Appendix 7

Damage Category Charts

Deflection Ratio Calculation

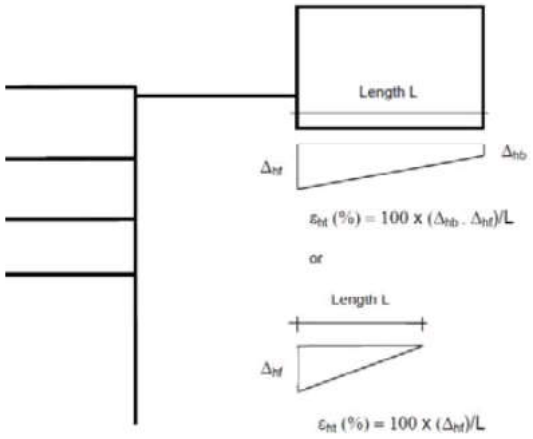
Historic Heave Values

Category of damage	Description of typical damage	Approximate crack width (mm)	Limiting tensile strain ε_{lim} (per cent)
0 Negligible	Hairline cracks of less than about 0.1 mm are classed as negligible	<0.1	0.0-0.05
1 Very slight	Fine cracks that can easily be treated during normal decoration. Perhaps isolated slight fracture in building. Cracks in external brickwork visible on inspection	<1	0.05-0.075
2 Slight	Cracks easily filled. Redecoration probably required. Several slight fractures showing inside of building. Cracks are visible externally and some repointing may be required externally to ensure weathertightness. Doors and windows may stick slightly.	<5	0.075-0.15
3 Moderate	The cracks require some opening up and can be patched by a mason. Recurrent cracks can be masked by suitable lining. Repointing of external brickwork and possibly a small amount of brickwork to be replaced. Doors and windows sticking. Service pipes may fracture. Weathertightness often impaired.	5-15 or a number of cracks > 3	0.15-0.3
4 Severe	Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Windows and frames distorted, floor sloping noticeably. Walls leaning or bulging noticeably, some loss of bearing in beams. Service pipes disrupted.	15-25 but also depends on number of cracks	>0.3
5 Very severe	This requires a major repair involving partial or complete rebuilding. Beams lose bearings, walls lean badly and require shoring. Windows broken with distortion, Danger of instability.	Usually > 25 but depends on number of cracks	

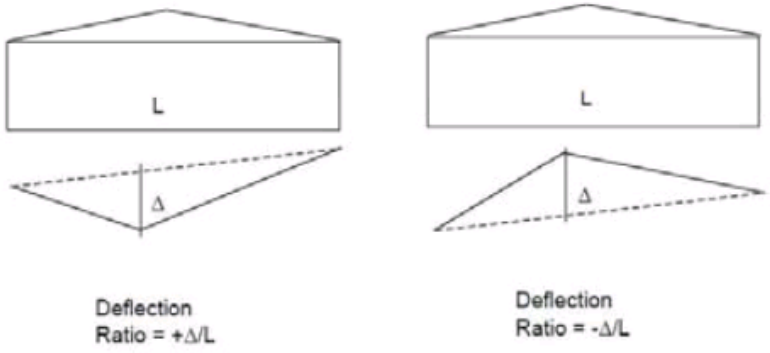
Damage Category Chart (CIRIA C580)

DETERMINATION OF HORIZONTAL TENSILE STRAINS AND DEFLECTION RATIOS

- Horizontal Tensile Strain ht
  To determine the resulting horizontal tensile strain that will develop in the adjacent properties, the lateral displacement to the rear of the property (hb) is subtracted from the lateral displacement at the front of the property (hf). The resulting differential lateral displacement is then divided by the length of the property perpendicular to the basement wall to determine the horizontal tensile strain. Where the lateral displacement is zero at the rear of the property the lateral displacement at the front of the property is divided by the distance from the front of the property to the point of zero lateral displacement to determine the lateral strain. This approach is illustrated below and has been adopted for both the lateral displacements caused by wall installation and excavation.



- Deflection Ratio /L
  The deflection ratio is defined as the off linear vertical displacement across a structure as illustrated below.



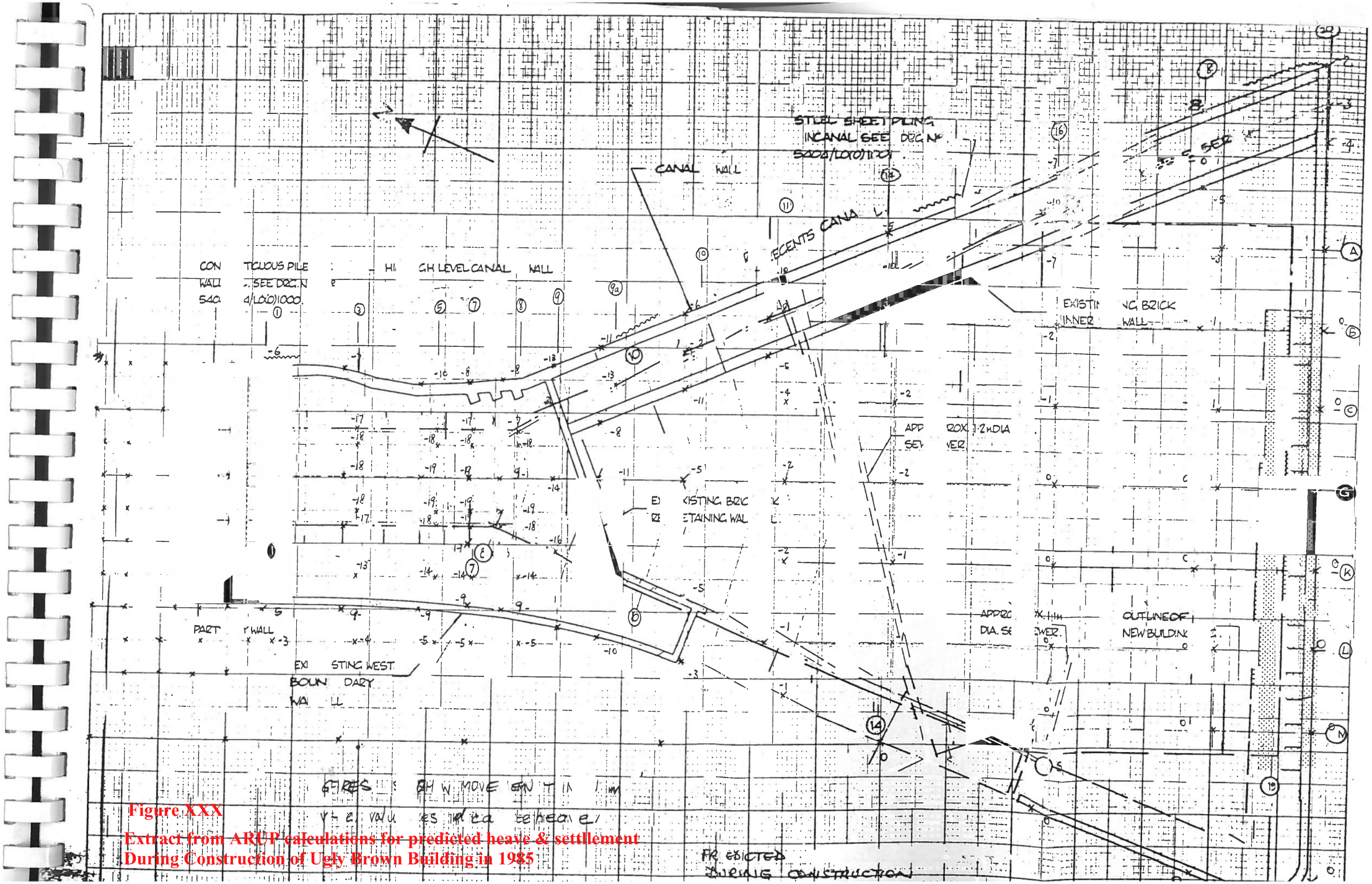


Figure XXX

Extract from ARUP calculations for predicted heave & settlement During Construction of Ugly Brown Building in 1985

Appendix 8

Statutory Authority Correspondence

Thames Water Sewer Records

Steffan Granger

From: Toby Pearce <Toby.Pearce@canalrivertrust.org.uk>
Sent: 23 October 2017 16:45
To: Steffan Granger
Subject: RE: Ugly Brown Building - SI works Adjacent to

Hi Steffan,

I would need to review RAMS for the work to satisfy myself that risks to the canal wall and loss of water are being managed appropriately.

Can your share SI contractors RAMS and PLI certificate.

Assuming I am happy for work to go ahead I will send our form 3, indemnity form, for you to complete and return. As the works aren't taking place on land you won't require a licence or permit for site access.

Regards,

Toby

From: Steffan Granger [mailto:Steffan@gdteam.co.uk]
Sent: 23 October 2017 10:40
To: Toby Pearce <Toby.Pearce@canalrivertrust.org.uk>
Cc: Nick Pogson <Nick.Pogson@canalrivertrust.org.uk>
Subject: Ugly Brown Building - SI works Adjacent to

Toby

We've just been instructed to undertake some Phase 2 SI works around the UBB asap, ideally at the start of November. Please see attached plan for information.

Can you confirm what I need to do to gain your approval to the SI works please. It includes 5No boreholes and 2No trial pits adjacent to the canal.

The boreholes are effectively dual purpose in that they will be used to prove existing soil conditions at depth in the usual manner, but they will also be used to determine the depth of the existing driven sheet and bored concrete piles. To do this it is proposed to lower a probe into the boreholes that will detect the adjacent sheet and concrete piles. We understand that the signal detected by this probe will change as it extends below the bottom of the adjacent piles thereby determining their depth.

We're proposing the trail pits adjacent to the piled walls to we can determine details of the existing capping beams included size and construction details.

We have been instructed to progress the SI at pace so I'd be grateful for a quick response please.

Many thanks

Regards
Steffan Granger
Associate

Registered / Head Office:
GD Partnership Ltd, The Cart Lodge,
Lullingstone Lane, Eynsford, Kent, DA4 0HZ

Tel: 01322 868 622
Mob: 07840 695 912
Reg: 4917723 [England]

Steffan Granger

From: Ana Pereira <Ana.Pereira@thameswater.co.uk>
Sent: 24 October 2017 18:16
To: Steffan Granger
Cc: Simon Hindle; Jason Russell - Reef (jrussell@reefestates.co.uk); Rudy Djajasaputra
Subject: RE: Your Refs; DS6032585 & OSS/12/678126 - Ted Baker / Ugly Brown Building - SI works Adjacent to Ex't Sewer

Steffan,

Can you please confirm how the position of the sewer has been established. Also, can you please provide the method statement for the boreholes.

Thames Water usually recommends that a condition survey is completed prior to any works are undertaken on site. This is to ensure that developers are not liable for any existing defects on the sewer. A post-construction condition survey will be required.

Thank you.

Kind regards,

Ana Pereira
Civil Engineer
Strategic Partnering

Planning for and enabling growth
Thames Water Utilities Ltd, Clearwater Court, Vastern Road, Reading, Berkshire, RG1 8DB
Mobile: 07747 640 175 ana.pereira@thameswater.co.uk

From: Steffan Granger [mailto:Steffan@gdteam.co.uk]
Sent: 24 October 2017 16:21
To: Ana Pereira
Cc: Simon Hindle; Jason Russell - Reef (jrussell@reefestates.co.uk); Rudy Djajasaputra
Subject: RE: Your Refs; DS6032585 & OSS/12/678126 - Ted Baker / Ugly Brown Building - SI works Adjacent to Ex't Sewer

Ana, thank you for the quick response and thank you for the copy of the guidance for working near Thames assets.

As I said in my email the piles will be bored and the nearest is at least 3m away from your sewer. In fact, two of the piles are greater than 4 and 4.5m away from the sewer. With regards to the pile that's just over 3m away from the sewer, it will be at least 20 times the diameter of the piles away from the sewer and (please note) it will be located behind the existing piles that were installed as a protective screen to your sewer.

As such, on this occasion I do not believe it is necessary to undertake an Engineering Impact Assessment, can you please confirm you agreement.

As you refer to in your email, we are about to embark on some much more significant works to demolish the existing building over that sewer and to request a Build Over Agreement for a replacement structure. It was in this respect that Michael was in contact with you. I will be speaking to my Client soon to arrange the payment for the Impact Study.

We are also waiting the Client's confirmation of his preferred surveyor to provide us an accurate location for this sewer. As soon as we have this we will be in touch to agree the survey with you.

I trust this is acceptable for now and look forward to receiving your confirmation.

Many thanks

Regards
Steffan Granger
Associate

Registered / Head Office:
GD Partnership Ltd, The Cart Lodge,
Lullingstone Lane, Eynsford, Kent, DA4 0HZ

Tel: 01322 868 622
Mob: 07840 695 912
Reg: 4917723 [England]

From: Ana Pereira [mailto:Ana.Pereira@thameswater.co.uk]
Sent: 24 October 2017 12:09
To: Steffan Granger <Steffan@gdteam.co.uk>
Cc: Simon Hindle <Simon.Hindle@thameswater.co.uk>
Subject: RE: Your Refs; DS6032585 & OSS/12/678126 - Ted Baker / Ugly Brown Building - SI works Adjacent to Ex't Sewer

Steffan,

We have been in contact with Michael Evans in regards to this scheme. An Impact Study reference **X2039/1144 6a St Pancras Way** has been set up to review the proposals for this site. We are awaiting costumer details to raise an invoice for this scheme to allow us to proceed with the review.

Please refer to the email attached.

Thank you.

Kind regards,

Ana Pereira
Civil Engineer
Strategic Partnering

Planning for and enabling growth
Thames Water Utilities Ltd, Clearwater Court, Vastern Road, Reading, Berkshire, RG1 8DB
Mobile: 07747 640 175 ana.pereira@thameswater.co.uk

From: Steffan Granger [mailto:Steffan@gdteam.co.uk]
Sent: 23 October 2017 11:06

To: Developer Services; Ana Pereira
Subject: Your Refs; DS6032585 & OSS/12/678126 - Ted Baker / Ugly Brown Building - SI works Adjacent to Ex't Sewer

Dear Developer Services

We've just been instructed to undertake some Phase 2 SI works around the UBB asap, ideally at the start of November. Please see attached plans for information, one detailing the proposed SI and the other from public sewer records being a location plan. The site is on St Pancras Way close to its junction with Granary St.

Can you confirm what I need to do to gain your approval to the SI works please. It includes 3No boreholes adjacent to the deep sewer, albeit they are respectively 3, 4 and 4.5m away from the outside edge of the sewer (based on currently assumed location) and they are all located behind the protective contig piled wall that runs either side of the sewer.

The boreholes are effectively dual purpose in that they will be used to prove existing soil conditions at depth in the usual manner, but they will also be used to determine the depth of the existing concrete piles. To do this we proposed to lower a probe into the boreholes that will detect the adjacent concrete piles. We understand that the signal detected by this probe will change as it extends below the bottom of the adjacent piles thereby determining their depth.

We have been instructed to progress the SI at pace so I'd be grateful for a quick response please.

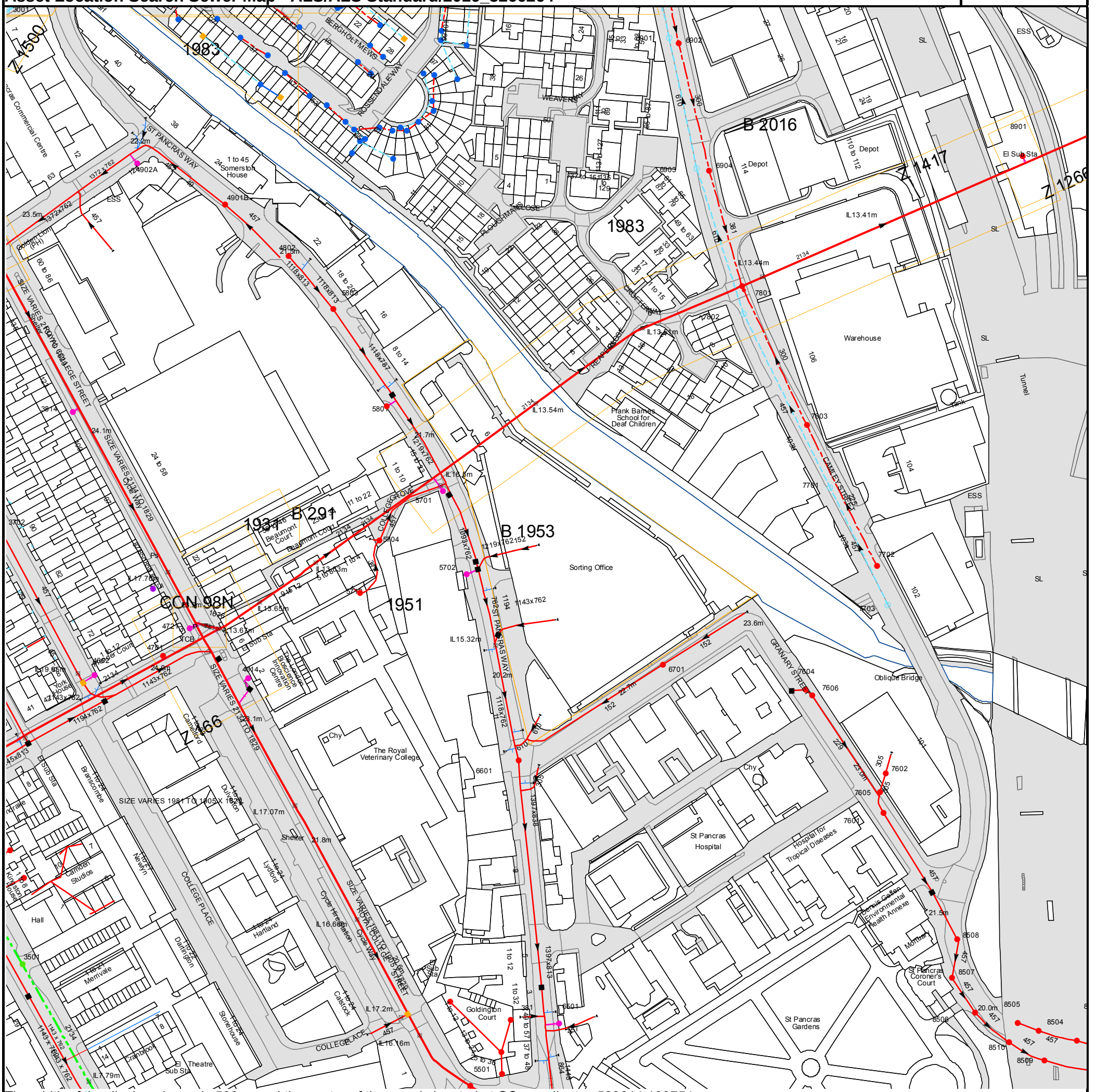
Many thanks

Regards
Steffan Granger
Associate

Registered / Head Office:
GD Partnership Ltd, The Cart Lodge,
Lullingstone Lane, Eynsford, Kent, DA4 0HZ

Tel: 01322 868 622
Mob: 07840 695 912
Reg: 4917723 [England]

Asset Location Search Sewer Map - ALS/ALS Standard/2016_3266264



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 529614,183754

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.

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
36DI	n/a	n/a
3501	22.84	8.17
36EB	n/a	n/a
4602	n/a	n/a
471A	n/a	n/a
4701	23.71	13.66
4721	23.86	n/a
4614	n/a	n/a
5718	20.05	17.31
5704	19.71	16.96
5701	21.24	14.4
55AE	n/a	n/a
5702	n/a	n/a
55AJ	n/a	n/a
6601	19.88	14.88
6501	n/a	n/a
6701	n/a	n/a
7604	23.2	22.52
7803	26.85	23.93
7606	n/a	n/a
7701	27.5	24.8
7702	27.5	25
7605	n/a	n/a
7601	23.22	22.53
7602	n/a	n/a
7703	27.5	25.4
8507	n/a	n/a
8508	n/a	n/a
8506	19.98	19.05
8505	20.03	19.46
8901	27.36	13.72
8504	20.07	19.31
8503	20.23	19.28
5501	18.95	15.59
55AI	n/a	n/a
55AF	n/a	n/a
8510	n/a	n/a
8509	n/a	n/a
59DH	n/a	n/a
59DI	n/a	n/a
59FH	n/a	n/a
59FI	n/a	n/a
59AF	n/a	n/a
59FD	n/a	n/a
59FG	n/a	n/a
5801	n/a	n/a
59AE	n/a	n/a
59DG	n/a	n/a
59AJ	n/a	n/a
59AD	n/a	n/a
59BA	n/a	n/a
59BC	n/a	n/a
59BB	n/a	n/a
59AC	n/a	n/a
59AB	n/a	n/a
59EG	n/a	n/a
59FC	n/a	n/a
59EF	n/a	n/a
59EH	n/a	n/a
6901	27.2	23.25
6902	27.75	22.6
6903	26.5	23.55
6904	26.5	22
7801	26.5	21.44
7802	26.5	23.9
49DF	n/a	n/a
50EC	n/a	n/a
3814	23.94	n/a
4902A	n/a	n/a
49DI	n/a	n/a
4901B	21.24	19.17
49CC	n/a	n/a
49DG	n/a	n/a
49CD	n/a	n/a
49AJ	n/a	n/a
4802	21.26	17.29
49CB	n/a	n/a
59EC	n/a	n/a
59AH	n/a	n/a
5803	21.36	16.99
59DJ	n/a	n/a
59EB	n/a	n/a
59AG	n/a	n/a
59FJ	n/a	n/a
3001	25.29	12.67

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.

Steffan Granger

From: Ana Pereira <Ana.Pereira@thameswater.co.uk>
Sent: 21 September 2017 13:58
To: Michael Evans
Cc: Simon Hindle
Subject: X2039/1144 6a St Pancras Way
Attachments: Guidance - working near our assets.pdf; IA CLDS - Study Estimate - X2039-1144 v1.pdf

Mike,

An Impact Study has been set up for your scheme, ref. X2039/1144 6a St Pancras Way. I have attached a guidance document for working near our assets, for reference.

Please note that Thames Water time reviewing your proposals and submissions is charged at cost. At this stage, an initial fee of £2,490.17 plus VAT is required (please see attached our cost estimate). This is an initial payment that will cover Thames Water time spent on this project. Please be advised that unspent amounts will be refunded at the end of the review.

Can you please provide us with client's details, including company name, postal address, contact name and telephone number and we will raise an invoice.

In regards to the CCTV survey, please note that condition surveys have to be graded in accordance with the requirements of the WRc Manual for Sewer Condition Classification. A TWOSA will have to be obtained from our Operations team prior to the survey being undertaken. The Operations team will be the best placed to advise on the flow rates and any other operational queries.

Can you please confirm if the laser point cloud survey can provide an accurate line and level of the sewer and if it will provide the condition of the sewer graded in accordance with the requirements of the WRc Manual for Sewer Condition Classification.

Once we have raised an invoice to cover the time spent on the project, we will be able to search our data base to confirm if any surveys have been completed for this area and if there are any record drawings available with the construction details of the sewer.

Thank you.

Kind regards,

Ana Pereira
Civil Engineer
Strategic Partnering

Planning for and enabling growth
Thames Water Utilities Ltd, Clearwater Court, Vastern Road, Reading, Berkshire, RG1 8DB
Mobile: 07747 640 175 ana.pereira@thameswater.co.uk

Original Text

From: Michael@gdteam.co.uk
To: DEVELOPER.SERVICES@THAMESWATER.CO.UK
CC: Steffan@gdteam.co.uk ;Rudy@gdteam.co.uk ;Asvin@gdteam.co.uk
Sent: 14.09.17 15:52:43
Subject: FW: Your ref: 6a StPancrass Way Our ref: 678126

Dear Sir's, we are the appointed Civil & Structural engineers on a project to redevelop the property at 6 St Pancras Way.

Please see the attached asset location search obtained from yourselves which shows the building over a 2134mm trunk sewer (We believe to be the Middle Sewer No. 2).

Our current proposal requires us to install concrete rotary bored piling approximately 5m either side of the sewer. Our initial conversations with yourselves suggested that we will need to provide detailed design drawings along with a condition survey before and after construction.

In order to do this we are currently looking at locating the sewer both horizontally and vertically to a great accuracy, due to the depth of the sewer we are limited to the methods available each with varying results in accuracy depending on the equipment used, ground and materials located between the sewer and ground surface.

We have narrowed this down to a couple of possible methods; traditional Theodolite survey and a Laser point cloud survey. The laser survey would also provide a detailed 3d colour model of the sewer through the section of our site.

Before we approach surveyors regarding the surveys please can you advise on the following;

- I understand some of the main trunk sewers have recently been position surveyed. Was this sewer included in the surveys?
- Would you accept a laser point cloud survey as a Sewer condition survey.
- Could you please tell us the approximate depth of water and approximate flow rate within the sewer, the surveyor suggested they would need the instrument to be stable during the survey to ensure accuracy.
- Further to the above is there a particular time scale which would be suitable to ensure the flows & water level would be at its lowest.
- Do you have any information on the wall thickness & construction of the existing sewer which will assist us in locating the approximate extents of the outside of the sewer following the survey.

Thankyou & Regards

Mike

Regards

Michael Evans MIHE
Civil Engineering Technician.
AUTODESK® EXPERT ELITE

Registered / Head Office:
GD Partnership Ltd, The Cart Lodge,
Lullingstone Lane, Eynsford, Kent, DA4 0HZ

Tel: 01322 868622
Fax: 01322 861050
Reg: 4917723 [England]

From: onlinecustomers@thameswater.co.uk [mailto:onlinecustomers@thameswater.co.uk]
Sent: 25 February 2016 09:56
To: Michael Evans <Michael@gdteam.co.uk>
Subject: Your ref: 6a StPancrass Way Our ref: 678126
Importance: High

Dear Customer

OSS/12/678126.
Your Reference: 6a StPancrass Way.
Site Address Supplied: Ted Baker Ltd, 6a, St. Pancras Way, London, NW1 0TB.

Thank you for placing your order with Thames Water Property Searches.□ Please see the attached file for further details regarding your case.

Yours faithfully

Customer Service Team
Thames Water Property Searches

□□□□□□
Thames Water Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13
(T) 0845 070 9148□□□ (E) OnlineCustomers@thameswater.co.uk (W) www.thameswater-propertysearches.co.uk

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www.facebook.com/thameswater. We're happy to help you 24/7.

Appendix 9

Ground Movement Assessment by RSK

18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT
UK

Telephone: +44 (0)1442 437500
Fax: +44 (0)1442 437550
www.rsk.co.uk

Our ref: 371654 L01 (01)

25th October 2017

GD Partnership
The Cart Lodge
Lullingstone Lane
Eynsford
Kent
DA4 0HZ

For the attention of Rudy Djajasaputra

Dear Sir

RE: SITE AT THE UGLY BROWN BUILDING, LONDON, NW1 0TB - PRELIMINARY GROUND MOVEMENT ASSESSMENT

1. INTRODUCTION

On the instructions of GD Partnership, on behalf of Reef Estates Ltd (the client), RSK Environment Ltd has been commissioned to assess the likely ground movements that will result from the redevelopment of the site through the demolition of the existing UBB building and erection of 6 new buildings ranging in height from 2 storeys to 12 storeys above ground and 2 basement levels, for a mixed use business floorspace, residential, hotel, gym and flexible retail and storage space development and with associated landscaping. RSK has been asked to assess the potential damage that is likely to occur to the following structures for inclusion into a basement impact assessment, which is being completed by GD Partnership Ltd;

- An existing ~2100mm diameter (OD) Thames Water (TW) brick sewer, formerly part of London historic sewer system, which bisects the site beneath the northern part of the site;
- An existing ~1200mm diameter (OD) Thames Water brick sewer (Culverted River Fleet), which is located beneath St Pancras Way;
- Canal Street Studios immediately to the north;
- Canal Tow Path and retaining wall to the east;
- Beaumont Court to the west;
- Series of three Travis Perkins buildings to the west;
- Series of three St Pancras Hospital Buildings to the south;
- Granary Street to the south;
- St Pancras Way to the west.

The opinions and recommendations expressed in this report are based on the anticipated ground conditions based on preliminary research completed for this assessment. No field work or laboratory testing has been completed at the subject site and this report should be considered as a preliminary assessment, to be reviewed once detailed site investigation information is available.

This report is subject to the RSK service constraints given in Appendix A.

2. PROJECT BACKGROUND AND SCOPE OF WORKS

The site is located at 2-6 St Pancras Way in the London Borough of Camden and occupied with a concrete structure known as the Ugly Brown Building (UBB). The northern building is currently vacant (Former Administration Building - Block A), the central building (former Welfare block - Block B) is occupied by Ted Baker Head quarters and the southern building (former sorting office - Block C) is occupied by the Verizon Data Centre, which is very sensitive to noise and vibration. Historically the site was occupied by a five-storey masonry structure called 'St Pancras Ale & Corn store', later became known as the Granary.

The Regent's Canal is located to the Northeast of the site. To the Southwest of the site is St Pancras Way, with Granary Street to the Southeast beyond which lies St Pancras Hospital. The existing building 'Canal Side Studios' formerly known as 'Atlantic Metals Building' occupies the Northwest boundary of the site. To the west of the site are a series of three buildings owned by Travis Perkins and a further building known as Beaumont Court.

It is understood from information provided by GD Partnership Ltd that the middle level sewer no. 2, a part of London's historic sewer system and now part of the Thames Water Authority's system, was constructed by tunnelling across the northern part of the site. The Thames Water service plan indicates the sewer is approximately 2m in diameter and is brick lined throughout, with its crown about 4.5m below the canal bed level at an approximate level of 15.60m AOD. The southern end of the administration block of UBB has been built bridging over the sewer with contiguous piles outside the easement area. The culverted course of the former River Fleet is also understood to run below St Pancras Way. Detailed information on the exact location and depth of the sewers in the vicinity of the site has been taken from the aforementioned drawings and Thames Water report.

The client has requested that an assessment be undertaken to estimate the likely magnitude of ground movements and the associated damage that would impact the various sewers and buildings as a result of the proposed development. This information is required to complete a basement impact assessment, which will form part of the planning submission for the proposed development.

From information provided by GD Partnership Ltd it is understood that the Canal Street Studios building comprises a reinforced concrete framed building superstructure supported on piled foundations with a pile cut off level of approximately 22.00m AOD. Information on the depth and dimensions of the piles is not provided. The Beaumont Court Building is 6 storeys plus semi basement level, and the superstructure appears to comprise a mix of either a reinforced concrete (RC) or steel framed and masonry (load bearing) walls. Details on the building foundations have not been provided but are likely to comprise piled foundations with a pile cut off level of approximately 20.00m AOD. The three Travis Perkins building superstructures appear to comprise a mix RC and masonry (load bearing) wall construction of between 6

or 7 storeys in height. Details on the building foundations have not been provided but are considered likely to comprise piled foundations with a pile cut off level of approximately 20.00m AOD.

3. PROPOSED DEVELOPMENT

The proposed redevelopment will involve the demolition of the existing UBB building and erection of 6 new buildings ranging in height from 2 storeys to 12 storeys in height above ground and 2 basement levels comprising a mixed-use business floorspace, residential, hotel, gym, flexible retail and storage space development with associated landscaping work. The new development comprises three plots A, B & C in which 'Plot A' will be offices, 'Plot B' will be the Ted Baker hotel & headquarters and 'Plot C' will comprise 4 major buildings for mixed-use offices, gym, residential & retail spaces.

The proposed basement level at the site varies from 13.4m to 19.10m AOD while the canal water level is at 23.13m AOD and canal Bed is at average 21.15m AOD. Plot A will have a single basement at 17.5m/18.0m AOD. Plot B will also have a single basement but at two different levels, the south-western portion adjacent to St Pancras Way at a level of 16.30m AOD, and the northern and eastern portion along the Canal edge, at a level of 19.10m AOD. Plot C will have two basements with lower basement level at 13.4m AOD.

None of the existing foundations, which comprise piled foundations, are to be reused as part of the new scheme , with the exception of part of the existing contiguous retaining wall spanning the Thames Water Sewer beneath the southern part of Plot A, which will be retained and included in the new scheme. .

The development of Plots A, B and C will be sequenced as follows:

1) Demolition of Plot A,
2) Installation of Plot A contiguous piled wall,
3) Excavation of Plot A new basement
4) Construction of Plot A new Building
5) Demolition of Plot B
6) Installation of Plot B contiguous piled wall,
7) Excavation of Plot B new basement
8) Construction of Plot B new Building
9) Demolition of Plot C
10) Installation of Plot C contiguous piled wall,
11) Excavation of Plot C new basement
12) Construction of Plot C new Building

Plans showing the existing building layouts, column loads, basement levels, proposed basement levels, difference between existing and proposed levels and proposed new building and foundation layouts are included in Appendix B.

4. PRELIMINARY GROUND MODEL

No ground investigation work has been completed at the site in relation to the proposed redevelopment. However, reference to published IStructE papers provide by GD Partnership Ltd, indicates that the former granary building was founded upon a concrete raft foundation that was placed directly upon London Clay by excavating approximately 6m below the canal water level. This was confirmed within nine borehole records which indicated that the hardstanding of the former granary building was underlain by approximately 25m of London Clay, that is in turn underlain by clay of the 'Woolwich and Reading Beds'.

The 1:10 560 scale and 1:50 000 geological maps for the area (Sheets TQ38SW and 256, respectively) published by the British Geological Survey (BGS) indicate that the site area is underlain by Bedrock Deposits of the London Clay Formation, with the Lambeth Group, Thanet Sand Formation and White Chalk Subgroup at depth.

Reference to available BGS and historical borehole records indicates that the site is likely to be underlain by up to 6m of made ground over the London Clay Formation to circa 30m below ground level over the Lambeth Group - Woolwich and Reading Beds & Upnor Member, with the Thanet Sand Formation and White Chalk Sub-group at depth.

The ground model based on the research completed is summarised in Table 1 below.

Table 1: Ground model

Strata	Description	Level at top of stratum (mAOD)	Thickness (m)
Made Ground	Gravelly Clay / Silty Clay	24.00 (GL)	4.00 to 6.00
London Clay	Firm/stiff, becoming very stiff with depth, medium to very high strength, fissured silty clay	20.00	25.00 to 28.00
Lambeth Group	Very stiff very high strength mottled clays / very dense silty fine sand / very dense very sandy gravel.	-8.00	~16.00
Notes:			

4.1 Preliminary Geotechnical Parameters

The parameters adopted for the ground movement assessment in PDISP are summarised in

Table 2 below. The parameters have been obtained from data held by RSK for previous investigations in the local area and reference to publicly available BGS borehole records within the local area.

Table 2: Summary of preliminary soil parameters

Material	Young's Modulus (kN/m^2)	Young's Modulus – Increase with Depth ($kN/m^2/m$)	Poisson's Ratio
Made Ground - Undrained	20000	0	0.5
Made Ground - Drained	16000	0	0.2
London Clay Formation - Undrained	20000	5714	0.5
London Clay Formation - Drained	16000	4571	0.2
Lambeth Group – Clay Undrained	120000	5000	0.5
Lambeth Group – Clay Drained	96000	4000	0.2

The undrained Young's Modulus (E_u) has been obtained using a relationship of $E_u = 400c_u$ for the cohesive London Clay. The drained Young's Modulus (E') has been obtained using the relationship of $E' = 0.8E_u$. The drained Young's Modulus for the coarse grained Made Ground has been obtained from the correlation $E'=2.0 \times N_{60}$, presented in CIRIA Report 143 (1995).

4.2 Adopted Ground Profile

The soil profile adopted for the modelling is summarised in Table 3 below;

Table 3: Assumed Soil Profile

Material	Level at Top (mOD)	Thickness (m)
Made Ground	24.00	4.00
London Clay	20.00	28.00
Lambeth Group	-8.00	20.00

A rigid boundary layer was assumed at -20.00mAOD below which no movement is considered to occur.

5. ASSEMENT APPROACH

5.1 PDISP - Ground Model Construction

A settlement / heave analysis has been completed adopting the OASYS PDISP 19.3 software produced by ARUP to assess the likely ground movements to be expected from the proposed development activities.

The PDISP computer package adopts the Boussinesq method of elastic analysis to calculate the stresses and strains generated within the soil, due to an applied loading and determines the associated

displacements by integrating the vertical strains. Settlements are defined as positive movements and heave as negative movements.

The loads applied in the PDISP model are split into two elements; negative loads to represent unloading or basement excavation and positive loads to represent reloading or construction. The negative loads have been applied at a level at which they are considered to be acting; at the basement excavation, at the base of the proposed foundations.

The following PDISP analyses have been undertaken to determine the ground movements at key stages in the constructions process. Both undrained and drained conditions have been considered for the appropriate stages.

- **1) Demolition of existing building (s) – Short Term**: This has been carried out by calculating the ground movements that would result from unloading the existing foundations assuming undrained soil parameters. In the absence of detailed information on the existing building foundations, the existing building load take down data provided by GD Partnership has been used to calculate approximate piled foundation dimension based on the pile configurations shown in the appended drawings ;

- **2) Basement Excavation(s) – Short Term**. This has been calculated by the removal of an overburden pressure for each of the proposed areas of basement extension. For this proposed development, there are three plots to be development (Plot A, Plot B and Plot C). Plot A will comprise two excavation depths of 4.2m an 4.7m below existing level, resulting in an unloading of 84kN/m2 (4.2 x 20 = 84, where 20kN/m3 is unit weight of soil) and 94kN/m2 (4.7 x 20 = 94, where 20kN/m3 is unit weight of soil). Plot B will comprise two excavation depths of 2.5m an 5.3m below existing level, resulting in an unloading of 50kN/m2 (2.5 x 20 = 50, where 20kN/m3 is unit weight of soil) and 103kN/m2 (5.3 x 20 = 103, where 20kN/m3 is unit weight of soil). Plot c will comprise a single excavation depth of 8.6m below existing level, resulting in an unloading of 172kN/m2 (8.6 x 20 = 172, where 20kN/m3 is unit weight of soil.

- **3) Loading from the proposed new superstructures on piled foundations –Short Term and Long Term**. The loads were modelled as individual piles with a load spread area located at a depth of 2/3 the length of the piles assuming a 1 in 4 load spread. In the absence of a preliminary piling scheme the analysis has considered individual piles of varying pile depth, chosen to accommodate the proposed column load at any given location, based on the pile layouts shown in the appended design drawings. Loads from core walls have been included in the assessment. Some additional load from these internal walls has been added to the nearest proposed pile location, with the remainder distributed on a series of additional piles located beneath the line of the wall. This loading case has been considered in both the short term and long term case, using undrained and drained parameters respectively.

The analysis has considered both undrained and drained soil conditions to give an indication of the immediate short term and the maximum expected long term ground movements resulting from the proposed development.

In order to model these conditions two analyses have been carried out, the first considering undrained ground stiffness parameters and a Poisson's ratio of 0.50 and the second considering a drained modulus and a Poisson's ratio of 0.20. The first of these analyses allows an assessment of the immediate elastic heave that would result from demolition of the existing structure and removal of overburden from the

lowering of the basement levels. This would typically be expected to occur over of a period of 12 months. The second analysis allows for long term net movements, following construction of the new development, to be determined, which will include the total heave that would develop in the long term and settlement following consolidation of the underlying clay due to the construction of the new building. The fully drained (long term) conditions would typically take many years to develop (10 years or more).

The ground movements have been isolated based on the particular phases of development in addition to the anticipated time frames of which any movements are anticipated to be realised, i.e. short term / long term. These movements have then been used in the empirical building damage assessment, using Oasys Xdisp, as discussed in Section 5.2. Contour plots of ground movements at the adjacent building foundation level for each phase are included in Appendix C-1.

5.2 Empirical Assessment of Building Damage

The approach adopted for the purpose of this assessment, combines both CIRIA C760 and the net long term vertical movements from for the various construction stages, obtained from PDISP.

In this case the results of numerical modelling using PDISP for various construction stages have been imported into the XDISP software and an assessment of potential damage for each stage has been completed using the C760 approach of assessing lateral strain and deflection ratio to determine potential damage category.

The deformations and associated potential damage of the various adjacent buildings have been determined at the end of the stages of construction presented in Table 4.

Table 4: Stages of Construction at which Building Damage are Assessed

Section of Development	No.	Construction Stage	Cumulative Effect
PLOT A	1	Demolition of existing structure (short-term)	(A)
PLOT A	2	Basement wall installation (short-term)	(A) + (C)
PLOT A	3	Basement excavation (short-term)	(A) + (C) + (D)
PLOT A	4	New structure (short-term)	(A) + (C) + (D) + (G)
PLOT B	5	Demolition of existing structure (short-term)	PLOT A No.4 + (A)
PLOT B	6	Basement wall installation (short-term)	PLOT A No.4 + (A) + (C)
PLOT B	7	Basement excavation (short-term)	PLOT A No.4 + (A) + (C) + (D)
PLOT B	8	New structure (short-term)	PLOT A No.4 + (A) + (C) + (D) + (G)
PLOT C	9	Demolition of existing structure (short-term)	PLOT B No.4 + (A)
PLOT C	10	Basement wall installation	PLOT B No.4 + (A) + (C)

Section of Development	No.	Construction Stage	Cumulative Effect
		(short-term)	
PLOT C	11	Basement excavation (short-term)	PLOT B No.4 + (A) + (C) + (D)
PLOT C	12	New structure (short-term)	PLOT A No.4 + (A) + (C) + (D) + (G)
FULL DEVELOPMENT	13	New structure (long-term)	{**Plot A** (B) + (C) + (D) + {(F) – (E)} + (H)} + {**Plot B** (B) + (C) + (D) + {(F) – (E)} + (H)} + {**Plot C** (B) + (C) + (D) + {(F) – (E)} + (H)}

The various elements of work used to determine the deformations for the buildings at the various stages of construction are given in Table 5. This table also defines how the associated movements have been determined and whether they are long or short term.

Table 5: Construction Sequence

Element	Construction Component	Calculation Method	Short or Long Term
A	Demolition of existing structure	PDISP	Short Term
B	Demolition of existing structure	PDISP	Long Term
C	Basement wall installation	CIRIA C760 (XDISP)	Short Term
D	Basement excavation	CIRIA C760 (XDISP)	Short Term
E	Basement excavation	PDISP	Short Term
F	Basement excavation	PDISP	Long Term
G	Loading of new structure	PDISP	Short Term
H	Loading of new structure	PDISP	Long Term

The ground deformations and building damage categories following each of these stages of construction have been derived by combining the deformations calculated for the various elements of work carried out. For example the short term deformations and building damage category after construction of the proposed building for PLOT A, have been calculated by summing the movements resulting from the short term movements from the demolition of the existing structure (Plot A) (A), installation of the contiguous piled wall, as estimated from CIRIA 760 (C), the short term movements resulting from excavation of the basement, also estimated from CIRIA 760 (D) and the short term settlements resulting from loading of the building of the new Plot A structure, as calculated by PDISP (G). The short term deformations and building damage category after construction of PLOT B have been calculated by summing the full short term net movements from the development sequence of Plot A with the resulting short term movements from the demolition of the existing structure (Plot B) (A), installation of the contiguous piled wall, as estimated from CIRIA 760 (C), the short term movements resulting from excavation of the basement, also estimated from CIRIA 760 (D) and the short term settlements resulting from loading of the building of the new Plot B structure, as calculated by PDISP (G). The same sequence has been followed for assessing the building damage category for Plot C using the cumulative resultant movements from the end of the PLOT B construction sequence.

The assessment has been undertaken using XDISP version 19.4.0.10 computer package supplied by OASYS, which uses the empirical approach outlined in CIRIA C580 to assess vertical and horizontal

ground movements resulting from installation of embedded retaining walls and excavation in front of walls. It should be noted that XDISP version 19.4.0.10 was developed at which time CIRIA C580 was still the current guidance, the only observable difference with regards to assessing building damage is a change to the ground movement curves for excavation in front of a low stiffness wall which were reduced in CIRIA C760.

The empirical approach is well described in CIRIA C760 “Embedded Retaining Walls – Guidance for Economic Design”. This document provides charts of vertical and horizontal ground movements resulting from installation of embedded retaining walls and excavation in front of the walls. These charts have been normalised with wall length and excavation depth to facilitate their use for new development.

The analysis undertaken assesses the ground movements for the buildings identified in Section 5.2.2, (horizontal and vertical) along the northern, western and southern perimeters of the site resulting from the installation of the contiguous piled retaining walls for Plots A, B and C, followed by the propping and excavation of the various basements in the short term (temporary case) using the empirical ground movement curves presented within CIRIA C580.

For all basement sections for Plots A, B and C, the assessment assumes a high stiffness retaining system, considered appropriate on assumption that the retaining walls will be sequentially propped as the basement excavation is progressed.

The analysis also assesses vertical and horizontal ground movements for a number of other assets local to the development identified in Section 5.2.3.

The assessment has been undertaken using XDISP version 19.4.0.4 computer package supplied by OASYS, which uses the empirical approach outlined in CIRIA C580 to assess vertical and horizontal ground movements resulting from installation of embedded retaining walls and excavation in front of the walls.

The empirical approach is well described in CIRIA C580 “Embedded Retaining Walls – Guidance for Economic Design”. This document provides charts of vertical and horizontal ground movements resulting from installation of embedded retaining walls and excavation in front of the walls. These charts have been normalised with wall length and excavation depth to facilitate their use for new development.

5.2.1 Assessment of Damage to Adjacent Properties

CIRIA C760 also provides a methodology to assessing the potential damage to properties within the zone of influence of the basement excavation. Figures 6.17 and 6.27 of CIRIA C760 summarise this approach. This methodology uses the relationship between Damage Category, horizontal strain and deflection ratio developed by Boscardin and Cording (1989) and Burland (2001).

The definition of the categories is presented below. The categories assume brick masonry with cement mortar and as such represent a conservative estimate of likely damage that will occur at these properties.

Table 6: Classification of damage category (from Table 2.5, CIRIA C760)

Category of damage	Description of typical damage	Approximate crack width (mm)	Limiting tensile strain □lim (%)
0 Negligible	Hairline cracks of less than about 0.1mm are classed as negligible.	<0.1	0.0- 0.05
1 Very slight	Fine cracks that can easily be treated during normal decoration. Cracks in external brickwork visible on inspection.	<1	0.05–0.075
2 Slight	Cracks easily filled. Redecoration probably required. Cracks are visible externally and some repointing may be required externally to ensure watertightness. Doors and windows may stick slightly.	<5	0.075 – 0.15
3 Moderate	The cracks require some opening up and can be patched by a mason. Repointing of external brickwork and possibly a small amount of brickwork to be replaced. Doors and windows sticking. Service pipes may fracture. Weathertightness often impaired.	5 – 15 or a number of cracks >3	0.15 – 0.3
4 Severe	Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Windows and frames distorted, floor sloping noticeably. Walls leaning or bulging noticeably, some loss of bearing in beams. Service pipes disrupted.	15 – 25 but also depends on number of cracks	>0.3
5 Very severe	This requires a major repair involving partial or complete rebuilding. Beams lose bearings, walls lean badly and require shoring. Windows broken with distortion. Danger of instability.	Usually >25 but depends on number of cracks	

5.2.2 Buildings to be Assessed

There are a number of buildings which surround the site, however, the properties considered to be potentially most at risk are those to the north comprising Canal Side Studios, to the west, comprising Beaumont Court, and three Travis Perkins Buildings and to the South, comprising three buildings forming part of St Pancras Hospital.

The buildings assessed in this report are presented in Figure 3, which provides a system for identifying the various structures.

From the information provided by GD Partnership we are able to derive a suite of parameters to assist in the completion of this portion of the assessment. Where site specific information is not known then conservative assumptions have been made.

On the basis of the available information, a summary of the specific dimensions and construction details used for these analyses are presented below.

Table 7: Specific dimensions used for analyses

Adjacent Property	Adopted Piled Wall Depth (m)	Adopted Excavation Depth (m.bbl)	Approximate Distance to Face of Property (m)	Approximate Length of Property Perpendicular to Basement (m)
Canal Side Studios (Southern Elevation)	20.00m – Basement Retaining wall for Plot-A	4.8m – Western part basement 4.2m – northern, central, eastern and southern part	2.50	30.00
Canal Side Studios (Eastern Elevation)	20.00m – Basement Retaining wall for Plot-A	4.7m – Western part basement 4.2m – northern, central, eastern and southern part	2.50	20.00
Canal Side Studios (Northern Elevation)	20.00m – Basement Retaining wall for Plot-A	4.7m – Western part basement 4.2m – northern, central, eastern and southern part	2.50	30.00
Canal Side Studios (Western Elevation)	20.00m – Basement Retaining wall for Plot-A	4.7m – Western part basement 4.2m – northern, central, eastern and southern part	2.50	20.00
Beaumont Court (Eastern Elevation)	20.00m – Basement Retaining wall for Plot-A	4.7m – Western part basement 4.2m – northern, central, eastern and southern part	15.00	18.00m – Eastern elevation
Beaumont Court (Northern Elevation) NB: Northern elevation comprises two north facing walls)	20.00m – Basement Retaining wall for Plot-A	4.7m – Western part basement 4.2m – northern, central, eastern and southern part	15.00	11.00 – Northern elevation (shortwall) 63.00 – Northern elevation (longwall)
Beaumont Court (Southern Elevation)	20.00m – Basement Retaining wall for Plot-A	4.7m – Western part basement 4.2m – northern, central, eastern and southern part	15.00	74.00 – Southern elevation
Travis Perkins (Building 1) – (Eastern Elevation)	20.00m – Basement Retaining wall for Plot-B	2.5m – Eastern and northern part basement 5.3m – Western and southern part basement	15.00	11.00
Travis Perkins (Building 1) – (Northern Elevation)	20.00m – Basement Retaining wall for Plot-B	2.5m – Eastern and northern part basement 5.3m – Western and southern part basement	15.00	11.00 – Northern & elevation (wall nearest excavation) 12.5m - Northern elevation (walls furthest from excavation)
Travis Perkins (Building 1) – (Southern Elevation)	20.00m – Basement Retaining wall for Plot- B	2.5m – Eastern and northern part basement 5.3m – Western and southern part basement	15.00	11.00 –Southern elevation (wall nearest excavation) 12.5m - Southern elevation (wall furthest from excavation)

Adjacent Property	Adopted Piled Wall Depth (m)	Adopted Excavation Depth (m.bbl)	Approximate Distance to Face of Property (m)	Approximate Length of Property Perpendicular to Basement (m)
Travis Perkins (Building 2) – (Northern Elevation)	20.00m – Basement Retaining wall for Plot- C	8.6m – Plot C Basement excavation	15.00	10.00 – Northern & Southern elevations
Travis Perkins (Building 2) – (Southern Elevation)	20.00m – Basement Retaining wall for Plot- C	8.6m – Plot C Basement excavation	15.00	10.00 – Northern & Southern elevations
Travis Perkins (Building 3) – (Northern Elevation)	20.00m – Basement Retaining wall for Plot- C	8.6m – Plot C Basement excavation	15.00	13.00 – Northern & Southern elevations
Travis Perkins (Building 3) – (Southern Elevation)	20.00m – Basement Retaining wall for Plot- C	8.6m – Plot C Basement excavation	15.00	13.00 – Northern & Southern elevations
St Pancras Hospital (Building 1) (Northern Elevation)	20.00m – Basement Retaining wall for Plot- C	8.6m – Plot C Basement excavation	13.00	12.00
St Pancras Hospital (Building 1) (Western Elevation)	20.00m – Basement Retaining wall for Plot - C	8.6m – Plot C Basement excavation	13.00	37.00 – Western Elevation
St Pancras Hospital (Building 1) (Eastern Elevation)	20.00m – Basement Retaining wall for Plot- C	8.6m – Plot C Basement excavation	13.00	23.00 – Eastern Elevation (nearest excavation) 14.00 – Eastern Elevation (furthest from excavation)
St Pancras Hospital (Building 2) (Western Elevation)	20.00m – Basement Retaining wall for Plot- C	8.6m – Plot C Basement excavation	13.00	36.00 – Eastern & Elevation
St Pancras Hospital (Building 2) (Eastern Elevation)	20.00m – Basement Retaining wall for Plot- C	8.6m – Plot C Basement excavation	13.00	36.00 – Western Elevation
St Pancras Hospital (Building 3) (Eastern Elevation)	20.00m – Basement Retaining wall for Plot- C	8.6m – Plot C Basement excavation	13.00	41.00 – Eastern Elevation
St Pancras Hospital (Building 3) (Western Elevation)	20.00m – Basement Retaining wall for Plot- C	8.6m – Plot C Basement excavation	13.00	9.00 – Western Elevation (nearest Excavation) 24.00 - Western Elevation (furthest Excavation)

Table 8: Specific construction details

Adjacent Property	Building Material	Assumed Foundation Type	Assumed Foundation Depth (m.bgl)
Canal Side Studios	Concrete / Steel Framed	Piled Foundations	2.00 – Pile cut-off level
Beaumont Court	Concrete / Steel Framed	Piled Foundations	2.00 – Pile cut-off level
Travis Perkins Building Nos. 1 - 3	Concrete / Steel Framed	Piled Foundations	2.00 – Pile cut-off level
St Pancras Hospital Building Nos. 1-3	Masonry	Strip / Pad	1.00

These parameters have then been used to determine the displacements and horizontal tensile strains and Deflection Ratios for the adjacent properties.

5.2.3 Other Assets to be Assessed

The above analysis has also been used to complete a preliminary assessment of the ground movements (horizontal and vertical) at a number of additional assets in close proximity the proposed development. These are listed in Table 9 below. The assessment has been completed using a combination of PDISP and XDISP computer package, where the PDISP analysis results were imported into the XDISP software, as described above.

Table 9: Assets to be Assessed

Asset Name	Adopted Piled Wall Depth (m)	Adopted Excavation Depth (m.bbl)	Approximate Distance to Asset (m)
Thames Water Brick Sewer ~2100mm	20.00m – Basement Retaining wall for Plot-A	4.8m – Western part basement 4.2m – northern, central, eastern and southern part	Directly beneath site, crossing southern extent of Plot A from West to East. Crown at ~15.60m AOD.
Thames Water Brick Sewer ~ 1200mm	20.00m – Basement Retaining wall for Plot-A, B and C	4.8m – Western part basement PLOT A 5.3m – Western and southern part PLOT B 8.6m – Plot C	10.00 from excavation
St Pancras Way	20.00m – Basement Retaining wall for Plot-A, B and C	4.8m – Western part basement PLOT A 5.3m – Western and southern part PLOT B 8.6m – Plot C	Immediately adjacent western elevation of development
Granary Street	20.00m – Basement Retaining wall for Plot- C	8.6m – Plot C	Immediately adjacent southern elevation of development
Canal Tow Path and Retaining Wall	20.00m – Basement Retaining wall for Plot-A, B and C	4.2m – Eastern part basement PLOT A 2.5m – Eastern and northern part basement 8.6m – Plot C	5.00

6. BUILDING DAMAGE ASSESSMENT

6.1 Results of Empirical Assessment of Ground Movements and Building Strains

A summary of estimated ground movements at the front and rear of the adjacent properties for each property during the key stages of construction are presented in Table 10. The calculated strains, deflection ratios and building damage category for building elevation where a damage category of 1 or greater, are presented in Table 11, for each of the key stages of construction.

The full results of the numerical analysis are included in Appendix C-2, which provide movements, strains and deflection ratios for each elevation of every adjacent building assessed, for every development stage through the construction sequence identified in Section 3. The results presented in the tables below are those of the worst case calculated from any stage through the development of Plots A, B and C.

In addition, plots of building damage interaction charts for all cases where the calculated building category is very slight (Category 1) or above are included in Appendix C-2.

Table 10: Ground Movements Resulting from Key Stages of Development Sequence

Adjacent Property	DEMOLITION				CONTIGUOUS WALL INSTALLATION				BASEMENT EXCAVATION				NEW LOADING – SHORT TERM				FULL DEVELOPMENT – LONG TERM			
	Ground Movement at Front of Adjacent Property		Ground Movement at Rear of Adjacent Property		Ground Movement at Front of Adjacent Property		Ground Movement at Rear of Adjacent Property		Ground Movement at Front of Adjacent Property		Ground Movement at Rear of Adjacent Property		Ground Movement at Front of Adjacent Property		Ground Movement at Rear of Adjacent Property		Ground Movement at Front of Adjacent Property		Ground Movement at Rear of Adjacent Property	
	Lateral (mm)	Vertical (mm)	Lateral (mm)	Vertical (mm)	Lateral (mm)	Vertical (mm)	Lateral (mm)	Vertical (mm)	Lateral (mm)	Vertical (mm)	Lateral (mm)	Vertical (mm)	Lateral (mm)	Vertical (mm)	Lateral (mm)	Vertical (mm)	Lateral (mm)	Vertical (mm)	Lateral (mm)	Vertical (mm)
Canal Side Studios (Southern Elevation)	0.00	12.4*	0.00	9.68*	0.69	12.40*	-1.60	9.68*	2.44	12.25	-5.15	9.51	2.43	12.46	-5.15	9.50	4.44	23.93	-5.15	19.26
Canal Side Studios (Eastern Elevation)	0.00	8.96*	0.00	3.84*	0.99	8.95*	0.74	3.84*	-5.17	9.51	-1.13	3.72	-6.01	8.79	0.10	3.72	-6.01	16.70	0.10	3.10
Canal Side Studios (Western Elevation)	0.00	6.79*	0.00	5.21*	4.04	12.40*	1.37	6.79*	11.47	12.45	2.10	6.02	11.47	12.45	2.10	6.02	11.47	23.93	2.10	5.40
Beaumont Court (Northern Elevation)	0.00	5.08*	0.00	3.23*	-3.24	7.59*	-0.89	3.24	-4.30	7.60*	-0.90	3.24*	-4.29	5.90*	-0.89*	1.76*	-4.30	7.82	-0.89	2.15
Beaumont Court (Southern Elevation)	0.00	4.77*	0.00	0.10*	2.99	5.00	0.00	0.02	3.70	10.70*	0.00	0.10*	3.70	8.36*	0.00	-0.43*	5.67	11.51	0.00	-0.68
Travis Perkins (Building 1) – (Northern Elevation)	0.00	-0.94**	0.00	-0.75**	-2.40	4.55*	-0.22	2.48*	-5.57	5.10**	-1.16	1.10**	-5.57	8.76**	-1.16	2.59**	-7.95	7.93	-1.39	1.91
Travis Perkins (Building 1) – (Southern Elevation)	0.00	-0.73**	0.00	-0.72**	2.14	3.55*	0.00	1.23*	8.05	5.89**	1.36	1.31	8.02	9.10**	1.36	2.31**	10.00	6.89	1.36	1.03
Travis Perkins (Building 2) – (Northern Elevation)	0.00	-0.47**	0.00	-0.40**	-1.83	3.52**	0.00	1.53**	-7.14	5.36**	-1.50	1.73**	-7.17	6.32**	-1.51	1.58**	2.81	-7.30	-0.48	-1.51
Travis Perkins (Building 2) – (Southern Elevation)	0.00	0.13**	0.00	0.07**	1.38	3.65**	0.00	1.55**	5.84	4.87**	0.66	1.66**	5.85	3.59**	0.66	0.64**	5.85	-1.21	0.66	0.80
Travis Perkins (Building 3) – (Northern Elevation)	0.00	0.16**	0.00	0.12**	-3.58	5.62**	-0.69	2.90**	-11.68	10.34**	-3.79	3.43**	-11.68	9.27**	-3.79	2.24**	-11.70	5.08	-3.79	-0.01
Travis Perkins (Building 3) – (Southern Elevation)	0.00	0.12**	0.00	0.09**	0.00	0.12**	0.00	0.09**	0.00	0.12**	0.00	0.09	0.00	-0.44**	0.00	-0.38**	0.00	-1.11	0.00	-1.32
St Pancras Hospital (Building 1) [1] (Western Elevation)	0.00	-0.40**	0.00	-0.22**	1.40	3.94**	0.00	0.22**	-4.84	5.68**	0.00	-0.22**	-5.10	5.27**	0.00	-0.73**	-5.10	2.81	0.00	-1.52
St Pancras Hospital (Building 1) [1] (Eastern Elevation)	0.00	-0.40**	0.00	-0.30**	3.39	4.92**	0.00	-0.27**	11.17	9.50**	0.07	0.87**	11.17	8.10**	0.07	-0.64**	11.17	4.50	0.00	-1.86
St Pancras Hospital (Building 2) [1] (Western Elevation)	0.00	-0.54**	0.00	-0.27**	-3.50	4.85**	0.00	-0.27**	-11.50	8.25**	0.00	-0.27**	-11.50	7.90**	0.00	-1.05**	-11.50	2.89	0.00	-2.27
St Pancras Hospital (Building 2) [1] (Eastern Elevation)	0.00	-0.58**	0.00	-0.27**	3.52	4.82**	0.00	-0.29**	11.55	9.45**	0.00	-0.29**	11.55	7.42	0.00	-1.12	11.55	1.18	0.00	-.41
St Pancras Hospital (Building 3) [1] (Eastern Elevation)	0.00	-0.49**	0.00	-0.24**	2.20	3.96**	0.00	-0.24**	8.03	6.68**	0.00	-0.24**	8.04	5.16**	0.00	-0.80	8.04	2.16	0.00	-1.59
St Pancras Hospital (Building 3) [1] (Western Elevation)	0.00	-0.44**	0.00	-0.29**	-1.50	3.15**	0.00	-0.29**	-6.15	4.49**	0.00	-0.29	-6.15	2.77*	0.00	-1.14	-6.15	-0.51	0.00	-2.44

Adjacent Property	DEMOLITION				CONTIGUOUS WALL INSTALLATION				BASEMENT EXCAVATION				NEW LOADING – SHORT TERM				FULL DEVELOPMENT – LONG TERM			
	Ground Movement at Front of Adjacent Property		Ground Movement at Rear of Adjacent Property		Ground Movement at Front of Adjacent Property		Ground Movement at Rear of Adjacent Property		Ground Movement at Front of Adjacent Property		Ground Movement at Rear of Adjacent Property		Ground Movement at Front of Adjacent Property		Ground Movement at Rear of Adjacent Property		Ground Movement at Front of Adjacent Property		Ground Movement at Rear of Adjacent Property	
	Lateral (mm)	Vertical (mm)	Lateral (mm)	Vertical (mm)	Lateral (mm)	Vertical (mm)	Lateral (mm)	Vertical (mm)	Lateral (mm)	Vertical (mm)	Lateral (mm)	Vertical (mm)	Lateral (mm)	Vertical (mm)	Lateral (mm)	Vertical (mm)	Lateral (mm)	Vertical (mm)	Lateral (mm)	Vertical (mm)

Notes:

* quoted value includes cumulative vertical displacements from full construction sequence up to the relevant stage, as detailed at the top of the table, of the development of Plot B.

** quoted value includes cumulative vertical displacements from full construction sequence up to the relevant stage, as detailed at the top of the table, of the development of Plot C.

Where no * is present the quoted result is from the development of Plot A up to and including the relevant stage as detailed at the top of the table, other than for the Full Development Case.

Displacements presented for Demolition, Installation, Excavation and New Loading stages are worst case calculated from one of either development of Plot A, B or C.

Lateral displacement recorded as movement along the line.

Positive lateral displacement values indicate ground movement towards the excavation.

Negative vertical displacement values indicate ground heave.

[1]Ground movements from demolition stage for these buildings are not included in the assessment of building, as building pre-dates UBB, so any ground movements associated with the demolition will return ground to equilibrium levels.

The calculated horizontal strains and deflection ratios are presented in Table 11, along with the Building Damage Category.

Table 11 – Calculated Horizontal strains and Deflection Ratios

Adjacent Property	PLOT	DEMOLITION				CONTIGUOUS WALL INSTALLATION				BASEMENT EXCAVATION				NEW LOADING – SHORT TERM				FULL DEVELOPMENT – LONG TERM			
		Horizontal Strain (%)	Deflection Ratio (%)	Maximum tensile strain ε_{lim} (%)	Damage Category	Horizontal Strain (%)	Deflection Ratio (%)	Maximum tensile strain ε_{lim} (%)	Damage Category	Horizontal Strain (%)	Deflection Ratio (%)	Maximum tensile strain ε_{lim} (%)	Damage Category	Horizontal Strain (%)	Deflection Ratio (%)	Maximum tensile strain ε_{lim} (%)	Damage Category	Horizontal Strain (%)	Deflection Ratio (%)	Maximum tensile strain ε_{lim} (%)	Damage Category
Canal Side Studios (Southern Elevation)	Plot A	--	--	--	**--**	--	--	--	**--**	0.000	0.060	0.057	**1**	0.000	0.055	0.051	**1**	--	--	--	--
	Plot B	0.000	0.060	0.057	**1**	0.000	0.060	0.057	**1**	0.000	0.060	0.057	**1**	0.000	0.060	0.057	**1**	--	--	--	**--**
	Plot C	0.000	0.060	0.057	**1**	0.000	0.060	0.057	**1**	0.000	0.060	0.057	**1**	0.000	0.060	0.057	**1**	--	--	--	**--**
	FINAL	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	0.000	0.084	0.078	**2**
Canal Side Studios (Western Elevation)	Plot A	--	--	--	**--**	--	--	--	**--**	0.073	0.003	0.074	**1**	0.060	0.012	0.070	**1**	--	--	--	**--**
	Plot B	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**
	Plot C	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**
	FINAL	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	0.056	0.020	0.075	**2**
Travis Perkins (Building 1) – (Northern Elevation)	Plot A	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**
	Plot B	--	--	--	**--**	--	--	--	**--**	0.058	0.000	0.058	**1**	--	--	--	**--**	--	--	--	**--**
	Plot C	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**
	FINAL	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	0.058	0.004	0.060	**1**
Travis Perkins (Building 1) – (Southern Elevation)	Plot A	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**
	Plot B	--	--	--	**--**	--	--	--	**--**	0.055	0.005	0.057	**1**	0.055	0.005	0.057	**1**	--	--	--	**--**
	Plot C	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**
	FINAL	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	0.071	0.004	0.073	**1**
Travis Perkins (Building 2) – (Northern Elevation)	Plot A	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**
	Plot B	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**
	Plot C	--	--	--	**--**	--	--	--	**--**	0.055	0.004	0.056	**1**	0.055	0.004	0.056	**1**	--	--	--	**--**
	FINAL	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	0.056	0.002	0.057	**1**
Travis Perkins (Building 2) – (Southern Elevation)	Plot A	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**
	Plot B	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**
	Plot C	--	--	--	**--**	--	--	--	**--**	0.050	0.003	0.051	**1**	0.050	0.003	0.051	**1**	--	--	--	**--**
	FINAL	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	0.050	0.002	0.051	**1**
Travis Perkins (Building 3) – (Northern Elevation)	Plot A	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**
	Plot B	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**
	Plot C	--	--	--	**--**	--	--	--	**--**	0.058	0.004	0.059	**1**	0.058	0.004	0.059	**1**	--	--	--	**--**
	FINAL	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	0.059	0.003	0.060	**1**
St Pancras Hospital (Building 1) (Eastern Elevation)	Plot A	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**
	Plot B	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**
	Plot C	--	--	--	**--**	--	--	--	**--**	0.048	0.006	0.058	**1**	0.048	0.006	0.058	**1**	--	--	--	**--**
	FINAL	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	0.047	0.050	0.054	**1**
St Pancras Hospital	Plot A	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**	--	--	--	**--**

Adjacent Property	PLOT	DEMOLITION				CONTIGUOUS WALL INSTALLATION				BASEMENT EXCAVATION				NEW LOADING – SHORT TERM				FULL DEVELOPMENT – LONG TERM			
		Horizontal Strain (%)	Deflection Ratio (%)	Maximum tensile strain ϵ_{lim} (%)	Damage Category	Horizontal Strain (%)	Deflection Ratio (%)	Maximum tensile strain ϵ_{lim} (%)	Damage Category	Horizontal Strain (%)	Deflection Ratio (%)	Maximum tensile strain ϵ_{lim} (%)	Damage Category	Horizontal Strain (%)	Deflection Ratio (%)	Maximum tensile strain ϵ_{lim} (%)	Damage Category	Horizontal Strain (%)	Deflection Ratio (%)	Maximum tensile strain ϵ_{lim} (%)	Damage Category
(Building 2) (Western Elevation)	Plot B	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Plot C	--	--	--	--	--	--	--	--	0.063	0.000	0.063	1	--	--	--	--	--	--	--	--
	FINAL	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.057	0.005	0.064	1
St Pancras Hospital (Building 2) (Eastern Elevation)	Plot A	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Plot B	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Plot C	--	--	--	--	--	--	--	--	0.063	0.000	0.063	1	--	--	--	--	--	--	--	--
	FINAL	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.056	0.003	0.060	1
St Pancras Hospital (Building 3) (Eastern Elevation)	Plot A	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Plot B	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Plot C	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	FINAL	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.053	0.002	0.055	1
St Pancras Hospital (Building 3) (Western Elevation)	Plot A	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Plot B	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Plot C	--	--	--	--	--	--	--	--	0.060	0.002	0.061	1	0.060	0.002	0.061	1	--	--	--	--
	FINAL	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.047	0.004	0.053	1

Notes:
-- = Damage Category 0 (Zero) not exceeded

7. EMPIRICAL ASSESSMENT OF GROUND MOVEMENTS ON HOMEFIELD RISE (ROAD) – SHORT TERM

From the analyses described in Section 5, a preliminary assessment the ground movements (horizontal and vertical) at a number of other assessments listed in Section 5.2.3, resulting from the various construction stages, has been completed. The assessment has been completed using a combination of PDISP and XDISP computer packages, where the PDISP analysis results were imported into the XDISP software.

Table 12 below provides a summary of the estimated vertical and horizontal movements for each of the assets, at each of the construction stages. Plots of movements (vertical and horizontal) along the asset are provided in Appendix C-3. The value provided in Table 12 is the worst case at any point along the displacement line.

Table 12: Results of Combined PDISP and XDISP Analysis

Adjacent Property	PLOT	DEMOLITION			CONTIGUOUS WALL INSTALLATION			BASEMENT EXCAVATION			NEW LOADING – SHORT TERM			FULL DEVELOPMENT – LONG TERM		
		Deformation (mm)			Deformation (mm)			Deformation (mm)			Deformation (mm)			Deformation (mm)		
		Vertical	Horizontal Along Asset	Horizontal Perpendicular to Asset	Vertical	Horizontal Along Asset	Horizontal Perpendicular to Asset	Vertical	Horizontal Along Asset	Horizontal Perpendicular to Asset	Vertical	Horizontal Along Asset	Horizontal Perpendicular to Asset	Vertical	Horizontal Along Asset	Horizontal Perpendicular to Asset
Thames Water Sewer – 2134mm	Plot A	-7.19	0.00	0.00	7.50	8.14	-0.16	10.25	13.69	-0.27	13.46	13.69	-0.27	-	-	-
	Plot B	-1.21	13.69	-0.27	8.54	-17.84	5.15	11.21	-22.10	6.86	14.10	-22.10	6.86	-	-	-
	Plot C	-7.20	-22.01	6.86	-7.19	-22.01	6.86	-7.19	-22.10	6.86	6.63	-2.10	6.86	-	-	-
	FINAL	-	-	-	-	-	-	-	-	-	-	-	-	35.52	-27.64	2.62
Thames Water Sewer (Fleet Culvert) -1200mm	Plot A	-0.11	0.00	0.00	6.86	-2.65	4.37	7.34	-2.94	6.92	8.19	-2.94	6.92	-	-	-
	Plot B	5.24	-2.95	6.92	10.26	-2.63	9.70	10.50	-2.92	11.91	11.30	-2.91	11.91	-	-	-
	Plot C	4.78	-2.91	11.91	6.98	-2.91	12.36	12.04	-7.80	20.90	22.21	-7.80	20.89	-	-	-
	FINAL	-	-	-	-	-	-	-	-	-	-	-	-	23.12	-7.80	20.89
St Pancras Way	Plot A	-0.32	0.00	0.00	8.60	4.99	6.49	10.93	7.66	11.34	17.18	7.66	11.34	-	-	-
	Plot B	10.45	7.66	11.34	13.66	7.65	14.66	17.14	7.66	18.46	17.80	7.66	18.46	-	-	-
	Plot C	9.12	7.66	18.46	14.51	7.66	18.46	20.55	-12.16	26.77	27.56	-12.16	26.77	-	-	-
	FINAL	-	-	-	-	-	-	-	-	-	-	-	-	33.88	-12.16	26.77
Granary Street	Plot A	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	-0.09	0.00	0.00	-	-	-
	Plot B	3.82	0.00	0.00	3.83	0.00	0.00	3.83	0.00	0.00	3.30	0.00	0.00	-	-	-
	Plot C	4.01	0.00	0.00	9.98	-6.65	-8.13	15.72	-17.56	-21.01	19.85	-17.56	-21.01	-	-	-
	FINAL	-	-	-	-	-	-	-	-	-	-	-	-	12.99	-17.56	21.01
Canal Tow Path and Retaining Wall	Plot A	0.01	0.00	0.00	4.39	0.43	-2.20	4.39	0.50	-2.20	3.78	0.50	-2.20	-	-	-
	Plot B	11.13	0.50	-2.20	14.39	0.50	-2.20	14.40	0.50	-2.20	12.69	0.50	-2.20	-	-	-
	Plot C	9.81	0.50	-2.20	11.01	0.50	-2.50	11.16	1.97	-5.95	20.87	1.97	-5.95	-	-	-
	FINAL	-	-	-	-	-	-	-	-	-	-	-	-	6.63	-1.97	-5.95

The results of the assessment indicate that the magnitude of resultant movements (settlement and horizontal) due to the proposed construction sequence on the two Thames Water Sewers are moderate for several phases of the construction sequence and a detailed Thames Water asset assessment should be carried out once detailed ground investigation information is available, to determine the impact on the sewers.

The results of the assessment indicate that the magnitude of resultant movements (settlement and horizontal) due to the proposed construction sequence on the adjacent tow path / retaining wall, and two roads (St Pancras Way and Granary Street) are nominal to moderation. Given the flexible nature of road pavement construction and the presence of the sheet piled retaining wall, it is considered that the proposed development is unlikely to cause undue distress to the existing roads or tow path in the short or long term case.

8. CONCLUSIONS

From the assessment above, it is evident that damage categories exhibited for each of the adjacent structures during the various phases of development are largely confined to Category 1 (Very Slight) or below, with the exception of the southern elevation of Canal Side Studios in the long term case, which has a damage category of 2 (Slight).

It is important to note that CIRIA C760 is primarily concerned with the effect basement excavations may have on shallow foundations and does not consider the impact on other building foundation types such as concrete framed structures on piles which transfer building loads to depth. Given that it is known that the Canal Side Studios, and the Travis Perkins buildings are of a RC framed construction and supported on piles it is unlikely that shallow ground movements from the proposed wall installation and basement excavation will impact the structure. As such, if we consider the presence of a deep foundation solution beneath this site then it is likely that the previously assessed damage Category 2 (Slight) and 1 (Very Slight) will likely be reduced to Category 0 (Negligible).

The Supplementary Planning Document (SPD) for basement development in Westminster states that “The design and construction should aim to limit damage to all buildings to a maximum of Category 2 as set out in CIRIA Report C580”, whilst the associated ‘Residential Basement Report’ produced by Alan Baxter indicates that basements “should be designed and constructed to limit damage to an adjoining building to Category 1, but certainly no more than Category 2”.

On this basis and given that there is no difference between the assessments in CIRIA C580 and CIRIA C760 the damage that has been predicted to occur as a result of the construction of the proposed development falls within the acceptable limits.

It should be stressed that the magnitude of ground movements depends to a great extent upon the quality of workmanship. As such, large local ground movements may occur where construction problems are encountered. Such movements have not been predicted by this work.

Although the ground movement assessment will be reviewed and reanalysed following the completion of the Phase 2 ground investigation at the start of RIBA Stage 4, it is not expected that the likely magnitude of modifications to the geotechnical parameters following the additional site investigations will have a significant influence on the outcome or overall conclusion of this assessment.

8.1 Control of Ground Movements

In order to reduce the potential for any movement over and above that expected, the following methods of safe practice should be considered prior to and during construction:

- Good workmanship will be required to ensure that underpinned wall installation induced settlements are kept to a minimum. It will be essential to ensure that the made ground or non-self supporting natural soils are not allowed to collapse prior to casting of the underpin sections. Consideration will need to be given to preventative measures should running sands or other such issues be encountered. Should such conditions be encountered then works should stop immediately and working practices reassessed.
- The contiguous piled wall should be installed to a suitable depth and have adequate embedment in stiff strata for satisfactory vertical and lateral stability;
- Any supports should be installed as early as possible in the construction sequence;
- Ground/basement slabs should be given sufficient time to cure and gain strength prior to removal of the temporary propping, if this is being adopted;
- Over-excavation should be avoided;
- A monitoring strategy should be put in place to ensure that the expected displacements are not exceeded. Limits of lateral and vertical displacement should be set beyond which the method of construction should be re-assessed.

Inadequate workmanship and poor construction control are particularly significant contributory sources of ground movements. Large local ground movements can be expected where construction problems are encountered.

We hope that you will find the enclosed of interest, however, please do not hesitate to contact either of the undersigned if you require any further information.

Yours faithfully

For **RSK Environment Ltd**

Mark Kentish
Principal Geotechnical Engineer

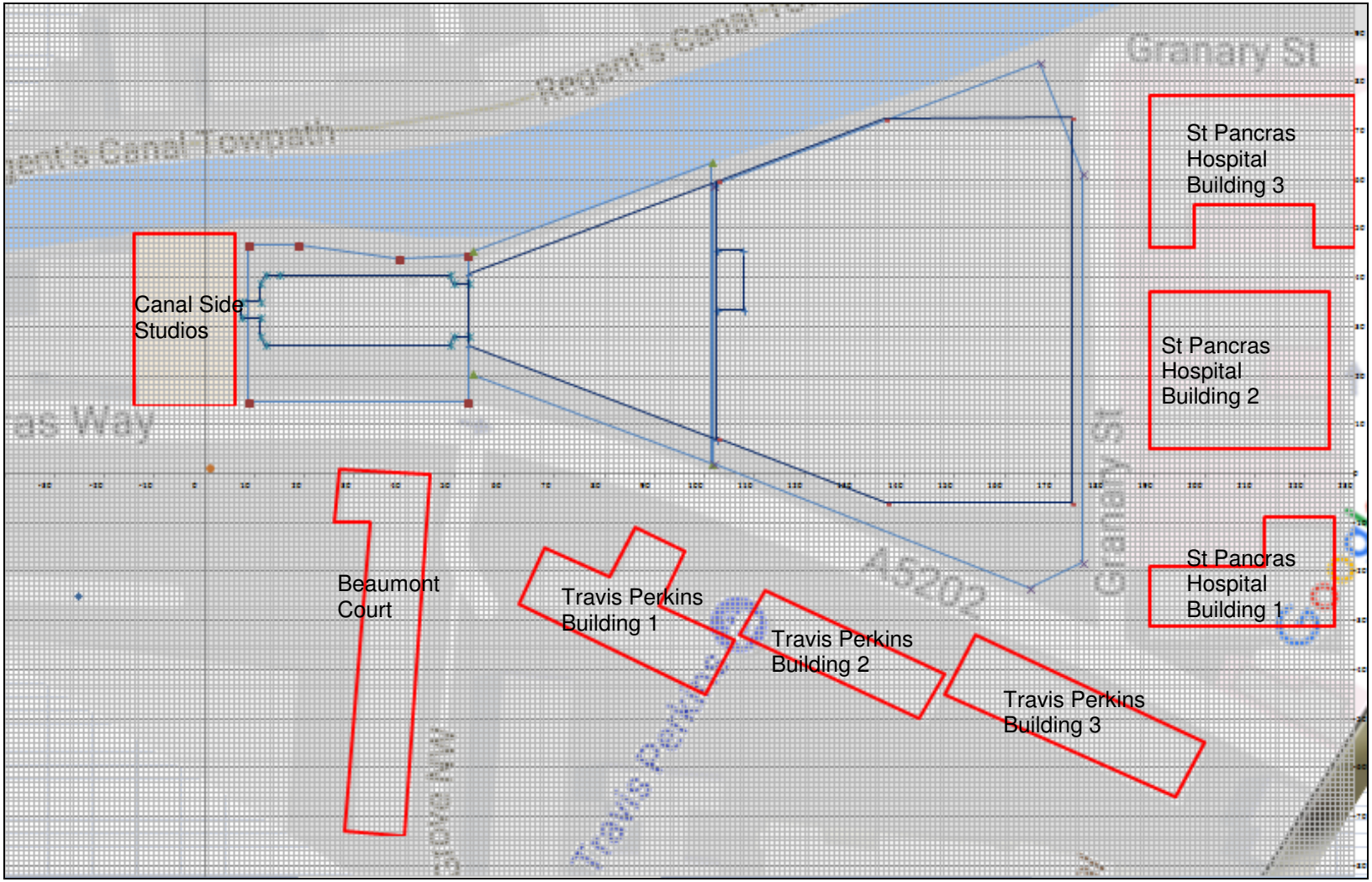
Dr Shon Williams
Director

FIGURES

RSK	**SITE LOCATION PLAN**	**Client:** Reef Estates Ltd	**Figure:** 1
		Site: Ugly Brown Building (UBB), St Pancras Way, London	**Job No:** 371654
		Source: Google	**Scale** NTS

RSK	**Plan Showing Proposed Building Configuration**	**Client:** Reef Estates Ltd	**Figure: 2**
		Project: Ugly Brown Building (UBB) Redevelopment	**Job No:** 371654
		Site: UBB	**Scale:** NTS

North



RSK	**Plan Showing Adjacent Building Layout Relative to Development For Building Damage Assessment**	**Client:** Reef Estates Ltd	**Figure: 3**
		Project: UBB	**Job No:** 371654
		Site: UBB	**Scale:** NTS

APPENDIX A
SERVICE CONSTRAINTS

RSK SERVICE CONSTRAINTS

1. This report and the site investigation carried out in connection with the report (together the "Services") were compiled and carried out by RSK Environment Limited (RSK) for Berkeley Homes (Eastern Counties) Ltd (the "client") in accordance with the terms of a contract between RSK and the "client", dated June 2015. The Services were performed by RSK with the skill and care ordinarily exercised by a reasonable environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.

2. Other than that expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.

3. Unless otherwise agreed the Services were performed by RSK exclusively for the purposes of the client. RSK is not aware of any interest of or reliance by any party other than the client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. **Any such party would be** well advised to seek independent advice from a competent environmental consultant and/or lawyer.

4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK 's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date hereof, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.

5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.

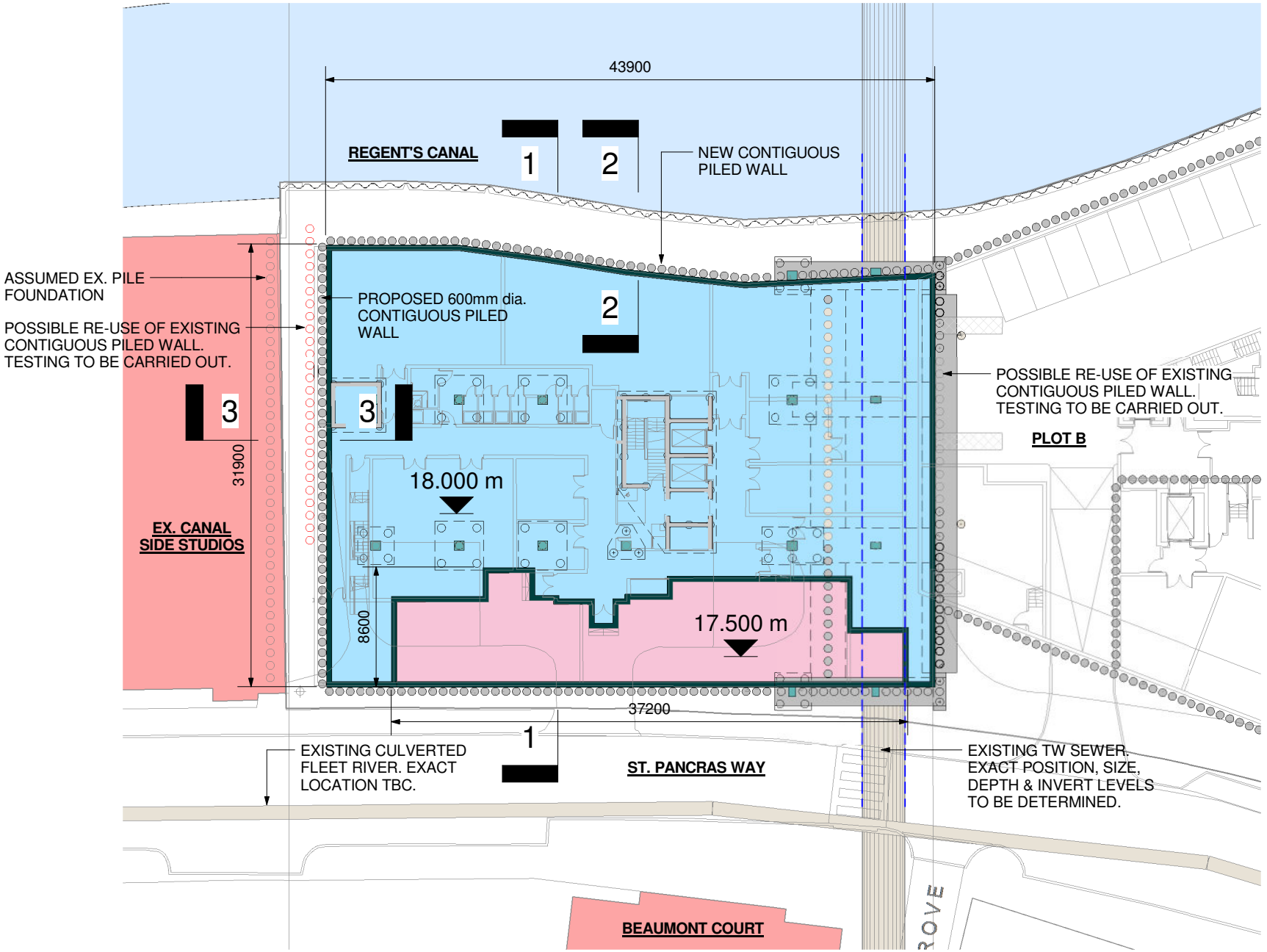
6. The observations and conclusions described in this report are based solely upon the Services which were provided pursuant to the agreement between the client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off the site of asbestos, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials.

7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a walk-over survey of the site together with RSK's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walk-over survey. Further RSK was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the client and RSK.

8. The phase II or intrusive environmental site investigation aspects of the Services is a limited sampling of the site at pre-determined borehole and soil vapour locations based on the operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and RSK] [based on an understanding of the available operational and historical information,] and it should not be inferred that other chemical species are not present.

9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site.

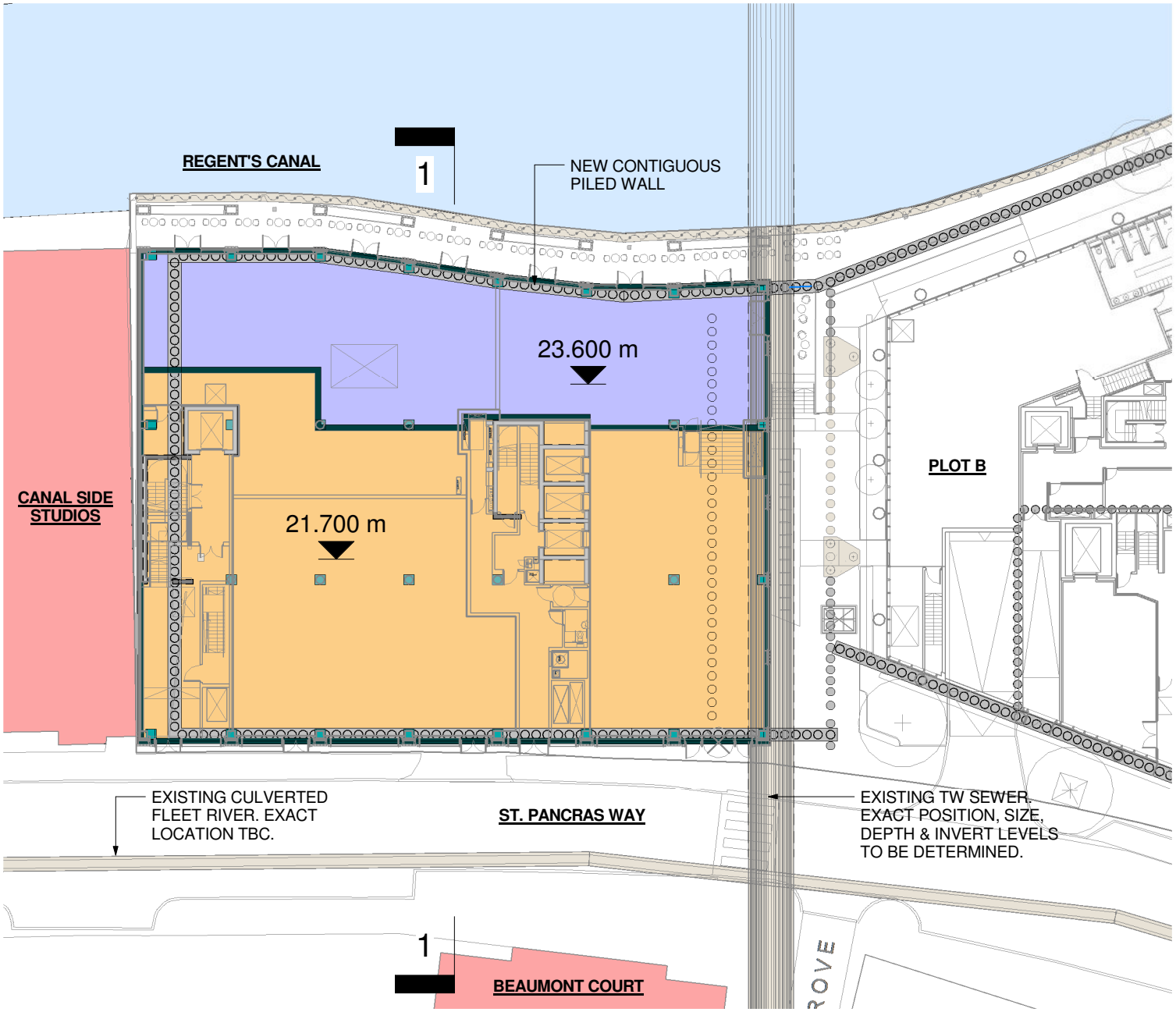
APPENDIX B
BACKGROUND INFORMATION



ALL FOUNDATIONS SHOWN ARE INDICATIVE ONLY

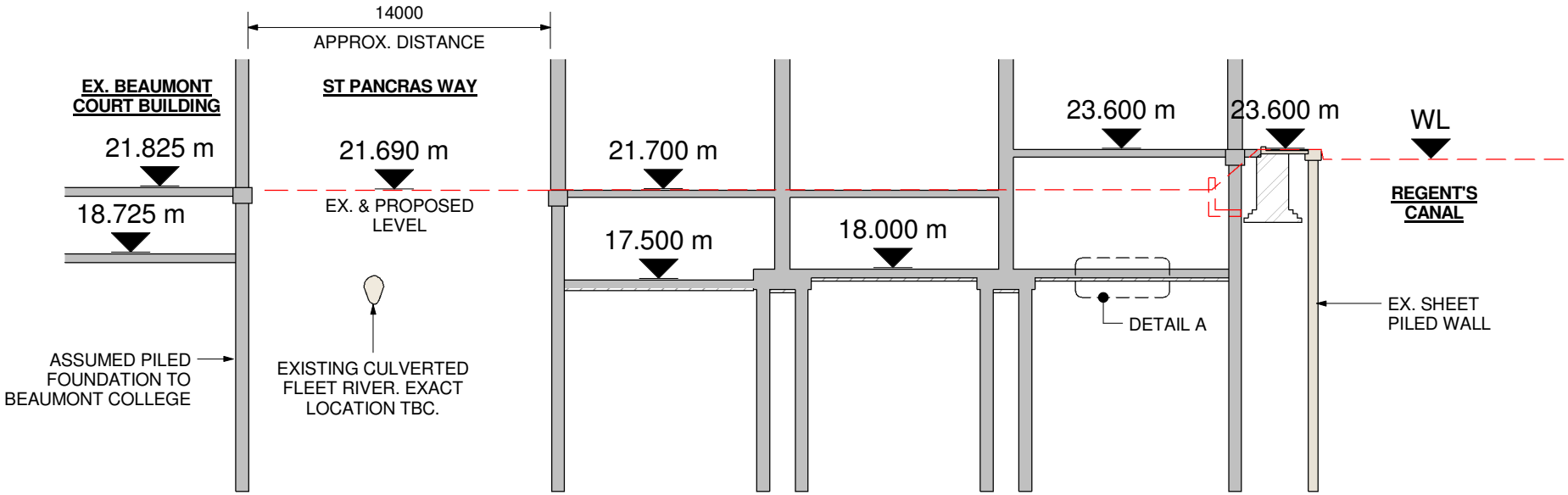
Client: REEF ESTATES	**Job No:** 16-017	**Project:** The Ugly Brown Building
Scale: 1 : 400 **Drawn:** MM **Checked:** YG **Date:** MAY 2017	**Drawing No:** S(SK) GA-10 B	**Drawing:** PLOT A - BASEMENT LAYOUT

GD Partnership Ltd.
Consulting Engineers
The Cart Lodge, Lullingstone Lane, Eynsford, Kent, DA4 0HZ
Tel: 01322 868622 Fax: 01322 861050
Email: contact@gdteam.co.uk



Client: REEF ESTATES	**Job No:** 16-017	**Project:** The Ugly Brown Building
Scale: 1 : 400 **Drawn:** MM **Checked:** YG **Date:** MAY 2017	**Drawing No:** S(SK) GA-11 A	**Drawing:** PLOT A - GROUND FLOOR LAYOUT

GD Partnership Ltd.
Consulting Engineers
The Cart Lodge, Lullingstone Lane, Eynsford, Kent, DA4 0HZ
Tel: 01322 868622 Fax: 01322 861050
Email: contact@gdteam.co.uk



SECTION 1-1

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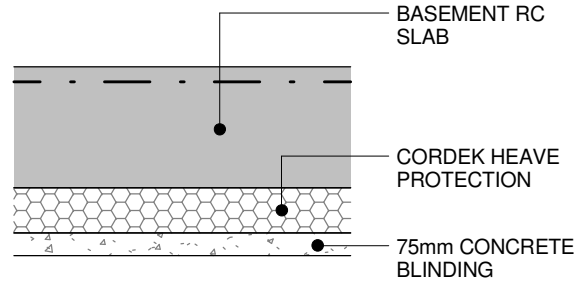
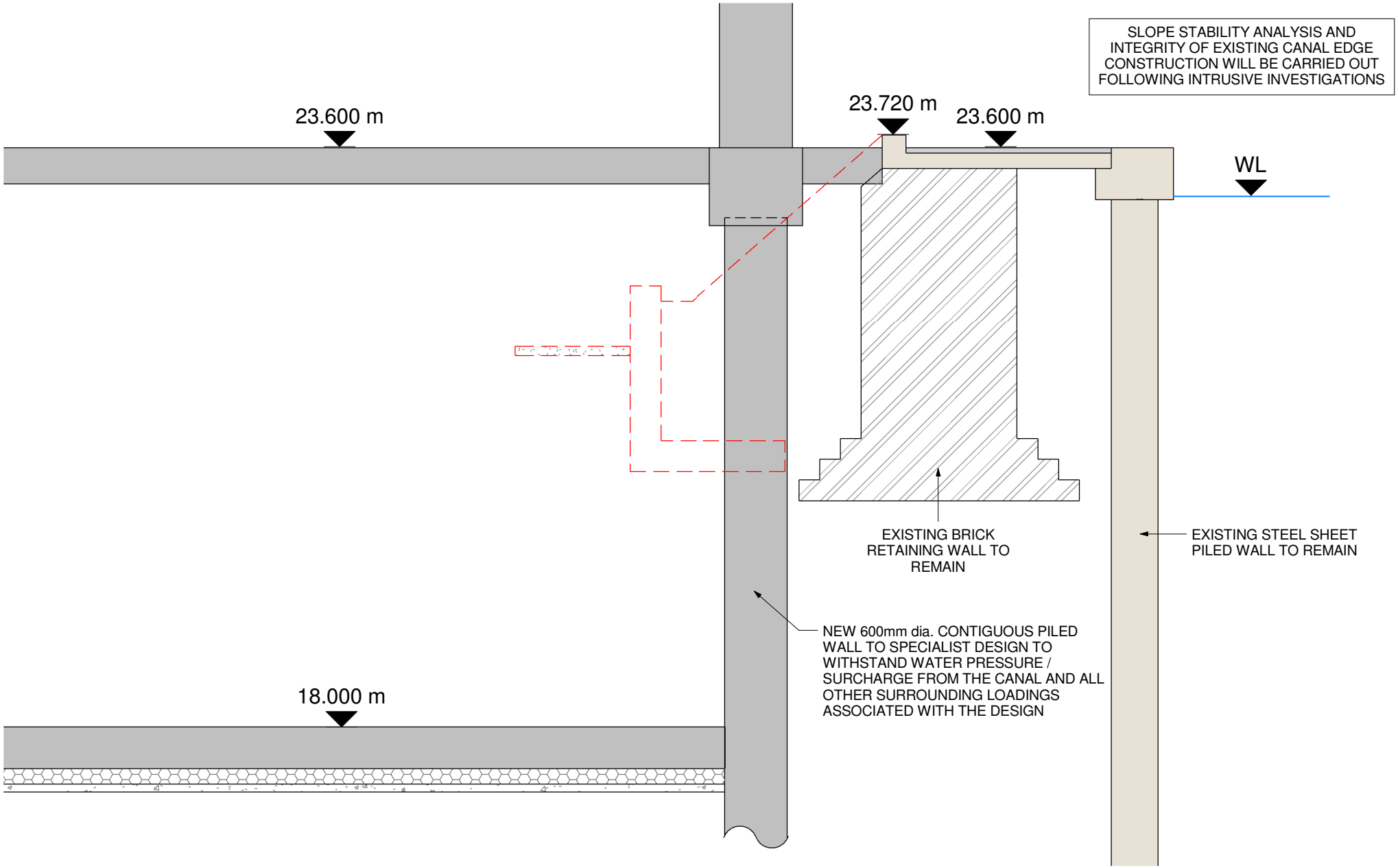


A DETAIL A

1 : 25

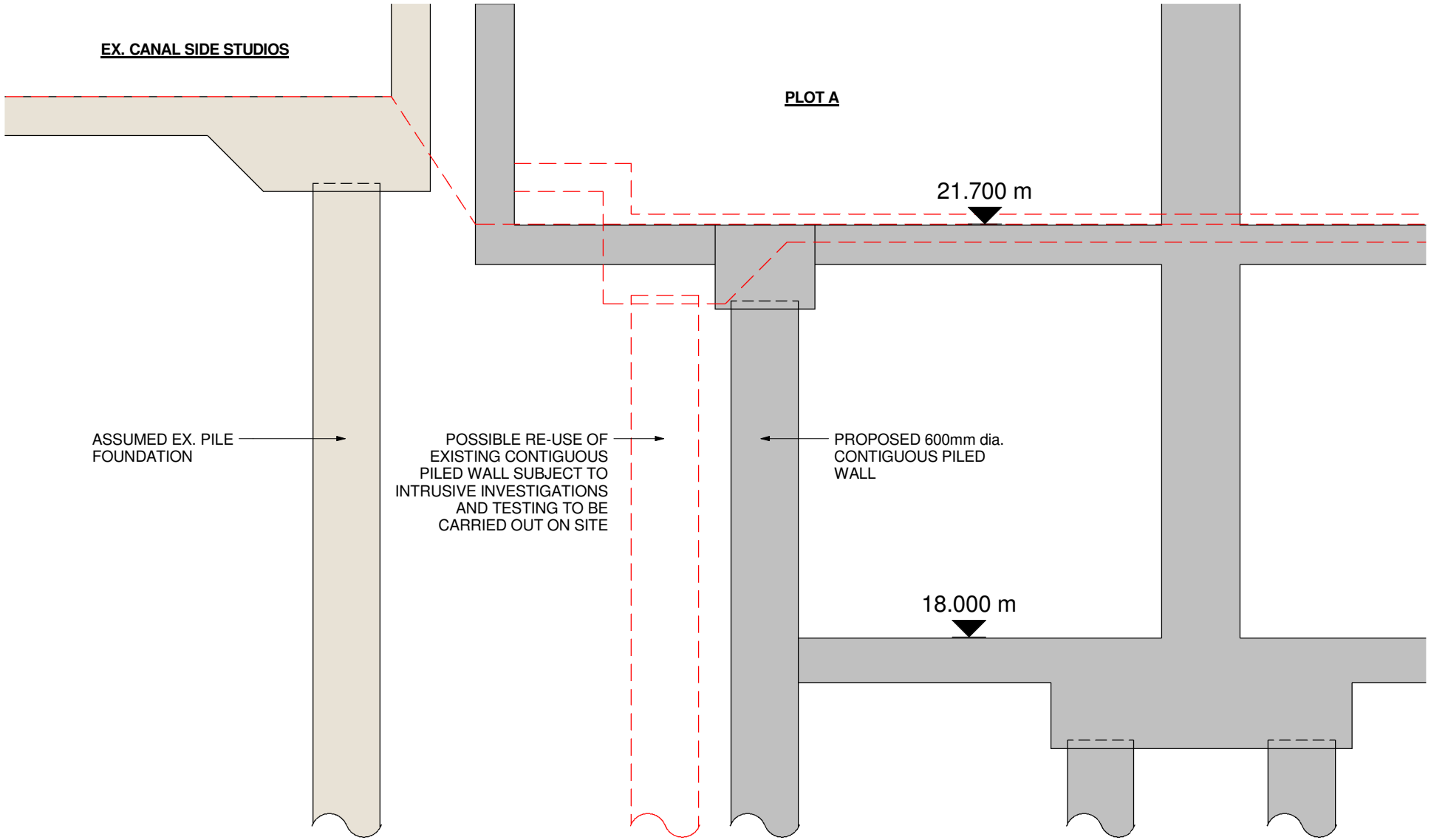
Client: REEF ESTATES	**Job No:** 16-017	**Project:** The Ugly Brown Building	GD Partnership Ltd. Consulting Engineers
Scale: As indicated **Drawn:** MM **Checked:** YG **Date:** MAY 2017	**Drawing No:** S(SK) GA-13 A	**Drawing:** SECTION 1-1 THROUGH PLOT A	

The Cart Lodge, Lullingstone Lane, Eynsford, Kent, DA4 0HZ
Tel: 01322 868622 Fax: 01322 861050
Email: contact@gdteam.co.uk



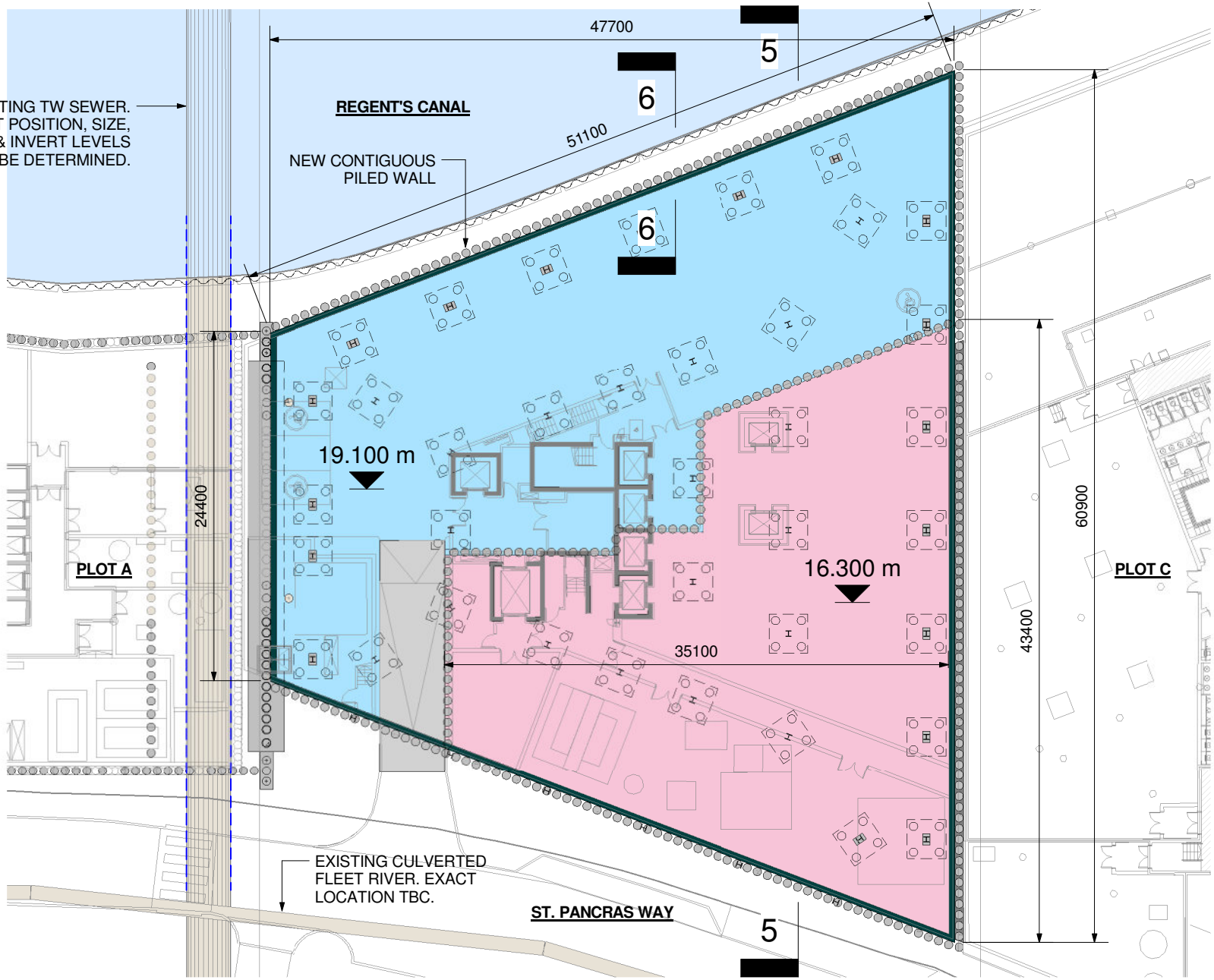
Client: REEF ESTATES	**Job No:** 16-017	**Project:** The Ugly Brown Building	GD Partnership Ltd. Consulting Engineers
Scale: 1 : 50 **Drawn:** MM **Checked:** YG **Date:** MAY 2017	**Drawing No:** S(SK) GA-14 A	**Drawing:** PLOT A - SECTION 2-2 THROUGH CANAL WALL	

The Cart Lodge, Lullingstone Lane, Eynsford, Kent, DA4 0HZ
Tel: 01322 868622 Fax: 01322 861050
Email: contact@gdteam.co.uk



Client: REEF ESTATES	**Job No:** 16-017	**Project:** The Ugly Brown Building	GD Partnership Ltd. Consulting Engineers
Scale: 1 : 50 **Drawn:** MM **Checked:** YG **Date:** MAY 2017	**Drawing No:** S(SK) GA-15 A	**Drawing:** PLOT A - SECTION 3-3 THROUGH NORTH WEST BOUNDARY ADJOINING CANAL SIDE STUDIOS	

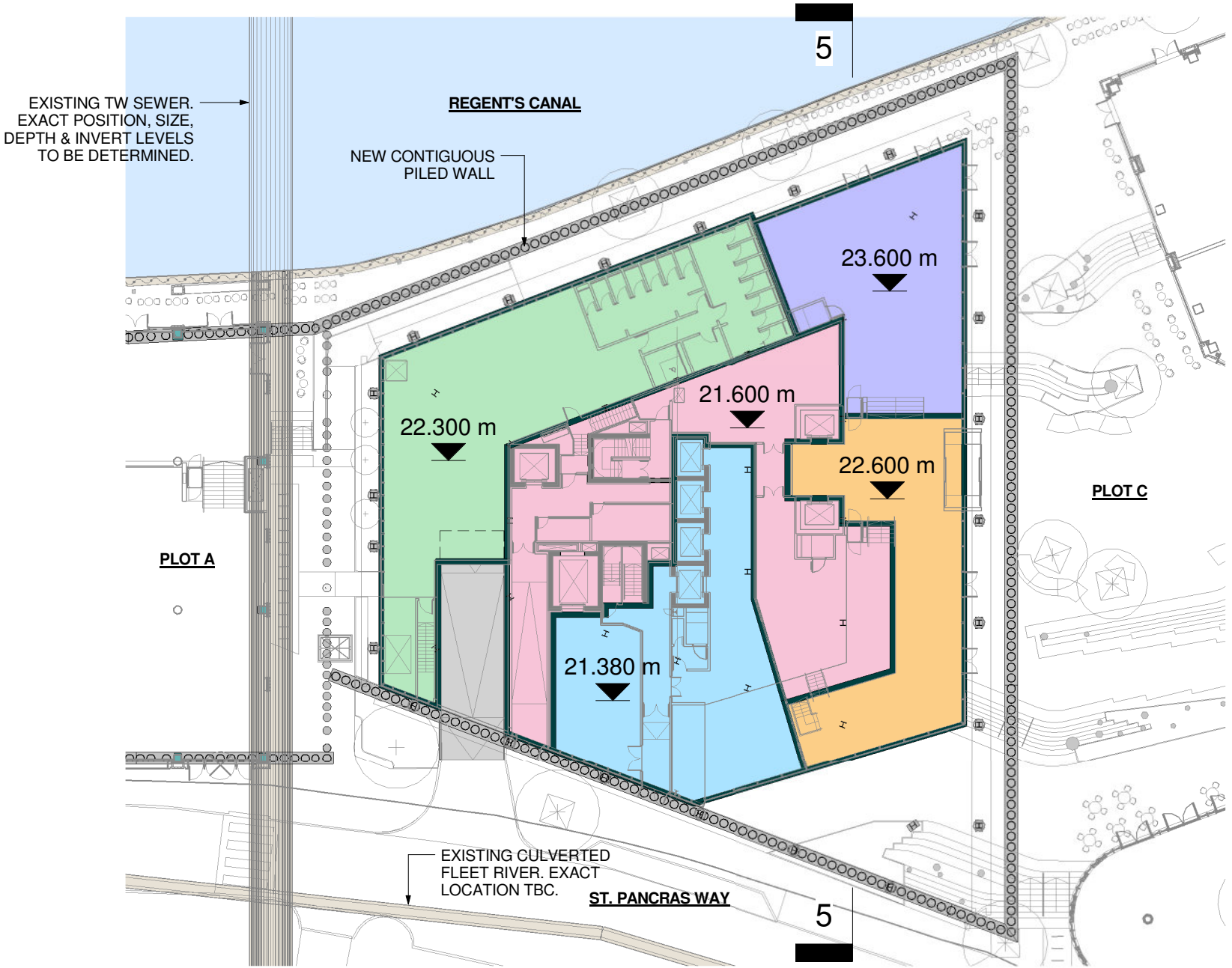
The Cart Lodge, Lullingstone Lane, Eynsford, Kent, DA4 0HZ
Tel: 01322 868622 Fax: 01322 861050
Email: contact@gdteam.co.uk



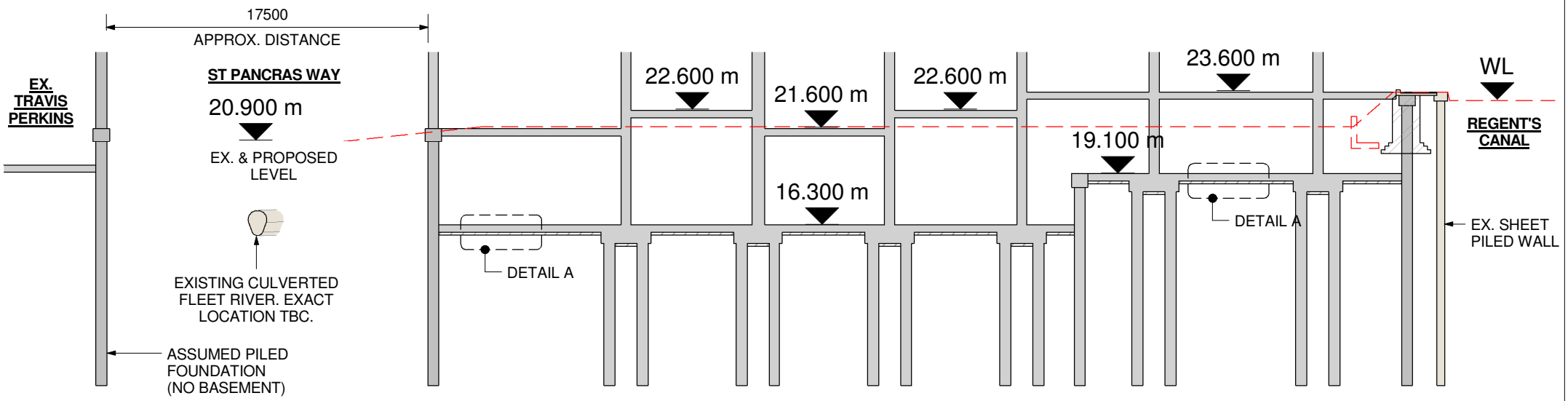
ALL FOUNDATIONS SHOWN ARE INDICATIVE ONLY

Client: REEF ESTATES	**Job No:** 16-017	**Project:** The Ugly Brown Building	GD Partnership Ltd. Consulting Engineers
Scale: 1 : 400 **Drawn:** MM **Checked:** YG **Date:** MAY 2017	**Drawing No:** S(SK) GA-50 B	**Drawing:** PLOT B - BASEMENT LAYOUT	

The Cart Lodge, Lullingstone Lane, Eynsford, Kent, DA4 0HZ
Tel: 01322 868622 Fax: 01322 861050
Email: contact@gdteam.co.uk



Client: REEF ESTATES	**Job No:** 16-017	**Project:** The Ugly Brown Building	GD Partnership Ltd. Consulting Engineers
Scale: 1 : 400 **Drawn:** MM **Checked:** YG **Date:** MAY 2017	**Drawing No:** S(SK) GA-51 A	**Drawing:** PLOT B - GROUND FLOOR LAYOUT	The Cart Lodge, Lullingstone Lane, Eynsford, Kent, DA4 0HZ Tel: 01322 868622 Fax: 01322 861050 Email: contact@gdteam.co.uk



SECTION 5-5

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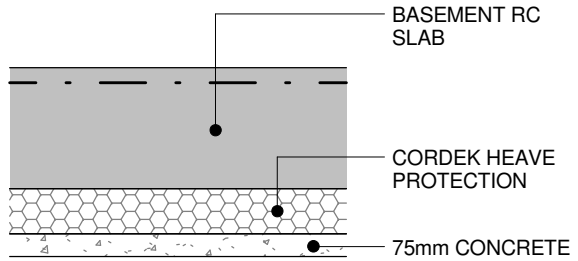
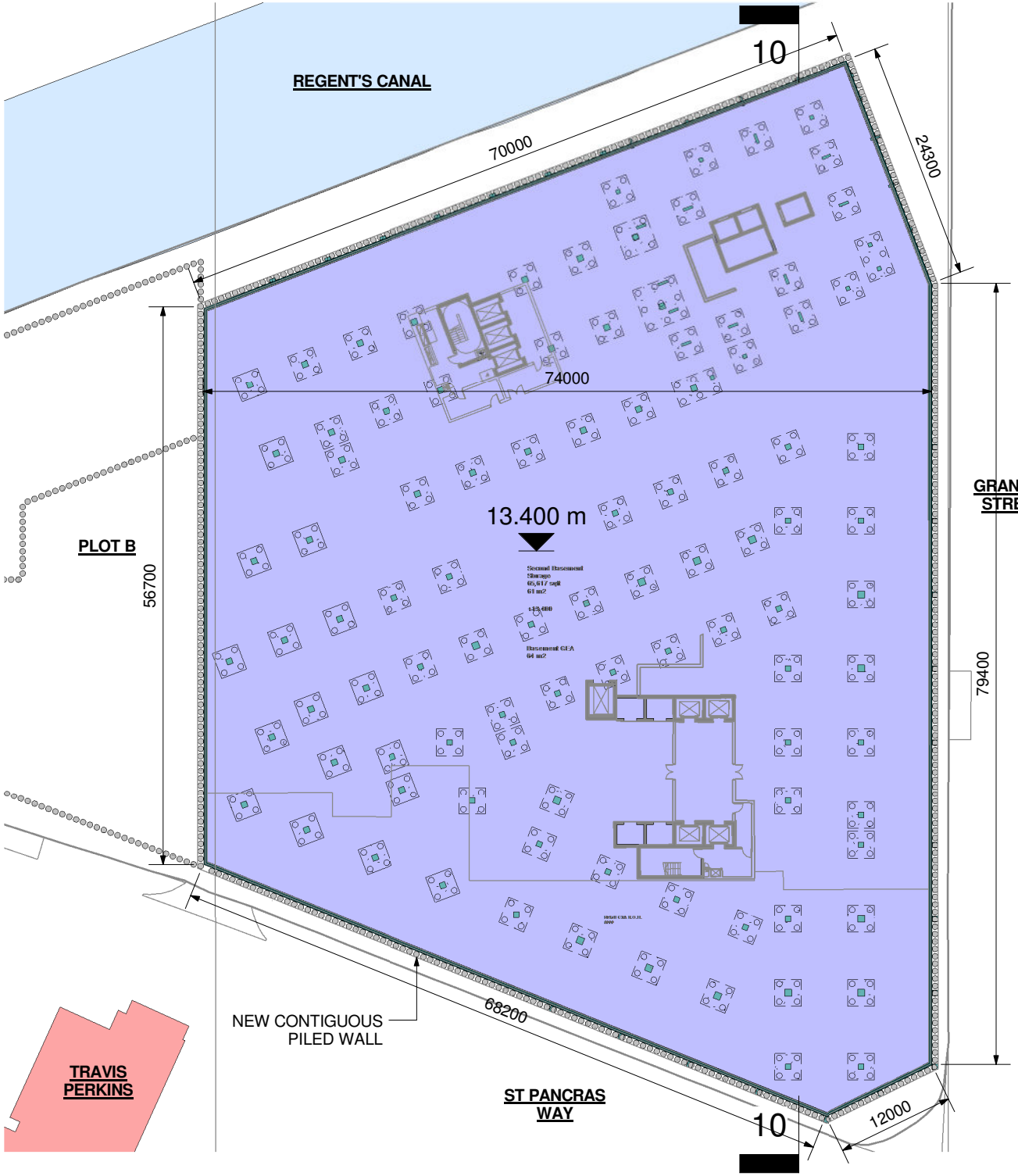


A DETAIL A

1 : 25

Client: REEF ESTATES	**Job No:** 16-017	**Project:** The Ugly Brown Building	GD Partnership Ltd. Consulting Engineers
Scale: As indicated **Drawn:** MM **Checked:** YG **Date:** MAY 2017	**Drawing No:** S(SK) GA-53 A	**Drawing:** SECTION 5-5 THROUGH PLOT B	

The Cart Lodge, Lullingstone Lane, Eynsford, Kent, DA4 0HZ
Tel: 01322 868622 Fax: 01322 861050
Email: contact@gdteam.co.uk



ST PANCRAS HOSPITAL BUILDING 3

ST PANCRAS HOSPITAL BUILDING 2

ST PANCRAS HOSPITAL BUILDING 1

ALL FOUNDATIONS SHOWN ARE INDICATIVE ONLY

Client:
REEF ESTATES

Scale: 1 : 600
Drawn: MM **Checked:** YG
Date: MAY 2017

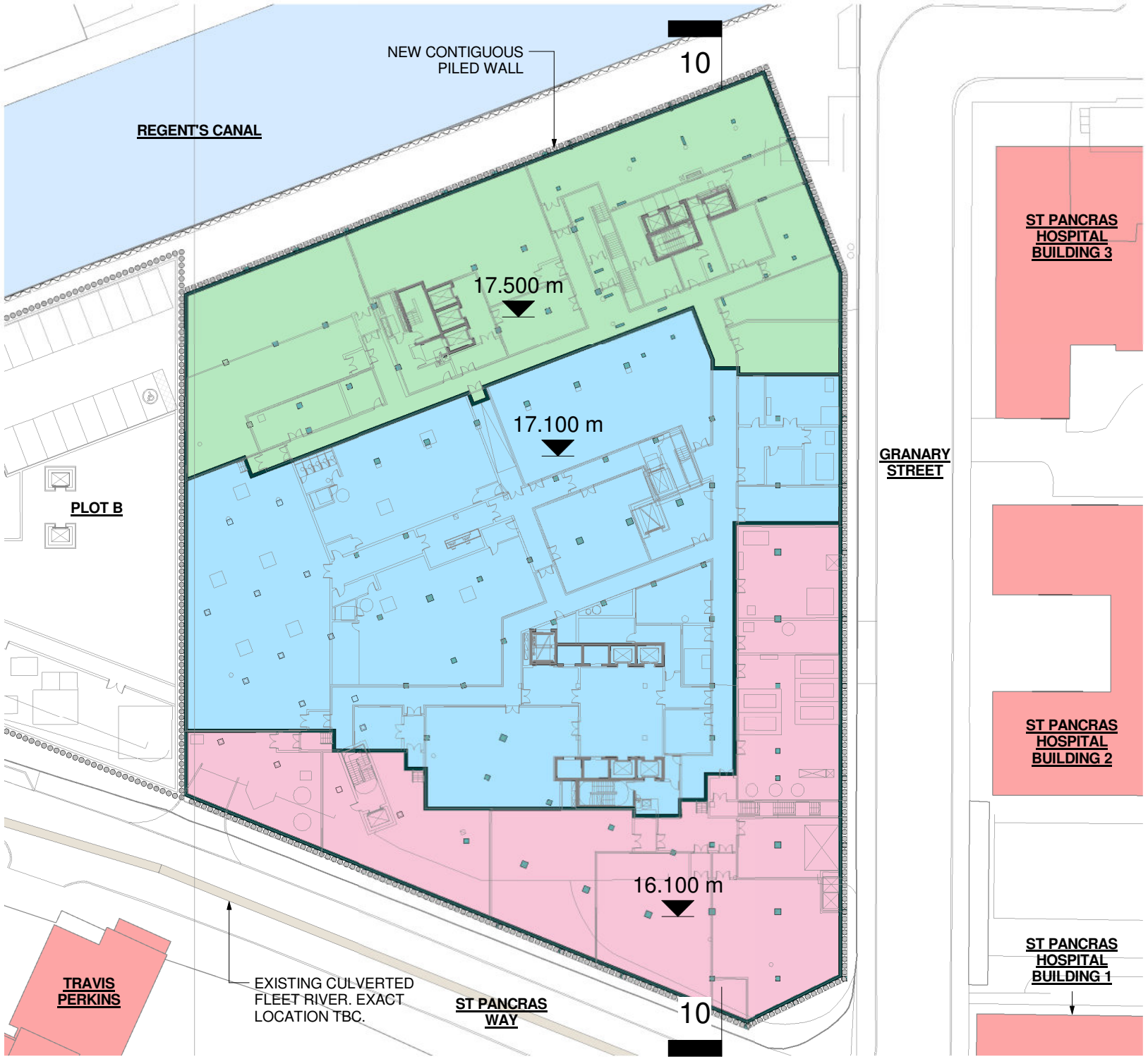
Job No:
16-017

Drawing No:
S(SK) GA-100 B

Project:
The Ugly Brown Building

Drawing:
PLOT C - BASEMENT LAYOUT LOWER LEVEL

GD Partnership Ltd.
Consulting Engineers
The Cart Lodge, Lullingstone Lane, Eynsford, Kent, DA4 0HZ
Tel: 01322 868622 Fax: 01322 861050
Email: contact@gdteam.co.uk



Client:
REEF ESTATES

Scale: 1 : 600
Drawn: MM **Checked:** YG
Date: MAY 2017

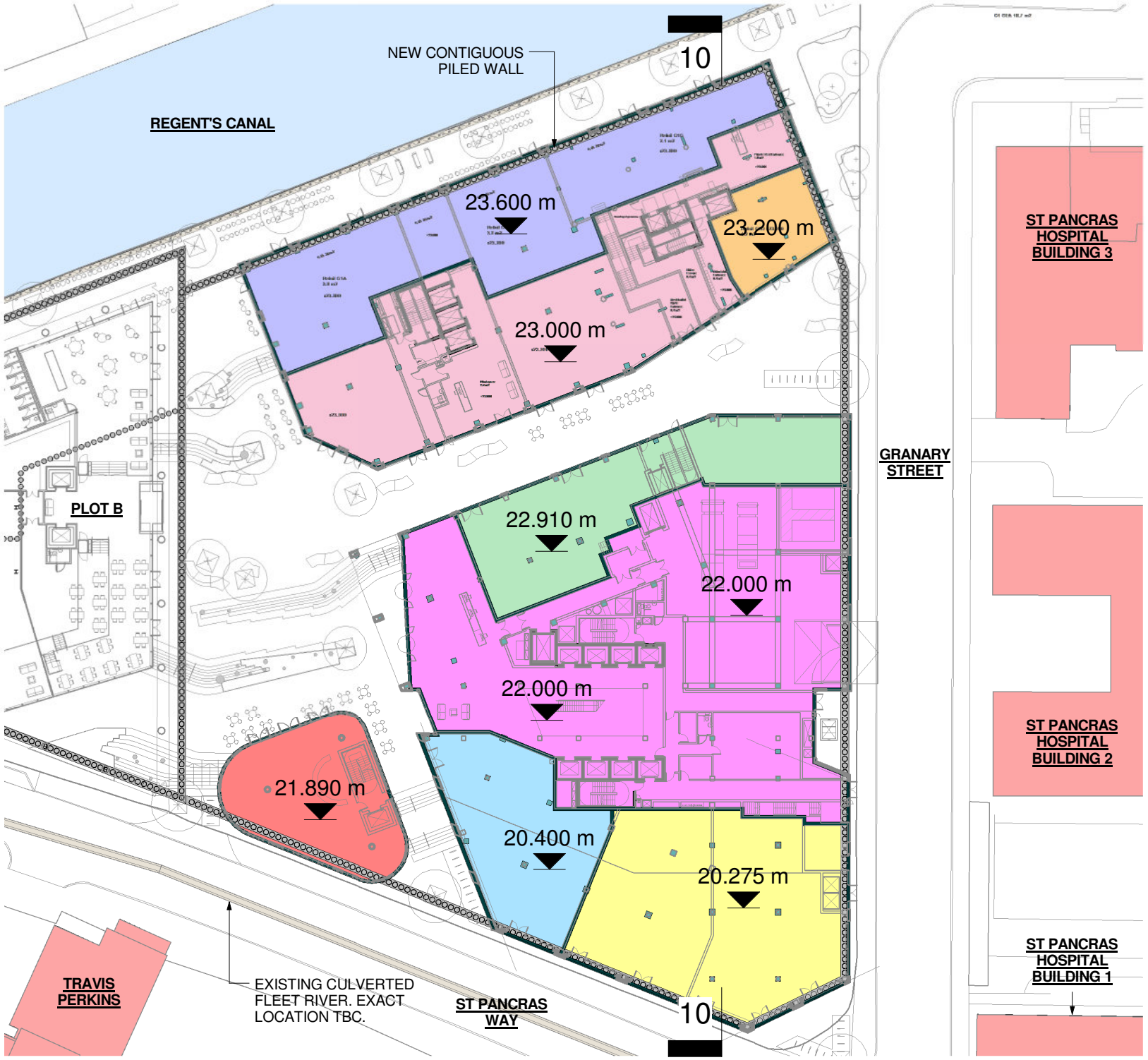
Job No:
16-017

Drawing No:
S(SK) GA-101 A

Project:
The Ugly Brown Building

Drawing:
PLOT C - BASEMENT LAYOUT UPPER LEVEL

GD Partnership Ltd.
Consulting Engineers
The Cart Lodge, Lullingstone Lane, Eynsford, Kent, DA4 0HZ
Tel: 01322 868622 Fax: 01322 861050
Email: contact@gdteam.co.uk



Client:
REEF ESTATES

Scale: 1 : 600
Drawn: MM **Checked:** YG
Date: MAY 2017

Job No:
16-017

Drawing No:
S(SK) GA-102 A

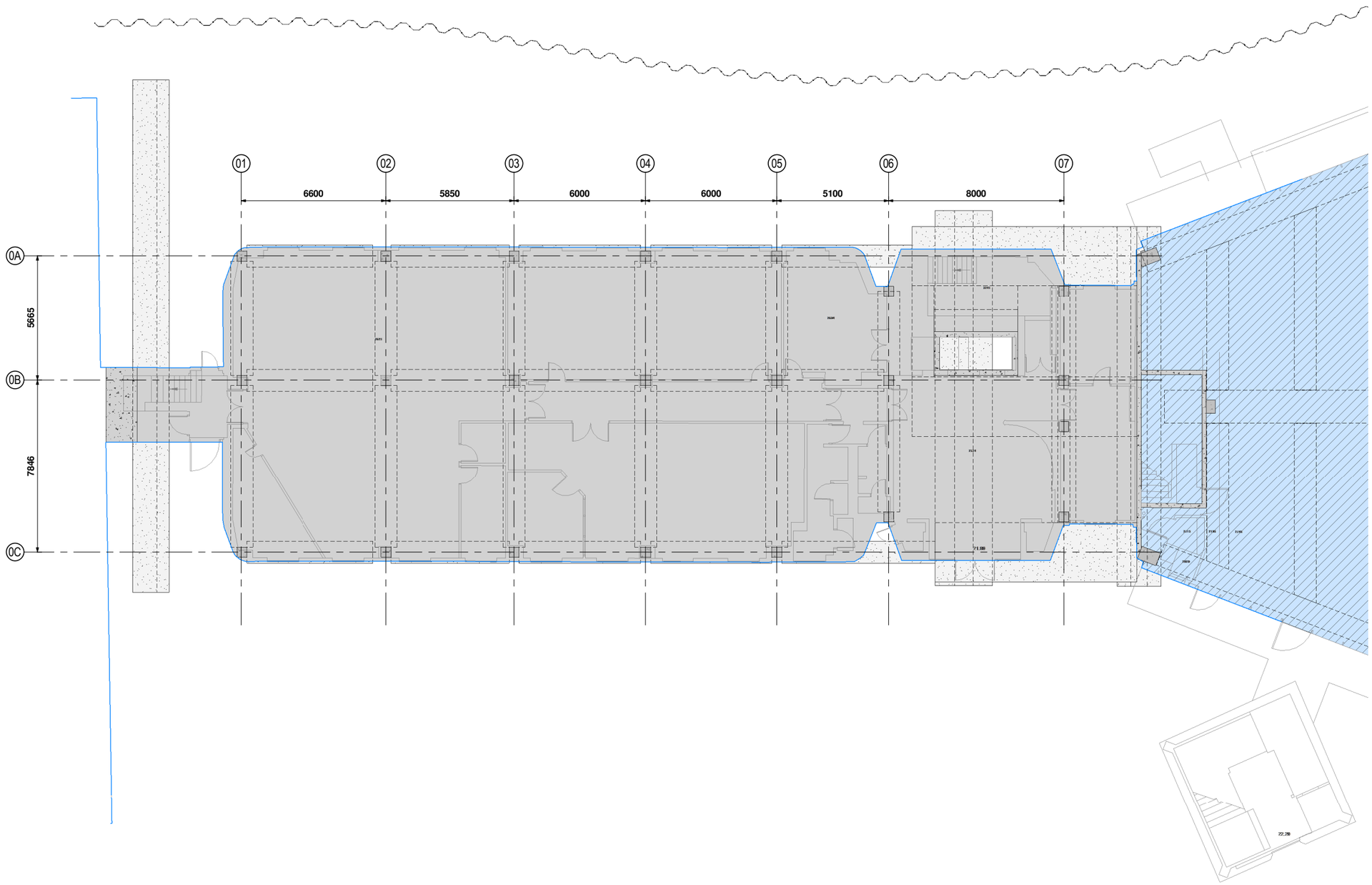
Project:
The Ugly Brown Building

Drawing:
PLOT C - GROUND FLOOR LAYOUT

GD Partnership Ltd.
Consulting Engineers
The Cart Lodge, Lullingstone Lane, Eynsford, Kent, DA4 0HZ
Tel: 01322 868622 Fax: 01322 861050
Email: contact@gdteam.co.uk

NOTES

1. DO NOT SCALE THIS DRAWING.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ENGINEERS, ARCHITECTS, AND SERVICES' ENGINEERS DRAWINGS & SPECIFICATIONS.
3. ALL DIMENSIONS ARE IN MILLIMETRES (mm).
4. WORK TO FIGURED DIMENSIONS ONLY.
5. ALL WORK TO COMPLY WITH THE RELEVANT BRITISH STANDARDS, CODES OF PRACTICE AND THE BUILDING REGULATIONS.



E0 PLOT A - EXISTING GROUND FLOOR PLAN
1 : 100

Rev	Date	By	Chkd	Description

GD Partnership Ltd.
Consulting Engineers
The Cart Lodge, Lullingstone Lane, Eynsford, Kent, DA4 0HZ
Tel: 01322 868622 Fax: 01322 861050
Email: contact@gdteam.co.uk

Client:
REEF ESTATES

Project:
The Ugly Brown Building

Drawing:
PLOT A - EXISTING GROUND FLOOR PLAN

Scale: 1 : 100	SCALES INDICATED@A1 (2x SCALE@A3)	
Drawn: MM	Checked: YG	Date: OCT. 2017

SKETCH

Job No:	Drawing No:	Rev:
16-017	SK(A) - 003	

NOTES

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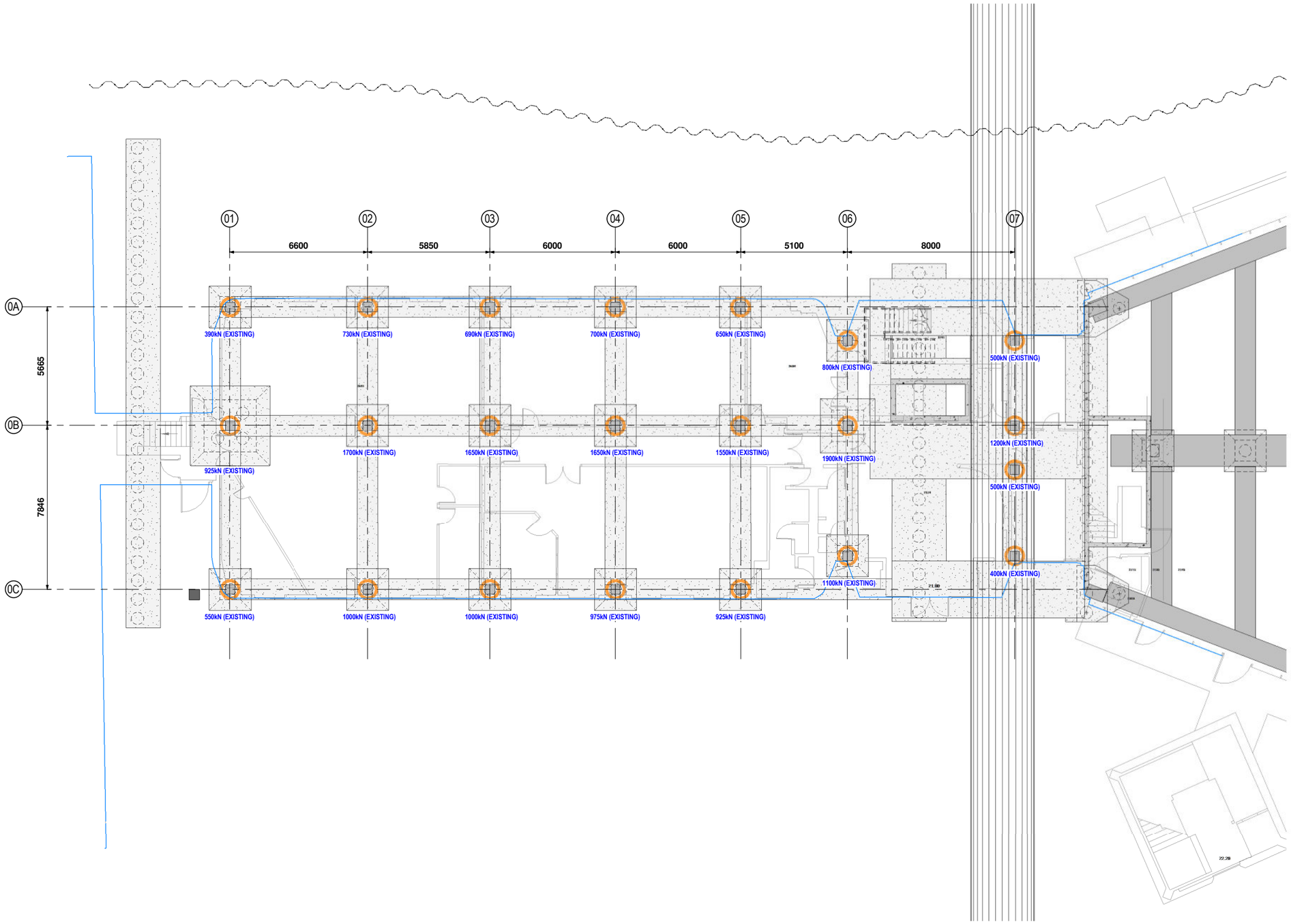
4. WORK TO FIGURED DIMENSIONS ONLY.
5. ALL WORK TO COMPLY WITH THE RELEVANT BRITISH STANDARDS, CODES OF PRACTICE AND THE BUILDING REGULATIONS.



E00 PLOT A - EX. FOUNDATION PLAN - LOADS
1 : 100

Rev	Date	By	Chkd	Description

GD Partnership Ltd.
Consulting Engineers
The Cart Lodge, Lullingstone Lane, Eynsford, Kent, DA4 0HZ
Tel: 01322 868622 Fax: 01322 861050
Email: contact@gdteam.co.uk

Client:
REEF ESTATES

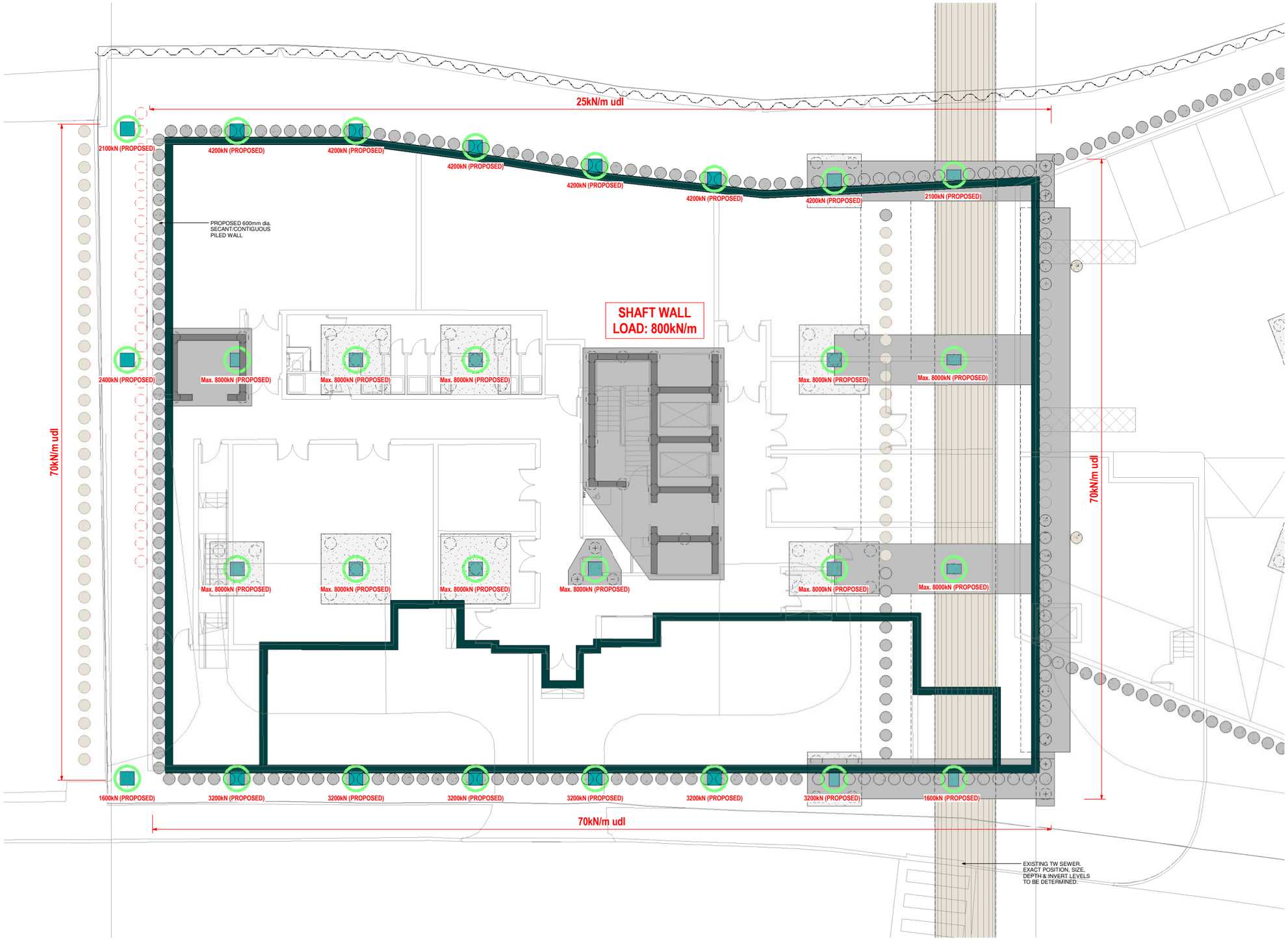
Project:
The Ugly Brown Building

Drawing:
PLOT A - EXISTING FOUNDATION LOADS

Scale: 1 : 100	SCALES INDICATED@A1 (2x SCALE@A3)	
Drawn: MM	Checked: YG	Date: OCT. 2017

SKETCH

Job No:	Drawing No:	Rev:
16-017	SK(A) - 200	



1 PLOT A - PROPOSED BASEMENT PLAN
1 : 100

NOTES

1. DO NOT SCALE THIS DRAWING.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ENGINEERS, ARCHITECTS, AND SERVICES' ENGINEERS DRAWINGS & SPECIFICATIONS.
3. ALL DIMENSIONS ARE IN MILLIMETRES (mm).
4. WORK TO FIGURED DIMENSIONS ONLY.
5. ALL WORK TO COMPLY WITH THE RELEVANT BRITISH STANDARDS, CODES OF PRACTICE AND THE BUILDING REGULATIONS.

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Consulting Engineers
The Cart Lodge, Lullingstone Lane, Eynsford, Kent, DA4 0HZ
Tel: 01322 868622 Fax: 01322 861050
Email: contact@gdteam.co.uk

Client:
REEF ESTATES

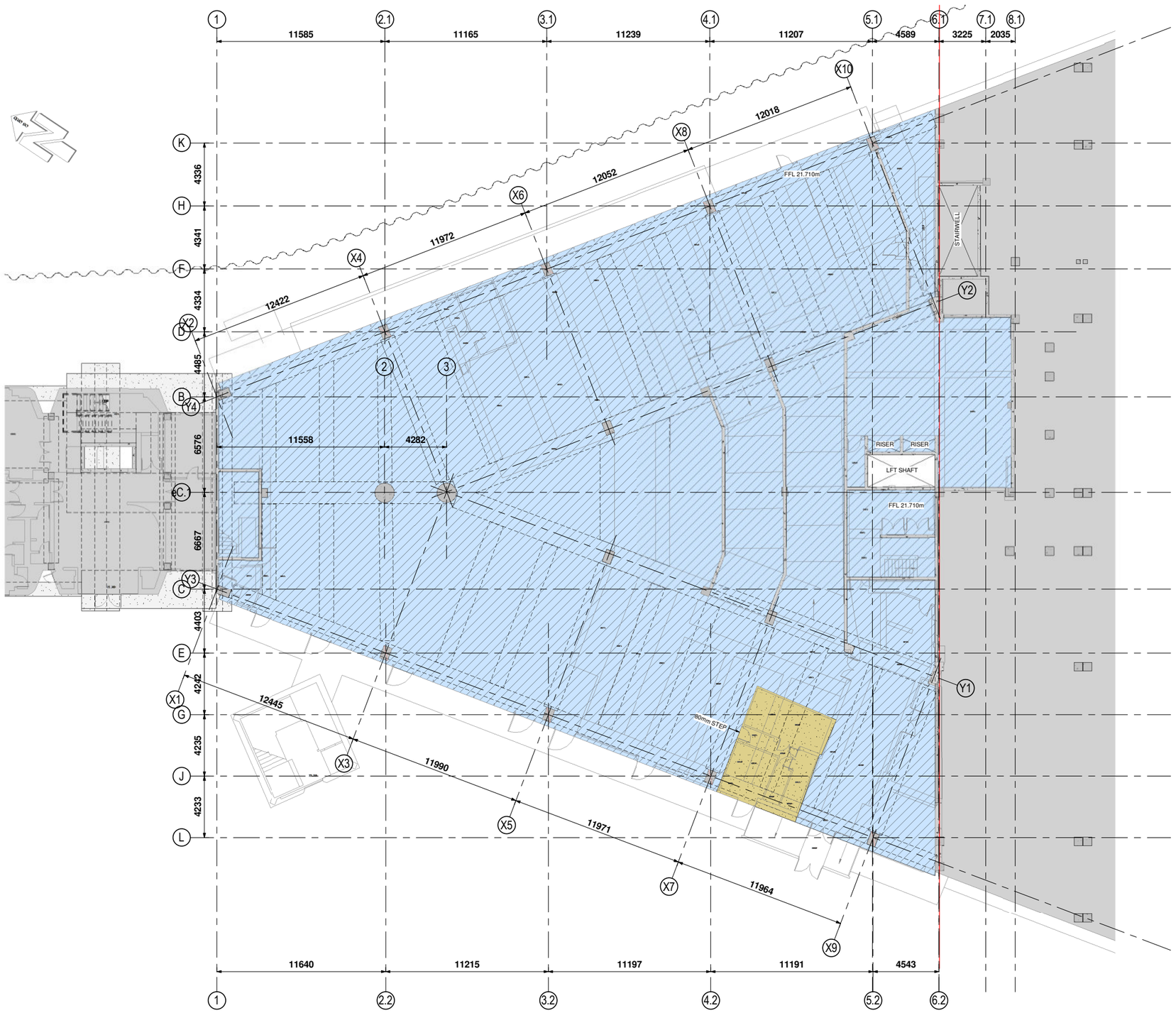
Project:
The Ugly Brown Building

Drawing:
PLOT A - PROPOSED FOUNDATION LOADS

Scale: 1 : 100 SCALES INDICATED@A1 (2x SCALE@A3)
Drawn: MM Checked: YG Date: OCT. 2017

SKETCH

Job No: 16-017 Drawing No: SK(A) - 250 A



E0 PLOT B - EXISTING GROUND FLOOR PLAN

1 : 150

NOTES

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2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ENGINEERS, ARCHITECTS, AND SERVICES' ENGINEERS DRAWINGS & SPECIFICATIONS.
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5. ALL WORK TO COMPLY WITH THE RELEVANT BRITISH STANDARDS, CODES OF PRACTICE AND THE BUILDING REGULATIONS.

Rev	Date	By	Chkd	Description

GD Partnership Ltd.
Consulting Engineers
The Cart Lodge, Lullingstone Lane, Eynsford, Kent, DA4 0HZ
Tel: 01322 868622 Fax: 01322 861050
Email: contact@gdteam.co.uk

Client:

REEF ESTATES

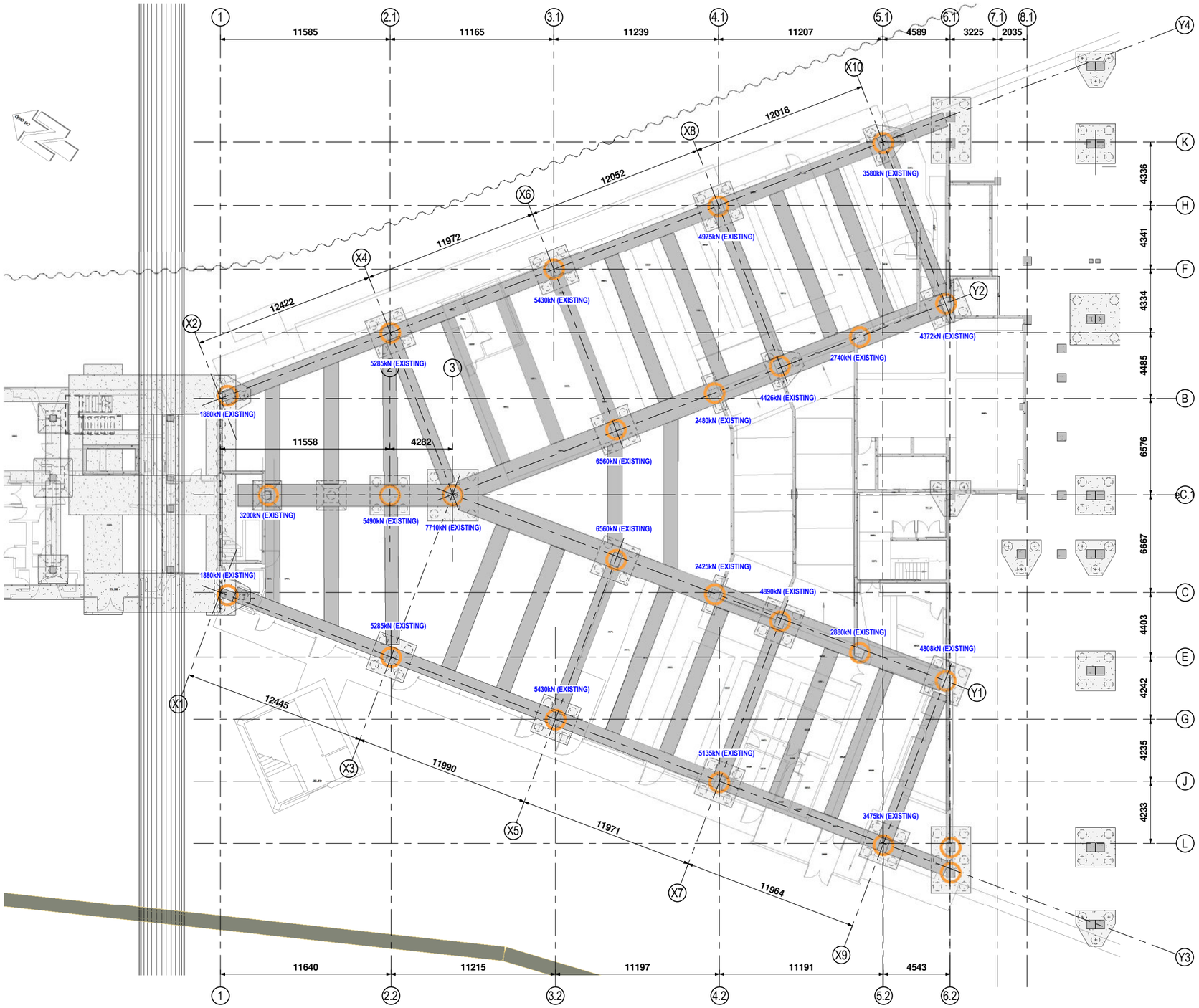
Project:

The Ugly Brown Building

Drawing:

PLOT B - EXISTING GROUND FLOOR PLAN

Scale: 1 : 150	**SCALES INDICATED@A1 (2x SCALE@A3)**		
Drawn: MM	**Checked:** YG	**Date:** OCT. 2017	
SKETCH	**Job No:** 16-017	**Drawing No:** SK(B) - 003	**Rev:**



E00 PLOT B - EXISTING FOUNDATION PLAN - LOADS

1 : 150

NOTES

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Rev	Date	By	Chkd	Description

GD Partnership Ltd.
Consulting Engineers
The Cart Lodge, Lullingstone Lane, Eynsford, Kent, DA4 0HZ
Tel: 01322 866622 Fax: 01322 861050
Email: contact@gdteam.co.uk

Client:

REEF ESTATES

Project:

The Ugly Brown Building

Drawing:

PLOT B - EXISTING FOUNDATION LOADS

Scale: 1 : 150	SCALES INDICATED@A1 (2x SCALE@A3)	
Drawn: MM	Checked: YG	Date: OCT. 2017

SKETCH

Job No:	Drawing No:	Rev:
16-017	SK(B) - 200	

NOTES

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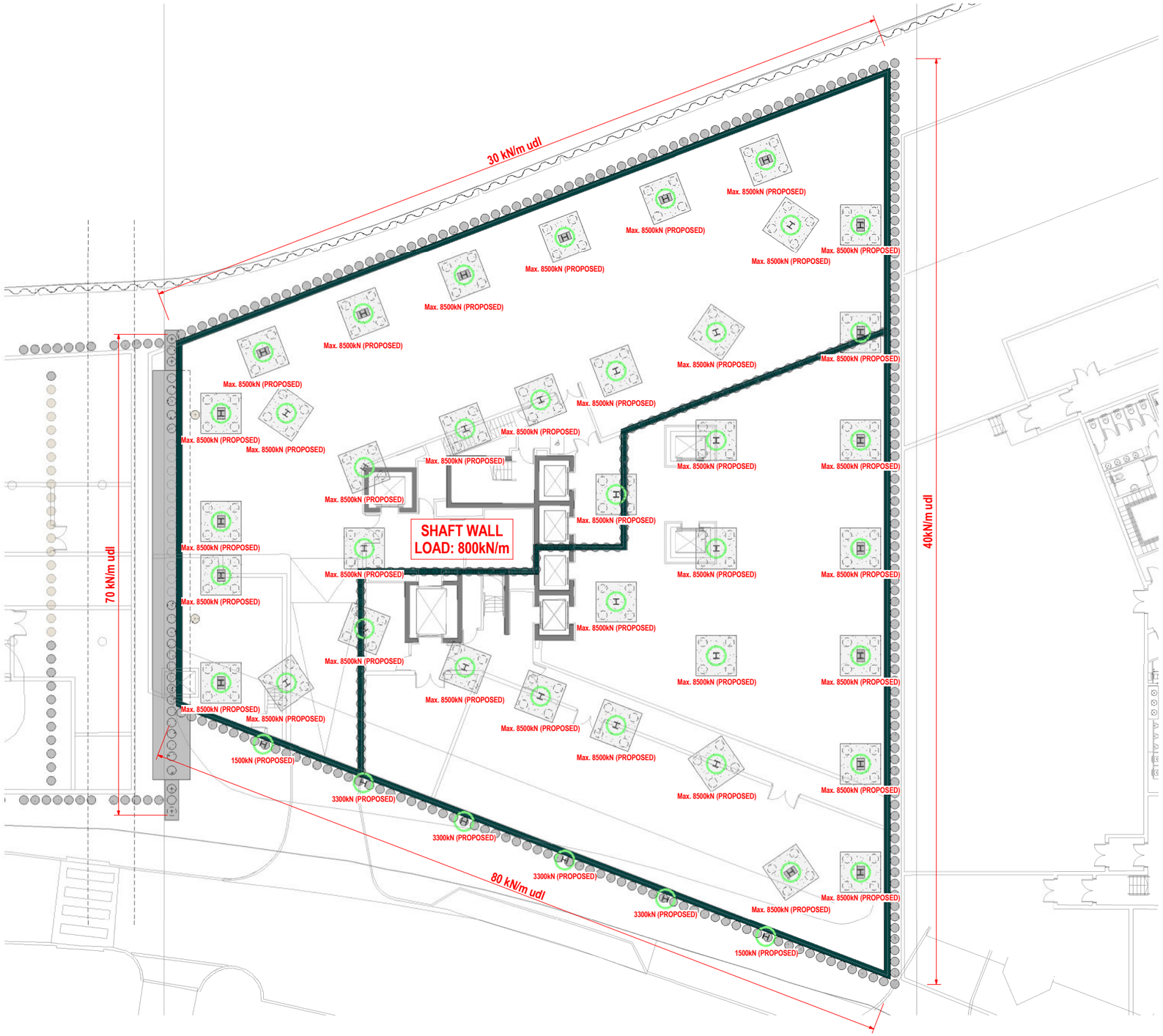
3 ALL DIMENSIONS ARE IN MILLIMETRES (mm).

4 WORK TO FIGURED DIMENSIONS ONLY.

5 ALL WORK TO COMPLY WITH THE RELEVANT BRITISH STANDARDS, CODES OF PRACTICE AND THE BUILDING REGULATIONS.



P00 PLOT B - PROPOSED BASEMENT PLAN
1 : 150

SKETCH

GD Partnership Ltd.
Consulting Engineers
The Cart Lodge, Lullingstone Lane, Eynsford, Kent, DA4 0HZ
Tel: 01322 868622 Fax: 01322 861050
Email: contact@gdteam.co.uk

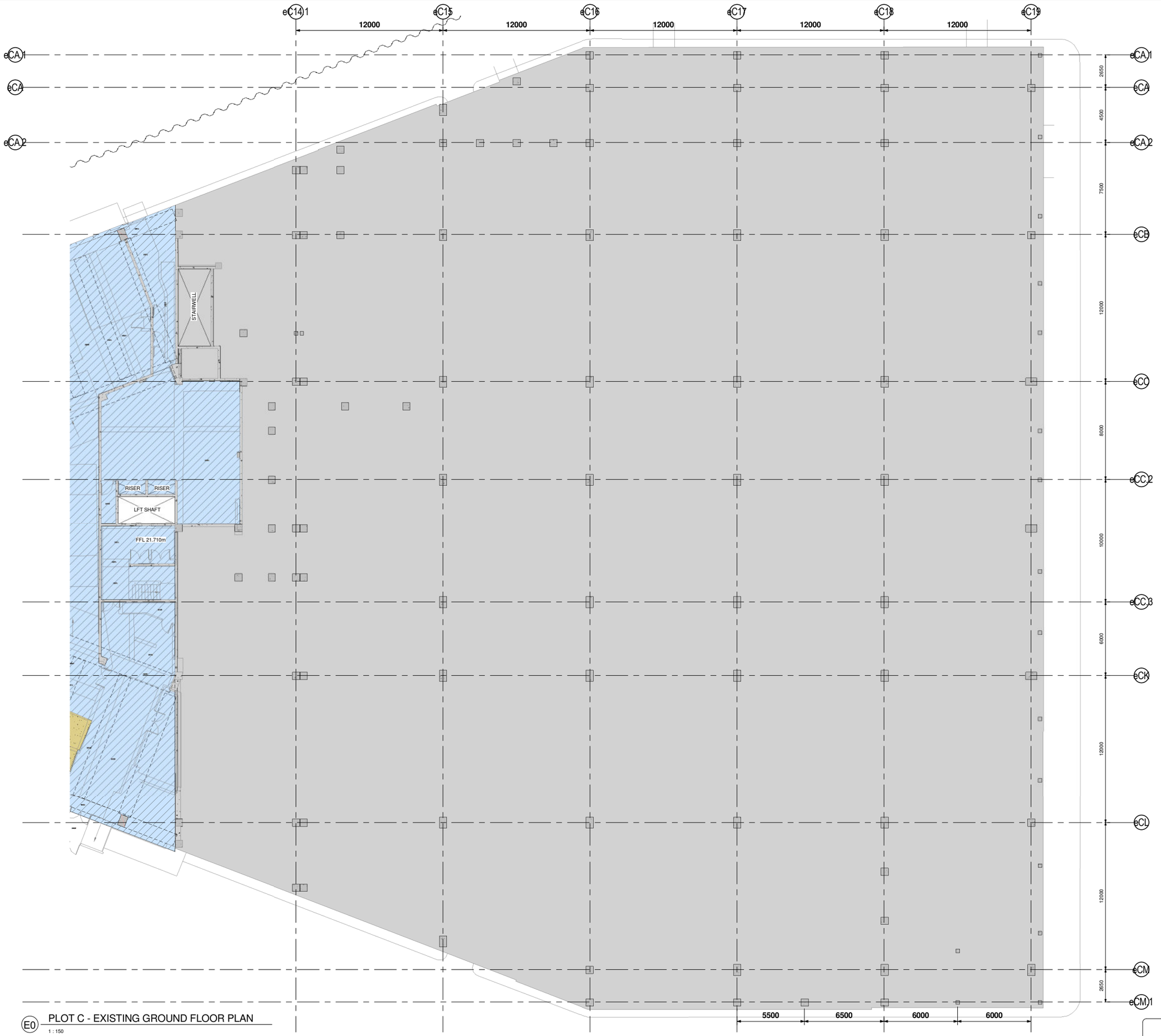
Client:
REEF ESTATES

Project:
The Ugly Brown Building

Drawing:
PLOT B - PROPOSED FOUNDATION LOADS

Scale: 1 : 150	SCALES INDICATED@A1 (2x SCALE@A3)	
Drawn: MM	Checked: YG	Date: OCT. 2017

Job No: 16-017
Drawing No: SK(B) - 250 A



E0 PLOT C - EXISTING GROUND FLOOR PLAN
1 : 150

NOTES

1. DO NOT SCALE THIS DRAWING.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ENGINEERS, ARCHITECTS, AND SERVICES' ENGINEERS DRAWINGS & SPECIFICATIONS.
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Rev	Date	By	Chkd	Description

GD Partnership Ltd.
Consulting Engineers
The Cart Lodge, Lullingstone Lane, Eynsford, Kent, DA4 0HZ
Tel: 01322 868622 Fax: 01322 861050
Email: contact@gdteam.co.uk

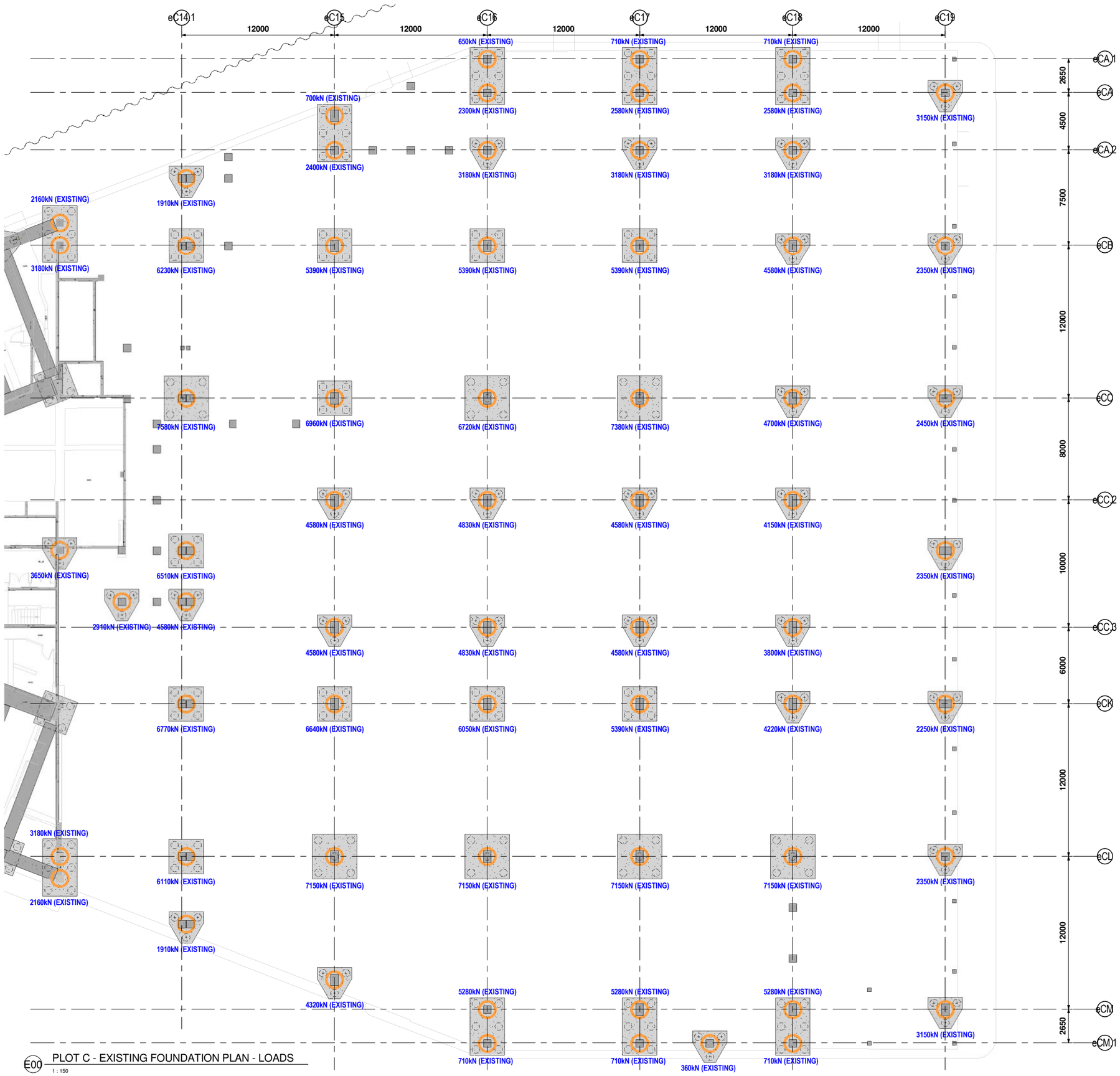
Client:
REEF ESTATES

Project:
The Ugly Brown Building

Drawing:
PLOT C - EXISTING GROUND FLOOR PLAN

Scale: 1 : 150 SCALES INDICATED@A1 (2x SCALE@A3)
Drawn: MM Checked: YG Date: OCT. 2017
Job No: 16-017 Drawing No: SK(C) - 003 Rev:

SKETCH



E00 PLOT C - EXISTING FOUNDATION PLAN - LOADS
1 : 150

NOTES

1. DO NOT SCALE THIS DRAWING.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ENGINEERS, ARCHITECTS, AND SERVICES' ENGINEERS DRAWINGS & SPECIFICATIONS.
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Rev	Date	By	Chkd	Description

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Consulting Engineers
The Cart Lodge, Lullingstone Lane, Eynsford, Kent, DA4 0HZ
Tel: 01322 868622 Fax: 01322 861050
Email: contact@gdteam.co.uk

Client:
REEF ESTATES

Project:
The Ugly Brown Building

Drawing:
PLOT C - EXISTING FOUNDATION LOADS

Scale: 1 : 150 — SCALES INDICATED@A1 (2x SCALE@A3)
Drawn: MM | **Checked:** YG | **Date:** OCT. 2017

SKETCH

Job No: 16-017 | **Drawing No:** SK(C) - 200 | **Rev:**

P00 PLOT C - PROPOSED BASEMENT PLAN - LOWER LEVEL
1 : 200

NOTES

1. DO NOT SCALE THIS DRAWING.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ENGINEERS, ARCHITECTS, AND SERVICES' ENGINEERS DRAWINGS & SPECIFICATIONS.
3. ALL DIMENSIONS ARE IN MILLIMETRES (mm).
4. WORK TO FIGURED DIMENSIONS ONLY.
5. ALL WORK TO COMPLY WITH THE RELEVANT BRITISH STANDARDS, CODES OF PRACTICE AND THE BUILDING REGULATIONS.

GD Partnership Ltd.
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PLOT C - PROPOSED FOUNDATION LOADS

Scale: 1 : 200	SCALES INDICATED@A1 (2x SCALE@A3)	
Drawn: MM	Checked: YG	Date: OCT. 2017

SKETCH

Job No: 16-017
Drawing No: SK(C) - 250 A