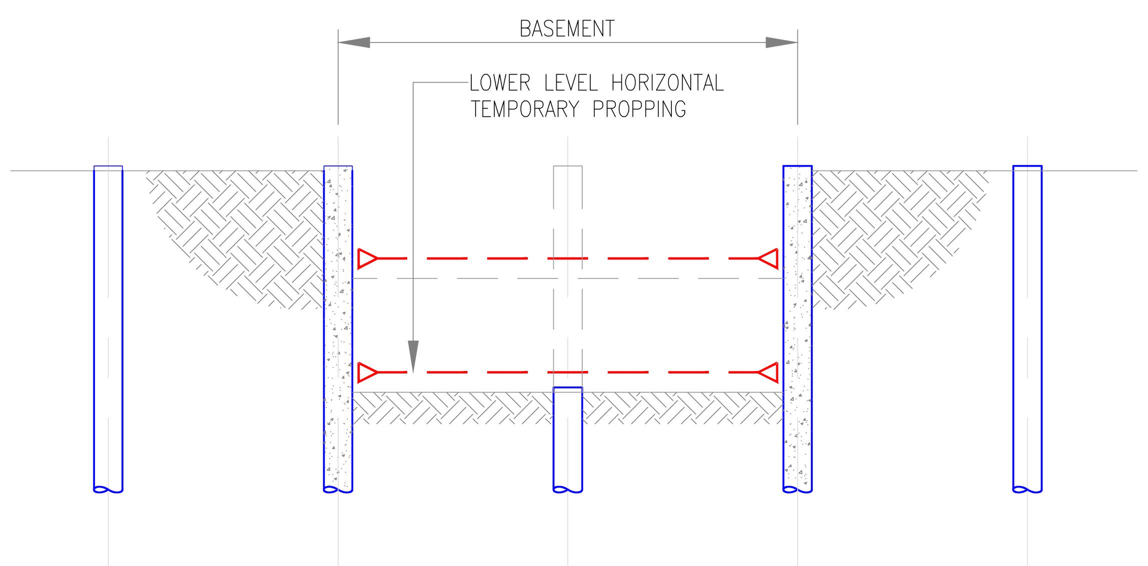
STAGE 2

- INSTALL CFA RC PILING
- DIG DOWN 1700mm WITHIN FUTURE BASEMENT AREA AND INSTALL HIGH LEVEL OF HORIZONTAL HEAVY DUTY PROPS BY RMD OR SIMILAR.



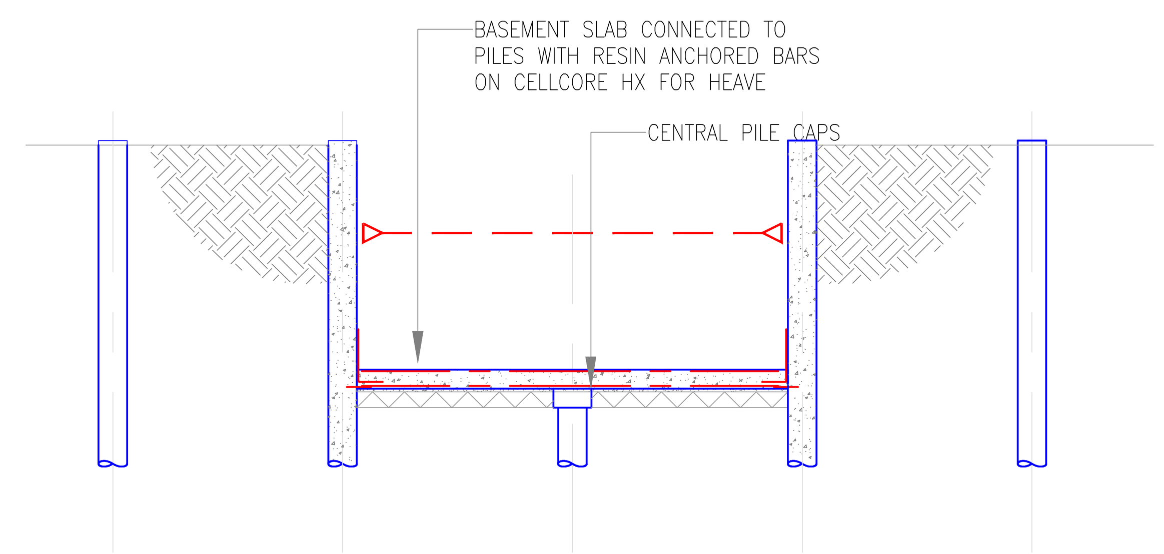
STAGE 3

- REDUCE EXCAVATION FURTHER DOWN 1800mm WITHIN BASEMENT AREA AND INSTALL LOWER LEVEL OF HORIZONTAL HEAVY DUTY PROPS IF REQUIRED BY PILING DESIGNER.
- CUT DOWN BASEMENT CENTRAL PILES TO NEW EXCAVATION LEVEL.



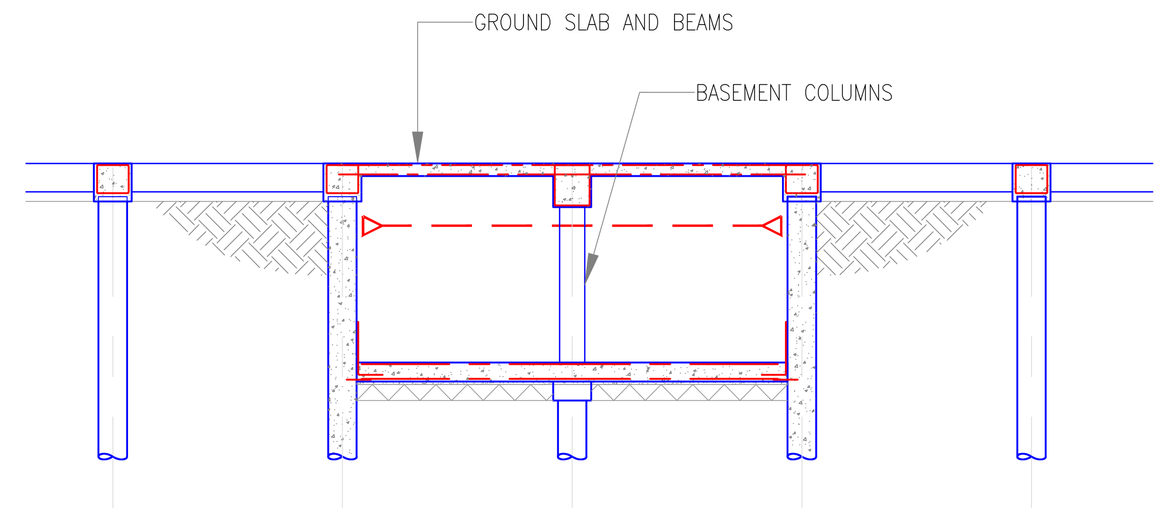
STAGE 4

- REDUCE EXCAVATION FURTHER DOWN TO BASEMENT SLAB FORMATION LEVEL;
- CAST RC PILE CAPS ON CENTRAL PILES LEAVING STARTER BARS FOR BASEMENT INTERNAL COLUMNS AND LIFT SHAFT;
- FORM BASE AND CELLCORE, BLIND AND CAST BASEMENT SLAB LEAVING STARTER BARS FOR LINING WALLS;
- WHEN CONCRETE HAS GAINED SUFFICIENT STRENGTH REMOVE LOWER LEVEL OF PROPPING.



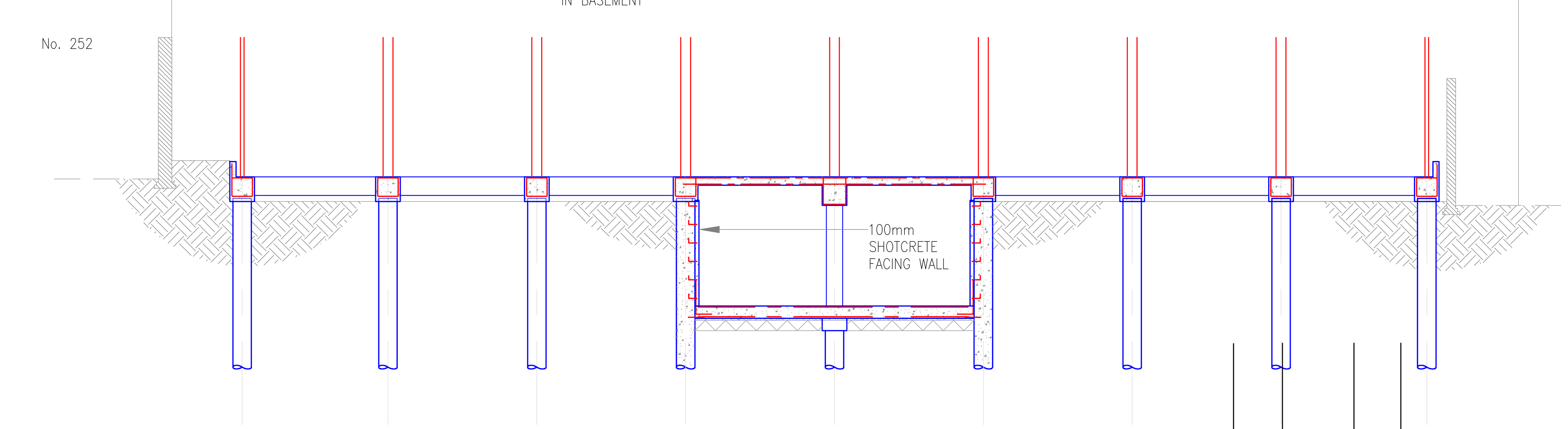
STAGE 5

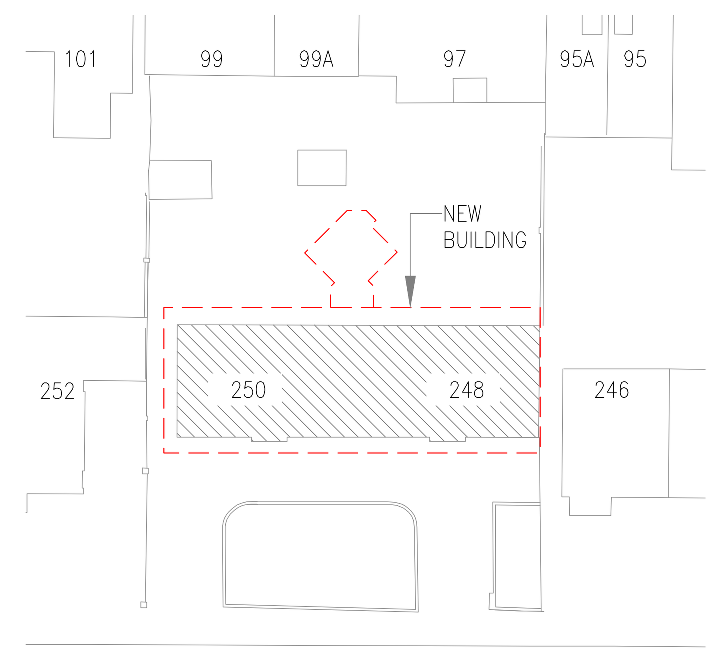
- CAST CENTRAL COLUMNS AND LIFT PIT;
- WHEN CONCRETE HAS GAINED SUFFICIENT STRENGTH REDUCE EXCAVATION AT GROUND LEVEL, CUT DOWN TOP OF PILES, INSTALL FORM-WORKS AND CAST ALL GROUND BEAMS AND SLAB;



STAGE 6

- WHEN CONCRETE HAS GAINED SUFFICIENT STRENGTH REMOVE HIGH LEVEL OF HORIZONTAL PROPPING AND INSTALL SUPERSTRUCTURES AND SHOTCRETE FACING WALLS IN BASEMENT





KEY PLAN

Rev	Date	By	Rev
A	06.11.20	CB	CELLCORE ADDED
–	23.10.20	AB	SCHEME

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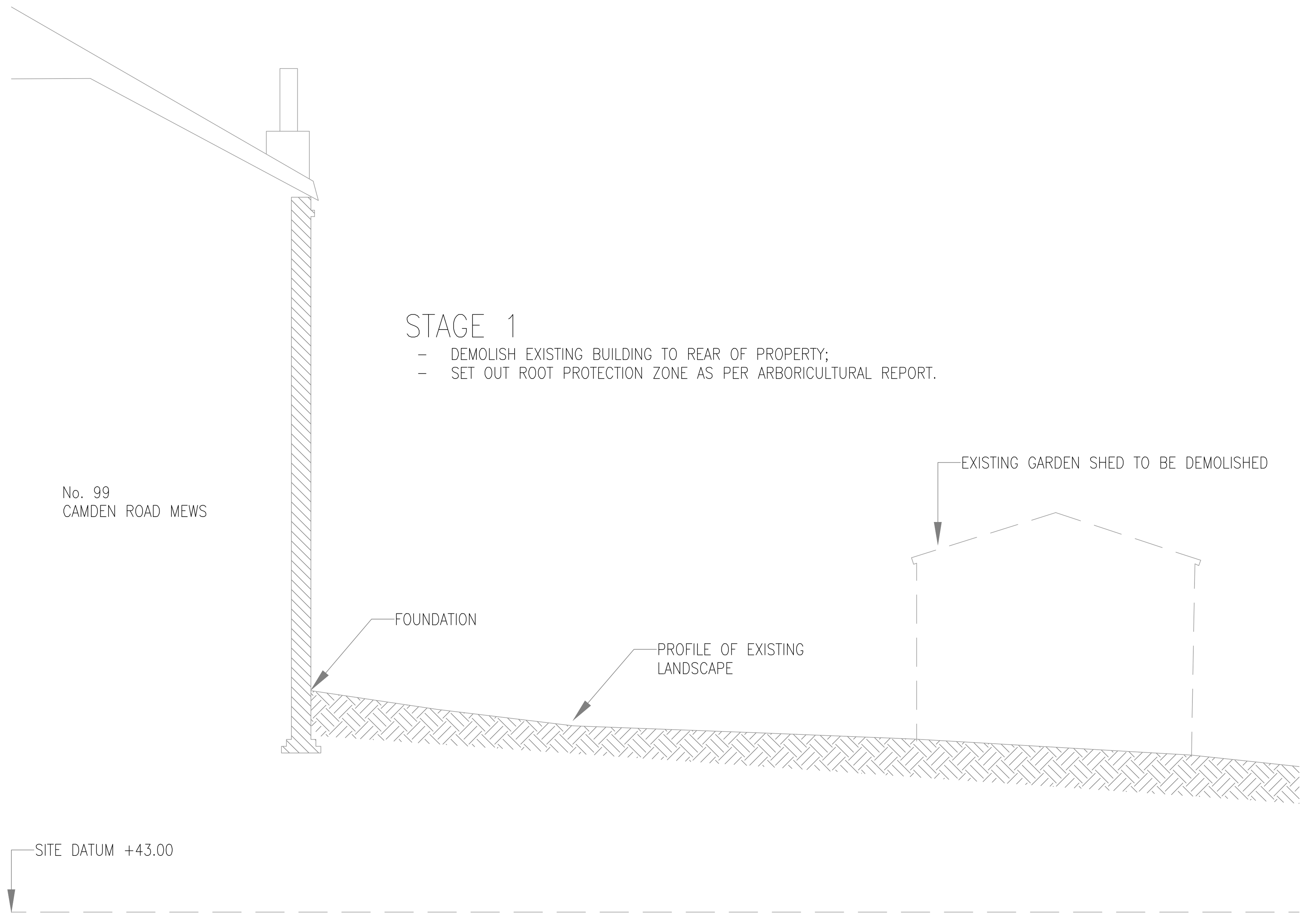
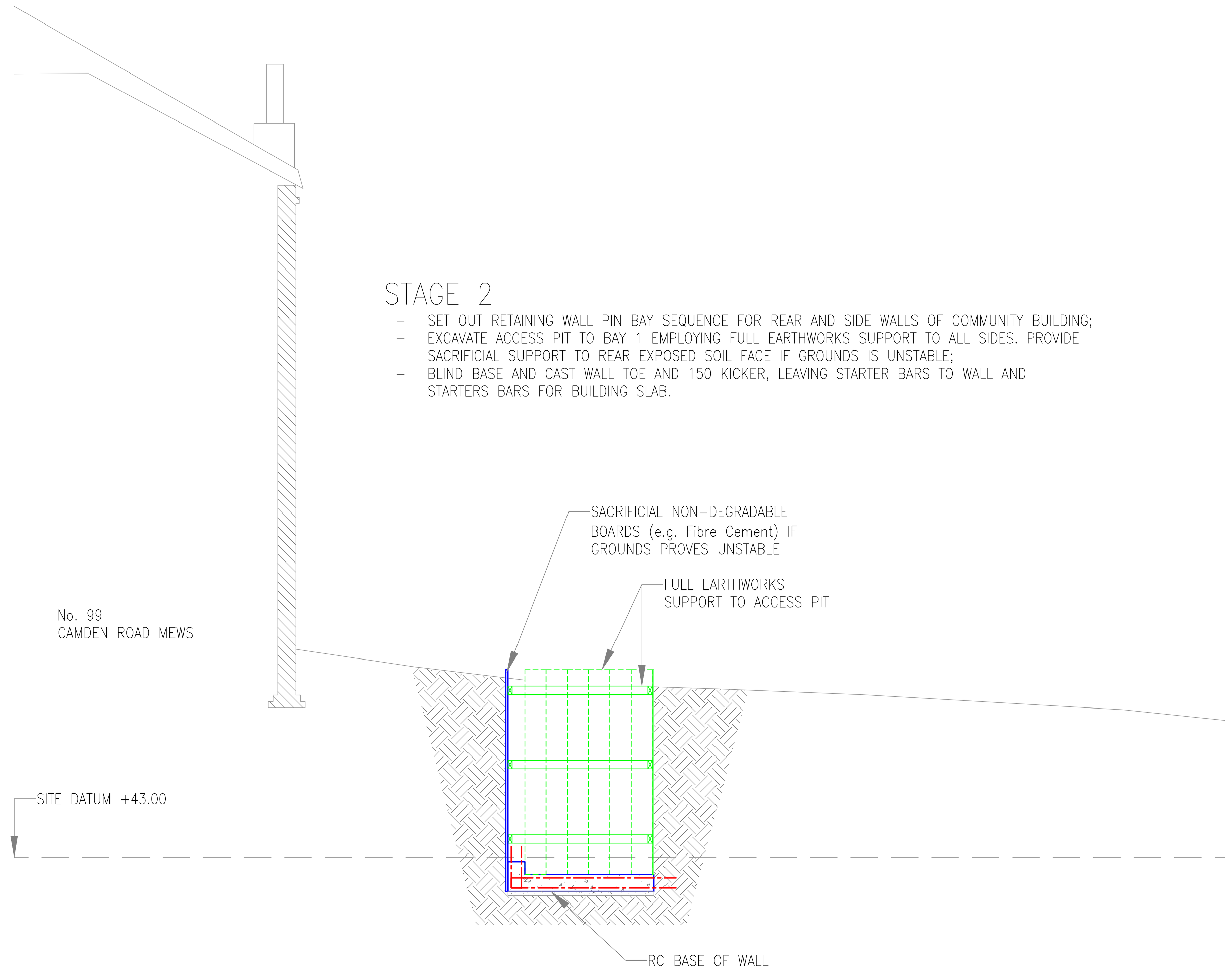
KEY PLAN

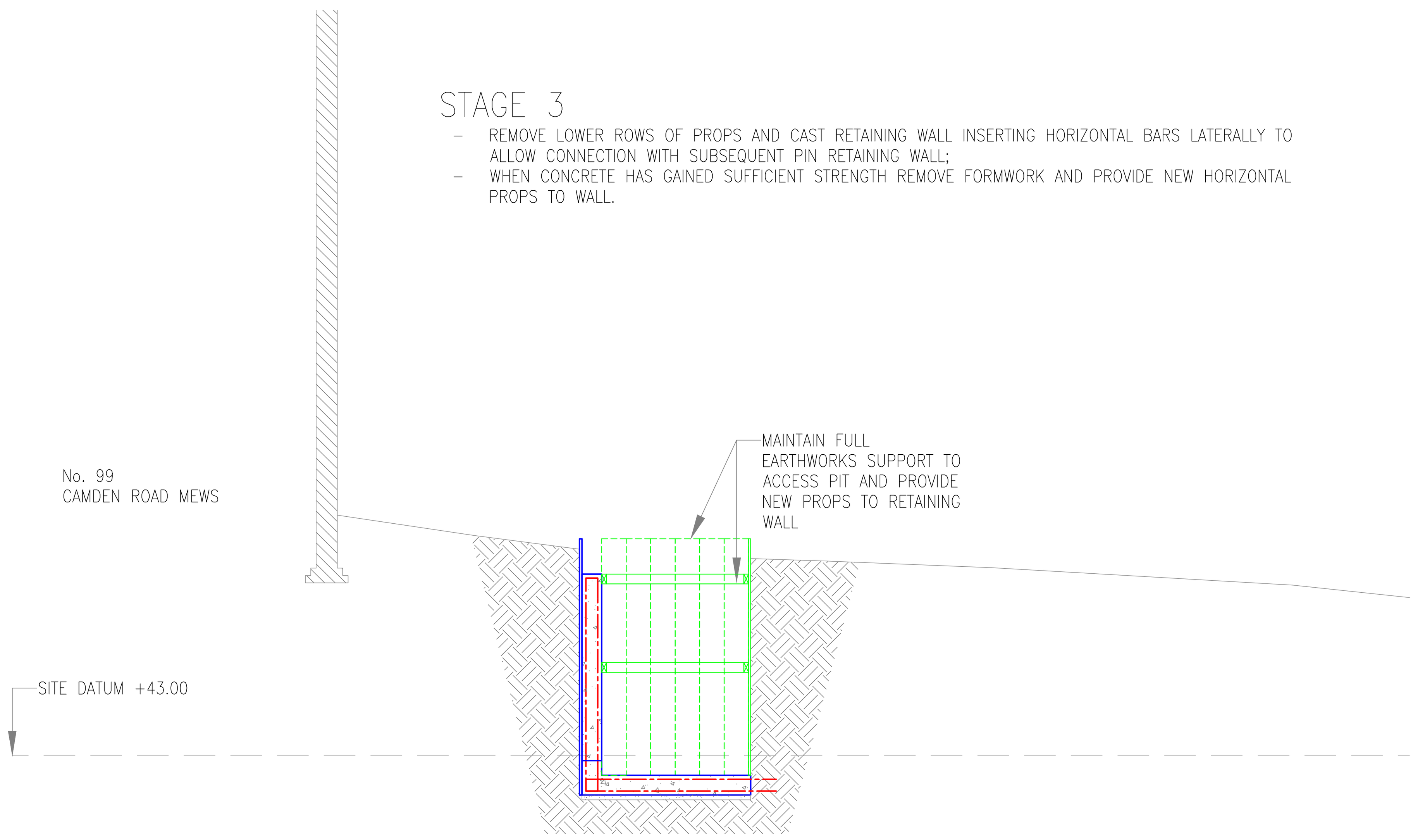
STAGE 1
- DEMOLISH EXISTING BUILDING TO REAR OF PROPERTY;
- SET OUT ROOT PROTECTION ZONE AS PER ARBORICULTURAL REPORT.



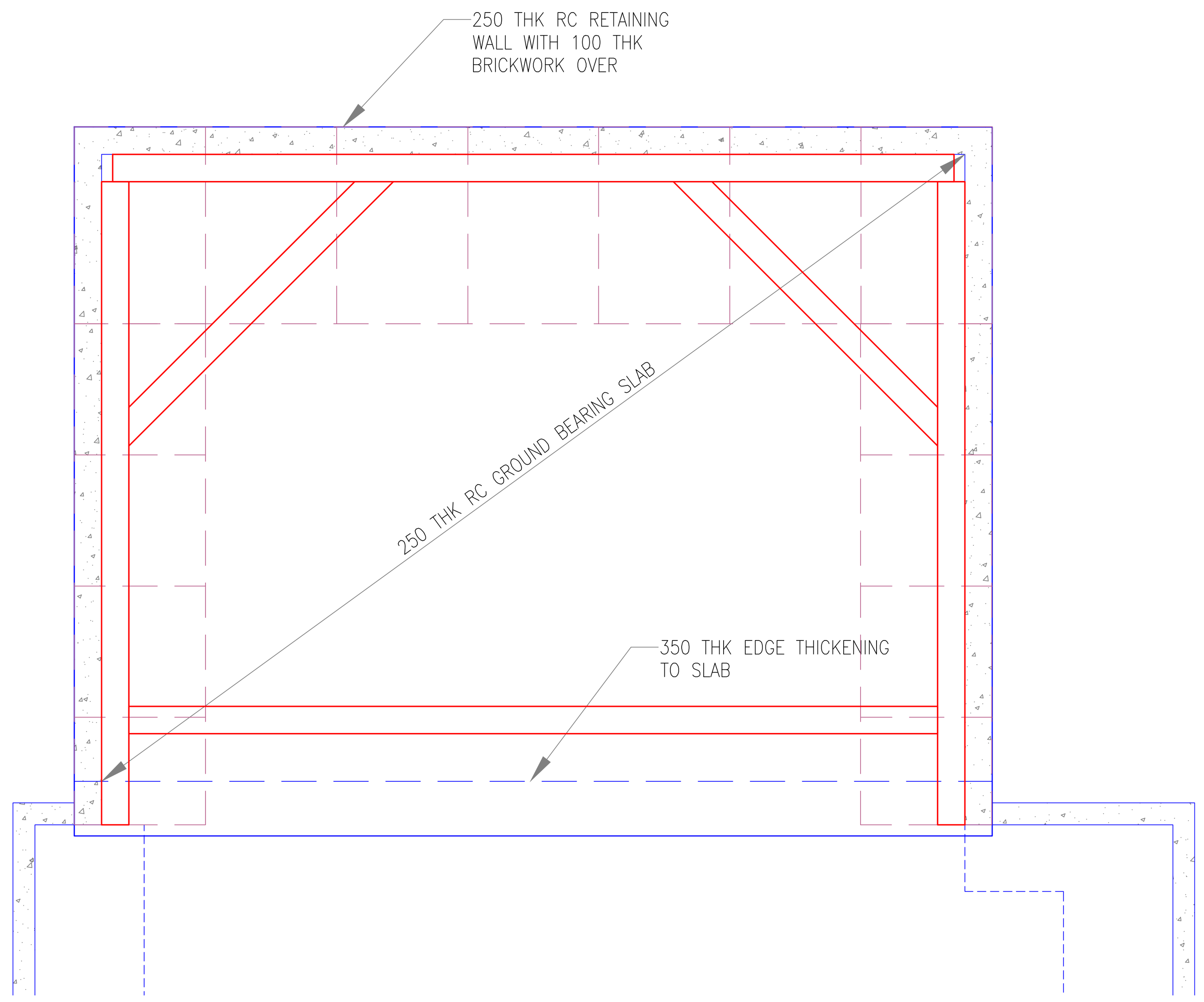
STAGE 2
- SET OUT RETAINING WALL PIN BAY SEQUENCE FOR REAR AND SIDE WALLS OF COMMUNITY BUILDING;
- EXCAVATE ACCESS PIT TO BAY 1 EMPLOYING FULL EARTHWORKS SUPPORT TO ALL SIDES. PROVIDE SACRIFICIAL SUPPORT TO REAR EXPOSED SOIL FACE IF GROUNDS IS UNSTABLE;
- BLIND BASE AND CAST WALL TOE AND 150 KICKER, LEAVING STARTER BARS TO WALL AND STARTERS BARS FOR BUILDING SLAB.



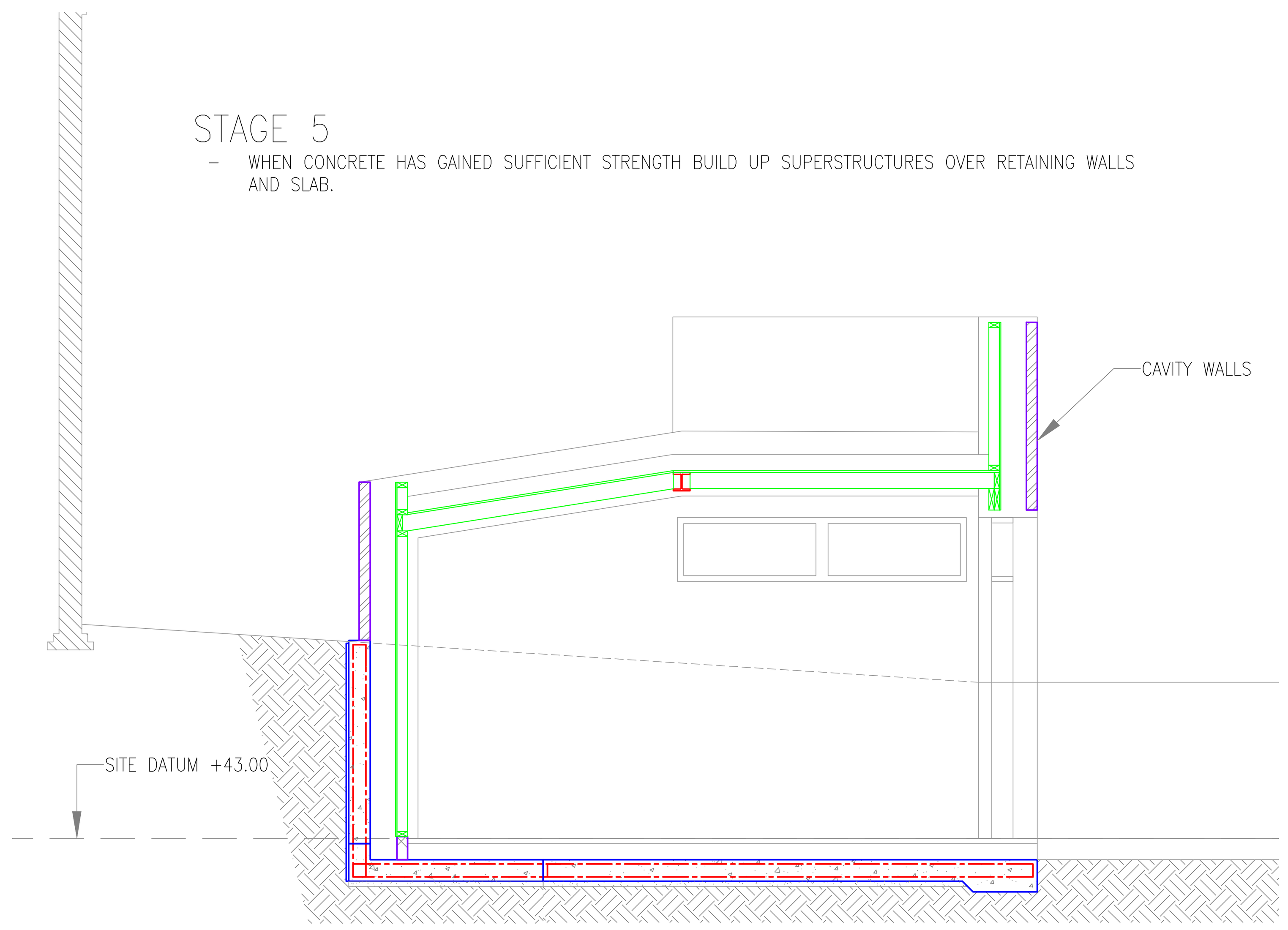
STAGE 3
- REMOVE LOWER ROWS OF PROPS AND CAST RETAINING WALL INSERTING HORIZONTAL BARS LATERALLY TO ALLOW CONNECTION WITH SUBSEQUENT PIN RETAINING WALL;
- WHEN CONCRETE HAS GAINED SUFFICIENT STRENGTH REMOVE FORMWORK AND PROVIDE NEW HORIZONTAL PROPS TO WALL.



STAGE 4
- REPEAT STAGE 2&3 PROPPING ACROSS TO CENTRAL PUDDLE OF EARTH AFTER EACH PIN IS CAST
- COMMENCE REDUCTION OF PUDDLE TO APPROX 1.2m ABOVE BASE SLAB
- INSTALL WALING BEAMS AND PROPS AT THIS LEVEL
- REMOVE REMAINDER OF CENTRAL PUDDLE AND CAST CENTRAL PORTION OF BASE SLAB
- REMOVE PROPS AND WALING BEAMS



STAGE 5
- WHEN CONCRETE HAS GAINED SUFFICIENT STRENGTH BUILD UP SUPERSTRUCTURES OVER RETAINING WALLS AND SLAB.



Rev	Date	By	Rev
A	06.11.20	CB	SEQUENCE MODIFIED
–	23.10.20	AB	SCHEME

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DRAWING STATUS SCHEME

CLIENT LONDON BOROUGH OF CAMDEN
5 PANCRAS SQUARE, KINGS CROSS
LONDON, N1C 4AG

DRAWING TITLE
STRUCTURAL METHODOLOGY
COMMUNITY BUILDING

JOB TITLE
CAMDEN ROAD HOSTEL
248-250 CAMDEN ROAD
LONDON, NW1 9HE

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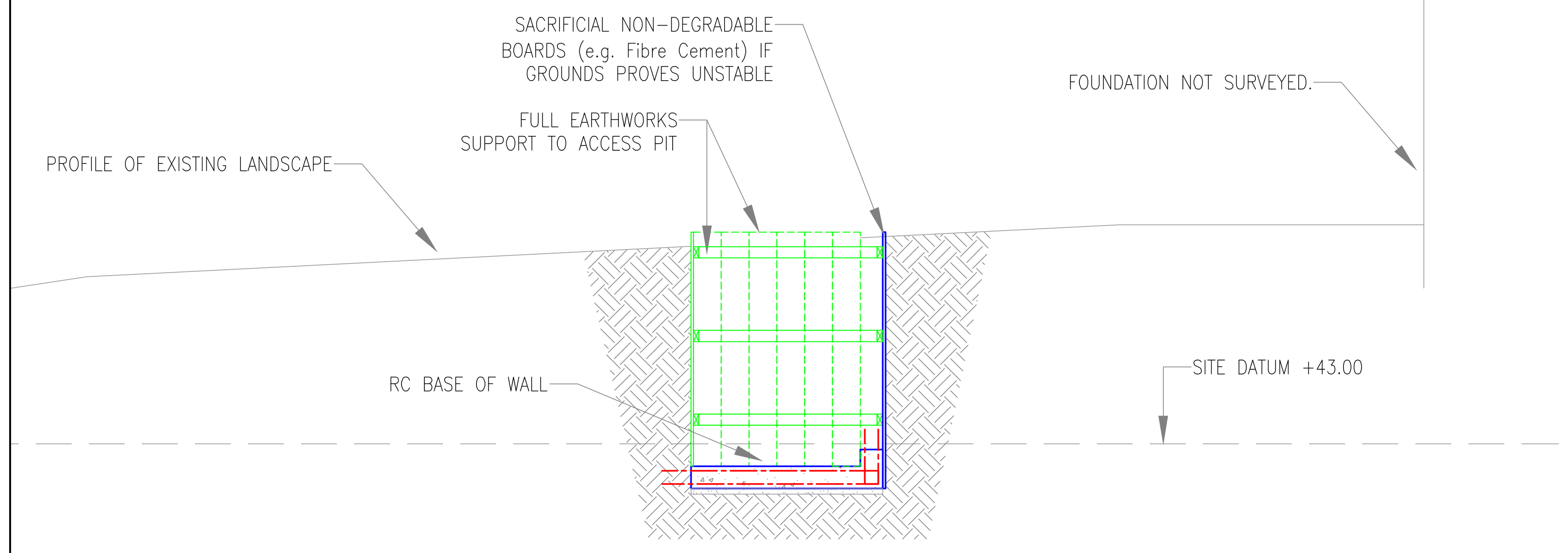
DATE	SCALE	DRAWN AB
17-04-2020	A1 – 1:50 A3 – 1:100	CHECKED CB
JOB No.	DRG No.	REVISION
1858	ST2	A

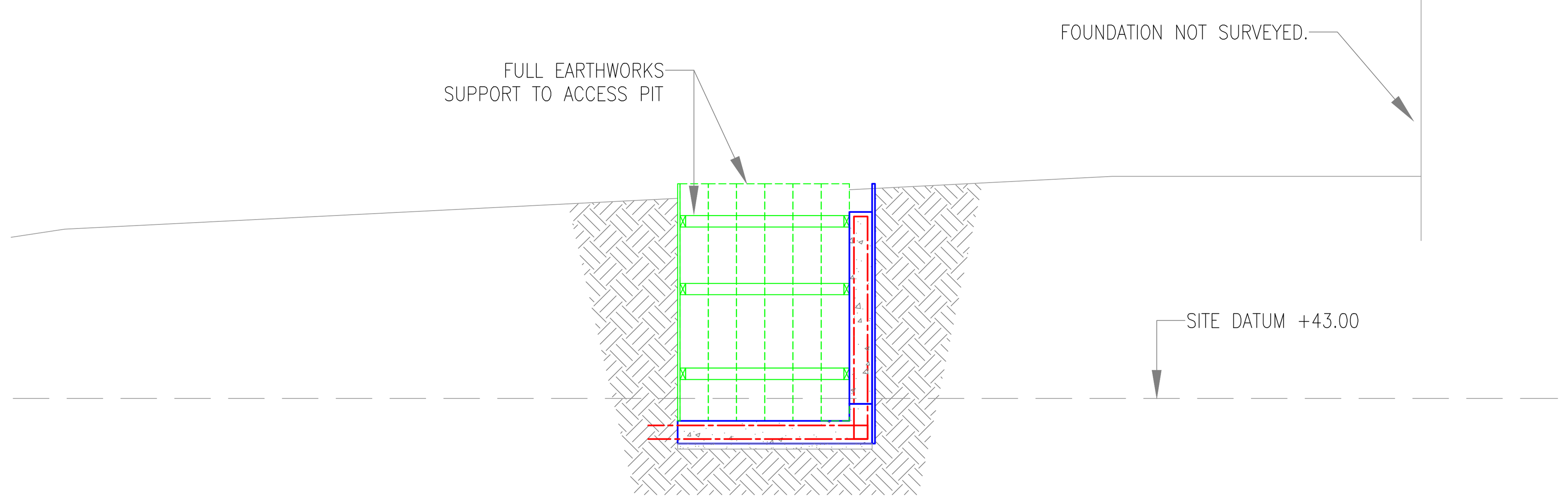
STAGE 1

- SET OUT ROOT PROTECTION ZONE AS PER ARBORICULTURAL REPORT;
- SET OUT RETAINING WALL PIN BAY SEQUENCE FOR REAR WALL AND 1000mm LONG PIN BAY SEQUENCE FOR SIDE WALLS OF WHEELCHAIR ACCESSIBLE BUILDING;
- EXCAVATE ACCESS PIT TO BAY 1 EMPLOYING FULL EARTHWORKS SUPPORT TO ALL SIDES. PROVIDE SACRIFICIAL SUPPORT TO REAR EXPOSED SOIL FACE IF GROUNDS IS UNSTABLE;
- BLIND BASE AND CAST WALL TOE AND 150 KICKER, LEAVING STARTER BARS TO WALL AND STARTERS BARS FOR BUILDING SLAB.



STAGE 2

- REMOVE LOWER ROWS OF PROPS AND CAST RETAINING WALL INSERTING HORIZONTAL BARS LATERALLY TO ALLOW CONNECTION WITH SUBSEQUENT PIN RETAINING WALL;
- WHEN CONCRETE HAS GAINED SUFFICIENT STRENGTH REMOVE FORMWORKS AND PROVIDE NEW HORIZONTAL PROPS TO WALL.



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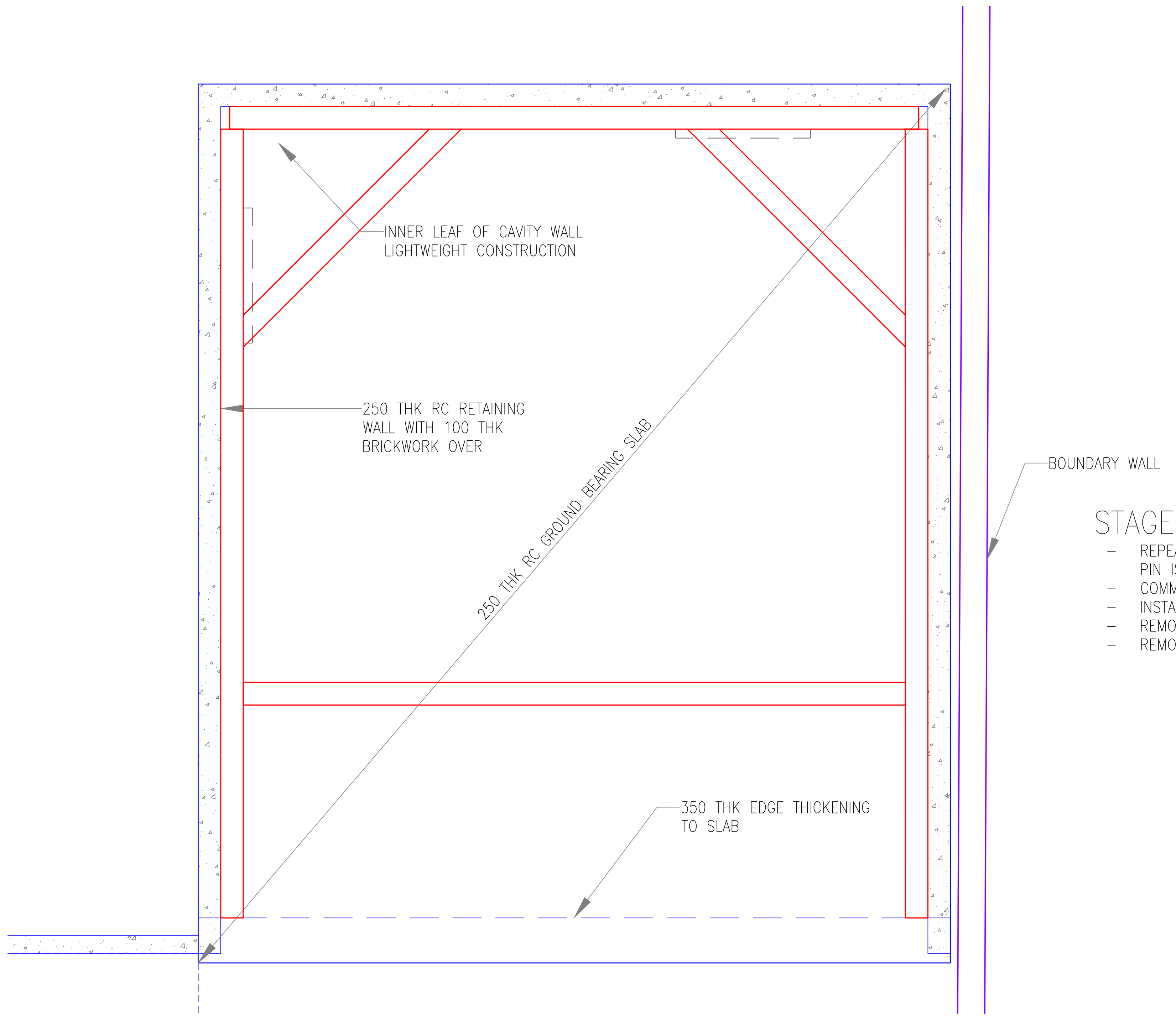
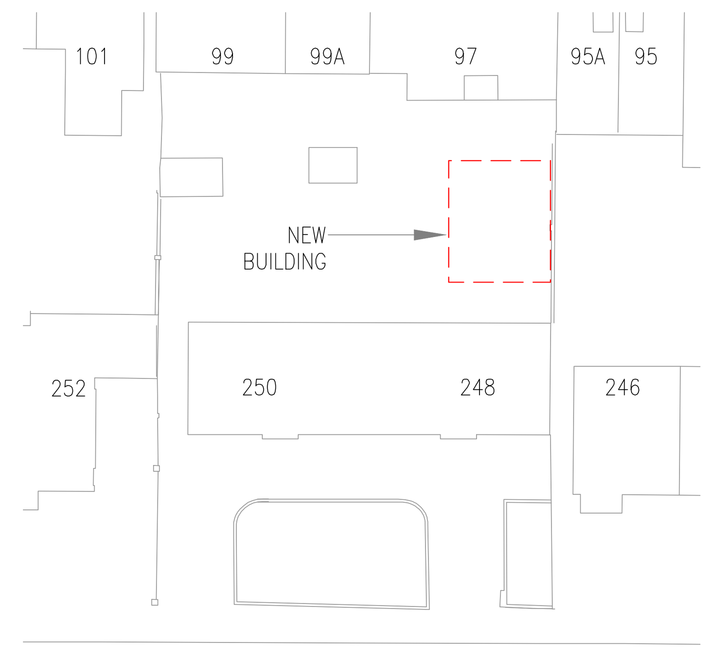


STAGE 3

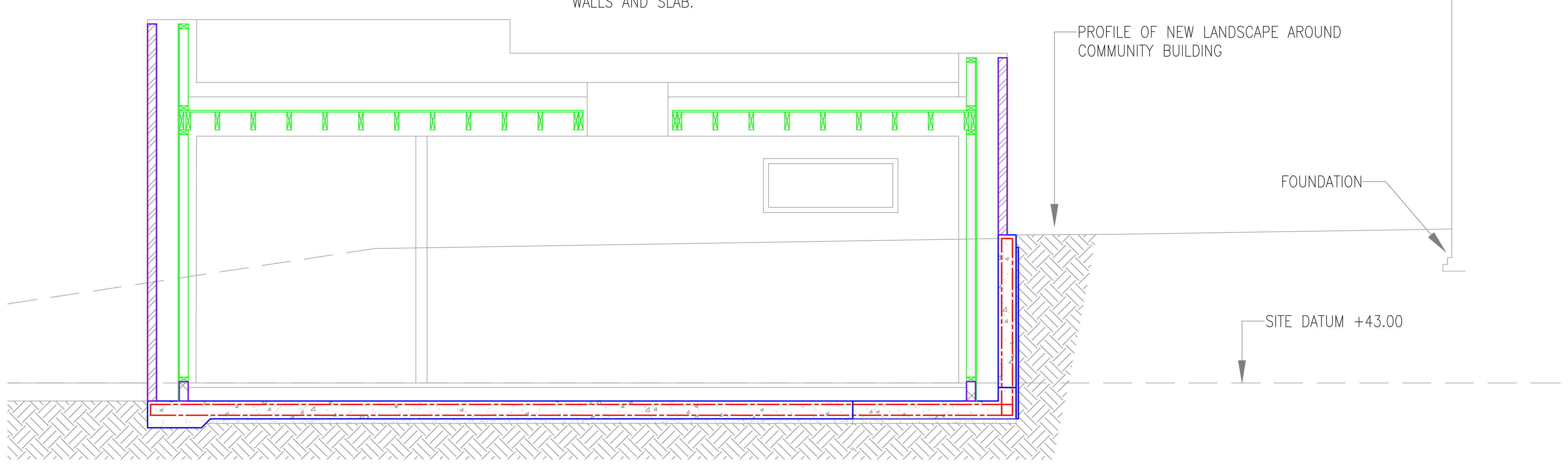
- REPEAT STAGE 1&2 PROPPING ACROSS TO CENTRAL PUDDLE OF EARTH AFTER EACH PIN IS CAST
- COMMENCE REDUCTION OF PUDDLE TO APPROX 1.2m ABOVE BASE SLAB
- INSTALL WALING BEAMS AND PROPS AT THIS LEVEL
- REMOVE REMAINDER OF CENTRAL PUDDLE AND CAST CENTRAL PORTION OF BASE SLAB
- REMOVE PROPS AND WALING BEAMS



KEY PLAN

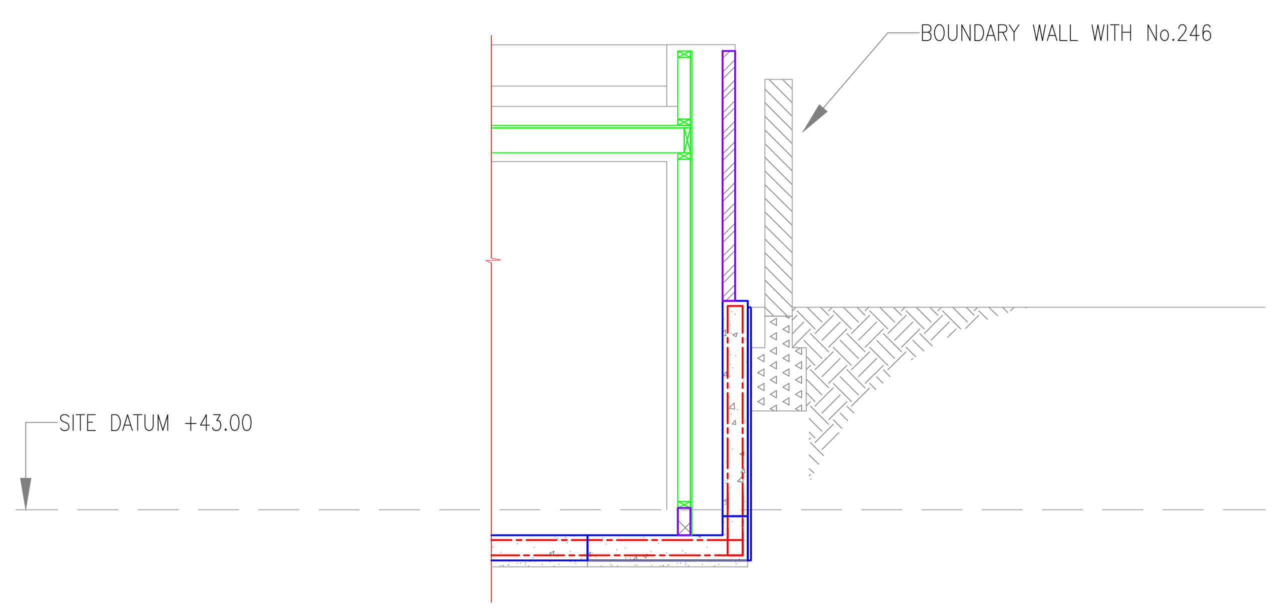
STAGE 4

- REPEAT STAGE 1 TO 2 UNTIL WHEELCHAIR ACCESSIBLE BUILDING REAR AND LATERAL RETAINING WALLS ARE COMPLETED;
- REDUCE LEVEL OF SOIL TO FRONT OF RETAINING WALL TO FORMATION LEVEL AND CAST GROUND SLAB AFTER PREPARING ADEQUATE SUBSOIL AND BLINDING;
- WHEN CONCRETE HAS GAINED SUFFICIENT STRENGTH BUILD UP SUPERSTRUCTURES OVER RETAINING WALLS AND SLAB.



STAGE 4–ALONG BOUNDARY WALL

- REPEAT STAGE 1 TO 2 UNTIL WHEELCHAIR ACCESSIBLE BUILDING SIDE WALL TO BOUNDARY IS COMPLETED;
- REDUCE LEVEL OF SOIL TO FRONT OF RETAINING WALL TO FORMATION LEVEL AND CAST GROUND SLAB AFTER PREPARING ADEQUATE SUBSOIL AND BLINDING,
- WHEN CONCRETE HAS GAINED SUFFICIENT STRENGTH BUILD UP SUPERSTRUCTURES OVER RETAINING WALLS AND SLAB.



Rev	Date	By	Rev
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–	23.10.20	AB	SCHEME

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DRAWING STATUS: SCHEME

CLIENT: LONDON BOROUGH OF CAMDEN, 5 PANCRAS SQUARE, KINGS CROSS, LONDON, N1C 4AG

DRAWING TITLE: STRUCTURAL METHODOLOGY WHEELCHAIR ACCESSIBLE BUILDING

JOB TITLE: CAMDEN ROAD HOSTEL, 248-250 CAMDEN ROAD, LONDON, NW1 9HE

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DATE	SCALE	DRAWN AB
17-04-2020	A1 – 1:50 A3 – 1:100	CHECKED CB
JOB No. 1858	DRG No. ST3	REVISION A

Structural Stage 3 Planning report

for

Camden Road Hostel

rodriguesassociates
1 Amwell Street
London
EC1R 1UL
Telephone 020 7837 1133
www.rodriguesassociates.com
November 2020

Structural Stage 3 Report

for

Camden Road Hostel

for

Camden council

Job No 1858

Rev	Date	Notes
1	06.11.20	Planning issue

By Carl Bauer CEng MICE MIStructE.
for
RODRIGUES ASSOCIATES

Introduction

This report sets out the structural scheme for the project at RIBA Stage 3 and outlines the structural considerations for the detailed design stage of the project.

This report should be read with drawings 1858-02 to 50.

Structure Summary

Maximum plan dimensions	30x12m and 5x5m stair/lift core
Stories	6 and 1 basement level
Maximum height	20m
Foundations	Piles and ground beams + bsmt
Floor structure	Steel joists for modules + RC deck
Vertical structure	Steel columns in modules
Lateral stabililty	Diagonal bracing in party walls Offset K bracing in front elevation. Floor plates provide diaphragm action

Imposed loads

Domestic and residential (All residential units all floors)	1.5 kN/m^2 UDL and 1.4 kN point load
Communal areas (Ground floor, access decks)	3 kN/m^2 UDL and 4.5 kN point load

Roof plant loading will be calculated based on the plant and access required.

All internal non-load bearing partitions are assumed to be light weight stud partitions and an allowance of 1.0kN/m^2 UDL should be made for these.

Wind loads are calculated to BS EN 1991-1-4 + UK NA

Robustness

The Building Regulations have the following requirement:

Disproportionate Collapse

A3. The building shall be constructed so that in the event of an accident the building will not suffer collapse to an extent disproportionate to the cause.

The Building Regulations Approved Document A – Structure 2010 edition, classifies the building as a Class 2B building and gives the following guidance for compliance with the Building Regulations.

For Class 2B buildings – Provide effective horizontal ties, as described in the Codes and Standards listed under paragraph 5.2 for framed and load-bearing wall construction (the latter being defined in paragraph 5.3 below), together

with effective vertical ties, as defined in the Codes and Standards listed under paragraph 5.2, in all supporting columns and walls.

Site Geology

A Geotechnical Survey Report has been produced by Fastrack (Ref 20269 Dec 19). The contents of this can be summarised as follows.

The site is underlain by London Clay, with no superficial deposits. Made Ground was encountered across the site to a maximum depth of approximately 2.10m with Silty CLAY underlying the Made Ground to considerable depth.

The London Clay falls into soil class CV and CH of the British Soil Classification System. The results show the samples to be high-very high plasticity. The plastic indices were found to range from 32-54%, this indicates that the Clay is of generally intermediate to high susceptibility to shrinkage and swelling with changes in moisture content.

The design sulphate class for buried concrete for this site is DS-3, with an ACEC class of AC-3.

For the main building conventional strip foundations could be utilised but are likely to be economically unviable due to size, shoring and health & safety risks. Therefore, a piled foundation taken down further into the London Clay is proposed. This will also mitigate any risk of differential settlement between the basement and ground floor. The borehole data contained within the Fastrack report is sufficient for a piling contractor to carry out a pile design.

Excavations on this site are likely to be unaffected by water inflows, with the groundwater levels likely to be at a depth greater than 15.00m.

The material encountered on this site was found to be of a generally cohesive nature, which would indicate that sides of excavations are likely to be self-supporting, certainly in the short term. However, temporary support should be considered for all excavations where collapse is to be avoided, with heavy duty closed shoring in excavations below 1.20m where construction workers access is required.

CBR tests were carried out at three locations across the site at a depth of 0.45m. Two tests came out at less than 3% suggesting poor quality subgrade should be allowed for in designing the base to any trafficked areas.

Soakaway tests showed a slow rate of infiltration within the London Clay. Therefore, the site is not considered suitable for a soakaway system.

Superstructure Main Building

In order to access the benefits of offsite construction in terms of cost, programme and quality, the brief is to design for volumetric modular construction. This allows for maximum offsite construction. In order to access the benefits of economy of scale, this project is one of two seeking to use the same offsite modular manufacturer.

To this end, the client and design team have been in contact with an offsite modular manufacturer to ensure that the design is appropriate for volumetric modular construction.

Any flammable materials for external walls are precluded because of current concerns from the client side over managing fire risks. Therefore, prefabricated timber or CLT based modules are not being considered. Steel is considered suitable as the main material in external walls.

Due to the number of stories the modular manufacturers have advised that hot rolled steel columns will be incorporated within the volumetric modules as the main load bearing elements. Between these steel columns there will be infill panels of light gauge steel studs and diagonal bracing to the main structure. We have assumed two internal columns along the party wall lines as this suits the locations of possible columns at ground floor level in the communal and office areas and allows column sizes to be minimised. It would be possible to use a single column in the centre of the party wall lines but beam sizes between columns would increase and column sizes and transfer structure might be required at first floor level to accommodate the communal and office area layouts.

The typical floor construction of the modules will be light gauge steel joists with boarding spanning between party walls at approximately 3.5m centres. Each volumetric module would also have a similar construction for its ceiling thereby providing a double layer of structure between modules.

The flat roof occurs at several levels as the building steps along its length. This would be of the same construction as the floors and this would need to allow for plant loading and maintenance access. Green roof and solar PV panel loads and fixings would also need to be allowed for in the ceiling structure of the top modules. The top modules would need to allow for windpost extensions to provide stability for the parapets.

Cladding is brick at ground floor level and this will be supported directly off the foundations. From first floor level up the cladding will be a rainscreen cladding supported from the superstructure at each level.

Superstructure Stair/Lift Core and Deck

This structure is not enclosed and therefore unheated. Drainage of the access deck will also need to be considered.

The lift core consists of 200mm thick reinforced concrete walls. This structure provides the lateral stability for the whole access core. Due to the limited length of the connection of the core landing to the deck of the main structure it may not be feasible to use the lift core to provide stability to the main structure. There is a possible alternative construction of the lift core using a braced steel frame instead of reinforced concrete construction. The frame would then require cladding so exposed reinforced concrete is considered simpler.

The stairs above ground level will be a lightweight steel stair with flat plate strings supporting steel plate treads and landings. The stair wraps around the concrete core and takes support from this. It would then cantilever out from this core to support landings and flights. This allows the exterior of the staircase structure to be limited to lightweight balustrading taking only horizontal loads.

The main landing and access deck consist of a 100mm thick RC slab on Comflor 51 metal decking. This is supported by steel beams. For the main landing these steel beams are supported by the concrete lift core. For the access deck they are supported by slender steel columns externally and they need to be supported back to the modular units internally. This connection will need to be designed to minimise thermal bridging using a thermal break. The modular manufacturers have expressed a preference for an independent internal line of vertical deck support against the façade. This would affect the MVHR cupboards and external benches but may be possible.

There will be a significant amount of balustrading surrounding the landings and access deck and the details of this will need to be carefully coordinated with the architecture as this will all be visible. It is envisaged that the main balustrade rail spans horizontally between columns with infill panels spanning vertically from the deck up to the balustrade rail. Much of the steelwork in this area will be exposed and so corrosion protection and maintenance need to be carefully considered in the detailing.

Substructure Main Building

The foundations of the existing building are likely to require removal or at least cutting down to below the level of any new structure as enabling works. Trial pits to a max depth of 1.7m were unable to encounter the base of these foundations. The foundations are unlikely to be much deeper than the level of the insitu ground at approx. 2m but this demolition of foundations is a project cost risk as the quantity and depth of existing foundations is unknown.

The party wall loads have been assessed to be of the order of 140kN/m. This would require significant width strip footings of the order of 1.4m. The presence of trees means that these footings may need to bear at depths of 1.5-2.5m to avoid problems with seasonal movements. Therefore, strip or pad footings are unlikely to be economical and piles will be required. We have assumed CFA piles will be used of 300 to 450mm diameter with depths of 10-15m. The majority of load will be on the party wall and gable wall lines so the piles would be placed under reinforced concrete capping beams on these lines.

For modular construction, the ground floor modules will have their own floor structure so a ground floor slab is not generally required, and the modular units will sit on a grillage of ground beams which double as pile caps. However, it is assumed that the basement will require a 200mm thick concrete slab over to provide more robust separation of the basement plant area from the ground floor modular units as well as propping the head of the basement walls.

The access deck external columns land on individual pile caps.

The basement is formed with a contiguous pile wall to minimise excavation required outside the basement zone for access and working space. Once the piles are installed and the capping beam cast, excavation can commence with temporary propping of the capping beam. Piles would also be required for internal columns in the basement which would terminate at basement level. A basement slab is designed as suspended and will have a collapsible material under it to allow for heave. This would span from external walls to internal pile caps (see basement slab calculation in appendices). Internally the contiguous piles are faced with sprayed concrete and the basement can be waterproofed with a drained cavity and a block finish. For the lift to access the basement level a lift pit approx. 1100mm deep is required. This will also require piles for support.

The slab over the basement requires downstand beams to transfer loads from superstructure columns to the basement perimeter capping beam and internal RC columns.

Lateral Stability to Main Building

In the East–West direction which is from the front to back of the building, the party and gable walls can be used to provide lateral stability. The party walls consist of double layers of structure with a wall from each modular unit adjacent to the next unit. These walls consist of hot rolled steel hollow section columns with light gauge steel infill. The infill between hot rolled steel columns will also need to accommodate bracing. This could possibly be in the form of flat plate cross bracing with only braces in tension actively contributing stiffness to the system. As there are double skin party walls at 3.5m centres, it may not be necessary to brace every bay in every wall.

Consideration also needs to be given to openings to the party wall lines. At ground floor there are two grid lines which require mostly open walls for the communal areas and therefore these can not contain bracing. The client has also expressed a desire to allow for potential future openings to allow for units to be combined. Therefore, it would be an advantage to have no more than 50% of the length of any party wall containing bracing. The location of this will need to be agreed at detailed design stage.

In the North-South direction which is along the length of the building, there is a long rear wall and front wall. The rear wall consists mostly of openings with windows, doors and side panes to each unit leaving little wall to provide any lateral bracing. Therefore, bracing will be assumed to be entirely in the front elevation wall with resulting torsion due to the off centre lateral stiffness being taken out in the East-West wall bracing. Even the front elevation has significant window openings so diagonal bracing will not be possible. Even K bracing would interrupt openings as currently proposed so some form of offset K bracing, or moment stability frames will be required in this elevation.

The floor plates will need to act as diaphragms. This means that there will need to be continuity of the diaphragm provided by the connection between the modules at each floor level. The walkway access deck relies on the main structure for its stability and so will require some form of connection back to the main structure to take lateral loads back whether or not an additional line of vertical support for the deck is provided against the façade.

Communal Building and Wheelchair Accessible Units

These buildings are isolated buildings in the landscape, partially sunk into the surrounding ground to be at the same level as the main building ground floor. They will therefore need to be surrounded on three sides by retaining walls.

As they are already partially sunk into the ground and loads are minimal from a single lightweight story, a ground bearing concrete raft is being considered as a foundation solution. The base slab and retaining walls consist of 250mm thick reinforced concrete with the base slab acting as a raft slab. The base slab will be designed to accommodate heave of the clay beneath. The Ground Movement Assessment has provided figures for expected heave which are within acceptable limits considering 50% of the heave will occur immediately in the excavation and the remaining heave will occur over a longer period. See appendices for typical retaining wall calculations for these buildings. The Arborocultural report identifies trees near or within the footprint of the building some of which are removed. Hence a calculation has been carried out to show that the proposed foundations are deeper than the zone of influence of those trees.

The remaining superstructure for this building could also be in light gauge metal framing either installed as volumetric modules, panels or stick built on site as there is a limited amount of wall. The roofs will again need to accommodate green roof loadings and maintenance access.

External Works

There are some retaining walls to deal with excavated areas of the garden. These can be formed in 200mm thick reinforced concrete walls with toes. Alternatives would be gabion walls or some form of planted modular precast concrete wall. These would have the advantage of being more permeable for rainwater drainage.

Any bases to paved and trafficked areas need to be carefully dealt with, especially in root protection zones. For the front paved area most of this area is covered by root protection zones so any trafficked areas here may need special treatment which is likely to raise levels slightly to accommodate load spreading bases. The poor quality subbase also needs to be taken into account. For the rear courtyard there is already a significant amount of dig so any base required can be accommodated. It would be possible to use the area under this courtyard for detention of rainwater. This could be done with a liner and a 300mm layer of type 3 open graded stone under a permeable paving. Alternatively, discreet rainwater tanks could be installed under the courtyard taking into account the RPAs of nearby trees.

Drainage

This section should be read in conjunction with the separate "Flood Risk Assessment and Surface Water Drainage Strategy" by Ambiental.

There is an existing manhole approximately 3m deep in the front of the site which takes combined foul and rainwater drainage to the public sewer in Camden Road. Most of the proposed foul and rainwater can drain to this with new drain runs. Foul and rainwater would be kept separate up to this manhole where they will combine. It is anticipated that all new foul and rainwater will run in 100 or 150 diameter plastic drain pipes in appropriate bedding.

Ambiental have recommended that a non-return valve be fitted to the outlet to the main drain to prevent flooding from backflow from the surcharged sewer main.

The condition of the existing drainage from this manhole to the main sewer will need to be assessed by CCTV survey. It will be difficult to do any works involving trenching along this line because of the damage this would do to protected tree roots from the mature trees on the front.

The proposed basement would need to have pumped drainage. It will need a cavity drain sump and potentially a sump for any plant drainage required. The drainage from the open staircase well to access the basement can possibly be combined with the cavity drainage.

There is a requirement not to increase peak rainwater runoff from the site. As the proposed impermeable area of the site is increased from the current, this will mean that some form of detention is likely to be required. This can be in the form of tanks or in the form of open graded stone or cellular crates under paved areas with a restricted outflow. Permeability tests carried out during the site investigation showed a slow rate of infiltration making the soil unsuitable for soakaways. This means that considerable detention capacity may be required in order to limit peak runoff without flooding the site. This is dealt with in detail in the Ambiental report.

APPENDIX – BASEMENT PRELIMINARY STRUCTURAL CALCULATIONS

The following calculations are for the permanent works to the basement structures proposed.

1 – Foundations near trees

The main hostel building basement is not affected by trees as it has deep piled foundations bearing below the zone of influence of any tree roots.

The other 2 buildings are potentially affected by the trees, both those removed and those remaining in place. Trees have been referenced to the Arborocultural report by Sharon Hosegood Associates. Generally this shows that the depths of foundations are deeper than the zone of influence of tree roots. Where the depth of influence exceeds the depth of foundation slightly, additional excavation and fill with hardcore would be required.

2 – Reinforced Concrete Retaining walls

The main hostel building basement walls consist of contiguous pile walls which will be designed by the piling designer for both bearing and retaining using the soil parameters provided in the Site Investigation report.

The design of the retaining wall for the other 2 buildings is included here. The minimum toe required to resist overturning is shown. However, the walls are considered propped at their toes because in the final state the rest of the building base slab will provide more than adequate resistance to sliding and in the temporary case the walls are propped as shown in the sequence drawings.

3 – Main hostel building basement slab

This is a suspended slab to allow for heave of the clay from unloading during excavation. Compressible Cellcore provides the void to allow for this heave. The slab still needs to be designed for both gravity permanent and variably loads and for potential hydrostatic pressure in the accidental case of external flooding. These loadcases have been allowed for in the design.

FOUNDATIONS NEAR TREES

In accordance with Appendix B of NHBC Part 4: Foundations - Chapter 4.2

Tedds calculation version 2.0.02

Site Details

Site location London

Reduction depth due to climate variations - Fig. 13 Z_c = **0.00** m

Soil Details

Plasticity index from lab tests I_p = **50** %

Percentage of particles < 425 µm p_{425} = **100** %

Modified plasticity index - cl. D5(b) $I'_p = I_p \times p_{425} / 100\ \%$ = **50** %

Volume change potential - Table 1 High

Details for Tree - 1 : T3 Pear- removed

Species of tree Broad leaf - Pear

The tree is to be removed from the site, and H_{act} is greater than or equal to 50% of H_m, with no further planting allowed.

Water demand of tree - Table 12 Moderate

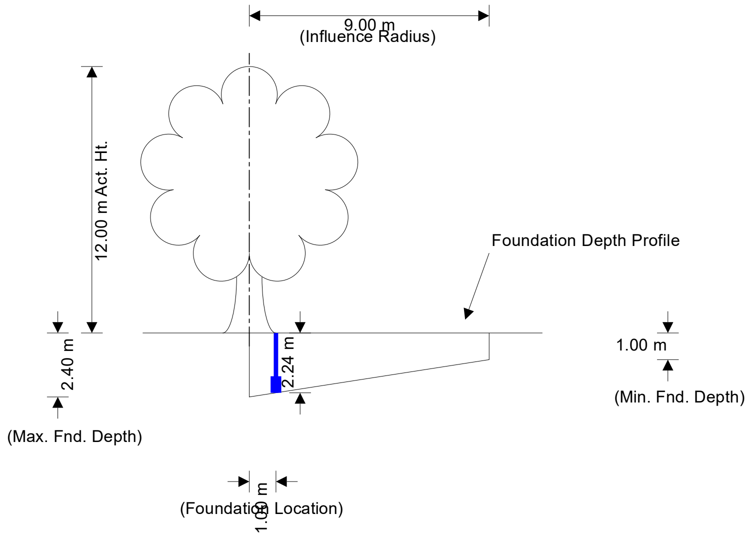
Mature height of tree - Table 12 H_{m1} = **12.00** m

Influence radius - Table 2 $r_{inf1} = 0.75 \times H_{m1}$ = **9.00** m

Measured height of tree H_{act1} = **12.00** m

Distance from centre of tree to face of foundations D_1 = **1.00** m

Effective height of tree - Fig. 1 H_{eff1} = **12.00** m



Minimum foundation depth - Table 5 Z_{min} = **1.00** m

Look up value for foundation depth - Chart 1 Soils with HIGH volume change potential

$Z_{LookUp1}$ = **2.24** m

Required foundation depth $Z_{req1} = Z_{LookUp1} - Z_c$ = **2.24** m

Details for Tree - 2 : T5 Cherry

Species of tree — Broad leaf - Wild Cherry

The tree is to remain at the site, with no further planting allowed.

Water demand of tree - Table 12 — Moderate

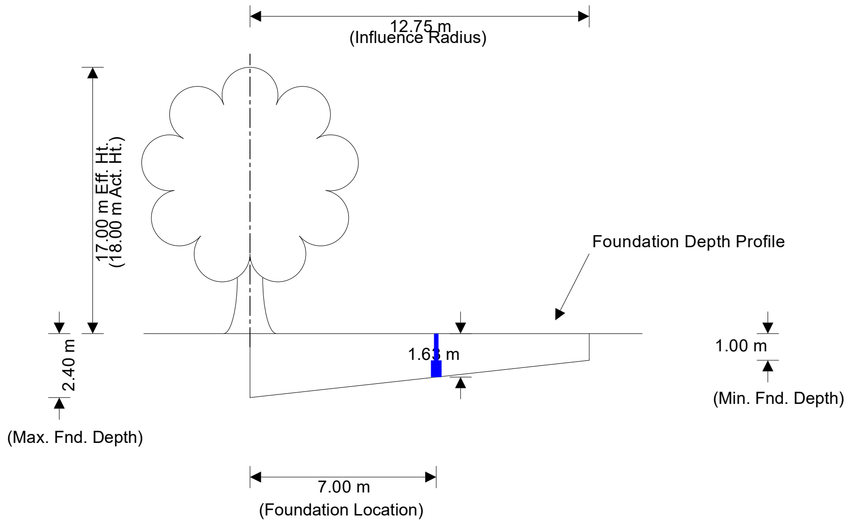
Mature height of tree - Table 12 — H_{m2} = **17.00** m

Influence radius - Table 2 — $r_{inf2} = 0.75 \times H_{m2}$ = **12.75** m

Measured height of tree — H_{act2} = **18.00** m

Distance from centre of tree to face of foundations — D_2 = **7.00** m

Effective height of tree - Fig. 1 — H_{eff2} = **17.00** m



Minimum foundation depth - Table 5 — Z_{min} = **1.00** m

Look up value for foundation depth - Chart 1 Soils with HIGH volume change potential

$Z_{LookUp2}$ = **1.63** m

Required foundation depth — $Z_{req2} = Z_{LookUp2} - Z_c$ = **1.63** m

Details for Tree - 3 : T2 Cherry - removed

Species of tree Broad leaf - Wild Cherry

The tree is to be removed from the site, and H_{act} is less than 50% of H_m, with no further planting allowed.

Water demand of tree - Table 12 Moderate

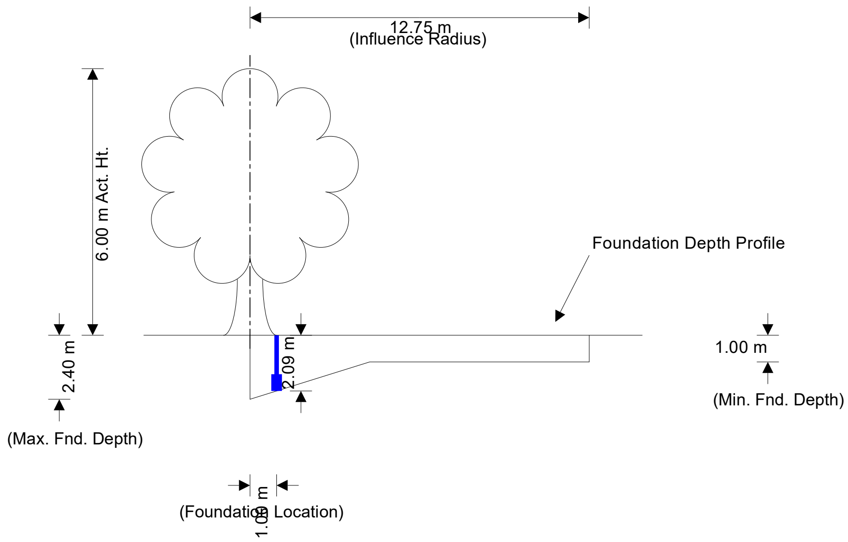
Mature height of tree - Table 12 H_{m3} = **17.00** m

Influence radius - Table 2 $r_{inf3} = 0.75 \times H_{m3}$ = **12.75** m

Measured height of tree H_{act3} = **6.00** m

Distance from centre of tree to face of foundations D_3 = **1.00** m

Effective height of tree - Fig. 1 H_{eff3} = **6.00** m



Minimum foundation depth - Table 5 Z_{min} = **1.00** m

Look up value for foundation depth - Chart 1 Soils with HIGH volume change potential

$Z_{LookUp3}$ = **2.09** m

Required foundation depth $Z_{req3} = Z_{LookUp3} - Z_c$ = **2.09** m

Details for Tree - 4 : T8 Rowan

Species of tree — Broad leaf - Whitebeam

The tree is to be removed from the site, and H_{act} is greater than or equal to 50% of H_m, with no further planting allowed.

Water demand of tree - Table 12 — Moderate

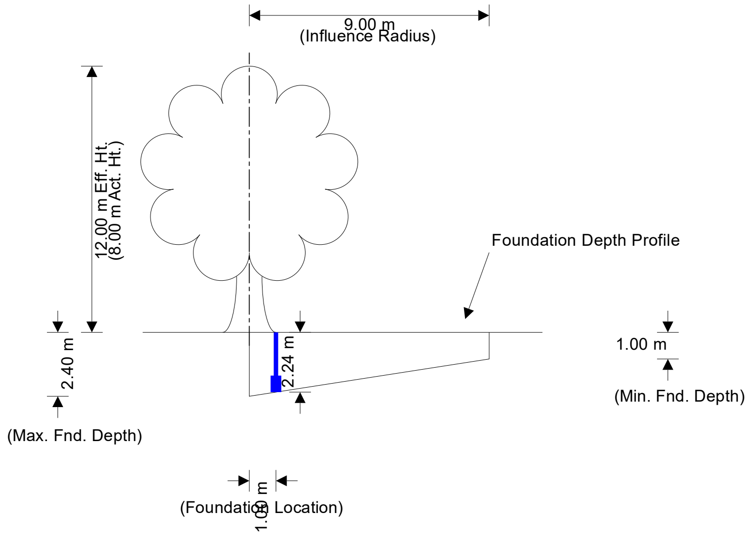
Mature height of tree - Table 12 — H_{m4} = **12.00** m

Influence radius - Table 2 — $r_{inf4} = 0.75 \times H_{m4}$ = **9.00** m

Measured height of tree — H_{act4} = **8.00** m

Distance from centre of tree to face of foundations — D_4 = **1.00** m

Effective height of tree - Fig. 1 — H_{eff4} = **12.00** m



Minimum foundation depth - Table 5 — Z_{min} = **1.00** m

Look up value for foundation depth - Chart 1 Soils with HIGH volume change potential

$Z_{LookUp4}$ = **2.24** m

Required foundation depth — $Z_{req4} = Z_{LookUp4} - Z_c$ = **2.24** m

Summary Table

Tree	Description	Name	Distance (m)	Measured Height (m)	Effective Height (m)	Tree to be removed	Required Foundation Depth (m)
1	T3 Pear- removed	Pear	1.0	12.0	12.0	Yes	2.24
2	T5 Cherry	Wild Cherry	7.0	18.0	17.0	No	1.63
3	T2 Cherry - removed	Wild Cherry	1.0	6.0	6.0	Yes	2.09
4	T8 Rowan	Whitebeam	1.0	8.0	12.0	Yes	2.24

RETAINING WALL ANALYSIS

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

Tedds calculation version 2.9.11

Analysis summary

Description	Unit	Capacity	Applied	F o S	Result
Bearing pressure	kN/m²	150	107.5	1.395	PASS

Design summary

Description	Unit	Provided	Required	Utilisation	Result
Stem p0 rear face - Flexural reinforcement	mm²/m	565.5	361.3	0.64	PASS
Stem p0 - Shear resistance	kN/m	105.2	40.0	0.38	PASS
Base top face - Flexural reinforcement	mm²/m	392.7	293.7	0.75	PASS
Base bottom face - Flexural reinforcement	mm²/m	1005.3	547.2	0.54	PASS
Base - Shear resistance	kN/m	105.2	29.8	0.28	PASS
Transverse stem reinforcement	mm²/m	392.7	250.0	0.64	PASS
Transverse base reinforcement	mm²/m	392.7	201.1	0.51	PASS

Retaining wall details

Stem type: Cantilever

Stem height: h_{stem} = **2050** mm

Stem thickness: t_{stem} = **250** mm

Angle to rear face of stem: α = **90** deg

Stem density: γ_{stem} = **25** kN/m³

Toe length: l_{toe} = **1600** mm

Base thickness: t_{base} = **250** mm

Base density: γ_{base} = **25** kN/m³

Height of retained soil: h_{ret} = **2050** mm

Angle of soil surface: β = **0** deg

Depth of cover: d_{cover} = **0** mm

Height of water: h_{water} = **1500** mm

Water density: γ_w = **9.8** kN/m³

Retained soil properties

Soil type: Firm clay

Moist density: γ_{mr} = **18** kN/m³

Saturated density: γ_{sr} = **18** kN/m³

Characteristic effective shear resistance angle: $\phi'_{r.k}$ = **20** deg

Characteristic wall friction angle: $\delta_{r.k}$ = **10** deg

Base soil properties

Soil type: Firm clay

Soil density: γ_b = **18** kN/m³

Characteristic effective shear resistance angle: $\phi'_{b.k}$ = **20** deg

Characteristic wall friction angle: $\delta_{b.k}$ = **10** deg

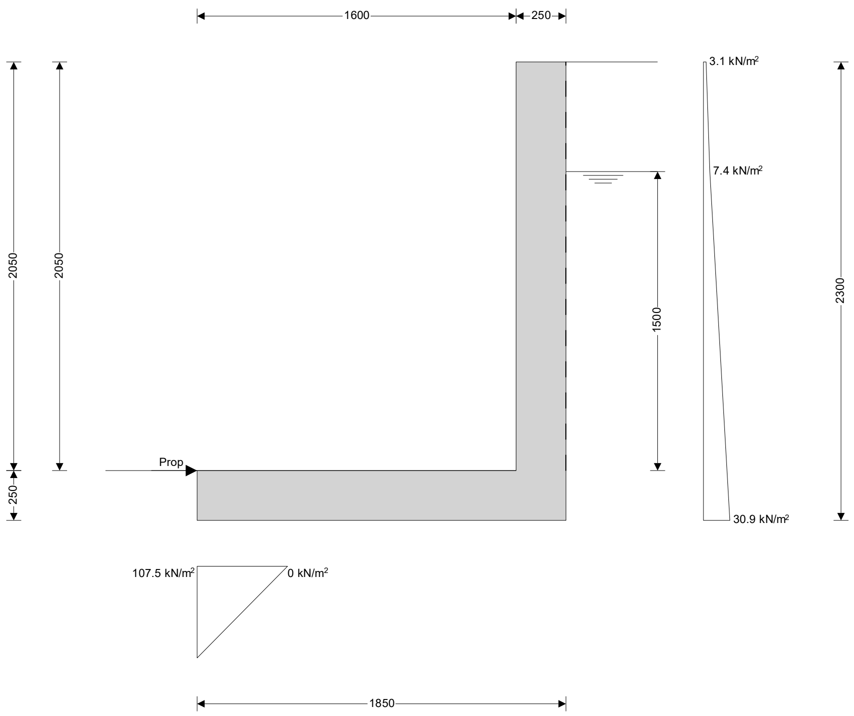
Characteristic base friction angle: $\delta_{bb.k}$ = **12** deg

Presumed bearing capacity: $P_{bearing}$ = **150** kN/m²

Loading details

Permanent surcharge load: $Surcharge_G$ = **2** kN/m²

Variable surcharge load: $Surcharge_Q$ = **5** kN/m²



General arrangement

Calculate retaining wall geometry

Base length	$l_{base} = l_{toe} + t_{stem} = \mathbf{1850}$ mm
Saturated soil height	$h_{sat} = h_{water} + d_{cover} = \mathbf{1500}$ mm
Moist soil height	$h_{moist} = h_{ret} - h_{water} = \mathbf{550}$ mm
Length of surcharge load	$l_{sur} = l_{heel} = \mathbf{0}$ mm
- Distance to vertical component	$x_{sur\_v} = l_{base} - l_{heel} / 2 = \mathbf{1850}$ mm
Effective height of wall	$h_{eff} = h_{base} + d_{cover} + h_{ret} = \mathbf{2300}$ mm
- Distance to horizontal component	$x_{sur\_h} = h_{eff} / 2 = \mathbf{1150}$ mm
Area of wall stem	$A_{stem} = h_{stem} * t_{stem} = \mathbf{0.513}$ m^2
- Distance to vertical component	$x_{stem} = l_{toe} + t_{stem} / 2 = \mathbf{1725}$ mm
Area of wall base	$A_{base} = l_{base} * t_{base} = \mathbf{0.463}$ m^2
- Distance to vertical component	$x_{base} = l_{base} / 2 = \mathbf{925}$ mm

Using Coulomb theory

Active pressure coefficient	$K_A = \sin(\alpha + \phi'_{r.k})^2 / (\sin(\alpha)^2 * \sin(\alpha - \delta_{r.k}) * [1 + \sqrt{[\sin(\phi'_{r.k} + \delta_{r.k}) * \sin(\phi'_{r.k} - \beta) / (\sin(\alpha - \delta_{r.k}) * \sin(\alpha + \beta))]}]^2) = \mathbf{0.447}$
Passive pressure coefficient	$K_P = \sin(90 - \phi'_{b.k})^2 / (\sin(90 + \delta_{b.k}) * [1 - \sqrt{[\sin(\phi'_{b.k} + \delta_{b.k}) * \sin(\phi'_{b.k}) / (\sin(90 + \delta_{b.k}))]}]^2) = \mathbf{2.635}$

Bearing pressure check

Vertical forces on wall

Wall stem	$F_{stem} = A_{stem} * \gamma_{stem} = \mathbf{12.8}$ kN/m
Wall base	$F_{base} = A_{base} * \gamma_{base} = \mathbf{11.6}$ kN/m

Total	$F_{total\_v} = F_{stem} + F_{base} + F_{water\_v} = \mathbf{24.4}$ kN/m

Horizontal forces on wall

Surcharge load	$F_{sur\_h} = K_A * \cos(\delta_{r.k}) * (Surcharge_G + Surcharge_Q) * h_{eff} = \mathbf{7.1}$ kN/m
Saturated retained soil	$F_{sat\_h} = K_A * \cos(\delta_{r.k}) * (\gamma_{sr} - \gamma_w) * (h_{sat} + h_{base})^2 / 2 = \mathbf{5.5}$ kN/m
Water	$F_{water\_h} = \gamma_w * (h_{water} + d_{cover} + h_{base})^2 / 2 = \mathbf{15}$ kN/m
Moist retained soil	$F_{moist\_h} = K_A * \cos(\delta_{r.k}) * \gamma_{mr} * ((h_{eff} - h_{sat} - h_{base})^2 / 2 + (h_{eff} - h_{sat} - h_{base}) * (h_{sat} + h_{base})) = \mathbf{8.8}$ kN/m
Base soil	$F_{pass\_h} = -K_P * \cos(\delta_{b.k}) * \gamma_b * (d_{cover} + h_{base})^2 / 2 = \mathbf{-1.5}$ kN/m
Total	$F_{total\_h} = F_{sur\_h} + F_{sat\_h} + F_{water\_h} + F_{moist\_h} + F_{pass\_h} = \mathbf{35}$ kN/m

Moments on wall

Wall stem	$M_{stem} = F_{stem} * x_{stem} = \mathbf{22.1}$ kNm/m
Wall base	$M_{base} = F_{base} * x_{base} = \mathbf{10.7}$ kNm/m
Surcharge load	$M_{sur} = -F_{sur\_h} * x_{sur\_h} = \mathbf{-8.1}$ kNm/m
Saturated retained soil	$M_{sat} = -F_{sat\_h} * x_{sat\_h} = \mathbf{-3.2}$ kNm/m
Water	$M_{water} = -F_{water\_h} * x_{water\_h} = \mathbf{-8.8}$ kNm/m
Moist retained soil	$M_{moist} = -F_{moist\_h} * x_{moist\_h} = \mathbf{-9}$ kNm/m
Total	$M_{total} = M_{stem} + M_{base} + M_{sur} + M_{sat} + M_{water} + M_{moist} = \mathbf{3.7}$ kNm/m

Check bearing pressure

Propping force	$F_{prop\_base} = F_{total\_h} = \mathbf{35}$ kN/m
Distance to reaction	$\bar{x} = M_{total} / F_{total\_v} = \mathbf{151}$ mm
Eccentricity of reaction	$e = \bar{x} - l_{base} / 2 = \mathbf{-774}$ mm
Loaded length of base	$l_{load} = 3 * \bar{x} = \mathbf{454}$ mm
Bearing pressure at toe	$q_{toe} = 2 * F_{total\_v} / l_{load} = \mathbf{107.5}$ kN/m^2
Bearing pressure at heel	$q_{heel} = \mathbf{0}$ kN/m^2
Factor of safety	$FoS_{bp} = P_{bearing} / \max(q_{toe}, q_{heel}) = \mathbf{1.395}$

PASS - Allowable bearing pressure exceeds maximum applied bearing pressure

RETAINING WALL DESIGN

In accordance with EN1992-1-1:2004 incorporating Corrigendum dated January 2008 and the UK National Annex incorporating National Amendment No.1

Tedds calculation version 2.9.11

Concrete details - Table 3.1 - Strength and deformation characteristics for concrete

Concrete strength class	C30/37
Characteristic compressive cylinder strength	$f_{ck} = \mathbf{30}$ N/mm^2
Characteristic compressive cube strength	$f_{ck,cube} = \mathbf{37}$ N/mm^2
Mean value of compressive cylinder strength	$f_{cm} = f_{ck} + 8$ N/mm^2 $= \mathbf{38}$ N/mm^2
Mean value of axial tensile strength	$f_{ctm} = 0.3$ N/mm$^2 \times (f_{ck} / 1$ N/mm$^2)^{2/3} = \mathbf{2.9}$ N/mm^2
5% fractile of axial tensile strength	$f_{ctk,0.05} = 0.7 \times f_{ctm} = \mathbf{2.0}$ N/mm^2
Secant modulus of elasticity of concrete	$E_{cm} = 22$ kN/mm$^2 \times (f_{cm} / 10$ N/mm$^2)^{0.3} = \mathbf{32837}$ N/mm^2
Partial factor for concrete - Table 2.1N	$\gamma_C = \mathbf{1.50}$
Compressive strength coefficient - cl.3.1.6(1)	$\alpha_{cc} = \mathbf{0.85}$
Design compressive concrete strength - exp.3.15	$f_{cd} = \alpha_{cc} \times f_{ck} / \gamma_C = \mathbf{17.0}$ N/mm^2
Maximum aggregate size	$h_{agg} = \mathbf{20}$ mm
Ultimate strain - Table 3.1	$\varepsilon_{cu2} = \mathbf{0.0035}$
Shortening strain - Table 3.1	$\varepsilon_{cu3} = \mathbf{0.0035}$
Effective compression zone height factor	$\lambda = \mathbf{0.80}$

Effective strength factor η = **1.00**

Bending coefficient k_1 K_1 = **0.40**

Bending coefficient k_2 $K_2 = 1.00 * (0.6 + 0.0014/\varepsilon_{cu2})$ = **1.00**

Bending coefficient k_3 K_3 =**0.40**

Bending coefficient k_4 $K_4 = 1.00 * (0.6 + 0.0014/\varepsilon_{cu2})$ =**1.00**

Reinforcement details

Characteristic yield strength of reinforcement f_{yk} = **500** N/mm^2

Modulus of elasticity of reinforcement E_s = **200000** N/mm^2

Partial factor for reinforcing steel - Table 2.1N γ_S = **1.15**

Design yield strength of reinforcement $f_{yd} = f_{yk} / \gamma_S$ = **435** N/mm^2

Cover to reinforcement

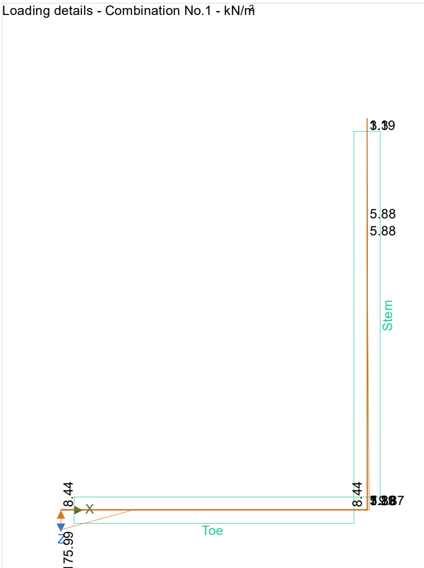
Front face of stem c_{sf} = **40** mm

Rear face of stem c_{sr} = **50** mm

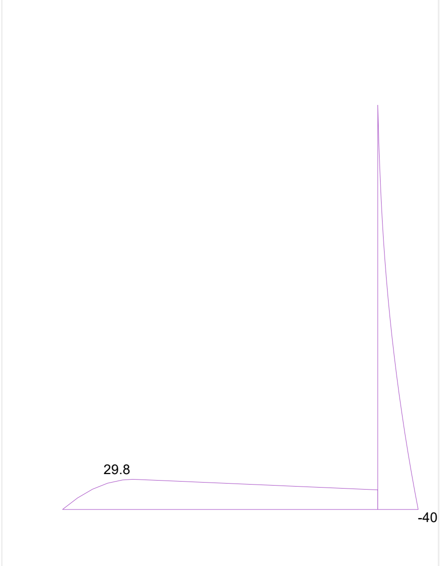
Top face of base c_{bt} = **50** mm

Bottom face of base c_{bb} = **75** mm

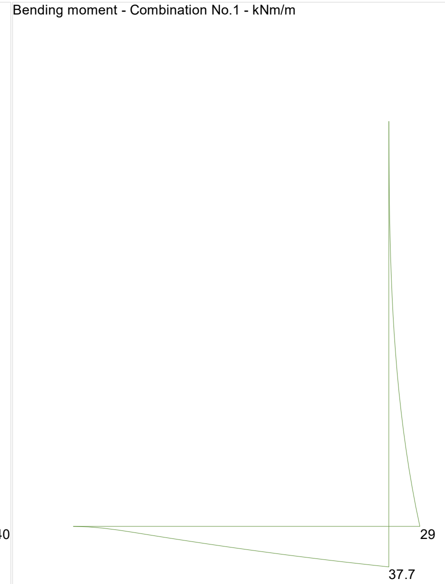
Loading details - Combination No.1 - kN/m²



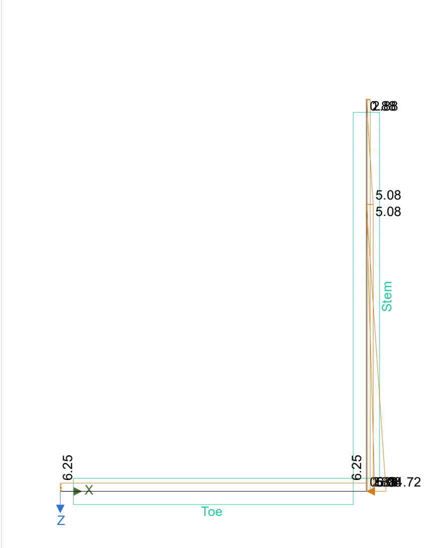
Shear force - Combination No.1 - kN/m



Bending moment - Combination No.1 - kNm/m

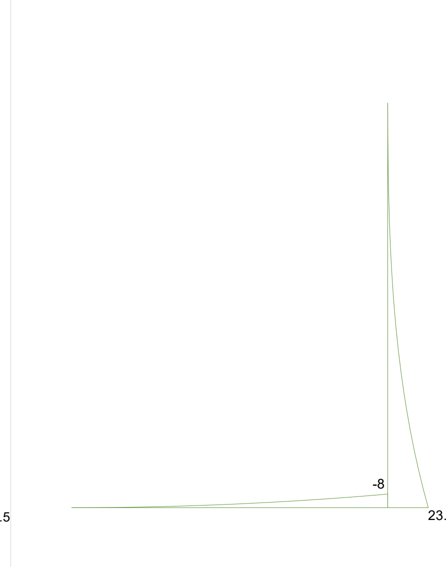


Loading details - Combination No.2 - kN/m



Shear force - Combination No.2 - kN/m

Bending moment - Combination No.2 - kNm/m



Check stem design at base of stem

Depth of section $h = \mathbf{250}$ mm

Rectangular section in flexure - Section 6.1

Design bending moment combination 1 $M = \mathbf{29}$ kNm/m

Depth to tension reinforcement $d = h - c_{sr} - \phi_{sr} / 2 = \mathbf{194}$ mm

$K = M / (d^2 \times f_{ck}) = \mathbf{0.026}$

$K' = (2 * \eta * \alpha_{cc}/\gamma_C)*(1 - \lambda * (\delta - K_1)/(2 * K_2))*(\lambda * (\delta - K_1)/(2 * K_2))$

$K' = \mathbf{0.207}$

K' > K - No compression reinforcement is required

Lever arm $z = \min(0.5 + 0.5 * (1 - 2 * K / (\eta * \alpha_{cc} / \gamma_C))^{0.5}, 0.95) * d = \mathbf{184}$ mm

Depth of neutral axis $x = 2.5 \times (d - z) = \mathbf{24}$ mm

Area of tension reinforcement required $A_{sr.req} = M / (f_{yd} \times z) = \mathbf{361}$ mm²/m

Tension reinforcement provided 12 dia.bars @ 200 c/c

Area of tension reinforcement provided $A_{sr.prov} = \pi * \phi_{sr}^2 / (4 * s_{sr}) = \mathbf{565}$ mm²/m

Minimum area of reinforcement - exp.9.1N $A_{sr.min} = \max(0.26 * f_{ctm} / f_{yk}, 0.0013) * d = \mathbf{292}$ mm²/m

Maximum area of reinforcement - cl.9.2.1.1(3) $A_{sr.max} = 0.04 * h = \mathbf{10000}$ mm²/m

$\max(A_{sr.req}, A_{sr.min}) / A_{sr.prov} = \mathbf{0.639}$

PASS - Area of reinforcement provided is greater than area of reinforcement required

Library item: Rectangular single output

Deflection control - Section 7.4

Reference reinforcement ratio $\rho_0 = \sqrt{}(f_{ck} / 1 \text{ N/mm}^2) / 1000 = \mathbf{0.005}$

Required tension reinforcement ratio $\rho = A_{sr.req} / d = \mathbf{0.002}$

Required compression reinforcement ratio $\rho' = A_{sr.2.req} / d_2 = \mathbf{0.000}$

Structural system factor - Table 7.4N $K_b = \mathbf{0.4}$

Reinforcement factor - exp.7.17 $K_s = \min(500 \text{ N/mm}^2 / (f_{yk} * A_{sr.req} / A_{sr.prov}), 1.5) = \mathbf{1.5}$

Limiting span to depth ratio - exp.7.16.a $\min(K_s * K_b * [11 + 1.5 * \sqrt{}(f_{ck} / 1 \text{ N/mm}^2) * \rho_0 / \rho + 3.2 * \sqrt{}(f_{ck} / 1 \text{ N/mm}^2) * (\rho_0 / \rho - 1)^{3/2}], 40 * K_b) = \mathbf{16}$

Actual span to depth ratio $h_{stem} / d = \mathbf{10.6}$

PASS - Span to depth ratio is less than deflection control limit

Crack control - Section 7.3

Limiting crack width	w_{max} = **0.3** mm
Variable load factor - EN1990 – Table A1.1	ψ_2 = **0.6**
Serviceability bending moment	M_{sls} = **19.1** kNm/m
Tensile stress in reinforcement	$\sigma_s = M_{sls} / (A_{sr.prov} * z)$ = **183.1** N/mm^2
Load duration	Long term
Load duration factor	k_t = **0.4**
Effective area of concrete in tension	$A_{c.eff}$ = min(2.5 * (h - d), (h - x) / 3, h / 2)
	$A_{c.eff}$ = **75250** mm^2/m
Mean value of concrete tensile strength	$f_{ct.eff} = f_{ctm}$ = **2.9** N/mm^2
Reinforcement ratio	$\rho_{p.eff} = A_{sr.prov} / A_{c.eff}$ = **0.008**
Modular ratio	$\alpha_e = E_s / E_{cm}$ = **6.091**
Bond property coefficient	k_1 = **0.8**
Strain distribution coefficient	k_2 = **0.5**
	k_3 = **3.4**
	k_4 = **0.425**
Maximum crack spacing - exp.7.11	$s_{r.max} = k_3 * c_{sr} + k_1 * k_2 * k_4 * \phi_{sr} / \rho_{p.eff}$ = **441** mm
Maximum crack width - exp.7.8	$w_k = s_{r.max} \times \max(\sigma_s – k_t \times (f_{ct.eff} / \rho_{p.eff}) \times (1 + \alpha_e \times \rho_{p.eff}), 0.6 \times \sigma_s) / E_s$
	w_k = **0.243** mm
	w_k / w_{max} = **0.808**

PASS - Maximum crack width is less than limiting crack width

Rectangular section in shear - Section 6.2

Design shear force	V = **40** kN/m
	$C_{Rd,c} = 0.18 / \gamma_C$ = **0.120**
	k = min(1 + √(200 mm / d), 2) = **2.000**
Longitudinal reinforcement ratio	$\rho_l = \min(A_{sr.prov} / d, 0.02)$ = **0.003**
	$v_{min} = 0.035\ N^{1/2}/mm * k^{3/2} * f_{ck}^{0.5}$ = **0.542** N/mm^2
Design shear resistance - exp.6.2a & 6.2b	$V_{Rd.c} = \max(C_{Rd.c} \times k \times (100\ N^2/mm^4 \times \rho_l \times f_{ck})^{1/3}, v_{min}) \times d$
	$V_{Rd.c}$ = **105.2** kN/m
	$V / V_{Rd.c}$ = **0.380**

PASS - Design shear resistance exceeds design shear force

Horizontal reinforcement parallel to face of stem - Section 9.6

Minimum area of reinforcement – cl.9.6.3(1)	$A_{sx.req} = \max(0.25 * A_{sr.prov}, 0.001 * t_{stem})$ = **250** mm^2/m
Maximum spacing of reinforcement – cl.9.6.3(2)	s_{sx_max} = **400** mm
Transverse reinforcement provided	10 dia.bars @ 200 c/c
Area of transverse reinforcement provided	$A_{sx.prov} = \pi * \phi_{sx}^2 / (4 * s_{sx})$ = **393** mm^2/m

PASS - Area of reinforcement provided is greater than area of reinforcement required

Check base design at toe

Depth of section	h = **250** mm

Rectangular section in flexure - Section 6.1

Design bending moment combination 1	M = **37.7** kNm/m
Depth to tension reinforcement	$d = h - c_{bb} - \phi_{bb} / 2$ = **167** mm
	$K = M / (d^2 \times f_{ck})$ = **0.045**
	$K' = (2 * \eta * \alpha_{cc}/\gamma_C)*(1 - \lambda * (\delta - K_1)/(2 * K_2))*(\lambda * (\delta - K_1)/(2 * K_2))$
	K' = **0.207**

K' > K - No compression reinforcement is required

Lever arm $z = \min(0.5 + 0.5 * (1 - 2 * K / (\eta * \alpha_{cc} / \gamma_C))^{0.5}, 0.95) * d = \mathbf{159}$ mm

Depth of neutral axis $x = 2.5 \times (d - z) = \mathbf{21}$ mm

Area of tension reinforcement required $A_{bb.req} = M / (f_{yd} \times z) = \mathbf{547}$ mm²/m

Tension reinforcement provided 16 dia.bars @ 200 c/c

Area of tension reinforcement provided $A_{bb.prov} = \pi * \phi_{bb}^2 / (4 * s_{bb}) = \mathbf{1005}$ mm²/m

Minimum area of reinforcement - exp.9.1N $A_{bb.min} = \max(0.26 * f_{ctm} / f_{yk}, 0.0013) * d = \mathbf{252}$ mm²/m

Maximum area of reinforcement - cl.9.2.1.1(3) $A_{bb.max} = 0.04 * h = \mathbf{10000}$ mm²/m

$\max(A_{bb.req}, A_{bb.min}) / A_{bb.prov} = \mathbf{0.544}$

PASS - Area of reinforcement provided is greater than area of reinforcement required

Library item: Rectangular single output

Crack control - Section 7.3

Limiting crack width $w_{max} = \mathbf{0.3}$ mm

Variable load factor - EN1990 – Table A1.1 $\psi_2 = \mathbf{0.6}$

Serviceability bending moment $M_{sls} = \mathbf{27.3}$ kNm/m

Tensile stress in reinforcement $\sigma_s = M_{sls} / (A_{bb.prov} * z) = \mathbf{171.3}$ N/mm²

Load duration Long term

Load duration factor $k_t = \mathbf{0.4}$

Effective area of concrete in tension $A_{c.eff} = \min(2.5 * (h - d), (h - x) / 3, h / 2)$

$A_{c.eff} = \mathbf{76375}$ mm²/m

Mean value of concrete tensile strength $f_{ct.eff} = f_{ctm} = \mathbf{2.9}$ N/mm²

Reinforcement ratio $\rho_{p.eff} = A_{bb.prov} / A_{c.eff} = \mathbf{0.013}$

Modular ratio $\alpha_e = E_s / E_{cm} = \mathbf{6.091}$

Bond property coefficient $k_1 = \mathbf{0.8}$

Strain distribution coefficient $k_2 = \mathbf{0.5}$

$k_3 = \mathbf{3.4}$

$k_4 = \mathbf{0.425}$

Maximum crack spacing - exp.7.11 $s_{r.max} = k_3 * c_{bb} + k_1 * k_2 * k_4 * \phi_{bb} / \rho_{p.eff} = \mathbf{462}$ mm

Maximum crack width - exp.7.8 $w_k = s_{r.max} \times \max(\sigma_s - k_t \times (f_{ct.eff} / \rho_{p.eff}) \times (1 + \alpha_e \times \rho_{p.eff}), 0.6 \times \sigma_s) / E_s$

$w_k = \mathbf{0.237}$ mm

$w_k / w_{max} = \mathbf{0.791}$

PASS - Maximum crack width is less than limiting crack width

Rectangular section in shear - Section 6.2

Design shear force $V = \mathbf{29.8}$ kN/m

$C_{Rd,c} = 0.18 / \gamma_C = \mathbf{0.120}$

$k = \min(1 + \sqrt{(200 \text{ mm} / d)}, 2) = \mathbf{2.000}$

Longitudinal reinforcement ratio $\rho_l = \min(A_{bb.prov} / d, 0.02) = \mathbf{0.006}$

$v_{min} = 0.035 \text{ N}^{1/2}/\text{mm} * k^{3/2} * f_{ck}^{0.5} = \mathbf{0.542}$ N/mm²

Design shear resistance - exp.6.2a & 6.2b $V_{Rd.c} = \max(C_{Rd.c} \times k \times (100 \text{ N}^2/\text{mm}^4 \times \rho_l \times f_{ck})^{1/3}, v_{min}) \times d$

$V_{Rd.c} = \mathbf{105.2}$ kN/m

$V / V_{Rd.c} = \mathbf{0.284}$

PASS - Design shear resistance exceeds design shear force

Check base design at toe

Depth of section $h = \mathbf{250}$ mm

Rectangular section in flexure - Section 6.1

Design bending moment combination 2 $M = \mathbf{8}$ kNm/m

Depth to tension reinforcement $d = h - c_{bt} - \phi_{bt} / 2 = \mathbf{195}$ mm

$K = M / (d^2 \times f_{ck})$ = **0.007**

$K' = (2 * \eta * \alpha_{cc}/\gamma_C)*(1 - \lambda * (\delta - K_1)/(2 * K_2))*(\lambda * (\delta - K_1)/(2 * K_2))$

K' = **0.207**

K' > K - No compression reinforcement is required

Lever arm $z = \min(0.5 + 0.5 * (1 - 2 * K / (\eta * \alpha_{cc} / \gamma_C))^{0.5}, 0.95) * d$ = **185** mm

Depth of neutral axis $x = 2.5 \times (d – z)$ = **24** mm

Area of tension reinforcement required $A_{bt.req} = M / (f_{yd} \times z)$ = **99** mm^2/m

Tension reinforcement provided 10 dia.bars @ 200 c/c

Area of tension reinforcement provided $A_{bt.prov} = \pi * \phi_{bt}^2 / (4 * s_{bt})$ = **393** mm^2/m

Minimum area of reinforcement - exp.9.1N $A_{bt.min} = \max(0.26 * f_{ctm} / f_{yk}, 0.0013) * d$ = **294** mm^2/m

Maximum area of reinforcement - cl.9.2.1.1(3) $A_{bt.max} = 0.04 * h$ = **10000** mm^2/m

$\max(A_{bt.req}, A_{bt.min}) / A_{bt.prov}$ = **0.748**

PASS - Area of reinforcement provided is greater than area of reinforcement required

Library item: Rectangular single output

Crack control - Section 7.3

Limiting crack width w_{max} = **0.3** mm

Variable load factor - EN1990 – Table A1.1 ψ_2 = **0.6**

Serviceability bending moment M_{sls} = **0** kNm/m

Tensile stress in reinforcement $\sigma_s = M_{sls} / (A_{bt.prov} * z)$ = **0** N/mm^2

Load duration Long term

Load duration factor k_t = **0.4**

Effective area of concrete in tension $A_{c.eff} = \min(2.5 * (h - d), (h - x) / 3, h / 2)$

$A_{c.eff}$ = **75208** mm^2/m

Mean value of concrete tensile strength $f_{ct.eff} = f_{ctm}$ = **2.9** N/mm^2

Reinforcement ratio $\rho_{p.eff} = A_{bt.prov} / A_{c.eff}$ = **0.005**

Modular ratio $\alpha_e = E_s / E_{cm}$ = **6.091**

Bond property coefficient k_1 = **0.8**

Strain distribution coefficient k_2 = **0.5**

k_3 = **3.4**

k_4 = **0.425**

Maximum crack spacing - exp.7.11 $s_{r.max} = k_3 * c_{bt} + k_1 * k_2 * k_4 * \phi_{bt} / \rho_{p.eff}$ = **496** mm

Maximum crack width - exp.7.8 $w_k = s_{r.max} \times \max(\sigma_s – k_t \times (f_{ct.eff} / \rho_{p.eff}) \times (1 + \alpha_e \times \rho_{p.eff}), 0.6 \times \sigma_s) / E_s$

w_k = **0** mm

w_k / w_{max} = **0**

PASS - Maximum crack width is less than limiting crack width

Secondary transverse reinforcement to base - Section 9.3

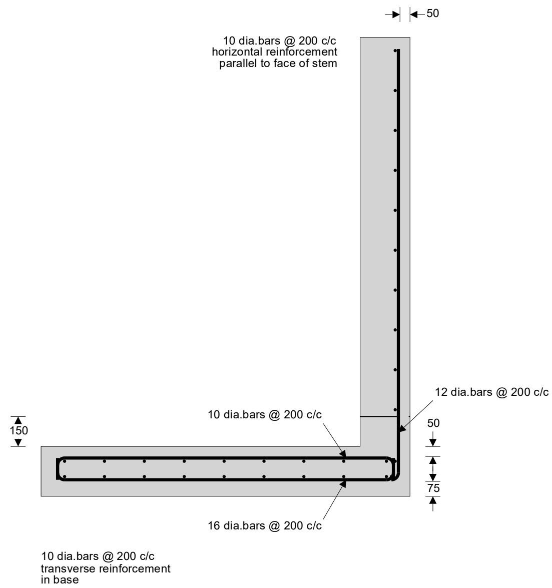
Minimum area of reinforcement – cl.9.3.1.1(2) $A_{bx.req} = 0.2 * A_{bb.prov}$ = **201** mm^2/m

Maximum spacing of reinforcement – cl.9.3.1.1(3) s_{bx_max} = **450** mm

Transverse reinforcement provided 10 dia.bars @ 200 c/c

Area of transverse reinforcement provided $A_{bx.prov} = \pi * \phi_{bx}^2 / (4 * s_{bx})$ = **393** mm^2/m

PASS - Area of reinforcement provided is greater than area of reinforcement required



Reinforcement details

RC MEMBER ANALYSIS & DESIGN (EN1992-1-1:2004)

In accordance with EN1992-1-1:2004 incorporating Corrigenda January 2008 and the UK national annex

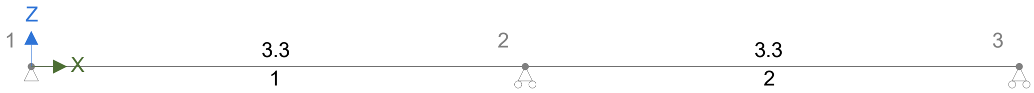
Tedds calculation version 3.3.03

ANALYSIS

Tedds calculation version 1.0.35

Geometry

Geometry (m) - Concrete (C30 2500 Quartzite) - R 1000x300



Span	Length (m)	Section	Start Support	End Support
1	3.3	R 1000x300	Pinned	Roller Pin X
2	3.3	R 1000x300	Roller Pin X	Roller Pin X

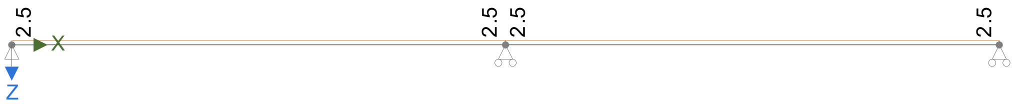
R 1000x300: Area 3000 cm^2, Inertia Major 225000 cm^4, Inertia Minor 2500000 cm^4, Shear area parallel to Minor 2500 cm^2, Shear area parallel to Major = 2500 cm^2

Concrete (C30 2500 Quartzite): Density 2500 kg/m^3, Youngs 32.836568 kN/mm^2, Shear 13.6819033 kN/mm^2, Thermal 0.00001 °C^{-1}

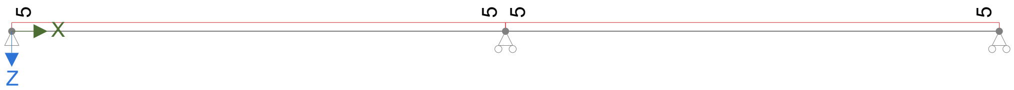
Loading

Self weight included

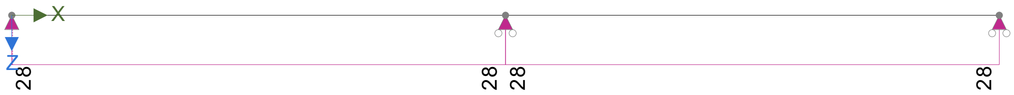
Permanent - Loading (kN/m)



Imposed - Loading (kN/m)



Hydro - Loading (kN/m)



Load combination factors

Load combination	Self Weight	Permanent	Imposed	Hydro
1.35G + 1.5Q + 1.5RQ (Strength)	1.35	1.35	1.50	
1.0G + 1.0Q + 1.0RQ (Service)	1.00	1.00	1.00	
1.0G + 1.0ψ_2Q (Quasi)	1.00	1.00	0.30	
Accidental Hydrostatic (Strength)	1.00	1.00		1.10

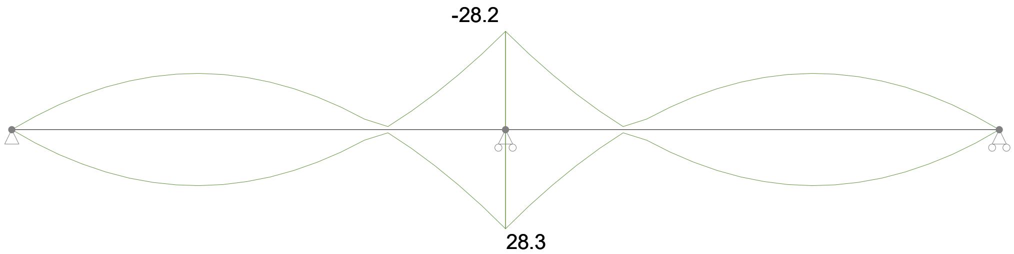
Member Loads

Member	Load case	Load Type	Orientation	Description
Beam	Permanent	UDL	GlobalZ	2.5 kN/m
Beam	Imposed	UDL	GlobalZ	5 kN/m
Beam	Hydro	UDL	GlobalZ	-28 kN/m

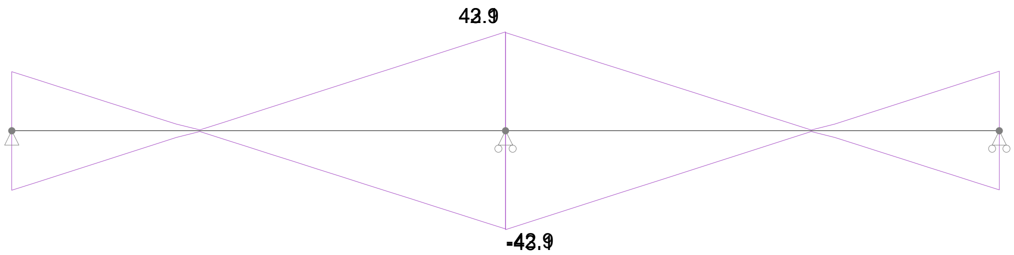
Results

Forces

Strength combinations - Moment envelope (kNm)



Strength combinations - Shear envelope (kN)



Concrete details - Table 3.1. Strength and deformation characteristics for concrete

Concrete strength class	C30/37
Aggregate type	Quartzite
Aggregate adjustment factor - cl.3.1.3(2)	AAF = **1.0**
Characteristic compressive cylinder strength	f_{ck} = **30** N/mm^2
Mean value of compressive cylinder strength	$f_{cm} = f_{ck}$ + 8 N/mm^2 = **38** N/mm^2
Mean value of axial tensile strength	f_{ctm} = 0.3 N/mm^2 * (f_{ck}/ 1 N/mm^2)$^{2/3}$ = **2.9** N/mm^2
Secant modulus of elasticity of concrete	E_{cm} = 22 kN/mm^2*(f_{cm} / 10 N/mm^2)$^{0.3}$ * AAF = **32837** N/mm^2
Ultimate strain - Table 3.1	ε_{cu2} = **0.0035**
Shortening strain - Table 3.1	ε_{cu3} = **0.0035**
Effective compression zone height factor	λ = **0.80**
Effective strength factor	η = **1.00**
Coefficient k_1	k_1 = **0.40**
Coefficient k_2	k_2 = 1.0 * (0.6 + 0.0014 / ε_{cu2}) = **1.00**
Coefficient k_3	k_3 = **0.40**
Coefficient k_4	k_4 = 1.0 * (0.6 + 0.0014 / ε_{cu2}) = **1.00**
Partial factor for concrete -Table 2.1N	γ_C = **1.50**
Compressive strength coefficient - cl.3.1.6(1)	α_{cc} = **0.85**
Design compressive concrete strength - exp.3.15	$f_{cd} = \alpha_{cc} * f_{ck} / \gamma_C$ = **17.0** N/mm^2

Compressive strength coefficient - cl.3.1.6(1) α_{ccw} = **1.00**

Design compressive concrete strength - exp.3.15 $f_{cwd} = \alpha_{ccw} * f_{ck} / \gamma_C$ = **20.0** N/mm^2

Maximum aggregate size h_{agg} = **20** mm

Density of reinforced concrete ρ = **2500** kg/m^3

Monolithic simple support moment factor β_1 = **0.25**

Reinforcement details

Characteristic yield strength of reinforcement f_{yk} = **500** N/mm^2

Partial factor for reinforcing steel - Table 2.1N γ_S = **1.15**

Design yield strength of reinforcement $f_{yd} = f_{yk} / \gamma_S$ = **435** N/mm^2

Nominal cover to reinforcement

Nominal cover to top reinforcement c_{nom_t} = **35** mm

Nominal cover to bottom reinforcement c_{nom_b} = **35** mm

Nominal cover to side reinforcement c_{nom_s} = **35** mm

Fire resistance

Standard fire resistance period R = **60** min

Number of sides exposed to fire 3

Minimum width of beam - EN1992-1-2 Table 5.6 b_{min} = **120** mm

Beam - Span 1

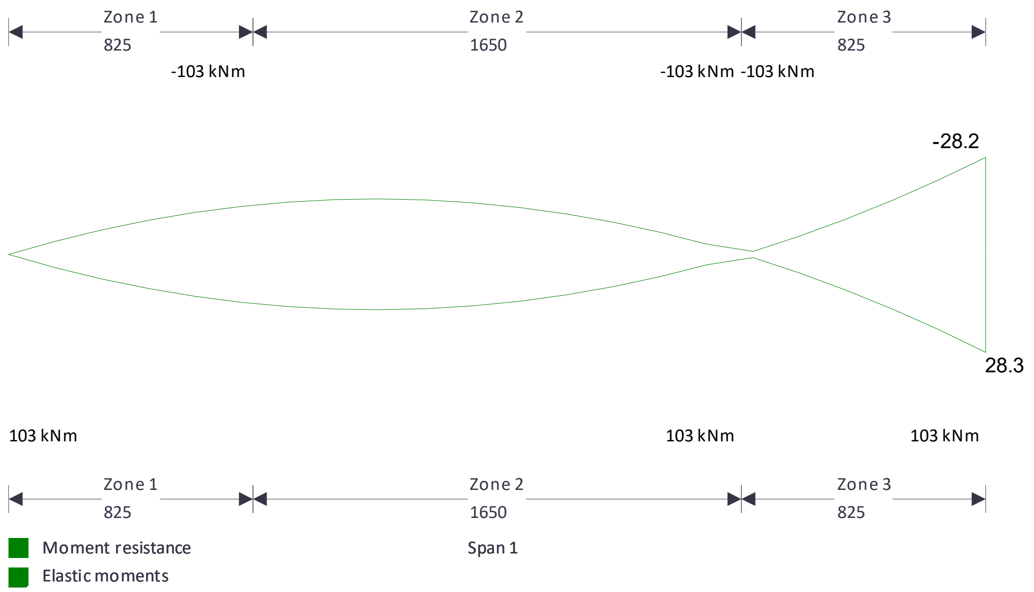
Rectangular section details

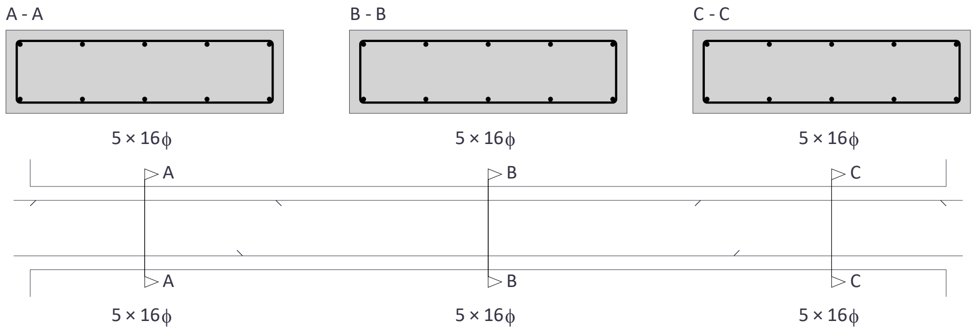
Section width b = **1000** mm

Section depth h = **300** mm

PASS - Minimum dimensions for fire resistance met

Moment design





Zone 1 (0 mm - 825 mm) Positive moment - section 6.1

Design bending moment	$M = \max(\beta_1 * \text{abs}(M_{m1\_s1\_min\_red}), \text{abs}(M_{m1\_s1\_z1\_max\_red})) = \mathbf{14.2}$ kNm
Effective depth of tension reinforcement	$d = \mathbf{249}$ mm
Redistribution ratio	$\delta = \min(M_{pos\_red\_z1} / M_{pos\_z1}, 1) = \mathbf{1.000}$
	$K = M / (b * d^2 * f_{ck}) = \mathbf{0.008}$
	$K' = (2 * \eta * \alpha_{cc} / \gamma_C) * (1 - \lambda * (\delta - k_1) / (2 * k_2)) * (\lambda * (\delta - k_1) / (2 * k_2)) = \mathbf{0.207}$
	K' > K - No compression reinforcement is required
Lever arm	$z = \min(0.5 * d * [1 + (1 - 2 * K / (\eta * \alpha_{cc} / \gamma_C))^{0.5}], 0.95 * d) = \mathbf{237}$ mm
Depth of neutral axis	$x = 2 * (d - z) / \lambda = \mathbf{31}$ mm
Area of tension reinforcement required	$A_{s,req} = M / (f_{yd} * z) = \mathbf{138}$ mm^2
Tension reinforcement provided	5 * 16ϕ
Area of tension reinforcement provided	$A_{s,prov} = \mathbf{1005}$ mm^2
Minimum area of reinforcement - exp.9.1N	$A_{s,min} = \max(0.26 * f_{ctm} / f_{yk}, 0.0013) * b * d = \mathbf{375}$ mm^2
Maximum area of reinforcement - cl.9.2.1.1(3)	$A_{s,max} = 0.04 * b * h = \mathbf{12000}$ mm^2

PASS - Area of reinforcement provided is greater than area of reinforcement required

Crack control - Section 7.3

Maximum crack width	$w_k = \mathbf{0.3}$ mm
Design value modulus of elasticity reinf – 3.2.7(4)	$E_s = \mathbf{200000}$ N/mm^2
Mean value of concrete tensile strength	$f_{ct,eff} = f_{ctm} = \mathbf{2.9}$ N/mm^2
Stress distribution coefficient	$k_c = \mathbf{0.4}$
Non-uniform self-equilibrating stress coefficient	$k = \min(\max(1 + (300\text{ mm} - \min(h, b)) * 0.35 / 500\text{ mm}, 0.65), 1) = \mathbf{1.00}$
Actual tension bar spacing	$s_{bar} = (b - (2 * (c_{nom\_s} + \phi_{m1\_s1\_z1\_v}) + \phi_{m1\_s1\_z1\_b\_L1} * N_{m1\_s1\_z1\_b\_L1})) / (N_{m1\_s1\_z1\_b\_L1} - 1) + \phi_{m1\_s1\_z1\_b\_L1} = \mathbf{224.5}$ mm
Maximum stress permitted - Table 7.3N	$\sigma_s = \mathbf{220}$ N/mm^2
Steel to concrete modulus of elast. ratio	$\alpha_{cr} = E_s / E_{cm} = \mathbf{6.09}$
Distance of the Elastic NA from bottom of beam	$y = (b * h^2 / 2 + A_{s,prov} * (\alpha_{cr} - 1) * (h - d)) / (b * h + A_{s,prov} * (\alpha_{cr} - 1)) = \mathbf{148}$ mm
Area of concrete in the tensile zone	$A_{ct} = b * y = \mathbf{148339}$ mm^2
Minimum area of reinforcement required - exp.7.1	$A_{sc,min} = k_c * k * f_{ct,eff} * A_{ct} / \sigma_s = \mathbf{780}$ mm^2

PASS - Area of tension reinforcement provided exceeds minimum required for crack control

Quasi-permanent moment	$M_{QP} = \max(\beta_1 * \text{abs}(M_{m1_s1_z2_neg_quasi}), \text{abs}(M_{m1_s1_z1_pos_quasi})) = \mathbf{7.8}$kNm
Permanent load ratio	$R_{PL} = M_{QP} / M = \mathbf{0.55}$
Service stress in reinforcement	$\sigma_{sr} = f_{yd} * A_{s,req} / A_{s,prov} * R_{PL} = \mathbf{33}$ N/mm^2
Maximum bar spacing - Tables 7.3N	$s_{bar,max} = \mathbf{300}$ mm

PASS - Maximum bar spacing exceeds actual bar spacing for crack control

Zone 1 (0 mm - 825 mm) Negative moment - section 6.1

Design bending moment — $M = max(\beta_1 * abs(M_{m1\_s1\_max\_red}), abs(M_{m1\_s1\_z1\_min\_red})) = \mathbf{14.3}$ kNm

Effective depth of tension reinforcement — $d = \mathbf{249}$ mm

Redistribution ratio — $\delta = min(M_{neg\_red\_z1} / M_{neg\_z1}, 1) = \mathbf{1.000}$

$K = M / (b * d^2 * f_{ck}) = \mathbf{0.008}$

$K' = (2 * \eta * \alpha_{cc} / \gamma_C) * (1 - \lambda * (\delta - k_1) / (2 * k_2)) * (\lambda * (\delta - k_1) / (2 * k_2)) = \mathbf{0.207}$

K' > K - No compression reinforcement is required

Lever arm — $z = min(0.5 * d * [1 + (1 - 2 * K / (\eta * \alpha_{cc} / \gamma_C))^{0.5}], 0.95 * d) = \mathbf{237}$ mm

Depth of neutral axis — $x = 2 * (d - z) / \lambda = \mathbf{31}$ mm

Area of tension reinforcement required — $A_{s,req} = M / (f_{yd} * z) = \mathbf{139}$ mm^2

Tension reinforcement provided — 5 * 16ϕ

Area of tension reinforcement provided — $A_{s,prov} = \mathbf{1005}$ mm^2

Minimum area of reinforcement - exp.9.1N — $A_{s,min} = max(0.26 * f_{ctm} / f_{yk}, 0.0013) * b * d = \mathbf{375}$ mm^2

Maximum area of reinforcement - cl.9.2.1.1(3) — $A_{s,max} = 0.04 * b * h = \mathbf{12000}$ mm^2

PASS - Area of reinforcement provided is greater than area of reinforcement required

Crack control - Section 7.3

Maximum crack width — $w_k = \mathbf{0.3}$ mm

Design value modulus of elasticity reinf – 3.2.7(4) — $E_s = \mathbf{200000}$ N/mm^2

Mean value of concrete tensile strength — $f_{ct,eff} = f_{ctm} = \mathbf{2.9}$ N/mm^2

Stress distribution coefficient — $k_c = \mathbf{0.4}$

Non-uniform self-equilibrating stress coefficient — $k = min(max(1 + (300 \text{ mm} - min(h, b)) * 0.35 / 500 \text{ mm}, 0.65), 1) = \mathbf{1.00}$

Actual tension bar spacing — $s_{bar} = (b - (2 * (c_{nom\_s} + \phi_{m1\_s1\_z1\_v}) + \phi_{m1\_s1\_z1\_t\_L1} * N_{m1\_s1\_z1\_t\_L1})) / (N_{m1\_s1\_z1\_t\_L1} - 1) + \phi_{m1\_s1\_z1\_t\_L1} = \mathbf{224.5}$ mm

Maximum stress permitted - Table 7.3N — $\sigma_s = \mathbf{220}$ N/mm^2

Steel to concrete modulus of elast. ratio — $\alpha_{cr} = E_s / E_{cm} = \mathbf{6.09}$

Distance of the Elastic NA from bottom of beam — $y = (b * h^2 / 2 + A_{s,prov} * (\alpha_{cr} - 1) * (h - d)) / (b * h + A_{s,prov} * (\alpha_{cr} - 1)) = \mathbf{148}$ mm

Area of concrete in the tensile zone — $A_{ct} = b * y = \mathbf{148339}$ mm^2

Minimum area of reinforcement required - exp.7.1 — $A_{sc,min} = k_c * k * f_{ct,eff} * A_{ct} / \sigma_s = \mathbf{780}$ mm^2

PASS - Area of tension reinforcement provided exceeds minimum required for crack control

Quasi-permanent moment — $M_{QP} = max(\beta_1 * abs(M_{m1_s1_z2_pos_quasi}), abs(M_{m1_s1_z1_neg_quasi})) = \mathbf{2.2}$kNm

Permanent load ratio — $R_{PL} = M_{QP} / M = \mathbf{0.15}$

Service stress in reinforcement — $\sigma_{sr} = f_{yd} * A_{s,req} / A_{s,prov} * R_{PL} = \mathbf{9}$ N/mm^2

Maximum bar spacing - Tables 7.3N — $s_{bar,max} = \mathbf{300}$ mm

PASS - Maximum bar spacing exceeds actual bar spacing for crack control

Minimum bar spacing (Section 8.2)

Top bar spacing — $s_{top} = (b - (2 * (c_{nom\_s} + \phi_{m1\_s1\_z1\_v}) + \phi_{m1\_s1\_z1\_t\_L1} * N_{m1\_s1\_z1\_t\_L1})) / (N_{m1\_s1\_z1\_t\_L1} - 1) = \mathbf{208.5}$ mm

Minimum allowable top bar spacing — $s_{top,min} = max(\phi_{m1\_s1\_z1\_t\_L1} * k_{s1}, h_{agg} + k_{s2}, 20\text{mm}) = \mathbf{25.0}$ mm

PASS - Actual bar spacing exceeds minimum allowable

Bottom bar spacing — $s_{bot} = (b - (2 * (c_{nom\_s} + \phi_{m1\_s1\_z1\_v}) + \phi_{m1\_s1\_z1\_b\_L1} * N_{m1\_s1\_z1\_b\_L1})) / (N_{m1\_s1\_z1\_b\_L1} - 1) = \mathbf{208.5}$ mm

Minimum allowable bottom bar spacing — $s_{bot,min} = max(\phi_{m1\_s1\_z1\_b\_L1} * k_{s1}, h_{agg} + k_{s2}, 20\text{mm}) = \mathbf{25.0}$ mm

PASS - Actual bar spacing exceeds minimum allowable

Zone 2 (825 mm - 2475 mm) Positive moment - section 6.1

Design bending moment	M = abs($M_{m1\_s1\_z2\_max\_red}$) = **16.0** kNm
Effective depth of tension reinforcement	d = **249** mm
Redistribution ratio	δ = min($M_{pos\_red\_z2}$ / M_{pos_z2}, 1) = **1.000**
	K = M / (b * d^2 * f_{ck}) = **0.009**
	K' = (2 * η * α_{cc} / γ_C) * (1 - λ * (δ - k_1) / (2 * k_2)) * (λ * (δ - k_1) / (2 * k_2)) = **0.207**

K' > K - No compression reinforcement is required

Lever arm	z = min(0.5 * d * [1 + (1 - 2 * K / (η * α_{cc} / γ_C))$^{0.5}$], 0.95 * d) = **237** mm
Depth of neutral axis	x = 2 * (d - z) / λ = **31** mm
Area of tension reinforcement required	$A_{s,req}$ = M / (f_{yd} * z) = **155** mm^2
Tension reinforcement provided	5 * 16ϕ
Area of tension reinforcement provided	$A_{s,prov}$ = **1005** mm^2
Minimum area of reinforcement - exp.9.1N	$A_{s,min}$ = max(0.26 * f_{ctm} / f_{yk}, 0.0013) * b * d = **375** mm^2
Maximum area of reinforcement - cl.9.2.1.1(3)	$A_{s,max}$ = 0.04 * b * h = **12000** mm^2

PASS - Area of reinforcement provided is greater than area of reinforcement required

Crack control - Section 7.3

Maximum crack width	w_k = **0.3** mm
Design value modulus of elasticity reinf – 3.2.7(4)	E_s = **200000** N/mm^2
Mean value of concrete tensile strength	$f_{ct,eff}$ = f_{ctm} = **2.9** N/mm^2
Stress distribution coefficient	k_c = **0.4**
Non-uniform self-equilibrating stress coefficient	k = min(max(1 + (300 mm - min(h, b)) * 0.35 / 500 mm, 0.65), 1) = **1.00**
Actual tension bar spacing	s_{bar} = (b - (2 * (c_{nom_s} + $\phi_{m1\_s1\_z2\_v}$) + $\phi_{m1\_s1\_z2\_b\_L1}$ * $N_{m1\_s1\_z2\_b\_L1}$ + $\phi_{m1\_s1\_z1\_b\_L1}$ * $N_{m1\_s1\_z1\_b\_L1}$)) / (($N_{m1\_s1\_z2\_b\_L1}$ + $N_{m1\_s1\_z1\_b\_L1}$) - 1) + $\phi_{m1\_s1\_z2\_b\_L1}$ = **224.5** mm
Maximum stress permitted - Table 7.3N	σ_s = **220** N/mm^2
Steel to concrete modulus of elast. ratio	α_{cr} = E_s / E_{cm} = **6.09**
Distance of the Elastic NA from bottom of beam	y = (b * h^2 / 2 + $A_{s,prov}$ * (α_{cr} - 1) * (h - d)) / (b * h + $A_{s,prov}$ * (α_{cr} - 1)) = **148** mm
Area of concrete in the tensile zone	A_{ct} = b * y = **148339** mm^2
Minimum area of reinforcement required - exp.7.1	$A_{sc,min}$ = k_c * k * $f_{ct,eff}$ * A_{ct} / σ_s = **780** mm^2

PASS - Area of tension reinforcement provided exceeds minimum required for crack control

Quasi-permanent moment	M_{QP} = abs($M_{m1\_s1\_z2\_pos\_quasi}$) = **8.7**kNm
Permanent load ratio	R_{PL} = M_{QP} / M = **0.55**
Service stress in reinforcement	σ_{sr} = f_{yd} * $A_{s,req}$ / $A_{s,prov}$ * R_{PL} = **37** N/mm^2
Maximum bar spacing - Tables 7.3N	$s_{bar,max}$ = **300** mm

PASS - Maximum bar spacing exceeds actual bar spacing for crack control

Deflection control - Section 7.4

Reference reinforcement ratio	ρ_{m0} = (f_{ck} / 1 N/mm^2)$^{0.5}$ / 1000 = **0.00548**
Required tension reinforcement ratio	ρ_m = $A_{s,req}$ / (b * d) = **0.00062**
Required compression reinforcement ratio	ρ'_m = $A_{s2,req}$ / (b * d) = **0.00000**
Structural system factor - Table 7.4N	K_b = **1.0**
Basic allowable span to depth ratio	$span\_to\_depth_{basic}$ = K_b * [11 + 1.5 * (f_{ck} / 1 N/mm^2)$^{0.5}$ * ρ_{m0} / ρ_m + 3.2 * (f_{ck} / 1 N/mm^2)$^{0.5}$ * (ρ_{m0} / ρ_m - 1)$^{1.5}$] = **462.720**
Reinforcement factor - exp.7.17	K_s = min($A_{s,prov}$ / $A_{s,req}$ * 500 N/mm^2 / f_{yk}, 1.5) = **1.500**
Flange width factor	F1 = 1 = **1.000**

Long span supporting brittle partition factor	F2 = 1 = **1.000**
Allowable span to depth ratio	$span\_to\_depth_{allow}$ = min($span\_to\_depth_{basic}$ * K_s * F1 * F2, 40 * K_b) = **40.000**
Actual span to depth ratio	$span\_to\_depth_{actual}$ = L_{m1_s1} / d = **13.253**

PASS - Actual span to depth ratio is within the allowable limit

Zone 2 (825 mm - 2475 mm) Negative moment - section 6.1

Design bending moment	M = abs($M_{m1\_s1\_z2\_min\_red}$) = **16.1** kNm
Effective depth of tension reinforcement	d = **249** mm
Redistribution ratio	δ = min($M_{neg\_red\_z2}$ / M_{neg_z2}, 1) = **1.000**
	K = M / (b * d^2 * f_{ck}) = **0.009**
	K' = (2 * η * α_{cc} / γ_C) * (1 - λ * (δ - k_1) / (2 * k_2)) * (λ * (δ - k_1) / (2 * k_2)) = **0.207**

K' > K - No compression reinforcement is required

Lever arm	z = min(0.5 * d * [1 + (1 - 2 * K / (η * α_{cc} / γ_C))$^{0.5}$], 0.95 * d) = **237** mm
Depth of neutral axis	x = 2 * (d - z) / λ = **31** mm
Area of tension reinforcement required	$A_{s,req}$ = M / (f_{yd} * z) = **157** mm^2
Tension reinforcement provided	5 * 16ϕ
Area of tension reinforcement provided	$A_{s,prov}$ = **1005** mm^2
Minimum area of reinforcement - exp.9.1N	$A_{s,min}$ = max(0.26 * f_{ctm} / f_{yk}, 0.0013) * b * d = **375** mm^2
Maximum area of reinforcement - cl.9.2.1.1(3)	$A_{s,max}$ = 0.04 * b * h = **12000** mm^2

PASS - Area of reinforcement provided is greater than area of reinforcement required

Crack control - Section 7.3

Maximum crack width	w_k = **0.3** mm
Design value modulus of elasticity reinf – 3.2.7(4)	E_s = **200000** N/mm^2
Mean value of concrete tensile strength	$f_{ct,eff}$ = f_{ctm} = **2.9** N/mm^2
Stress distribution coefficient	k_c = **0.4**
Non-uniform self-equilibrating stress coefficient	k = min(max(1 + (300 mm - min(h, b)) * 0.35 / 500 mm, 0.65), 1) = **1.00**
Actual tension bar spacing	s_{bar} = (b - (2 * (c_{nom_s} + $\phi_{m1\_s1\_z2\_v}$) + $\phi_{m1\_s1\_z2\_t\_L1}$ * $N_{m1\_s1\_z2\_t\_L1}$)) / ($N_{m1\_s1\_z2\_t\_L1}$ - 1) + $\phi_{m1\_s1\_z2\_t\_L1}$ = **224.5** mm
Maximum stress permitted - Table 7.3N	σ_s = **220** N/mm^2
Steel to concrete modulus of elast. ratio	α_{cr} = E_s / E_{cm} = **6.09**
Distance of the Elastic NA from bottom of beam	y = (b * h^2 / 2 + $A_{s,prov}$ * (α_{cr} - 1) * (h - d)) / (b * h + $A_{s,prov}$ * (α_{cr} - 1)) = **148** mm
Area of concrete in the tensile zone	A_{ct} = b * y = **148339** mm^2
Minimum area of reinforcement required - exp.7.1	$A_{sc,min}$ = k_c * k * $f_{ct,eff}$ * A_{ct} / σ_s = **780** mm^2

PASS - Area of tension reinforcement provided exceeds minimum required for crack control

Quasi-permanent moment	M_{QP} = abs($M_{m1\_s1\_z2\_neg\_quasi}$) = **0.0**kNm
Permanent load ratio	R_{PL} = M_{QP} / M = **0.00**
Service stress in reinforcement	σ_{sr} = f_{yd} * $A_{s,req}$ / $A_{s,prov}$ * R_{PL} = **0** N/mm^2
Maximum bar spacing - Tables 7.3N	$s_{bar,max}$ = **300** mm

PASS - Maximum bar spacing exceeds actual bar spacing for crack control

Deflection control - Section 7.4

Reference reinforcement ratio	ρ_{m0} = (f_{ck} / 1 N/mm^2)$^{0.5}$ / 1000 = **0.00548**
Required tension reinforcement ratio	ρ_m = $A_{s,req}$ / (b * d) = **0.00063**
Required compression reinforcement ratio	ρ'_m = $A_{s2,req}$ / (b * d) = **0.00000**
Structural system factor - Table 7.4N	K_b = **1.0**

Basic allowable span to depth ratio — $span\_to\_depth_{basic} = K_b * [11 + 1.5 * (f_{ck} / 1\ N/mm^2)^{0.5} * \rho_{m0} / \rho_m + 3.2 * (f_{ck} / 1\ N/mm^2)^{0.5} * (\rho_{m0} / \rho_m - 1)^{1.5}] =$ **457.924**

Reinforcement factor - exp.7.17 — $K_s = \min(A_{s,prov} / A_{s,req} * 500\ N/mm^2 / f_{yk}, 1.5) =$ **1.500**

Flange width factor — F1 = 1 = **1.000**

Long span supporting brittle partition factor — F2 = 1 = **1.000**

Allowable span to depth ratio — $span\_to\_depth_{allow} = \min(span\_to\_depth_{basic} * K_s * F1 * F2, 40 * K_b) =$ **40.000**

Actual span to depth ratio — $span\_to\_depth_{actual} = L_{m1\_s1} / d =$ **13.253**

PASS - Actual span to depth ratio is within the allowable limit

Minimum bar spacing (Section 8.2)

Top bar spacing — $s_{top} = (b - (2 * (c_{nom\_s} + \phi_{m1\_s1\_z2\_v}) + \phi_{m1\_s1\_z2\_t\_L1} * N_{m1\_s1\_z2\_t\_L1})) / (N_{m1\_s1\_z2\_t\_L1} - 1) =$ **208.5** mm

Minimum allowable top bar spacing — $s_{top,min} = \max(\phi_{m1\_s1\_z2\_t\_L1} * k_{s1}, h_{agg} + k_{s2}, 20mm) =$ **25.0** mm

PASS - Actual bar spacing exceeds minimum allowable

Bottom bar spacing — $s_{bot} = (b - (2 * (c_{nom\_s} + \phi_{m1\_s1\_z2\_v}) + \phi_{m1\_s1\_z2\_b\_L1} * N_{m1\_s1\_z2\_b\_L1} + \phi_{m1\_s1\_z1\_b\_L1} * N_{m1\_s1\_z1\_b\_L1})) / ((N_{m1\_s1\_z2\_b\_L1} + N_{m1\_s1\_z1\_b\_L1}) - 1) =$ **208.5** mm

Minimum allowable bottom bar spacing — $s_{bot,min} = \max(\phi_{m1\_s1\_z2\_b\_L1} * k_{s1}, h_{agg} + k_{s2}, 20mm) =$ **25.0** mm

PASS - Actual bar spacing exceeds minimum allowable

Zone 3 (2475 mm - 3300 mm) Positive moment - section 6.1

Design bending moment — $M = abs(M_{m1\_s1\_z3\_max\_red}) =$ **28.3** kNm

Effective depth of tension reinforcement — d = **249** mm

Redistribution ratio — $\delta = \min(M_{pos\_red\_z3} / M_{pos\_z3}, 1) =$ **1.000**

$K = M / (b * d^2 * f_{ck}) =$ **0.015**

$K' = (2 * \eta * \alpha_{cc} / \gamma_C) * (1 - \lambda * (\delta - k_1) / (2 * k_2)) * (\lambda * (\delta - k_1) / (2 * k_2)) =$ **0.207**

K' > K - No compression reinforcement is required

Lever arm — $z = \min(0.5 * d * [1 + (1 - 2 * K / (\eta * \alpha_{cc} / \gamma_C))^{0.5}], 0.95 * d) =$ **237** mm

Depth of neutral axis — $x = 2 * (d - z) / \lambda =$ **31** mm

Area of tension reinforcement required — $A_{s,req} = M / (f_{yd} * z) =$ **276** mm²

Tension reinforcement provided — 5 * 16ϕ

Area of tension reinforcement provided — $A_{s,prov} =$ **1005** mm²

Minimum area of reinforcement - exp.9.1N — $A_{s,min} = \max(0.26 * f_{ctm} / f_{yk}, 0.0013) * b * d =$ **375** mm²

Maximum area of reinforcement - cl.9.2.1.1(3) — $A_{s,max} = 0.04 * b * h =$ **12000** mm²

PASS - Area of reinforcement provided is greater than area of reinforcement required

Crack control - Section 7.3

Maximum crack width — $w_k =$ **0.3** mm

Design value modulus of elasticity reinf – 3.2.7(4) — $E_s =$ **200000** N/mm²

Mean value of concrete tensile strength — $f_{ct,eff} = f_{ctm} =$ **2.9** N/mm²

Stress distribution coefficient — $k_c =$ **0.4**

Non-uniform self-equilibrating stress coefficient — k = min(max(1 + (300 mm - min(h, b)) * 0.35 / 500 mm, 0.65), 1) = **1.00**

Actual tension bar spacing — $s_{bar} = (b - (2 * (c_{nom\_s} + \phi_{m1\_s1\_z3\_v}) + \phi_{m1\_s1\_z3\_b\_L1} * N_{m1\_s1\_z3\_b\_L1})) / (N_{m1\_s1\_z3\_b\_L1} - 1) + \phi_{m1\_s1\_z3\_b\_L1} =$ **224.5** mm

Maximum stress permitted - Table 7.3N — $\sigma_s =$ **220** N/mm²

Steel to concrete modulus of elast. ratio — $\alpha_{cr} = E_s / E_{cm} =$ **6.09**

Distance of the Elastic NA from bottom of beam $y = (b * h^2 / 2 + A_{s,prov} * (\alpha_{cr} - 1) * (h - d)) / (b * h + A_{s,prov} * (\alpha_{cr} - 1)) =$ **148** mm

Area of concrete in the tensile zone $A_{ct} = b * y =$ **148339** mm^2

Minimum area of reinforcement required - exp.7.1 $A_{sc,min} = k_c * k * f_{ct,eff} * A_{ct} / \sigma_s =$ **780** mm^2

PASS - Area of tension reinforcement provided exceeds minimum required for crack control

Quasi-permanent moment $M_{QP} = abs(M_{m1\_s1\_z3\_pos\_quasi}) =$ **0.1**kNm

Permanent load ratio $R_{PL} = M_{QP} / M =$ **0.00**

Service stress in reinforcement $\sigma_{sr} = f_{yd} * A_{s,req} / A_{s,prov} * R_{PL} =$ **0** N/mm^2

Maximum bar spacing - Tables 7.3N $s_{bar,max} =$ **300** mm

PASS - Maximum bar spacing exceeds actual bar spacing for crack control

Zone 3 (2475 mm - 3300 mm) Negative moment - section 6.1

Design bending moment $M = abs(M_{m1\_s1\_z3\_min\_red}) =$ **28.2** kNm

Effective depth of tension reinforcement d = **249** mm

Redistribution ratio $\delta = min(M_{neg\_red\_z3} / M_{neg\_z3}, 1) =$ **1.000**

$K = M / (b * d^2 * f_{ck}) =$ **0.015**

$K' = (2 * \eta * \alpha_{cc} / \gamma_C) * (1 - \lambda * (\delta - k_1) / (2 * k_2)) * (\lambda * (\delta - k_1) / (2 * k_2)) =$ **0.207**

K' > K - No compression reinforcement is required

Lever arm $z = min(0.5 * d * [1 + (1 - 2 * K / (\eta * \alpha_{cc} / \gamma_C))^{0.5}], 0.95 * d) =$ **237** mm

Depth of neutral axis $x = 2 * (d - z) / \lambda =$ **31** mm

Area of tension reinforcement required $A_{s,req} = M / (f_{yd} * z) =$ **274** mm^2

Tension reinforcement provided 5 * 16ϕ

Area of tension reinforcement provided $A_{s,prov} =$ **1005** mm^2

Minimum area of reinforcement - exp.9.1N $A_{s,min} = max(0.26 * f_{ctm} / f_{yk}, 0.0013) * b * d =$ **375** mm^2

Maximum area of reinforcement - cl.9.2.1.1(3) $A_{s,max} = 0.04 * b * h =$ **12000** mm^2

PASS - Area of reinforcement provided is greater than area of reinforcement required

Crack control - Section 7.3

Maximum crack width $w_k =$ **0.3** mm

Design value modulus of elasticity reinf – 3.2.7(4) $E_s =$ **200000** N/mm^2

Mean value of concrete tensile strength $f_{ct,eff} = f_{ctm} =$ **2.9** N/mm^2

Stress distribution coefficient $k_c =$ **0.4**

Non-uniform self-equilibrating stress coefficient k = min(max(1 + (300 mm - min(h, b)) * 0.35 / 500 mm, 0.65), 1) = **1.00**

Actual tension bar spacing $s_{bar} = (b - (2 * (c_{nom\_s} + \phi_{m1\_s1\_z3\_v}) + \phi_{m1\_s1\_z3\_t\_L1} * N_{m1\_s1\_z3\_t\_L1})) / (N_{m1\_s1\_z3\_t\_L1} - 1) + \phi_{m1\_s1\_z3\_t\_L1} =$ **224.5** mm

Maximum stress permitted - Table 7.3N $\sigma_s =$ **220** N/mm^2

Steel to concrete modulus of elast. ratio $\alpha_{cr} = E_s / E_{cm} =$ **6.09**

Distance of the Elastic NA from bottom of beam $y = (b * h^2 / 2 + A_{s,prov} * (\alpha_{cr} - 1) * (h - d)) / (b * h + A_{s,prov} * (\alpha_{cr} - 1)) =$ **148** mm

Area of concrete in the tensile zone $A_{ct} = b * y =$ **148339** mm^2

Minimum area of reinforcement required - exp.7.1 $A_{sc,min} = k_c * k * f_{ct,eff} * A_{ct} / \sigma_s =$ **780** mm^2

PASS - Area of tension reinforcement provided exceeds minimum required for crack control

Quasi-permanent moment $M_{QP} = abs(M_{m1\_s1\_z3\_neg\_quasi}) =$ **15.4**kNm

Permanent load ratio $R_{PL} = M_{QP} / M =$ **0.55**

Service stress in reinforcement $\sigma_{sr} = f_{yd} * A_{s,req} / A_{s,prov} * R_{PL} =$ **65** N/mm^2

Maximum bar spacing - Tables 7.3N $s_{bar,max} =$ **300** mm

PASS - Maximum bar spacing exceeds actual bar spacing for crack control