
GROUND MOVEMENT ASSESSMENT REPORT

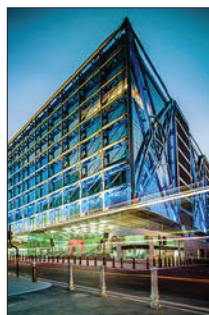
7 Branch Hill
London NW3 1LT

Client: Mrs Cheryl Plaza



Engineer: Sinclair Johnston and Partners

J13022A

March 2016



Document Control

Project title	7 Branch Hill, London, NW3 7LT	Project ref	J13022A
Report prepared by	 Martin Cooper BEng CEng MICE FGS		
Report checked and approved for issue by	 Steve Branch BSc MSc CGeol FGS FRGS MIEEnvSc		
Issue No	Status	Date	Approved for Issue
1	Final	17 March 2016	

This report has been issued by the GEA office indicated below. Any enquiries regarding the report should be directed to the office indicated or to Steve Branch in our Herts office.



Hertfordshire

tel 01727 824666

mail@gea-ltd.co.uk



Nottinghamshire

tel 01509 674888

midlands@gea-ltd.co.uk

Geotechnical & Environmental Associates Limited (GEA) disclaims any responsibility to the Client and others in respect of any matters outside the scope of this work. This report has been prepared with reasonable skill, care and diligence within the terms of the contract with the Client and taking account of the manpower, resources, investigation and testing devoted to it in agreement with the Client. This report is confidential to the Client and GEA accepts no responsibility of whatsoever nature to third parties to whom this report or any part thereof is made known, unless formally agreed beforehand. Any such party relies upon the report at their own risk. This report may provide advice based on an interpretation of legislation, guidance notes and codes of practice. GEA does not however provide legal advice and if specific legal advice is required a lawyer should be consulted.

© Geotechnical & Environmental Associates Limited 2016

CONTENTS

1.0	INTRODUCTION	1
1.1	Proposed Development	1
1.2	Limitations	2
2.0	THE SITE	2
2.1	Site Description	2
3.0	SUMMARY OF GROUND CONDITIONS	3
4.0	CONSTRUCTION SEQUENCE	4
4.1	Temporary Support to the Existing Structure	4
4.2	Installation of Underpinning	4
4.3	Installation of Bored Pile Walls	4
4.4	Permanent Works	4
5.0	OUTLINE RETAINING WALL DESIGN	5
6.0	GROUND MOVEMENTS	5
6.1	Ground Movements - Surrounding the Basement	7
6.2	Results	8
7.0	DAMAGE ASSESSMENT	8
7.1	Damage to Neighbouring Structures	10
7.2	Monitoring of Ground Movements	10
7.3	Mitigation	11
8.0	CONCLUSIONS	11
	APPENDICES	

1.0 INTRODUCTION

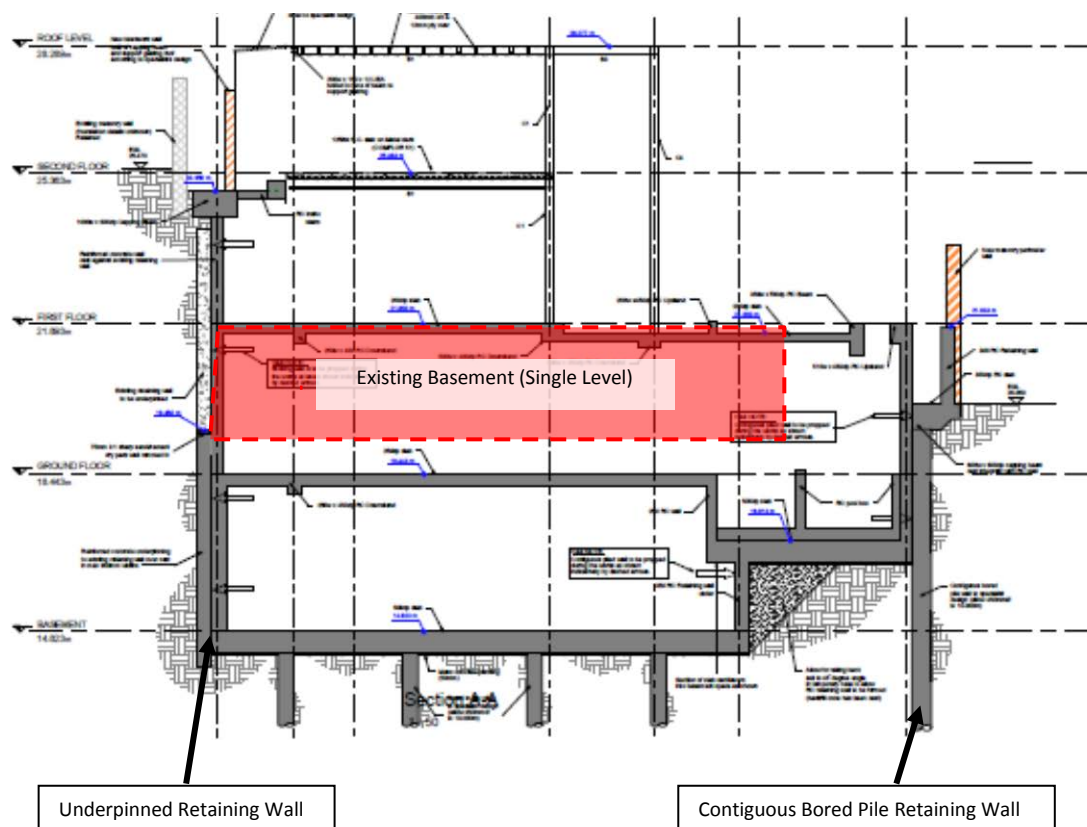
Geotechnical and Environmental Associates (GEA) has been commissioned by Sinclair Johnston (SJ&P), on behalf of Mrs Cheryl Plaza, to complete a ground movement assessment for the proposed redevelopment of 7 Branch Hill in Hampstead, London, NW3 7LT, which is to include the construction of a new house with the deepening of the existing single level basement.

A Site Investigation and Basement Impact Assessment Report has previously been carried out by GEA (report ref J13022, dated April 2013), the findings of which were used to inform a Basement Impact Assessment (BIA) which was undertaken by Sinclair Johnston & Partners (SJ&P). The BIA included an initial ground movement assessment but further work was deemed to be required following the independent review of the BIA by Card Geotechnics Limited (CGL). This report provides the additional analysis required.

The purpose of this assessment has been to determine the effects of the proposed basement construction upon the neighbouring structures.

1.1 Proposed Development

It is understood that it is proposed to demolish the existing building and construct a new three-storey building with a deepening of the existing single-storey basement. The site is essentially cut into the hillside and ground level at the site entrance is equivalent to the basement level at the rear (east) of the site. The existing basement walls will be retained and underpinned to form the walls of the new basement with piled walls to provide earth retention at the site entrance. The extent of the works is shown on the drawing section below.



The new basement will measure roughly 22.0 m by 15.0 m in maximum plan dimension and will extend to a depth of roughly 10.0 m from the existing upper ground level of roughly 128 m OD although from hereon in the levels will be referenced to a site datum (SD) level where the existing ground level at the site entrance from Branch Hill is designated a level of 20.0 m SD. On this basis, the existing basement is at 19.7 m SD and the floor of the existing swimming pool is at 17.3 m SD.

The proposed excavation will extend to around 14.2 m SD across much of the site and therefore represents an overall basement depth of around 8.0 m below existing ground level. However, with an existing basement in place already, the effect of the new excavation is to lower the existing levels by between 5.5 m and 3.1 m.

The existing basement is reported by SJ&P to have been constructed within a temporary sheet pile retaining wall in the 1980s. The sheet piles effectively became redundant on completion of construction because all loads were thereafter transferred into the reinforced concrete frame of the current building.

This report is specific to the proposed development and the advice herein should be reviewed if the proposals are amended.

1.2 Limitations

The conclusions and recommendations made in this report are limited to those that can be made on the basis of the investigation. The results of the work should be viewed in the context of the range of data sources consulted, the number of locations where the ground was sampled and the number of soil, gas or groundwater samples tested; no liability can be accepted for information in other data sources or conditions not revealed by the sampling or testing. Any comments made on the basis of information obtained from the client or other third parties are given in good faith on the assumption that the information is accurate; no independent validation of such information has been made by GEA.

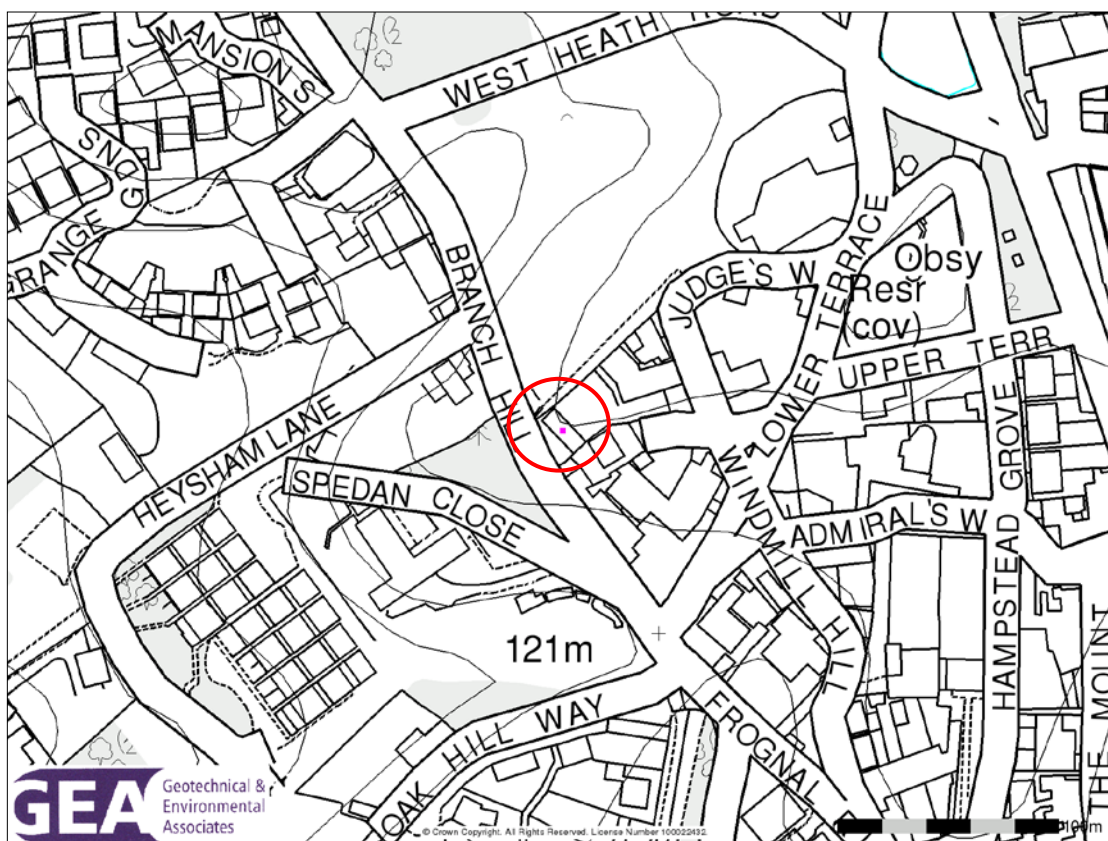
2.0 THE SITE

2.1 Site Description

The site is located approximately 400 m to the northwest of Hampstead London Underground Station and is roughly rectangular in shape, with maximum dimensions of approximately 20 m southwest to northeast by 22 m northwest to southeast. It fronts onto Branch Hill to the southwest and is bordered by houses with associated private gardens to the east and south, the communal garden of Upper Terrace Lodge to the northeast and by open heathland to the north. The site may be additionally located by National Grid Reference 526100, 186125 and is shown on the map overleaf.

Ground level in the area generally slopes up towards the northeast such that the site has been built into the hillside and is at a number of different levels. The site is currently occupied by a detached three-storey house that is cut into the slope, with a pool at ground floor level, a paved forecourt in the southern corner of the site and brick retaining walls on all sides. Steps lead up from the forecourt to a terrace and garden area at first floor level that is laid to lawn with planted borders. The borders are planted with small shrubs and bushes along with three

semi-mature and mature silver birch trees of up to 15 m in height. A water feature and small pond measuring approximately 0.5 m by 1.0 m are present in the north of the site.



The centre of the forecourt is at a level of approximately 20.0 m SD and the raised garden area is at a level of about 22.0 m SD and is essentially level.

3.0 SUMMARY OF GROUND CONDITIONS

The GEA site investigation confirmed the expected ground conditions in that, below a variable thickness of made ground, the Bagshot Formation was proved to the full depth investigated.

The topsoil / made ground extended to depths of 0.35 m (19.65 m SD) beneath the driveway and 2.81 m (19.2 m SD) from garden level. The underlying Bagshot Formation initially comprised medium dense dark greenish grey and brown silty clayey fine sand to a depth of 4.30 m (15.7 m SD) or orange-brown silty clayey sandy gravel. Below the initial horizon, medium dense orange-brown mottled pale greenish-grey clayey silty sand with bands of orange-brown mottled greenish-grey sand extended to the maximum depth investigated, of 16.00 m (4.0 m SD).

Groundwater was not encountered during drilling. A groundwater monitoring standpipe was installed to a depth of 16.00 m in Borehole No 1 and monitoring approximately one week and three weeks after installation recorded water at depths of 11.30 m (8.70 m SD) and 11.28 m (8.72 m SD) respectively.

The ground conditions are also shown alongside the proposed structure on the appended SJ&P Drawing No 7922 / SK14.

4.0 CONSTRUCTION SEQUENCE

The following sequence of operations has been provided by SJ&P to enable analysis of the ground movements around the basement both during and after construction.

Essentially the sequence may be considered as four groups of activities, the first three comprising the short and medium term temporary works whilst the fourth represents the construction of the permanent works.

4.1 Temporary Support to the Existing Structure

SJ&P Drawing Nos 7922/P005 and P006 show that prior to demolition, the existing reinforced concrete structure will be propped at two levels using flying shores that rake back to sections of the existing basement slab. The existing retaining walls will, therefore, no longer need to rely on the walls and floors of the current building to provide lateral support, which will allow demolition to proceed. It is understood that these props may be preloaded to allow for relaxation of the structure during demolition but both vertical and horizontal components of the load will be supported and little or no deflection is anticipated.

4.2 Installation of Underpinning

Following demolition, the retained sections of the existing walls will be underpinned using reinforced concrete underpins. The pins will be installed using a standard 'hit and miss' five-pin sequence as indicated in SJ&P Drawing No 7922/009. The underpins will be propped at two or more levels during excavation.

4.3 Installation of Bored Pile Walls

In the western part of the site, the basement walls will be formed by a contiguous bored pile wall which will be propped at two levels to act as temporary support during excavation of the basement.

4.4 Permanent Works

When the final excavation depths have been reached the permanent works will be formed, which will comprise a 0.5 m thick piled basement slab cast upon 50 mm of blinding concrete. The basement walls are to be cast from the 'bottom-up' and will be formed of reinforced concrete lining walls. Reinforced concrete will be used for floor slabs which will be cast on top of sections of lining wall. Following the curing of the ground floor slab, the temporary steel props will be released and removed. The combination of basement slabs and lining walls will form a complete reinforced concrete basement box.

5.0 OUTLINE RETAINING WALL DESIGN

At this stage, a piling contractor has not been appointed so there is no detailed design on which to base a ground movement assessment. However, the SJ&P drawings indicate that the bored pile walls will be installed from a level of approximately 20.0 m with excavations in front of the walls extending to between 15.5 m SD (4.5 m of dig) and 14.0 m SD (6.0 m of dig) and note that pile lengths of 10.0 m have been assumed for 450 mm diameter piles at 600 mm centre to centre spacings.

In our experience these pile lengths and diameters should be suitable for the proposed excavation on the basis that the piles are propped at capping beam level as well as at a lower level during the excavation and that the lining wall and slabs will provide long term propping. The formal pile design will be undertaken by the piling contractor in due course and will set out more accurate predictions of ground movements. However, at this stage there is considered to be sufficient detail in the SJ&P documents to make certain assumptions upon which the ground movements can be based.

The wall is proposed to be a contiguous bored pile wall and justification for the choice of wall is provided in the GEA Site Investigation Report Section 8.1.1. CIRIA report C580¹ only provides installation movements for contiguous bored pile walls in stiff clay and these curves have been adopted for this wall in the absence of alternative data. With the temporary and permanent propping arrangements in mind, a piled wall of high stiffness is considered and the ground movements for excavation in front of a wall embedded in sand are considered the most appropriate ground movement curves for the excavation phase of the development.

6.0 GROUND MOVEMENTS

The assessment of ground movements within and surrounding the excavation is not straightforward for this site due to the different levels on and around the site, the retention of the existing basement retaining walls and the combination of bored pile walls and underpinning to support the new excavation.

There are, however certain principles in the design of the new building that provide fixity to parts of the structure and remove certain mechanisms by which stress changes would lead to ground movement.

The site is underlain by a significant thickness (in excess of 16 m) of the essentially granular Bagshot Deposits with the London Clay anticipated to be present at a depth of about 20 m (2 m SD) below the existing ground level. In addition, the new structure has been designed with a 500 mm thick reinforced concrete basement raft slab. The weight of the new structure will offset the greater part of the unloading but any net unloading will be transferred from the basement slab into the reinforced concrete piles which will be integral to the slab. These piles are predominantly designed to resist the out of balance horizontal forces from the retaining walls and will be designed to resist lateral loads in combination with tensile forces. Any potential for heave is therefore deemed to be locked into the structure but in any case the stress change that would lead to heave of the London Clay would be limited due to the thickness of granular material above. Further consideration of heave movements is therefore deemed unnecessary.

¹ Gaba, A, Simpson, B, Powrie, W and Beadman, D (2003) *Embedded retaining walls – guidance for economic design*. CIRIA Report C580.

As discussed earlier in this report and within the SJ&P Design and Construction Statement, the existing building is a reinforced concrete box that was cast against a temporary steel sheet pile wall. Given the age of the existing building at over 30 years and given that the ground conditions comprise the Bagshot Formation, it is considered that ground movements from that building would have taken place almost immediately after construction and certainly would have, by now, ceased. The existing retaining walls will be propped using flying shores and waling beams prior to and during the demolition of the existing building thus not allowing movement into the site.

It is however considered that ground movements may occur as a result of the installation of the underpinning and piling and then by the subsequent excavation of the basement to its formation level. These two mechanisms are assessed in the following sections.

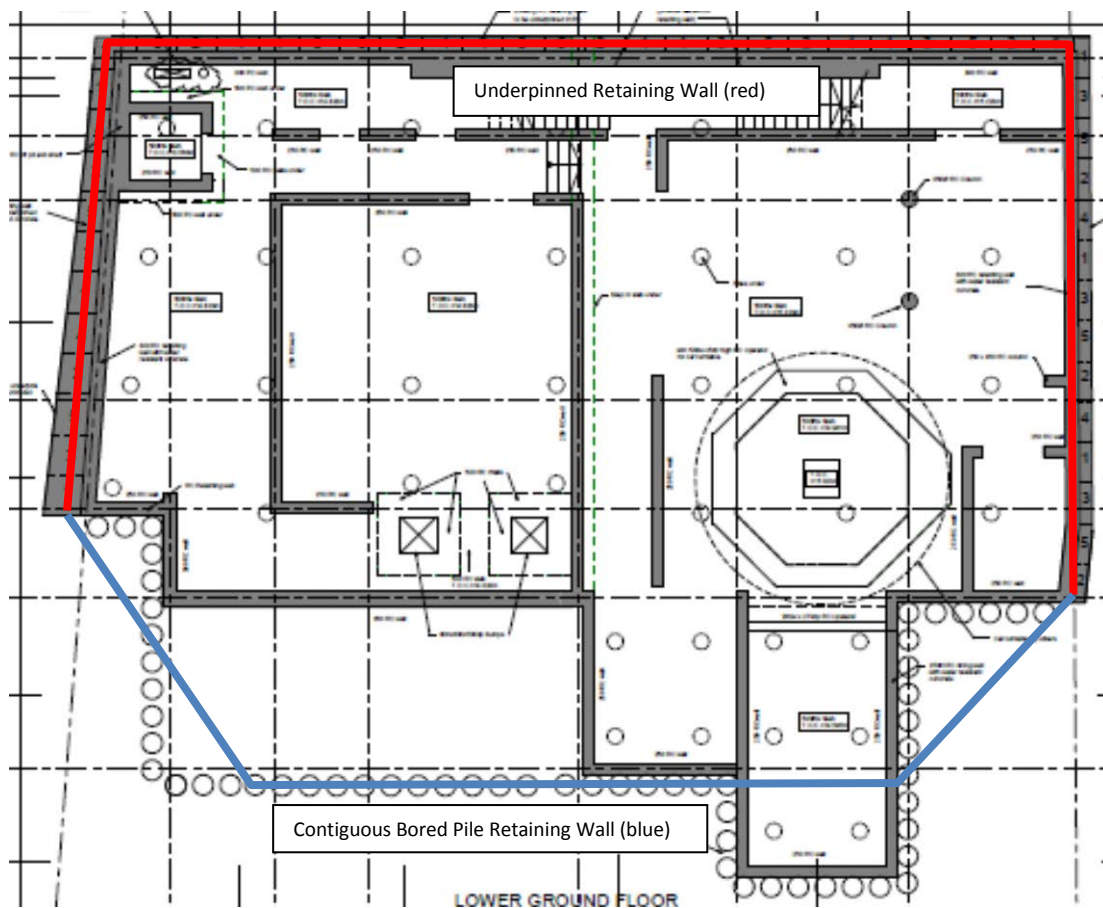
CGL, in their independent review of the SJ&P BIA, suggest that the CIRIA C580 methods of ground movement analysis may not be entirely appropriate for this site whilst SJ&P in their response consider the methods appropriate.

For this analysis GEA consider that the methods in C580 may cautiously be used to model the wall installation and excavation phases. The analysis has been undertaken using the X-Disp computer program licensed from the OASYS suite of geotechnical modelling software from Arup and which is commonly used within the ground engineering industry.

The X-Disp program has been used to predict ground movements likely to arise from the construction of the proposed basement. This includes the settlement of the ground (vertical movement) and the lateral movement of soil behind the proposed retaining walls (horizontal movement).

For the purpose of these analyses, the corners have been defined by x and y coordinates, with the x-direction parallel with the orientation north-south, whilst the y-direction is parallel with the orientation of east-west. Vertical movement is in the z-direction.

X-Disp effectively takes a series of two-dimensional planes and builds them into a pseudo three-dimensional model. It is limited in that re-entrant corners cannot be modelled due to the complexity of interaction at such corners and as such this basement profile has been modelled as a hexagon as shown below.



X-Disp is also slightly limited in that only movements at or below the installation level of the wall can be calculated. This is because the movements are derived from the CIRIA C580 movement curves which only refer to measurements at or below the surface of installation.

SJ&P Drawing No 7922 / 022 shows that the underpinning installation level is 19.45 m SD and the underpins will extend to a level of 14.32 m SD. Similarly, the contiguous bored pile wall will be installed from a level of 20.0 m SD and the piles will extend to a depth of 10 m and found at a level of 10 m SD. The excavation level in front of both walls has been taken as 14.8 m SD from the same drawing. These are the levels for the eastern part of the site and are most relevant in determining the effect on the surrounding buildings.

The full outputs of all the analyses along with samples of the output movement contour plots are included within the appendix.

6.1 Ground Movements – Surrounding the Basement

6.1.1 Model Used

For the X-Disp analysis, the soil movement relationships used for the embedded retaining walls are based on the default values within CIRIA report C580. The C580 movements were derived from a number of historic case studies of the short term movements that result from wall installation and basement excavation. The ground movement curves for ‘installation of contiguous bored pile wall in stiff clay’ have been adopted as most appropriate for the contiguous wall at the western part of the site.

The drawings provided by SJ&P indicate that the reinforced concrete underpinning to form the new basement structure will be supported or propped in the temporary condition to maintain its stability during the excavation and that reinforced concrete retaining walls will be cast at a later stage in the appropriate areas. It would seem reasonable to adopt the ground movement curves for 'no horizontal and vertical movement' for this analysis but in practice there will always be a potential for a small degree of movement to take place, typically 2 mm to 5 mm, and a more conservative approach using the ground movement curves for the panel-like installation of a diaphragm wall have been adopted.

Following wall installation, the excavation phase has been modelled and the movement curves for excavation in front of a wall in sand have been adopted.

6.1.2 Results

The X-Disp analysis has been used to estimate the movements behind the walls resulting from pile installation and basement excavation. This includes the settlement of the ground (vertical movement) and the lateral movement of soil behind the wall (horizontal movement). The contour graphs of these movement predictions are appended for the piling and underpinning phase together with the total movement prediction which combined the effects.

The predicted movements are summarised in the table below; the results are presented to the degree of accuracy required to allow predicted variations in ground movements around the structure to be illustrated, but may not reflect the anticipated accuracy of the predictions.

Phase of Works	Maximum Movement at 19.5 m SD	
	Vertical Settlement (mm)	Horizontal Movement (mm)
Piling / Underpinning	Up to 5	Up to 5
Combined Piling / Underpinning and Basement Excavation	5 to 10	10 to 15

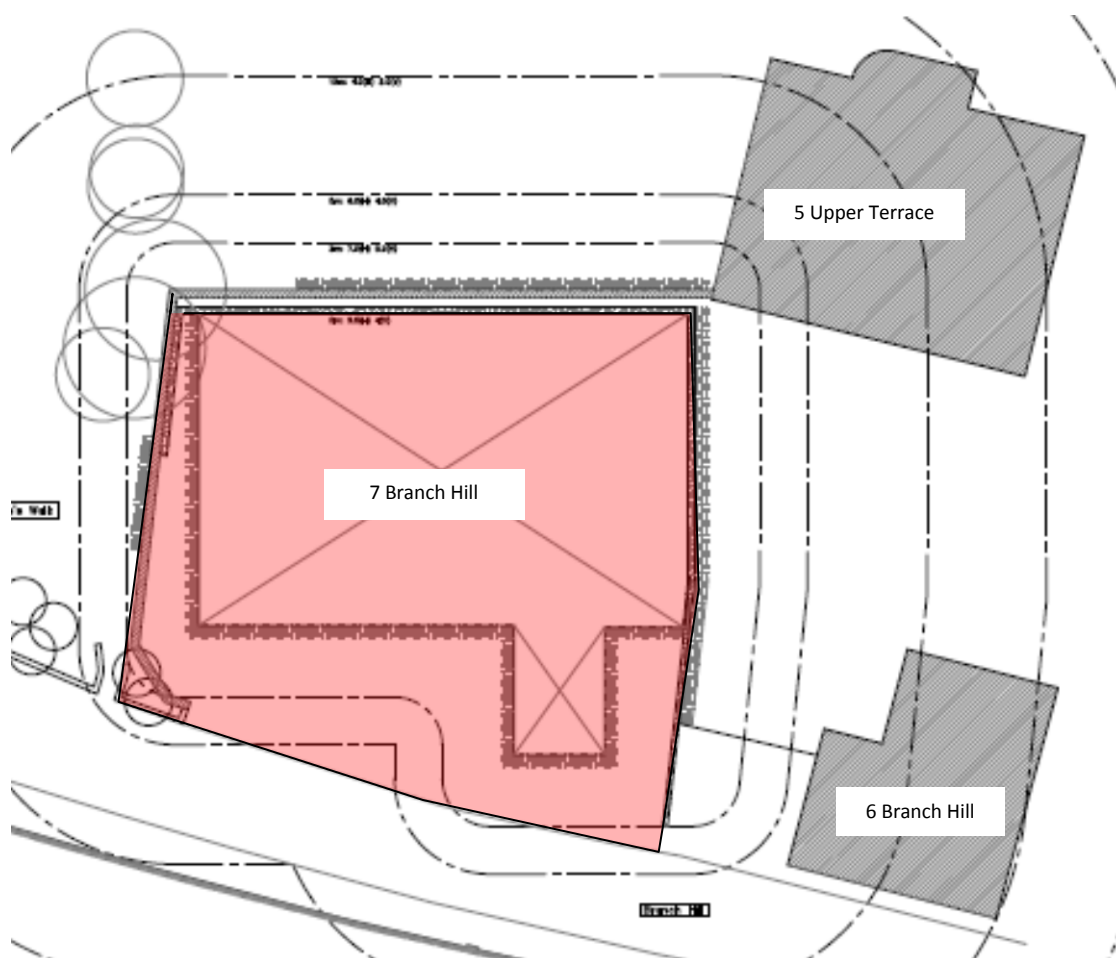
The movements set out in the table above are the maximum movements and generally occur immediately or just outside the line of the basement walls; the effects of the excavation reduce with distance away from these walls.

7.0 DAMAGE ASSESSMENT

In addition to the above assessment of the likely movements that will result from the proposed development, some of the neighbouring structures have been considered as sensitive structures, requiring Building Damage Assessments, on the basis of the 'Burland' classification given in Table 2.5 of C580. These include:

- ❑ No 5 Upper Terrace which is just to the southeast adjacent to the site boundary. The foundation depths of this building are unknown but from observation of the ground level around the site are assumed to be roughly 24.0 m SD;
- ❑ No 6 Branch Hill which is south of the site and with the ground level being sensibly level between the two, is assumed to be supported upon spread foundations bearing at 1.0 m depth, that is 19.0 m SD.

The sensitive structures outlined above have been modelled as lines in the analysis and are those along which the damage assessment has been undertaken, as shown on the annotated SJ&P drawing below.



For the analyses it has been straightforward to assess the effects of the proposed basement on No 6 Branch Hill but the movements for No 5 Upper Terrace are more difficult to model due to its higher foundation level and being above the underpinning rather than the piling. For the purpose of this assessment it has been assumed that movements that are experienced at the surface level of the underpinning will be transmitted vertically at the same magnitude because the existing retaining wall will not allow it to move laterally. This would mean that the movements of the foundation of No 5 Upper Terrace would be the same if it were bearing at 19.45 m and hence could be included in the ground model at that level. This is deemed to be a conservative approach for three reasons. Firstly, the underpinning is of a reinforced concrete wall which is stiffer than a masonry wall and will not be subject to as much deflection as a mortar filled masonry wall. With best practice and dry-packing of the pins the movements during installation of the underpins should be closer to zero than 5 mm. Secondly the ground movements from installation derive from ground loss during construction. For any finite ground loss at any given level, the ground loss above it cannot be greater than at the given level, which in this case is the level of the underpin itself. There would rather tend to be a reduction in ground loss and smaller movements in a similar manner to those experienced by tunnelling for example. Thirdly, working on the assumption that the movements at the higher level are the same as those at the installation level takes no account of wall friction behind the existing basement wall.

On this basis the foundations of No 5 Upper Terrace may be modelled as bearing at 19.45 m SD and the movements experienced and damage assessment are considered appropriate for the building as it bears at a higher level.

7.1 Damage to Neighbouring Structures

The combined movements resulting from both pile installation and basement excavation calculated using the X-Disp modelling software have been used to carry out an assessment of the likely damage to adjacent properties and the results are summarised in the table below.

Building Damage Assessment		
Sensitive Structure	Elevation	Category of Damage*
5 Upper Terrace	North (Wall 1)	Category 0 (Negligible)
	East (Wall 2)	Category 0 (Negligible)
	South (Wall 3)	Category 0 (Negligible)
	West (Wall 4)	Category 0 (Negligible)
6 Branch Hill	North (Wall 5)	Category 0 (Negligible)
	East (Wall 6)	Category 0 (Negligible)
	North (Wall 7)	Category 0 (Negligible)
	East (Wall 8)	Category 0 (Negligible)
	South (Wall 9)	Category 0 (Negligible)
	West (Wall 10)	Category 0 (Negligible)

*From Table 2.5 of C580¹: Classification of visible damage to walls.

The building damage reports for sensitive structures highlighted in the above table and shown graphically on the appended plan predict that the damage to the adjoining and nearby structures would be Category 0 (negligible).

On this basis, the damage that would inevitably occur as a result of such an excavation would fall within acceptable limits.

7.2 Monitoring of Ground Movements

The predictions of ground movement based on the ground movement analysis should be checked by monitoring of adjacent properties and structures. The structures to be monitored during the construction stages include:

- The existing structure during demolition as the ground movement analysis has been based largely on there being little or no movement from that wall;
- The elevations of 5 Upper Terrace and 6 Branch Hill.

Condition surveys of the above existing structures are likely to be carried out before and after the proposed works.

The precise monitoring strategy will be developed at a later stage but SJ&P have indicated the potential target locations on their Drawing No 7922 / P007 whilst remaining subject to discussions and agreements with the owners of the adjacent properties and structures before construction takes place. It is, however, expected that monthly monitoring would take place throughout the construction and that the frequency would increase to at least weekly during the groundworks elements and daily where excavation against critical areas is underway.

7.3 Mitigation

Reference to the detailed results indicates that the predicted damage to the existing structures is within Category 0.

8.0 CONCLUSIONS

The analysis has concluded that the predicted damage to the neighbouring properties would be 'Negligible'; on this basis, the damage that would inevitably occur as a result of such an excavation would fall within the acceptable limits.

The separate phases of work, including piling / underpinning and subsequent excavation of the proposed basement structures will in practice be separated by a number of weeks during which time construction of capping beams and pile curing will take place. This will provide an opportunity for the ground movements during and immediately after piling to be measured and the data acquired can be fed back into the design and compared with the predicted values. Such a comparison will allow the ground model to be reviewed and the predicted wall movements to be reassessed prior to the main excavation taking place so that propping arrangements can be adjusted if required.

APPENDICES

Ground Conditions Section Summary

SOIL DISPLACEMENT MODEL RESULTS

X-DISP ANALYSIS

Pile Installation

Contour Plots of Vertical Movements and Horizontal Movements

Pile Installation and Basement Excavation

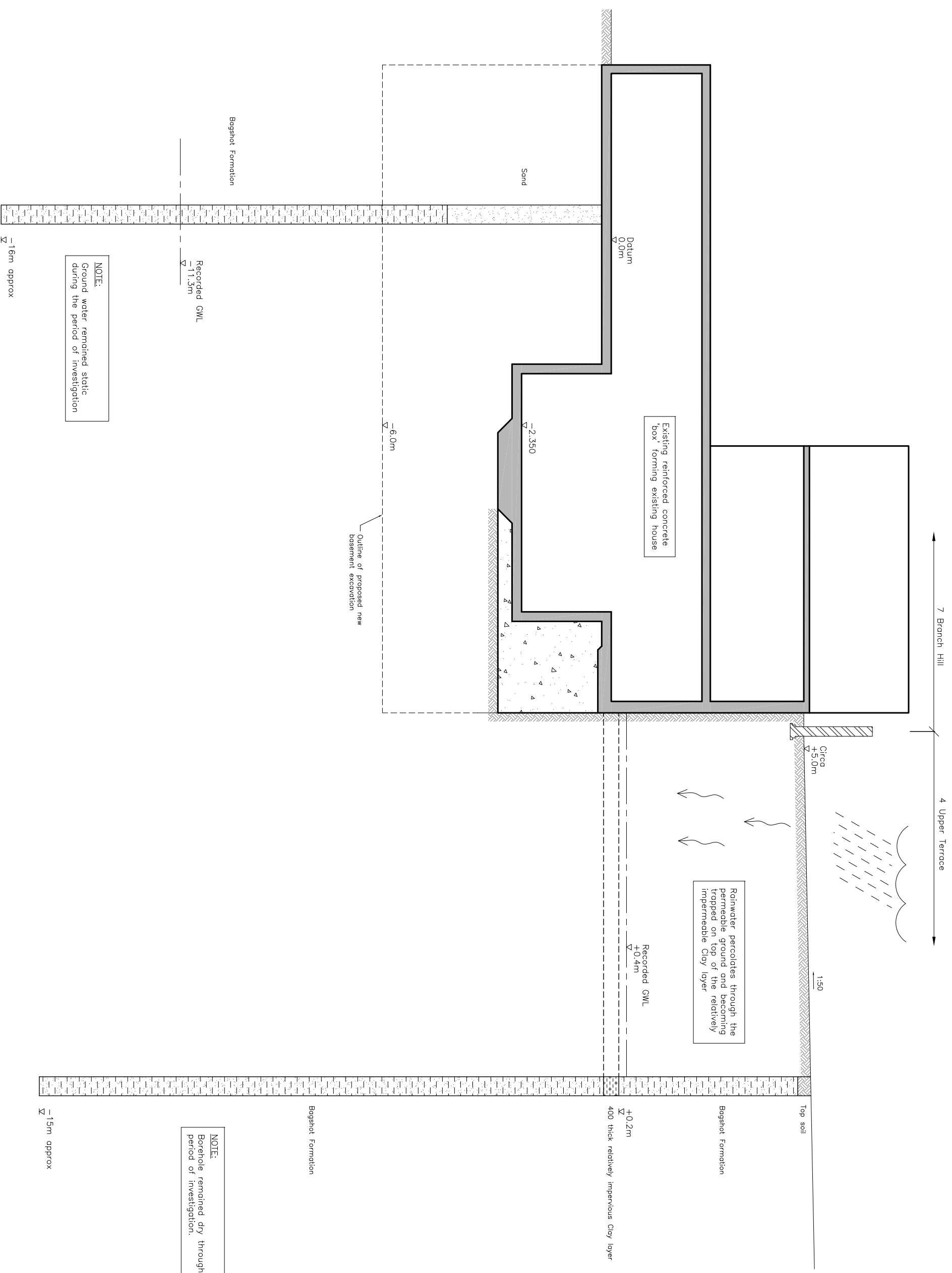
Contour Plots of Combined Vertical Movements and Horizontal Movements

BUILDING DAMAGE ASSESSMENT (X-DISP)

Tabular Output of Results

NOTES:

- All structural engineering drawings are to be read with the specification and with all relevant Architect's and Service Engineer's drawings and specifications.
- Do not scale from this drawing. In either paper or digital form, use the written dimensions only. To check drawings have been printed to intended scale this bar should be 50mm long @ A1 or 25mm long @ A3.
- All dimensions are in millimetres and levels in metres.



NOTE:
Borehole remained dry throughout period of investigation.

NOTE:
Ground water remained static during the period of investigation

Rev	Date	Issued	Amendment
-	18.12.13	TJM	Issued for planning.

Status: **PLANNING**

SINCLAIR JOHNSTON
Consulting Civil & Structural Engineers

93 Great Suffolk Street
London SE1 1DB
T: 020 7993 1900
F: 020 7993 1900
www.sinclairjohnston.co.uk

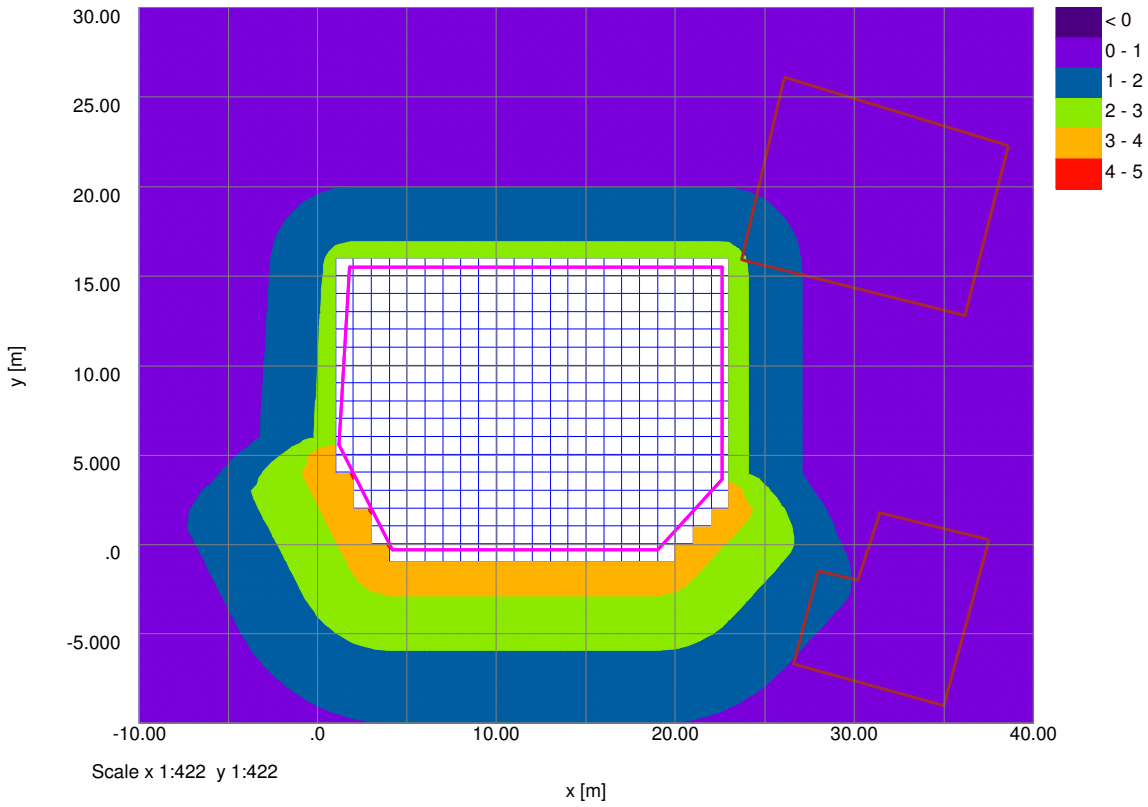
JUDGE'S LODGE
Z BRANCH HILL, NW3

GROUND CONDITIONS

Drawn: T. Musson Scale: 1:100 at A3
Project No./Drawing No. 7922/SK014 Rev: -

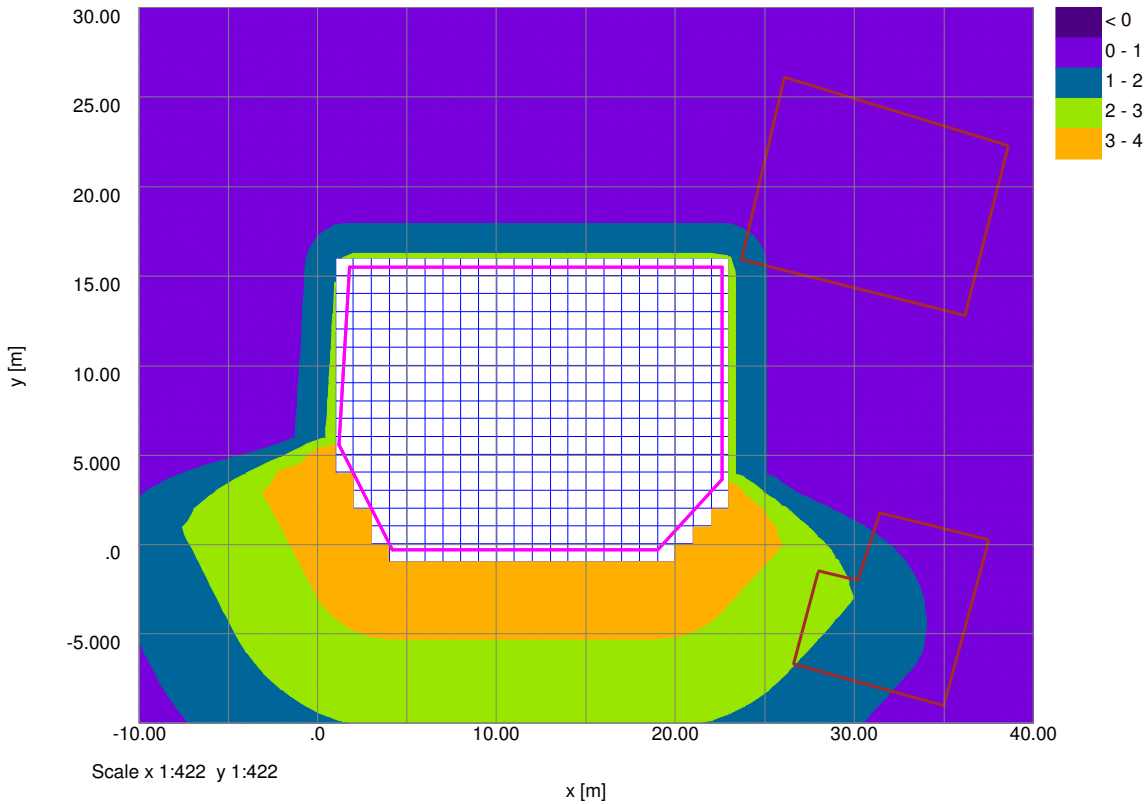
Job No.	Sheet No.	Rev.
Drg. Ref.		
Made by MC	Date 11-Mar-2016	Checked

Horizontal Displacement Contours: Grid 1 (level 19.450m) Interval 1mm



Job No.	Sheet No.	Rev.
Drg. Ref.		
Made by MC	Date 11-Mar-2016	Checked

Vertical Settlement Contours: Grid 1 (level 19.450m) (Interval 1mm)





7 Branch Hill, London, NW3 7LT
Ground Movement Assessment
Piling and Underpinning Phase

Dr. Ref.

Made by **Date** **Checked**
MC **11-Mar-2016**

Problem Type

Problem Type : Tunnelling and Embedded Wall Excavations

Displacement Data

Type	Name	Direction of extrusion	Point/Line/Line for extrusion			No. of intervals across extrusion/line	Extrusion depth	No. of intervals along extrusion	Calculate	Surface type for tunnels		
			First point		Second point							
			X [m]	Y [m]	Z (level) [m]	X [m]	Y [m]	Z (level) [m]				
Grid	Grid 1	Global X	-10.00000	-10.00000	19.45000	-	30.00000	19.45000	40	50.00000	Yes	Surface
Line	Line 1	-	23.70000	15.95000	19.45000	26.10000	26.05000	19.45000	10	-	Yes	Surface
Line	Line 2	-	26.10000	26.10000	19.45000	38.60000	22.30000	19.45000	10	-	Yes	Surface
Line	Line 3	-	38.60000	22.25000	19.45000	36.20000	12.85000	19.45000	10	-	Yes	Surface
Line	Line 4	-	36.20000	12.80000	19.45000	23.70000	15.90000	19.45000	10	-	Yes	Surface
Line	Line 5	-	26.60000	-6.65000	19.00000	28.00000	-1.55000	19.00000	5	-	Yes	Surface
Line	Line 6	-	28.00000	-1.50000	19.00000	30.20000	-2.00000	19.00000	5	-	Yes	Surface
Line	Line 7	-	30.20000	-1.95000	19.00000	31.40000	1.75000	19.00000	5	-	Yes	Surface
Line	Line 8	-	31.40000	1.80000	19.00000	37.50000	0.30000	19.00000	10	-	Yes	Surface
Line	Line 9	-	37.50000	0.25000	19.00000	35.00000	-8.95000	19.00000	10	-	Yes	Surface
Line	Line 10	-	35.00000	-9.00000	19.00000	26.60000	-6.70000	19.00000	10	-	Yes	Surface

Vertical Ground Movement Curves

Curve Name: No vertical ground movement
Coordinates: [Distance from wall / wall depth or max. excavation depth (x), Depth / wall depth or max. excavation depth (y), Settlement / wall depth or max. excavation depth (z) (%)]
 [0.000,0.000,0.000][1.000,0.000,0.000][0.000,1.000,0.000][1.000,1.000,0.000]
Curve Fitting Method: Polynomial
Method:
 x Order: 1
 y Order: 0
 Polynomial: z = 0.0x + 0.0
 Coeff. of Determination: -2147483648.E+2147483647

Curve Name: Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))
Coordinates: [Distance from wall / wall depth or max. excavation depth (x), Depth / wall depth or max. excavation depth (y), Settlement / wall depth or max. excavation depth (z) (%)]
 [0.000,0.000,0.040][2.000,0.000,0.000]
Curve Fitting Method: Polynomial
Method:
 x Order: 1
 y Order: 0
 Polynomial: z = -2.0E-2x + 4.0E-2
 Coeff. of Determination: 1.0

Curve Name: Installation of planar diaphragm wall in stiff clay (CIRIA 580 Fig. 2.9(b))
Coordinates: [Distance from wall / wall depth or max. excavation depth (x), Depth / wall depth or max. excavation depth (y), Settlement / wall depth or max. excavation depth (z) (%)]
 [0.000,0.000,0.050][0.050,0.000,0.047][0.100,0.000,0.043][0.150,0.000,0.040][0.200,0.000,0.037][0.250,0.000,0.034][0.300,0.000,0.031][0.350,0.000,0.028][0.400,0.000,0.025][0.450,0.000,0.022][0.500,0.000,0.020][0.550,0.000,0.018][0.600,0.000,0.016][0.650,0.000,0.014][0.700,0.000,0.012][0.750,0.000,0.010][0.800,0.000,0.008][0.850,0.000,0.007][0.900,0.000,0.006][0.950,0.000,0.005][1.000,0.000,0.004][1.050,0.000,0.003][1.100,0.000,0.003][1.150,0.000,0.002][1.200,0.000,0.002][1.250,0.000,0.001][1.300,0.000,0.001][1.350,0.000,0.001][1.400,0.000,0.001][1.450,0.000,0.000][1.500,0.000,0.000]
Curve Fitting Method: Polynomial
Method:
 x Order: 4
 y Order: 0
 Polynomial: z = -1.2355E-2x⁴ + 3.4814E-2x³ - 2.8885E-3x² - 6.5618E-2x + 4.9987E-2
 Coeff. of Determination: 1.0000

Horizontal Ground Movement Curves

Curve Name: No horizontal ground movement
Coordinates: [Distance from wall / wall depth or max. excavation depth (x), Depth / wall depth or max. excavation depth (y), Horizontal movement / wall depth or max. excavation depth (z) (%)]
 [0.000,0.000,0.000][1.000,0.000,0.000][0.000,1.000,0.000][1.000,1.000,0.000]
Curve Fitting Method: Polynomial
Method:
 x Order: 0
 y Order: 0
 Polynomial: z = 0.0
 Coeff. of Determination: -2147483648.E+2147483647

Curve Name: Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))
Coordinates: [Distance from wall / wall depth or max. excavation depth (x), Depth / wall depth or max. excavation depth (y), Horizontal movement / wall depth or max. excavation depth (z) (%)]
 [0.000,0.000,0.041][0.050,0.000,0.039][0.100,0.000,0.036][0.150,0.000,0.034][0.200,0.000,0.032][0.250,0.000,0.030][0.300,0.000,0.029][0.350,0.000,0.027][0.400,0.000,0.025][0.450,0.000,0.023][0.500,0.000,0.022][0.550,0.000,0.020][0.600,0.000,0.019][0.650,0.000,0.018][0.700,0.000,0.016][0.750,0.000,0.015][0.800,0.000,0.014][0.850,0.000,0.013][0.900,0.000,0.012][0.950,0.000,0.010][1.000,0.000,0.009][1.050,0.000,0.008][1.100,0.000,0.007][1.150,0.000,0.006][1.200,0.000,0.005][1.250,0.000,0.004][1.300,0.000,0.004][1.350,0.000,0.003][1.400,0.000,0.002][1.450,0.000,0.001][1.500,0.000,0.000]
Curve Fitting Method: Polynomial
Method:
 x Order: 3
 y Order: 0
 Polynomial: z = -4.2486E-3x³ + 1.9096E-2x² - 4.6221E-2x + 4.0729E-2
 Coeff. of Determination: 1.0000

Curve Name: Installation of planar diaphragm wall in stiff clay (CIRIA 580 Fig. 2.9(a))
Coordinates: [Distance from wall / wall depth or max. excavation depth (x), Depth / wall depth or max. excavation depth (y), Horizontal movement / wall depth or max. excavation depth (z) (%)]
 [0.000,0.000,0.050][1.500,0.000,0.000]
Curve Fitting Method: Polynomial
Method:
 x Order: 1
 y Order: 0
 Polynomial: z = -3.33E-2x + 5.00E-2
 Coeff. of Determination: 1.00

Polygonal Excavations

Excavation Name: Piling
Surface level [m]: 20.000
Contribution: Positive
Enabled: Yes
Surface movement curves which are selected are applied between surface and [m]: 10.000
Corner x y Base Stiffened Previous Side Next Side



GEA LIMITED
(GEOTECHNICAL & ENV ASSOC) J13022A

Job No.	Sheet No.	Rev.
Dr. Ref.		
Made by	Date	Checked
MC	11-Mar-2016	

7 Branch Hill, London, NW3 7LT
Ground Movement Assessment
Piling and Underpinning Phase

	Level			d	p1	p2*	d	p1	p2*
	[m]	[m]	[m]	[m]	[%]	[%]	[m]	[%]	[%]
1	1.2000	5.6000	10.000	No	-	-	-	-	-
2	1.8000	15.500	14.470	No	-	-	-	-	-
3	22.600	15.500	14.470	No	-	-	-	-	-
4	22.600	3.6500	10.000	No	-	-	-	-	-
5	19.000	-0.30000	10.000	No	-	-	-	-	-
6	4.2000	-0.30000	10.000	No	-	-	-	-	-

Side	Corner 1		Corner 2		Vertical		Horizontal	
	x	y	x	y	[m]	[%]	[m]	[%]
1	1.2000	5.6000	1.8000	15.500	No vertical ground movement	-	No horizontal ground movement	-
2	1.8000	15.500	22.600	15.500	No vertical ground movement	-	No horizontal ground movement	-
3	22.600	15.500	22.600	3.6500	No vertical ground movement	-	No horizontal ground movement	-
4	22.600	3.6500	19.000	-0.30000	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	-	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))	-
5	19.000	-0.30000	4.2000	-0.30000	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	-	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))	-
6	4.2000	-0.30000	1.2000	5.6000	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	-	Installation of contiguous bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))	-

Excavation Name: Underpinning
Surface level [m]: 19.450
Contribution: Positive
Enabled: Yes
 Surface movement curves which are selected are applied between surface and [m]: 14.470

Corner	x	y	Base Level	Stiffened	Previous Side	Next Side	
						d	p1 p2*
	[m]	[m]	[m]			[m]	[%]
1	1.2000	5.6000	14.470	No	-	-	-
2	1.8000	15.500	14.470	No	-	-	-
3	22.600	15.500	14.470	No	-	-	-
4	22.600	3.6500	14.470	No	-	-	-
5	19.000	-0.30000	10.000	No	-	-	-
6	4.2000	-0.30000	10.000	No	-	-	-

Side	Corner 1		Corner 2		Vertical		Horizontal	
	x	y	x	y	[m]	[%]	[m]	[%]
1	1.2000	5.6000	1.8000	15.500	Installation of planar diaphragm wall in stiff clay (CIRIA 580 Fig. 2.9(b))	-	Installation of planar diaphragm wall in stiff clay (CIRIA 580 Fig. 2.9(a))	-
2	1.8000	15.500	22.600	15.500	Installation of planar diaphragm wall in stiff clay (CIRIA 580 Fig. 2.9(b))	-	Installation of planar diaphragm wall in stiff clay (CIRIA 580 Fig. 2.9(a))	-
3	22.600	15.500	22.600	3.6500	Installation of planar diaphragm wall in stiff clay (CIRIA 580 Fig. 2.9(b))	-	Installation of planar diaphragm wall in stiff clay (CIRIA 580 Fig. 2.9(a))	-
4	22.600	3.6500	19.000	-0.30000	No vertical ground movement	-	No horizontal ground movement	-
5	19.000	-0.30000	4.2000	-0.30000	No vertical ground movement	-	No horizontal ground movement	-
6	4.2000	-0.30000	1.2000	5.6000	No vertical ground movement	-	No horizontal ground movement	-

Damage Category Strains

Name	0 (Negligible)		1 (Very Slight)		2 (Slight)		3 (Moderate)	
	to	to	to	to	to	to	to	
	1 (Very Slight)	2 (Slight)	3 (Moderate)	4 (Severe)				
Burland Strain Limits	0.0	500.00E-6	750.00E-6	0.0015000				

Specific Structures - Geometry

Structure Name	Sub-Structure Name	Displacement Line	Start Distance Along Line	End Distance Along Line	Vertical Offsets from Line for Vertical Movement Calculations	Vertical Displacement Limit Sensitivity	Damage Category Strains	Poisson's Ratio	E/G
			[m]	[m]	[m]	[mm]			
5 Upper Terrace North Wall	Line 1		0.00000	10.30000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
5 Upper Terrace East Wall	Line 2		0.00000	13.00000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
5 Upper Terrace South Wall	Line 3		0.00000	9.65000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
5 Upper Terrace West Wall	Line 4		0.00000	12.80000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
6 Branch Hill North 1	Line 5		0.00000	5.20000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
6 Branch Hill East 1	Line 6		0.00000	2.20000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
6 Branch Hill North 2	Line 7		0.00000	3.80000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
6 Branch Hill East 2	Line 8		0.00000	6.20000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
6 Branch Hill South	Line 9		0.00000	9.50000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
6 Branch Hill West	Line 10		0.00000	8.70000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000

Specific Structures - Bending Parameters

Structure Name	Sub-Structure Name	Height	Default Properties	Hogging		Sagging	
				2nd Moment of Area (per unit width)	Distance of Bending Strain from N.A.	Distance of N.A. from Edge of Beam in Tension	2nd Moment of Area (per unit width)
				[m ³]	[m]	[m]	[m ³]
5 Upper Terrace North Wall		12.000	Yes	576.00	12.000	12.000	144.00
5 Upper Terrace East Wall		12.000	Yes	576.00	12.000	12.000	144.00
5 Upper Terrace South Wall		12.000	Yes	576.00	12.000	12.000	144.00
5 Upper Terrace West Wall		12.000	Yes	576.00	12.000	12.000	144.00
6 Branch Hill North 1		13.000	Yes	732.33	13.000	13.000	183.08
6 Branch Hill East 1		13.000	Yes	732.33	13.000	13.000	183.08
6 Branch Hill North 2		13.000	Yes	732.33	13.000	13.000	183.08
6 Branch Hill East 2		13.000	Yes	732.33	13.000	13.000	183.08
6 Branch Hill South		13.000	Yes	732.33	13.000	13.000	183.08
6 Branch Hill West		13.000	Yes	732.33	13.000	13.000	183.08

Building Segment Combinations

Structure Name	Sub-Structure Name	Vertical Offset from Line for Vertical Movement Calculations	Segment Start	Length	Curvature	Combined Segment
			[m]	[m]	[m]	[m]
No structures have segments combined.						

Warnings

1 Multiple excavations have been specified. The displacements resulting from these excavations are calculated by summing the displacements resulting from each individual excavation. No account has been taken of the interactions between excavations (e.g. overlapping zones of influence or 'shielding' of one excavation by another).

Displacement and Strain Results

Type/No.	Coordinates	Displacements	Angle of
----------	-------------	---------------	----------



GEA LIMITED
(GEOTECHNICAL & ENV ASSOC) J13022A

Table with 3 columns: Job No., Sheet No., Rev.
Row 1: Job No. (blank), Sheet No. (blank), Rev. (blank)
Row 2: Drg. Ref. (blank)
Row 3: Made by MC, Date 11-Mar-2016, Checked (blank)

7 Branch Hill, London, NW3 7LT
Ground Movement Assessment
Piling and Underpinning Phase

Main data table with columns: Type/No., Name, Dist., Coordinates (x, y, z), Displacements (x, y, z), Horizontal displacement, Horizontal displacement, Angle of Line to x Axis.



GEA LIMITED
(GEOTECHNICAL & ENV ASSOC) J13022A

Job No. Sheet No. Rev.

7 Branch Hill, London, NW3 7LT
Ground Movement Assessment
Piling and Underpinning Phase

Dr. Ref.

Made by MC

Date 11-Mar-2016

Checked

Table with columns: Type/No., Name, Dist., Coordinates (x, y, z), Displacements (x, y, z), Horizontal displacement, Horizontal displacement, Angle of Line to x Axis. Contains 25 rows of data points with numerical values and descriptive text like 'Point lies within an excavation.'



GEA LIMITED

(GEOTECHNICAL & ENV ASSOC) J13022A

7 Branch Hill, London, NW3 7LT
Ground Movement Assessment
Piling and Underpinning Phase

Job No. Sheet No. Rev.

Drg. Ref.

Made by
MC

Date
11-Mar-2016

Checked

Table with columns: Type/No., Name, Dist., Coordinates (x, y, z), Displacements (x, y, z), Horizontal displacement, Horizontal displacement, Angle of Line to x Axis. Contains 50 rows of data points and notes.



GEA LIMITED

(GEOTECHNICAL & ENV ASSOC) J13022A

Job No.

Sheet No.

Rev.

7 Branch Hill, London, NW3 7LT
Ground Movement Assessment
Piling and Underpinning Phase

Dr. Ref.

Made by
MC

Date
11-Mar-2016

Checked

Table with columns: Type/No., Coordinates (x, y, z), Displacements (x, y, z), Horizontal displacement, Horizontal displacement, Angle of Line to x Axis. Contains 288 rows of data points and their corresponding displacements.



GEA LIMITED
(GEOTECHNICAL & ENV ASSOC) J13022A

7 Branch Hill, London, NW3 7LT
 Ground Movement Assessment
 Piling and Underpinning Phase

Job No. Sheet No. Rev.

Dr. Ref.

Made by Date Checked
 MC 11-Mar-2016

Type/No.		Coordinates			Displacements			Angle of Line to x Axis	
Name	Dist.	x	y	z	x	y	z	Horizontal displacement	Horizontal displacement
		20.00000	28.00000	19.45000	0.0	0.0	0.0	-	-
		21.00000	28.00000	19.45000	0.0	0.0	0.0	-	-
		22.00000	28.00000	19.45000	0.0	0.0	0.0	-	-
		23.00000	28.00000	19.45000	0.0	0.0	0.0	-	-
		24.00000	28.00000	19.45000	0.0	0.0	0.0	-	-
		25.00000	28.00000	19.45000	0.0	0.0	0.0	-	-
		26.00000	28.00000	19.45000	0.0	0.0	0.0	-	-
		27.00000	28.00000	19.45000	0.0	0.0	0.0	-	-
		28.00000	28.00000	19.45000	0.0	0.0	0.0	-	-
		29.00000	28.00000	19.45000	0.0	0.0	0.0	-	-
		30.00000	28.00000	19.45000	0.0	0.0	0.0	-	-
		31.00000	28.00000	19.45000	0.0	0.0	0.0	-	-
		32.00000	28.00000	19.45000	0.0	0.0	0.0	-	-
		33.00000	28.00000	19.45000	0.0	0.0	0.0	-	-
		34.00000	28.00000	19.45000	0.0	0.0	0.0	-	-
		35.00000	28.00000	19.45000	0.0	0.0	0.0	-	-
		36.00000	28.00000	19.45000	0.0	0.0	0.0	-	-
		37.00000	28.00000	19.45000	0.0	0.0	0.0	-	-
		38.00000	28.00000	19.45000	0.0	0.0	0.0	-	-
		39.00000	28.00000	19.45000	0.0	0.0	0.0	-	-
		40.00000	28.00000	19.45000	0.0	0.0	0.0	-	-
		-10.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		-9.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		-8.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		-7.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		-6.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		-5.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		-4.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		-3.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		-2.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		-1.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		0.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		1.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		2.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		3.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		4.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		5.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		6.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		7.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		8.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		9.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		10.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		11.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		12.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		13.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		14.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		15.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		16.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		17.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		18.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		19.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		20.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		21.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		22.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		23.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		24.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		25.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		26.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		27.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		28.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		29.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		30.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		31.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		32.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		33.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		34.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		35.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		36.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		37.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		38.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		39.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
		40.00000	29.00000	19.45000	0.0	0.0	0.0	-	-
Line 1	Line 1	22.70000	15.95000	19.45000	-1.9379	-0.79280	1.7229	-1.2193	1.7022
	1.0381	23.94000	16.96000	19.45000	-1.2370	-1.3478	1.2600	-1.5973	0.89192
	2.0762	24.18000	17.97000	19.45000	-0.81510	-1.2742	0.79541	-1.4282	0.49843
	3.1144	24.42000	18.98000	19.45000	-0.54729	-1.0465	0.43523	-1.1446	0.29053
	4.1525	24.66000	19.99000	19.45000	-0.35167	-0.76651	0.20281	-0.82704	0.16494
	5.1906	24.90000	21.00000	19.45000	-0.19399	-0.46389	0.082020	-0.48190	0.08190
	6.2287	25.14000	22.01000	19.45000	-0.058403	-0.14969	0.025495	-0.15913	0.022215
	7.2669	25.38000	23.02000	19.45000	0.0	0.0	0.0	0.0	0.0
	8.3050	25.62000	24.03000	19.45000	0.0	0.0	0.0	0.0	0.0
	9.3431	25.86000	25.04000	19.45000	0.0	0.0	0.0	0.0	0.0
	10.381	26.10000	26.05000	19.45000	0.0	0.0	0.0	0.0	0.0
Line 2	Line 2	26.10000	26.10000	19.45000	0.0	0.0	0.0	0.0	0.0
	1.3065	27.35000	25.72000	19.45000	0.0	0.0	0.0	0.0	0.0
	2.6130	28.60000	25.34000	19.45000	0.0	0.0	0.0	0.0	0.0
	3.9195	29.85000	24.96000	19.45000	0.0	0.0	0.0	0.0	0.0
	5.2259	31.10000	24.58000	19.45000	0.0	0.0	0.0	0.0	0.0
	6.5324	32.35000	24.20000	19.45000	0.0	0.0	0.0	0.0	0.0
	7.8389	33.60000	23.82000	19.45000	0.0	0.0	0.0	0.0	0.0



GEA LIMITED
(GEOTECHNICAL & ENV ASSOC) J13022A

Job No. **Sheet No.** **Rev.**

7 Branch Hill, London, NW3 7LT
Ground Movement Assessment
Piling and Underpinning Phase

Dr. Ref.

Made by **Date** **Checked**
MC **11-Mar-2016**

Dist.	Coordinates			Displacements		Horizontal displacement along the line	Horizontal displacement perpendicular to Line
	x	y	z	x	y		
6.7911	36.92000	15.67000	19.45000	0.0	0.0	0.0	0.0
7.7612	36.68000	14.73000	19.45000	0.0	0.0	0.0	0.0
8.7314	36.44000	13.79000	19.45000	0.0	0.0	0.0	0.0
9.7015	36.20000	12.85000	19.45000	0.0	0.0	0.0	0.0

Structure: 5 Upper Terrace | Sub-structure: West Wall

Dist.	Coordinates			Displacements		Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
	x	y	z	x	y		
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	36.20000	12.80000	19.45000	0.0	0.0	0.0	0.0
1.2879	34.95000	13.11000	19.45000	0.0	0.0	0.0	0.0
2.5757	33.70000	13.35000	19.45000	0.0	0.0	0.0	0.0
3.8636	32.45000	13.73000	19.45000	0.0	0.0	0.0	0.0
5.1515	31.20000	14.04000	19.45000	0.0	0.0	0.0	0.0
6.4393	29.95000	14.35000	19.45000	-0.040000	0.0	0.038824	0.0096283
7.7272	28.70000	14.66000	19.45000	-0.45667	0.0	0.44324	0.10992
9.0151	27.45000	14.97000	19.45000	-0.87333	0.0	0.94766	0.21022
10.303	26.20000	15.28000	19.45000	-1.2900	0.0	1.2521	0.31051
11.591	24.95000	15.59000	19.45000	-1.7048	-0.065292	1.6390	0.47374
12.879	23.70000	15.90000	19.45000	-1.9734	-0.17161	1.7427	1.1715

Structure: 6 Branch Hill | Sub-structure: North 1

Dist.	Coordinates			Displacements		Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
	x	y	z	x	y		
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	26.60000	-6.65000	19.00000	-0.70768	0.64497	0.43463	0.85317
1.0577	26.88000	-5.63000	19.00000	-0.78302	0.71364	0.48090	0.94400
2.1155	27.16000	-4.61000	19.00000	-0.86078	0.78451	0.52866	1.0377
3.1732	27.44000	-3.59000	19.00000	-0.94117	0.85777	0.57803	1.1347
4.2309	27.72000	-2.57000	19.00000	-1.0244	0.93362	0.62914	1.2350
5.2887	28.00000	-1.55000	19.00000	-1.1107	1.0122	0.68213	1.3390

Structure: 6 Branch Hill | Sub-structure: East 1

Dist.	Coordinates			Displacements		Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
	x	y	z	x	y		
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	28.00000	-1.50000	19.00000	-1.1168	1.0179	-1.3146	0.74505
0.45122	28.44000	-1.60000	19.00000	-1.0426	0.93728	-1.2244	0.68291
0.90244	28.88000	-1.70000	19.00000	-0.95990	0.81775	-1.1173	0.58468
1.3537	29.32000	-1.80000	19.00000	-0.87942	0.71322	-1.0156	0.50059
1.8049	29.76000	-1.90000	19.00000	-0.80172	0.62145	-0.91951	0.42831
2.2561	30.20000	-2.00000	19.00000	-0.72709	0.54054	-0.82881	0.36596

Structure: 6 Branch Hill | Sub-structure: North 2

Dist.	Coordinates			Displacements		Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
	x	y	z	x	y		
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	30.20000	-1.95000	19.00000	-0.72896	0.53713	0.28604	0.85911
0.77795	30.44000	-1.21000	19.00000	-0.70243	0.43544	0.19749	0.80250
1.5559	30.68000	-0.47000	19.00000	-0.64489	0.32883	0.11384	0.71488
2.3338	30.92000	0.27000	19.00000	-0.55840	0.22685	0.043516	0.60115
3.1118	31.16000	1.01000	19.00000	-0.44844	0.13830	-0.0067880	0.46924
3.8897	31.40000	1.75000	19.00000	-0.32326	0.069794	-0.033337	0.32902

Structure: 6 Branch Hill | Sub-structure: East 2

Dist.	Coordinates			Displacements		Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
	x	y	z	x	y		
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	31.40000	1.80000	19.00000	-0.31599	0.066431	-0.32272	-0.010947
0.62817	32.01000	1.65000	19.00000	-0.28142	0.059813	-0.28756	-0.0091171
1.2563	32.62000	1.50000	19.00000	-0.24728	0.053060	-0.25280	-0.0075235
1.8845	33.23000	1.35000	19.00000	-0.21363	0.046222	-0.21848	-0.0061265
2.5127	33.84000	1.20000	19.00000	-0.18044	0.039331	-0.18461	-0.0048939
3.1409	34.45000	1.05000	19.00000	-0.14768	0.032401	-0.15114	-0.0037991
3.7690	35.06000	0.90000	19.00000	-0.11525	0.025437	-0.11799	-0.0028198
4.3972	35.67000	0.75000	19.00000	-0.083071	0.018432	-0.085069	-0.0019376
5.0254	36.28000	0.60000	19.00000	-0.051011	0.011373	-0.052251	-0.001368
5.6535	36.89000	0.45000	19.00000	-0.018938	0.0042409	-0.019403	-0.00101E-6
6.2817	37.50000	0.30000	19.00000	0.0	0.0	0.0	0.0

Structure: 6 Branch Hill | Sub-structure: South

Dist.	Coordinates			Displacements		Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
	x	y	z	x	y		
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	37.50000	0.25000	19.00000	0.0	0.0	0.0	0.0
0.95336	37.25000	-0.67000	19.00000	0.0	0.0	0.0	0.0
1.9067	37.00000	-1.59000	19.00000	0.0	0.0	0.0	0.0
2.8601	36.75000	-2.51000	19.00000	0.0	0.0	0.0	0.0
3.8134	36.50000	-3.43000	19.00000	0.0	0.0	0.0	0.0
4.7668	36.25000	-4.35000	19.00000	0.0	0.0	0.0	0.0
5.7202	36.00000	-5.27000	19.00000	0.0	0.0	0.0	0.0
6.6735	35.75000	-6.19000	19.00000	0.0	0.0	0.0	0.0
7.6269	35.50000	-7.11000	19.00000	0.0	0.0	0.0	0.0
8.5803	35.25000	-8.03000	19.00000	0.0	0.0	0.0	0.0
9.5336	35.00000	-8.95000	19.00000	0.0	0.0	0.0	0.0

Structure: 6 Branch Hill | Sub-structure: West

Dist.	Coordinates			Displacements		Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
	x	y	z	x	y		
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	35.00000	-9.00000	19.00000	0.0	0.0	0.0	0.0
0.87092	34.16000	-8.77000	19.00000	0.0	0.0	0.0	0.0
1.7418	33.32000	-8.54000	19.00000	0.0	0.0	0.0	0.0
2.6128	32.48000	-8.31000	19.00000	0.0	0.0	0.0	0.0
3.4837	31.64000	-8.08000	19.00000	-0.056088	0.051118	0.067596	-0.034491
4.3546	30.80000	-7.85000	19.00000	-0.15756	0.14360	0.18989	-0.096889
5.2255	29.96000	-7.62000	19.00000	-0.26036	0.23729	0.31378	-0.16011
6.0964	29.12000	-7.39000	19.00000	-0.36537	0.33300	0.44034	-0.22468
6.9674	28.28000	-7.16000	19.00000	-0.47348	0.43152	0.57063	-0.29116
7.8383	27.44000	-6.93000	19.00000	-0.58555	0.53367	0.70570	-0.36008
8.7092	26.60000	-6.70000	19.00000	-0.70248	0.64023	0.84662	-0.43199

7 Branch Hill, London, NW3 7LT
Ground Movement Assessment
Piling and Underpinning Phase

Drg. Ref.

Made by
MC

Date
11-Mar-2016

Checked

Dist.	Coordinates			Displacements	
	x	y	z	x	y
				Horizontal displacement along the	Horizontal displacement perpendicular

Specific Building Damage Results - Vertical Displacements

Structure: 5 Upper Terrace | Sub-structure: North Wall

Dist.	Coordinates			Displacements
[m]	x [m]	y [m]	z [m]	z [mm]

Vertical Offset 1

0.0	23.70000	15.95000	19.45000	1.7229
1.0381	23.94000	16.96000	19.45000	1.1200
2.0762	24.18000	17.97000	19.45000	0.78541
3.1144	24.42000	18.98000	19.45000	0.43523
4.1525	24.66000	19.99000	19.45000	0.20281
5.1906	24.90000	21.00000	19.45000	0.082020
6.2287	25.14000	22.01000	19.45000	0.025495
7.2669	25.38000	23.02000	19.45000	0.0
8.3050	25.62000	24.03000	19.45000	0.0
9.3431	25.86000	25.04000	19.45000	0.0
10.381	26.10000	26.05000	19.45000	0.0

Structure: 5 Upper Terrace | Sub-structure: East Wall

Dist.	Coordinates			Displacements
[m]	x [m]	y [m]	z [m]	z [mm]

Vertical Offset 1

0.0	26.10000	26.10000	19.45000	0.0
1.3065	27.35000	25.72000	19.45000	0.0
2.6130	28.60000	25.34000	19.45000	0.0
3.9195	29.85000	24.96000	19.45000	0.0
5.2259	31.10000	24.58000	19.45000	0.0
6.5324	32.35000	24.20000	19.45000	0.0
7.8389	33.60000	23.82000	19.45000	0.0
9.1454	34.85000	23.44000	19.45000	0.0
10.452	36.10000	23.06000	19.45000	0.0
11.758	37.35000	22.68000	19.45000	0.0
13.065	38.60000	22.30000	19.45000	0.0

Structure: 5 Upper Terrace | Sub-structure: South Wall

Dist.	Coordinates			Displacements
[m]	x [m]	y [m]	z [m]	z [mm]

Vertical Offset 1

0.0	38.60000	22.25000	19.45000	0.0
0.97015	38.36000	21.31000	19.45000	0.0
1.9403	38.12000	20.37000	19.45000	0.0
2.9105	37.88000	19.43000	19.45000	0.0
3.8806	37.64000	18.49000	19.45000	0.0
4.8508	37.40000	17.55000	19.45000	0.0
5.8209	37.16000	16.61000	19.45000	0.0
6.7911	36.92000	15.67000	19.45000	0.0
7.7612	36.68000	14.73000	19.45000	0.0
8.7314	36.44000	13.79000	19.45000	0.0
9.7015	36.20000	12.85000	19.45000	0.0

Structure: 5 Upper Terrace | Sub-structure: West Wall

Dist.	Coordinates			Displacements
[m]	x [m]	y [m]	z [m]	z [mm]

Vertical Offset 1

0.0	36.20000	12.80000	19.45000	0.0
1.2879	34.95000	13.11000	19.45000	0.0
2.5757	33.70000	13.42000	19.45000	0.0
3.8636	32.45000	13.73000	19.45000	0.0
5.1515	31.20000	14.04000	19.45000	0.0
6.4393	29.95000	14.35000	19.45000	0.0074836
7.7272	28.70000	14.66000	19.45000	0.072023
9.0151	27.45000	14.97000	19.45000	0.21840
10.303	26.20000	15.28000	19.45000	0.53884
11.591	24.95000	15.59000	19.45000	1.0661
12.879	23.70000	15.90000	19.45000	1.7340

Structure: 6 Branch Hill | Sub-structure: North 1

Dist.	Coordinates			Displacements
[m]	x [m]	y [m]	z [m]	z [mm]

Vertical Offset 1

0.0	26.60000	-6.65000	19.00000	2.0211
1.0577	26.88000	-5.63000	19.00000	2.1171
2.1155	27.16000	-4.61000	19.00000	2.2132
3.1732	27.44000	-3.59000	19.00000	2.3092
4.2309	27.72000	-2.57000	19.00000	2.4052
5.2887	28.00000	-1.55000	19.00000	2.5012

Structure: 6 Branch Hill | Sub-structure: East 1

Dist.	Coordinates			Displacements
[m]	x [m]	y [m]	z [m]	z [mm]

Vertical Offset 1

0.0	28.00000	-1.50000	19.00000	2.5080
0.45122	28.44000	-1.60000	19.00000	2.4070
0.90244	28.88000	-1.70000	19.00000	2.2436
1.3537	29.32000	-1.80000	19.00000	2.0925
1.8049	29.76000	-1.90000	19.00000	1.9523
2.2561	30.20000	-2.00000	19.00000	1.8216

Structure: 6 Branch Hill | Sub-structure: North 2

Dist.	Coordinates			Displacements
[m]	x [m]	y [m]	z [m]	z [mm]

Vertical Offset 1

0.0	30.20000	-1.95000	19.00000	1.8146
0.77795	30.44000	-1.21000	19.00000	1.6182
1.5559	30.68000	-0.47000	19.00000	1.3947
2.3338	30.92000	0.27000	19.00000	1.1507
3.1118	31.16000	1.01000	19.00000	0.89391
3.8897	31.40000	1.75000	19.00000	0.63282

Structure: 6 Branch Hill | Sub-structure: East 2

Dist.	Coordinates			Displacements
[m]	x [m]	y [m]	z [m]	z [mm]

Vertical Offset 1

0.0	31.40000	1.80000	19.00000	0.61723
0.62817	32.01000	1.65000	19.00000	0.58824
1.2563	32.62000	1.50000	19.00000	0.55779
1.8845	33.23000	1.35000	19.00000	0.52611



GEA LIMITED
(GEOTECHNICAL & ENV ASSOC) J13022A

7 Branch Hill, London, NW3 7LT
Ground Movement Assessment
Piling and Underpinning Phase

Job No.	Sheet No.	Rev.
Dr. Ref.		
Made by MC	Date 11-Mar-2016	Checked

Dist.	Coordinates			z	z
	x	y	z		
[m]	[m]	[m]	[m]	[mm]	[mm]
2.5127	33.84000	1.20000	19.00000	0.49342	
3.1409	34.45000	1.05000	19.00000	0.45988	
3.7690	35.06000	0.90000	19.00000	0.42560	
4.3972	35.67000	0.75000	19.00000	0.39069	
5.0254	36.28000	0.60000	19.00000	0.35523	
5.6535	36.89000	0.45000	19.00000	0.31930	
6.2817	37.50000	0.30000	19.00000	0.28296	

Structure: 6 Branch Hill | Sub-structure: South

Dist.	Coordinates			z	z
	x	y	z		
[m]	[m]	[m]	[m]	[mm]	[mm]
Vertical Offset 1					
0.0	37.50000	0.25000	19.00000	0.28637	
0.95336	37.25000	-0.67000	19.00000	0.36675	
1.9067	37.00000	-1.59000	19.00000	0.44163	
2.8601	36.75000	-2.51000	19.00000	0.50747	
3.8134	36.50000	-3.43000	19.00000	0.56103	
4.7668	36.25000	-4.35000	19.00000	0.59942	
5.7202	36.00000	-5.27000	19.00000	0.62025	
6.6735	35.75000	-6.19000	19.00000	0.62165	
7.6269	35.50000	-7.11000	19.00000	0.60230	
8.5803	35.25000	-8.03000	19.00000	0.55656	
9.5336	35.00000	-8.95000	19.00000	0.46957	

Structure: 6 Branch Hill | Sub-structure: West

Dist.	Coordinates			z	z
	x	y	z		
[m]	[m]	[m]	[m]	[mm]	[mm]
Vertical Offset 1					
0.0	35.00000	-9.00000	19.00000	0.46283	
0.87092	34.16000	-8.77000	19.00000	0.61799	
1.7418	33.32000	-8.54000	19.00000	0.77314	
2.6128	32.48000	-8.31000	19.00000	0.92829	
3.4837	31.64000	-8.08000	19.00000	1.0834	
4.3546	30.80000	-7.85000	19.00000	1.2386	
5.2255	29.96000	-7.62000	19.00000	1.3938	
6.0964	29.12000	-7.39000	19.00000	1.5489	
6.9674	28.28000	-7.16000	19.00000	1.7041	
7.8383	27.44000	-6.93000	19.00000	1.8592	
8.7092	26.60000	-6.70000	19.00000	2.0144	

Specific Building Damage Results - All Segments

Structure: 5 Upper Terrace | Sub-structure: North Wall

Vertical Offset from Line for Vertical Movement	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement	Maximum Gradient of Vertical Displacement	Min. Radius of Curvature	Damage Category
0.0	1	0.0	0.54917	Sagging	0.0	-0.036405	0.0072810	364.18E-6	446.00E-6	38456.	0 (Negligible)
	2	0.54917	3.6033	Hogging	0.0039474	0.016436	0.017342	364.18E-6	447.48E-6	9165.2	0 (Negligible)

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 5 Upper Terrace | Sub-structure: East Wall

Vertical Offset from Line for Vertical Movement	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement	Maximum Gradient of Vertical Displacement	Min. Radius of Curvature	Damage Category
0.0	All settlements are less than the Settlement Trough Limit Sensitivity.										

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 5 Upper Terrace | Sub-structure: South Wall

Vertical Offset from Line for Vertical Movement	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement	Maximum Gradient of Vertical Displacement	Min. Radius of Curvature	Damage Category
0.0	All settlements are less than the Settlement Trough Limit Sensitivity.										

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 5 Upper Terrace | Sub-structure: West Wall

Vertical Offset from Line for Vertical Movement	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement	Maximum Gradient of Vertical Displacement	Min. Radius of Curvature	Damage Category
0.0	1	9.0151	3.7849	Hogging	0.0047857	0.023479	0.024633	-313.92E-6	-518.57E-6	9067.9	0 (Negligible)

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 6 Branch Hill | Sub-structure: North 1

Vertical Offset from Line for Vertical Movement	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement	Maximum Gradient of Vertical Displacement	Min. Radius of Curvature	Damage Category
0.0	1	0.0	5.2000	Sagging	0.0	0.0046741	0.0046742	-50.088E-6	-90.781E-6	6.3264E+9	0 (Negligible)

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 6 Branch Hill | Sub-structure: East 1

Vertical Offset from Line for Vertical Movement	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement	Maximum Gradient of Vertical Displacement	Min. Radius of Curvature	Damage Category
0.0	1	0.0	1.0733	Sagging	0.0031621	0.021976	0.022377	-237.41E-6	362.02E-6	2512.5	0 (Negligible)
	2	1.0733	1.1267	Hogging	692.34E-6	0.021184	0.021231	-225.21E-6	334.75E-6	18444.	0 (Negligible)

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 6 Branch Hill | Sub-structure: North 2

Vertical Offset from Line for Vertical Movement	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement	Maximum Gradient of Vertical Displacement	Min. Radius of Curvature	Damage Category
0.0	1	0.0	1.0733	Sagging	0.0031621	0.021976	0.022377	-237.41E-6	362.02E-6	2512.5	0 (Negligible)
	2	1.0733	1.1267	Hogging	692.34E-6	0.021184	0.021231	-225.21E-6	334.75E-6	18444.	0 (Negligible)

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.



Job No.	Sheet No.	Rev.
Dr. Ref.		
Made by	Date	Checked
MC	11-Mar-2016	

7 Branch Hill, London, NW3 7LT
Ground Movement Assessment
Piling and Underpinning Phase

Calculations

[m]	[m]	[m]	[%]	[%]	[%]	Curve	Curve	[m]		
0.0	1	0.0	3.8000	Sagging	0.0013542	-0.0083241	0.0018376	113.84E-6	335.62E-6	21137.0

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 6 Branch Hill | Sub-structure: East 2

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature	Damage Category
[m]		[m]	[m]	[%]	[%]	[%]	[%]	[%]	[%]	[m]	
0.0	1	0.0	6.2000	Sagging	157.11E-6	0.0051644	0.0052733	-55.958E-6	57.857E-6	257260.0	0 (Negligible)

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 6 Branch Hill | Sub-structure: South

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature	Damage Category
[m]		[m]	[m]	[%]	[%]	[%]	[%]	[%]	[%]	[m]	
0.0	1	0.0	9.5000	Sagging	0.0023325	0.0	0.0023065	0.0	91.244E-6	19836.0	0 (Negligible)

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 6 Branch Hill | Sub-structure: West

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature	Damage Category
[m]		[m]	[m]	[%]	[%]	[%]	[%]	[%]	[%]	[m]	
0.0	1	0.0	8.7000	Sagging	0.0	0.0097141	0.0097146	-161.78E-6	-178.15E-6	89.881E+6	0 (Negligible)

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Specific Building Damage Results - Critical Values for All Segments within Each Sub-Structure

Structure: 5 Upper Terrace | Sub-structure: North Wall

Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]	[mm]	[mm]	[%]	[%]	[%]	[m]	[m]	
0.0	0.0039474	-0.036405	447.48E-6	1.7229	0.017342	364.18E-6	447.48E-6	9165.2	38456.0	0 (Negligible)

Structure: 5 Upper Terrace | Sub-structure: East Wall

Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]	[mm]	[mm]	[%]	[%]	[%]	[m]	[m]	

Structure: 5 Upper Terrace | Sub-structure: South Wall

Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]	[mm]	[mm]	[%]	[%]	[%]	[m]	[m]	

Structure: 5 Upper Terrace | Sub-structure: West Wall

Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]	[mm]	[mm]	[%]	[%]	[%]	[m]	[m]	
0.0	0.0047857	0.023479	-518.57E-6	1.6932	0.024633	-313.92E-6	-518.57E-6	9067.9		0 (Negligible)

Structure: 6 Branch Hill | Sub-structure: North 1

Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]	[mm]	[mm]	[%]	[%]	[%]	[m]	[m]	
0.0	0.0	0.0046741	-90.781E-6	2.4932	0.0046742	-50.088E-6	-90.781E-6		-6.3264E+9	0 (Negligible)

Structure: 6 Branch Hill | Sub-structure: East 1

Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]	[mm]	[mm]	[%]	[%]	[%]	[m]	[m]	
0.0	0.0031621	0.021976	362.02E-6	2.5080	0.022377	-237.41E-6	362.02E-6	18444.0	2512.5	0 (Negligible)

Structure: 6 Branch Hill | Sub-structure: North 2

Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]	[mm]	[mm]	[%]	[%]	[%]	[m]	[m]	
0.0	0.0013542	-0.0083241	335.62E-6	1.8146	0.0018376	113.84E-6	335.62E-6		21137.0	0 (Negligible)

Structure: 6 Branch Hill | Sub-structure: East 2

Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]	[mm]	[mm]	[%]	[%]	[%]	[m]	[m]	



7 Branch Hill, London, NW3 7LT
Ground Movement Assessment
Piling and Underpinning Phase

Dr. Ref.

Made by
MC

Date
11-Mar-2016

Checked

Line for Vertical Movement Calculations	Strain		Strain	Horizontal Displacement Curve	Vertical Displacement Curve	Curvature (Hogging)	Curvature (Sagging)	
[m]	[%]	[%]	[mm]	[%]	[mm]	[m]	[m]	
0.0	157.11E-6	0.0051644	57.857E-6	0.61723	0.0052733	-55.958E-6	57.857E-6	- 257260.0 (Negligible)

Structure: 6 Branch Hill | Sub-structure: South

Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0.0	0.0023325	0.0	91.244E-6	0.62158	0.0023065	0.0	91.244E-6	-	19836.0	0 (Negligible)

Structure: 6 Branch Hill | Sub-structure: West

Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0.0	0.0	0.0097141	-178.15E-6	2.0127	0.0097146	-161.78E-6	-178.15E-6	-	89.881E+6	0 (Negligible)

Specific Building Damage Results - Critical Segments within Each Structure

Structure Name	Parameter	Critical Sub-Structure	Critical Segment	Start	End	Curvature	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
				[m]	[m]				[%]	[m]	[m]	
5 Upper Terrace	Maximum Slope	West Wall	North Wall	1	9.0151	12.800 Hogging	518.57E-6	1.6932	0.024633	9067.9	-	0 (Negligible)
	Maximum Settlement			1	0.0	0.54917 Sagging	446.00E-6	1.7229	0.0072810	-	38456.0	0 (Negligible)
	Max. Tensile Strain	West Wall		1	9.0151	12.800 Hogging	518.57E-6	1.6932	0.024633	9067.9	-	0 (Negligible)
	Min. Radius of Curvature (Hogging)			1	9.0151	12.800 Hogging	518.57E-6	1.6932	0.024633	9067.9	-	0 (Negligible)
	Min. Radius of Curvature (Sagging)			1	0.0	0.54917 Sagging	446.00E-6	1.7229	0.0072810	-	38456.0	0 (Negligible)
6 Branch Hill	Maximum Slope	East 1	East 1	1	0.0	1.0733 Sagging	362.02E-6	2.5080	0.022377	-	2512.5	0 (Negligible)
	Maximum Settlement			1	0.0	1.0733 Sagging	362.02E-6	2.5080	0.022377	-	2512.5	0 (Negligible)
	Max. Tensile Strain	East 1		1	0.0	1.0733 Sagging	362.02E-6	2.5080	0.022377	-	2512.5	0 (Negligible)
	Min. Radius of Curvature (Hogging)			2	1.0733	2.2000 Hogging	334.75E-6	2.1864	0.021231	18444.	-	0 (Negligible)
	Min. Radius of Curvature (Sagging)			1	0.0	1.0733 Sagging	362.02E-6	2.5080	0.022377	-	2512.5	0 (Negligible)

Specific Building Damage Results - All Combined Segments

Structure: 5 Upper Terrace | Sub-structure: North Wall

Vertical Offset from Line for Vertical Movement Calculations	Combined Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Damage Category
[m]	[m]	[m]	[m]		[%]	[%]	[%]	
No structures have segments combined.								

Structure: 5 Upper Terrace | Sub-structure: East Wall

Vertical Offset from Line for Vertical Movement Calculations	Combined Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Damage Category
[m]	[m]	[m]	[m]		[%]	[%]	[%]	
No structures have segments combined.								

Structure: 5 Upper Terrace | Sub-structure: South Wall

Vertical Offset from Line for Vertical Movement Calculations	Combined Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Damage Category
[m]	[m]	[m]	[m]		[%]	[%]	[%]	
No structures have segments combined.								

Structure: 5 Upper Terrace | Sub-structure: West Wall

Vertical Offset from Line for Vertical Movement Calculations	Combined Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Damage Category
[m]	[m]	[m]	[m]		[%]	[%]	[%]	
No structures have segments combined.								

Structure: 6 Branch Hill | Sub-structure: North 1

Vertical Offset from Line for Vertical Movement Calculations	Combined Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Damage Category
[m]	[m]	[m]	[m]		[%]	[%]	[%]	
No structures have segments combined.								

Structure: 6 Branch Hill | Sub-structure: East 1

Vertical Offset from Line for Vertical Movement Calculations	Combined Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Damage Category
[m]	[m]	[m]	[m]		[%]	[%]	[%]	
No structures have segments combined.								



7 Branch Hill, London, NW3 7LT
 Ground Movement Assessment
 Piling and Underpinning Phase

Drg. Ref.

Made by
MC

Date
11-Mar-2016

Checked

Vertical Offset from Line for Vertical	Combined Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Damage Category
--	------------------	-------	--------	-----------	------------------	---------------------------	---------------------	-----------------

Structure: 6 Branch Hill | Sub-structure: North 2

Vertical Offset from Line for Vertical Movement Calculations	Combined Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]	

No structures have segments combined.

Structure: 6 Branch Hill | Sub-structure: East 2

Vertical Offset from Line for Vertical Movement Calculations	Combined Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]	

No structures have segments combined.

Structure: 6 Branch Hill | Sub-structure: South

Vertical Offset from Line for Vertical Movement Calculations	Combined Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]	

No structures have segments combined.

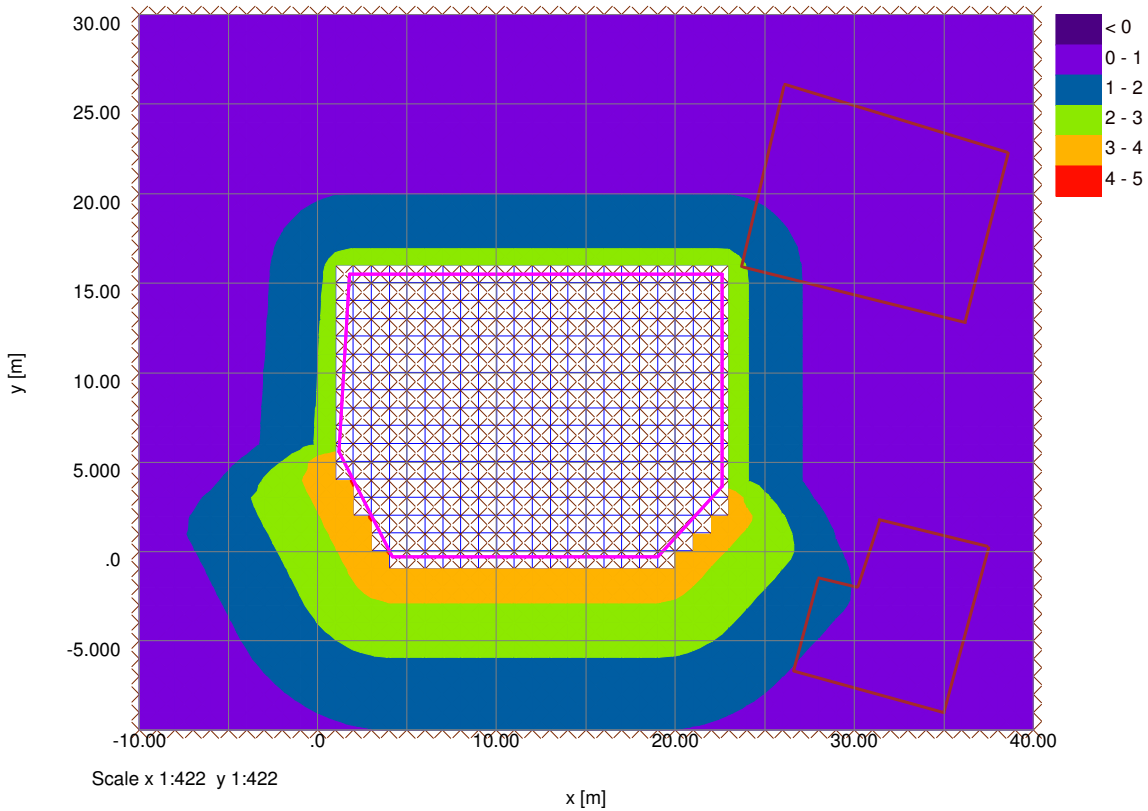
Structure: 6 Branch Hill | Sub-structure: West

Vertical Offset from Line for Vertical Movement Calculations	Combined Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]	

No structures have segments combined.

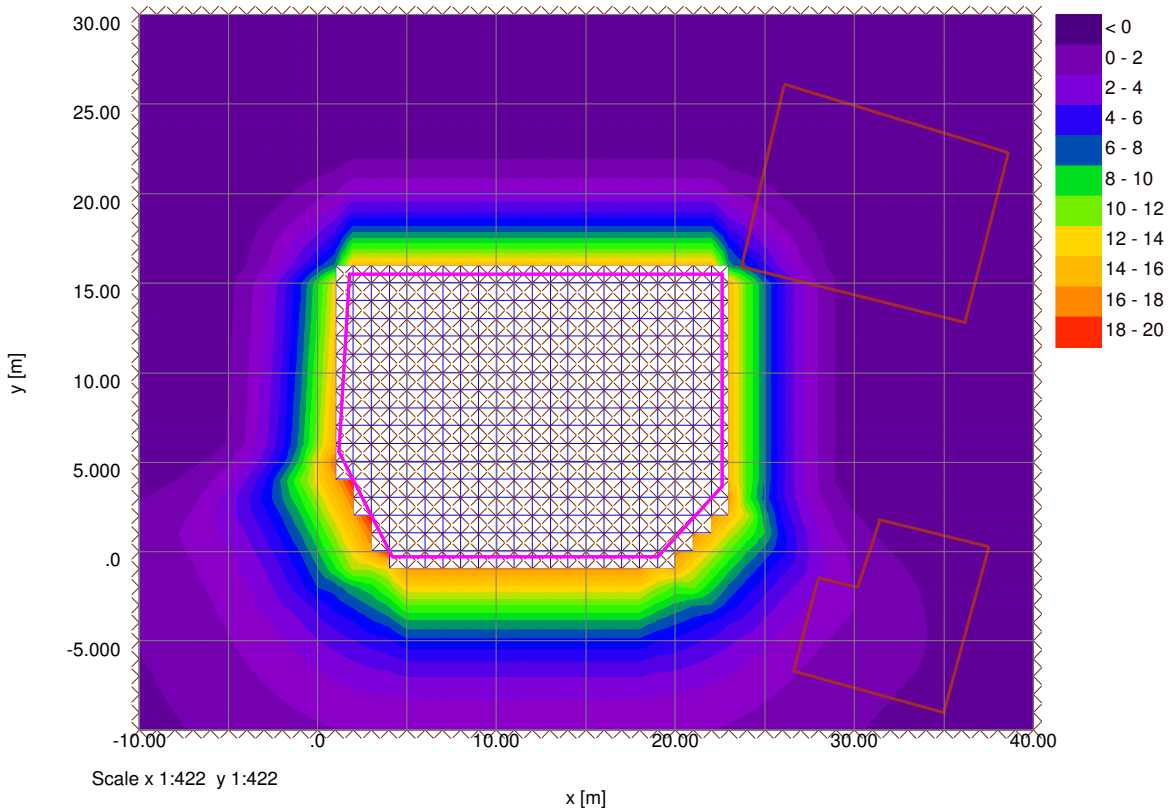
7 Branch Hill, London, NW3 7LT
Ground Movement Assessment
Piling, Underpinning and excavation Phase

Horizontal Displacement Contours: Grid 1 (level 19.450m) Interval 1mm



7 Branch Hill, London, NW3 7LT
Ground Movement Assessment
Piling, Underpinning and excavation Phase

Vertical Settlement Contours: Grid 1 (level 19.450m) (Interval 1mm)





GEA LIMITED
(GEOTECHNICAL & ENV ASSOC) J13022A

Job No. **Sheet No.** **Rev.**

7 Branch Hill, London, NW3 7LT
Ground Movement Assessment
Piling, Underpinning and excavation Phase

Dr. Ref.

Made by **Date** **Checked**
MC **11-Mar-2016**

Problem Type

Problem Type : Tunnelling and Embedded Wall Excavations

Displacement Data

Type	Name	Direction of extrusion	Point/Line/Line for extrusion				No. of intervals across extrusion/line	Extrusion depth	No. of intervals along extrusion	Calculate	Surface type for tunnels	
			First point		Second point							
			X	Y	Z (level)	X	Y	Z (level)				
			[m]	[m]	[m]	[m]	[m]	[m]				
Grid	Grid 1	Global X	-10.00000	-10.00000	19.45000	-	30.00000	19.45000	40	50	Yes	Sub-surface
Line	Line 1	-	23.70000	15.95000	19.45000	26.10000	26.05000	19.45000	10	-	Yes	Surface
Line	Line 2	-	26.10000	26.10000	19.45000	38.60000	22.35000	19.45000	10	-	Yes	Surface
Line	Line 3	-	38.60000	22.25000	19.45000	36.20000	12.85000	19.45000	10	-	Yes	Surface
Line	Line 4	-	36.20000	12.80000	19.45000	23.70000	15.90000	19.45000	10	-	Yes	Surface
Line	Line 5	-	26.60000	-6.65000	19.00000	28.00000	-1.55000	19.00000	5	-	Yes	Surface
Line	Line 6	-	28.00000	-1.50000	19.00000	30.20000	-2.00000	19.00000	5	-	Yes	Surface
Line	Line 7	-	30.20000	-1.95000	19.00000	31.40000	1.75000	19.00000	5	-	Yes	Surface
Line	Line 8	-	31.40000	1.80000	19.00000	37.50000	0.30000	19.00000	10	-	Yes	Surface
Line	Line 9	-	37.50000	0.25000	19.00000	35.00000	-8.95000	19.00000	10	-	Yes	Surface
Line	Line 10	-	35.00000	-9.00000	19.00000	26.60000	-6.70000	19.00000	10	-	Yes	Surface

Vertical Ground Movement Curves

Curve Name: No vertical ground movement
Coordinates: [Distance from wall / wall depth or max. excavation depth (x), Depth / wall depth or max. excavation depth (y), Settlement / wall depth or max. excavation depth (z) (%)]
[0.000,0.000,0.000][1.000,0.000,0.000][0.000,1.000,0.000][1.000,1.000,0.000]
Curve Fitting Method: Polynomial
Method: Polynomial
x Order: 1
y Order: 0
Polynomial: z = 0.0x + 0.0
Coeff. of Determination: -2147483648.E+2147483647

Curve Name: Excavation in front of wall in sand (CIRIA 580 Fig. 2.12)
Coordinates: [Distance from wall / wall depth or max. excavation depth (x), Depth / wall depth or max. excavation depth (y), Settlement / wall depth or max. excavation depth (z) (%)]
[0.000,0.000,0.305][0.100,0.000,0.268][0.200,0.000,0.234][0.300,0.000,0.203]
[0.400,0.000,0.174][0.500,0.000,0.148][0.600,0.000,0.125][0.700,0.000,0.105]
[0.800,0.000,0.086][0.900,0.000,0.070][1.000,0.000,0.056][1.100,0.000,0.044]
[1.200,0.000,0.034][1.300,0.000,0.025][1.400,0.000,0.018][1.500,0.000,0.012]
[1.600,0.000,0.008][1.700,0.000,0.004][1.800,0.000,0.002][1.900,0.000,0.001]
[2.000,0.000,0.000]
Curve Fitting Method: Polynomial
Method: Polynomial
x Order: 3
y Order: 0
Polynomial: z = -2.18E-2x³ + 1.62E-1x² - 3.89E-1x + 3.05E-1
Coeff. of Determination: 1.00

Horizontal Ground Movement Curves

Curve Name: No horizontal ground movement
Coordinates: [Distance from wall / wall depth or max. excavation depth (x), Depth / wall depth or max. excavation depth (y), Horizontal movement / wall depth or max. excavation depth (z) (%)]
[0.000,0.000,0.000][1.000,0.000,0.000][0.000,1.000,0.000][1.000,1.000,0.000]
Curve Fitting Method: Polynomial
Method: Polynomial
x Order: 0
y Order: 0
Polynomial: z = 0.0
Coeff. of Determination: -2147483648.E+2147483647

Polygonal Excavations

Excavation Name: Excavation in front of Piling
Surface level [m]: 20.000
Contribution: Positive
Enabled: Yes
Surface movement curves which are selected are applied between surface and [m]: 14.800

Corner	x	y	Base Level	Stiffened	Previous Side	Next Side				
	[m]	[m]	[m]		d	p1	p2*	d	p1	p2*
	[m]	[m]	[m]		[m]	[%]	[%]	[m]	[%]	[%]
1	1.2000	5.6000	14.800	Yes	0.0	67.000	25.000	0.0	67.000	25.000
2	1.8000	15.500	14.800	No	-	-	-	-	-	-
3	22.600	15.500	14.800	No	-	-	-	-	-	-
4	22.600	3.6500	14.800	Yes	0.0	67.000	25.000	0.0	67.000	25.000
5	19.000	-0.30000	14.800	Yes	0.0	67.000	25.000	0.0	67.000	25.000
6	4.2000	-0.30000	14.800	Yes	0.0	67.000	25.000	0.0	67.000	25.000

Side	Corner 1		Corner 2		Ground Movement Curve	
	x	y	x	y	Vertical	Horizontal
	[m]	[m]	[m]	[m]		
1	1.2000	5.6000	1.8000	15.500	No vertical ground movement	No horizontal ground movement
2	1.8000	15.500	22.600	15.500	No vertical ground movement	No horizontal ground movement
3	22.600	15.500	22.600	3.6500	No vertical ground movement	No horizontal ground movement
4	22.600	3.6500	19.000	-0.30000	Excavation in front of wall in sand (CIRIA 580 Fig. 2.12)	No horizontal ground movement
5	19.000	-0.30000	4.2000	-0.30000	Excavation in front of wall in sand (CIRIA 580 Fig. 2.12)	No horizontal ground movement
6	4.2000	-0.30000	1.2000	5.6000	Excavation in front of wall in sand (CIRIA 580 Fig. 2.12)	No horizontal ground movement

Excavation Name: Excavation in front of Underpinning
Surface level [m]: 19.450
Contribution: Positive
Enabled: Yes
Surface movement curves which are selected are applied between surface and [m]: 14.800

Corner	x	y	Base Level	Stiffened	Previous Side	Next Side				
	[m]	[m]	[m]		d	p1	p2*	d	p1	p2*
	[m]	[m]	[m]		[m]	[%]	[%]	[m]	[%]	[%]
1	1.2000	5.6000	14.800	Yes	0.0	67.000	25.000	0.0	67.000	25.000
2	1.8000	15.500	14.800	Yes	0.0	67.000	25.000	0.0	67.000	25.000
3	22.600	15.500	14.800	Yes	0.0	67.000	25.000	0.0	67.000	25.000
4	22.600	3.6500	14.800	Yes	0.0	67.000	25.000	0.0	67.000	25.000
5	19.000	-0.30000	10.000	No	-	-	-	-	-	-
6	4.2000	-0.30000	10.000	No	-	-	-	-	-	-

Side	Corner 1		Corner 2		Ground Movement Curve	
	x	y	x	y	Vertical	Horizontal
	[m]	[m]	[m]	[m]		
1	1.2000	5.6000	1.8000	15.500	Excavation in front of wall in sand (CIRIA 580 Fig. 2.12)	No horizontal ground movement
2	1.8000	15.500	22.600	15.500	Excavation in front of wall in sand (CIRIA 580 Fig. 2.12)	No horizontal ground movement



GEA LIMITED
(GEOTECHNICAL & ENV ASSOC) J13022A

Job No.	Sheet No.	Rev.
Dr. Ref.		
Made by MC	Date 11-Mar-2016	Checked

7 Branch Hill, London, NW3 7LT
Ground Movement Assessment
Piling, Underpinning and excavation Phase

Side	Corner 1		Corner 2		Ground Movement Curve	
	x [m]	y [m]	x [m]	y [m]	Vertical	Horizontal
3	22.600	15.500	22.600	3.6500	Excavation in front of wall in sand (CIRIA 580 Fig. 2.12)	No horizontal ground movement
4	22.600	3.6500	19.000	-0.30000	No vertical ground movement	No horizontal ground movement
5	19.000	-0.30000	4.2000	-0.30000	No vertical ground movement	No horizontal ground movement
6	4.2000	-0.30000	1.2000	5.6000	No vertical ground movement	No horizontal ground movement

Damage Category Strains

Name	0 (Negligible) to 1 (Very Slight)	1 (Very Slight) to 2 (Slight)	2 (Slight) to 3 (Moderate)	3 (Moderate) to 4 (Severe)
Burland Strain Limits	0.0	500.00E-6	750.00E-6	0.0015000

Specific Structures - Geometry

Structure Name	Sub-Structure Name	Displacement Line	Start Distance Along Line	End Distance Along Line	Vertical Offsets from Line for Vertical Movement Calculations	Vertical Displacement Limit	Damage Category Strains	Poisson's Ratio	E/G
5 Upper Terrace North Wall	Line 1	Line 1	0.00000	10.30000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
5 Upper Terrace East Wall	Line 2	Line 2	0.00000	13.00000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
5 Upper Terrace South Wall	Line 3	Line 3	0.00000	9.65000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
5 Upper Terrace West Wall	Line 4	Line 4	0.00000	12.80000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
6 Branch Hill North 1	Line 5	Line 5	0.00000	5.20000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
6 Branch Hill East 1	Line 6	Line 6	0.00000	2.20000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
6 Branch Hill North 2	Line 7	Line 7	0.00000	3.80000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
6 Branch Hill East 2	Line 8	Line 8	0.00000	6.20000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
6 Branch Hill South	Line 9	Line 9	0.00000	9.50000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
6 Branch Hill West	Line 10	Line 10	0.00000	8.70000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000

Specific Structures - Bending Parameters

Structure Name	Sub-Structure Name	Height [m]	Default Properties	Hogging			Sagging		
				2nd Moment of Area (per unit width)	Distance of Bending from N.A.	Distance of Beam in Tension	2nd Moment of Area (per unit width)	Distance of Bending from N.A.	Distance of Beam in Tension
5 Upper Terrace North Wall	Line 1	12.000	Yes	576.00	12.000	12.000	144.00	6.0000	6.0000
5 Upper Terrace East Wall	Line 2	12.000	Yes	576.00	12.000	12.000	144.00	6.0000	6.0000
5 Upper Terrace South Wall	Line 3	12.000	Yes	576.00	12.000	12.000	144.00	6.0000	6.0000
5 Upper Terrace West Wall	Line 4	12.000	Yes	576.00	12.000	12.000	144.00	6.0000	6.0000
6 Branch Hill North 1	Line 5	13.000	Yes	732.33	13.000	13.000	183.08	6.5000	6.5000
6 Branch Hill East 1	Line 6	13.000	Yes	732.33	13.000	13.000	183.08	6.5000	6.5000
6 Branch Hill North 2	Line 7	13.000	Yes	732.33	13.000	13.000	183.08	6.5000	6.5000
6 Branch Hill East 2	Line 8	13.000	Yes	732.33	13.000	13.000	183.08	6.5000	6.5000
6 Branch Hill South	Line 9	13.000	Yes	732.33	13.000	13.000	183.08	6.5000	6.5000
6 Branch Hill West	Line 10	13.000	Yes	732.33	13.000	13.000	183.08	6.5000	6.5000

Building Segment Combinations

Structure Name	Sub-Structure Name	Vertical Offset from Line for Vertical Movement Calculations	Segment Start	Segment Length	Curvature	Combined Segment
No structures have segments combined.						

Warnings

- Multiple excavations have been specified. The displacements resulting from these excavations are calculated by summing the displacements resulting from each individual excavation. No account has been taken of the interactions between excavations (e.g. overlapping zones of influence or 'shielding' of one excavation by another).

Displacement and Strain Results

Type/No.		Coordinates				Displacements			Angle of Line to x Axis	
Name	Dist.	x	y	z	x	y	z	Horizontal displacement along the line	Horizontal displacement perpendicular to line	to x Axis
	[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]	[mm]	[°]
Grid 1	Grid 1	-10.00000	-10.00000	19.45000	0.0	0.0	0.56064	-	-	*
		-9.00000	-10.00000	19.45000	0.0	0.0	0.72384	-	-	*
		-8.00000	-10.00000	19.45000	0.0	0.0	0.88276	-	-	*
		-7.00000	-10.00000	19.45000	0.026223	0.022711	1.0367	-	-	*
		-6.00000	-10.00000	19.45000	0.11989	0.11402	1.1848	-	-	*
		-5.00000	-10.00000	19.45000	0.20054	0.21144	1.3262	-	-	*
		-4.00000	-10.00000	19.45000	0.26612	0.31480	1.4597	-	-	*
		-3.00000	-10.00000	19.45000	0.31410	0.42316	1.5840	-	-	*
		-2.00000	-10.00000	19.45000	0.34166	0.53453	1.6976	-	-	*
		-1.00000	-10.00000	19.45000	0.34609	0.64560	1.7988	-	-	*
		0.00000	-10.00000	19.45000	0.32543	0.75159	1.8860	-	-	*
		1.00000	-10.00000	19.45000	0.27923	0.84642	1.9656	-	-	*
		2.00000	-10.00000	19.45000	0.20939	0.92322	2.0334	-	-	*
		3.00000	-10.00000	19.45000	0.12066	0.97536	2.0817	-	-	*
		4.00000	-10.00000	19.45000	0.020572	0.99776	2.1038	-	-	*
		5.00000	-10.00000	19.45000	0.0	0.99841	2.1182	-	-	*
		6.00000	-10.00000	19.45000	0.0	0.99841	2.1182	-	-	*
		7.00000	-10.00000	19.45000	0.0	0.99841	2.1182	-	-	*
		8.00000	-10.00000	19.45000	0.0	0.99841	2.1182	-	-	*
		9.00000	-10.00000	19.45000	0.0	0.99841	2.1182	-	-	*
		10.00000	-10.00000	19.45000	0.0	0.99841	2.1182	-	-	*
		11.00000	-10.00000	19.45000	0.0	0.99841	2.1182	-	-	*
		12.00000	-10.00000	19.45000	0.0	0.99841	2.1182	-	-	*
		13.00000	-10.00000	19.45000	0.0	0.99841	2.1182	-	-	*
		14.00000	-10.00000	19.45000	0.0	0.99841	2.1182	-	-	*
		15.00000	-10.00000	19.45000	0.0	0.99841	2.1182	-	-	*
		16.00000	-10.00000	19.45000	0.0	0.99841	2.1182	-	-	*
		17.00000	-10.00000	19.45000	0.0	0.99841	2.1182	-	-	*
		18.00000	-10.00000	19.45000	0.0	0.99841	2.1182	-	-	*
		19.00000	-10.00000	19.45000	0.0	0.99841	2.1080	-	-	*
		20.00000	-10.00000	19.45000	-0.10127	0.98234	2.0913	-	-	*
		21.00000	-10.00000	19.45000	-0.19295	0.93581	2.0469	-	-	*
		22.00000	-10.00000	19.45000	-0.26704	0.86344	1.9813	-	-	*
		23.00000	-10.00000	19.45000	-0.31821	0.77166	1.9015	-	-	*
		24.00000	-10.00000	19.45000	-0.34401	0.66738	1.8174	-	-	*
		25.00000	-10.00000	19.45000	-0.34448	0.55690	1.7189	-	-	*
		26.00000	-10.00000	19.45000	-0.32134	0.44528	1.6076	-	-	*
		27.00000	-10.00000	19.45000	-0.27721	0.33612	1.4853	-	-	*
		28.00000	-10.00000	19.45000	-0.21493	0.23165	1.3536	-	-	*
		29.00000	-10.00000	19.45000	-0.13712	0.13301	1.2137	-	-	*
		30.00000	-10.00000	19.45000	-0.045507	0.041475	1.0672	-	-	*
		31.00000	-10.00000	19.45000	0.0	0.0	0.91939	-	-	*
		32.00000	-10.00000	19.45000	0.0	0.0	0.77157	-	-	*
		33.00000	-10.00000	19.45000	0.0	0.0	0.62375	-	-	*
		34.00000	-10.00000	19.45000	0.0	0.0	0.47593	-	-	*
		35.00000	-10.00000	19.45000	0.0	0.0	0.32811	-	-	*
		36.00000	-10.00000	19.45000	0.0	0.0	0.18029	-	-	*
		37.00000	-10.00000	19.45000	0.0	0.0	0.032475	-	-	*
		38.00000	-10.00000	19.45000	0.0	0.0	0.0	-	-	*



7 Branch Hill, London, NW3 7LT
Ground Movement Assessment
Piling, Underpinning and excavation Phase

Job No.	Sheet No.	Rev.
Drg. Ref.		
Made by MC	Date 11-Mar-2016	Checked

Type/No.	Coordinates	Displacements	Angle of Line to x Axis
Name	Dist.	x y z	x y z Horizontal displacement Horizontal displacement
27.00000	-7.00000	19.45000 -0.62686 0.57131 1.9148	- - *
28.00000	-7.00000	19.45000 -0.51841 0.47248 1.7670	- - *
29.00000	-7.00000	19.45000 -0.41390 0.37723 1.6192	- - *
30.00000	-7.00000	19.45000 -0.31256 0.28486 1.4714	- - *
31.00000	-7.00000	19.45000 -0.21362 0.19469 1.3235	- - *
32.00000	-7.00000	19.45000 -0.11633 0.10602 1.1757	- - *
33.00000	-7.00000	19.45000 -0.019924 0.018159 1.0279	- - *
34.00000	-7.00000	19.45000 0.0 0.0 0.88009	- - *
35.00000	-7.00000	19.45000 0.0 0.0 0.70173	- - *
36.00000	-7.00000	19.45000 0.0 0.0 0.52397	- - *
37.00000	-7.00000	19.45000 0.0 0.0 0.36509	- - *
38.00000	-7.00000	19.45000 0.0 0.0 0.20894	- - *
39.00000	-7.00000	19.45000 0.0 0.0 0.069418	- - *
40.00000	-7.00000	19.45000 0.0 0.0 0.0	- - *
-10.00000	-6.00000	19.45000 0.0 0.0 0.95176	- - *
-9.00000	-6.00000	19.45000 0.10429 0.05030 1.1300	- - *
-8.00000	-6.00000	19.45000 0.24547 0.12482 1.3083	- - *
-7.00000	-6.00000	19.45000 0.38933 0.19814 1.4866	- - *
-6.00000	-6.00000	19.45000 0.52508 0.29343 1.6631	- - *
-5.00000	-6.00000	19.45000 0.65341 0.40483 1.8355	- - *
-4.00000	-6.00000	19.45000 0.77045 0.53556 2.0233	- - *
-3.00000	-6.00000	19.45000 0.87004 0.68878 2.2688	- - *
-2.00000	-6.00000	19.45000 0.94290 0.86686 2.5727	- - *
-1.00000	-6.00000	19.45000 0.97610 1.0700 2.9230	- - *
0.00000	-6.00000	19.45000 0.95315 1.2936 3.2934	- - *
1.00000	-6.00000	19.45000 0.85609 1.5249 3.6680	- - *
2.00000	-6.00000	19.45000 0.67147 1.7397 4.0705	- - *
3.00000	-6.00000	19.45000 0.40058 1.9028 4.4066	- - *
4.00000	-6.00000	19.45000 0.069397 1.9778 4.6142	- - *
5.00000	-6.00000	19.45000 0.0 0.0 4.8800	- - *
6.00000	-6.00000	19.45000 0.0 1.9800 5.1693	- - *
7.00000	-6.00000	19.45000 0.0 1.9800 5.1693	- - *
8.00000	-6.00000	19.45000 0.0 1.9800 5.1693	- - *
9.00000	-6.00000	19.45000 0.0 1.9800 5.1693	- - *
10.00000	-6.00000	19.45000 0.0 1.9800 5.1693	- - *
11.00000	-6.00000	19.45000 0.0 1.9800 5.1693	- - *
12.00000	-6.00000	19.45000 0.0 1.9800 5.1693	- - *
13.00000	-6.00000	19.45000 0.0 1.9800 5.1693	- - *
14.00000	-6.00000	19.45000 0.0 1.9800 5.1693	- - *
15.00000	-6.00000	19.45000 0.0 1.9800 5.1693	- - *
16.00000	-6.00000	19.45000 0.0 1.9800 5.1693	- - *
17.00000	-6.00000	19.45000 0.0 1.9800 5.1693	- - *
18.00000	-6.00000	19.45000 0.0 1.9800 5.1693	- - *
19.00000	-6.00000	19.45000 0.0 1.9800 4.7658	- - *
20.00000	-6.00000	19.45000 -0.33786 1.9258 4.5822	- - *
21.00000	-6.00000	19.45000 -0.62376 1.7777 4.2548	- - *
22.00000	-6.00000	19.45000 -0.82642 1.5702 3.8858	- - *
23.00000	-6.00000	19.45000 -0.94022 1.3398 3.4977	- - *
24.00000	-6.00000	19.45000 -0.97658 1.1133 3.0822	- - *
25.00000	-6.00000	19.45000 -0.95319 0.90553 2.6366	- - *
26.00000	-6.00000	19.45000 -0.84782 0.72269 2.3814	- - *
27.00000	-6.00000	19.45000 -0.72975 0.66509 2.1013	- - *
28.00000	-6.00000	19.45000 -0.61707 0.56239 1.9017	- - *
29.00000	-6.00000	19.45000 -0.50901 0.46391 1.7539	- - *
30.00000	-6.00000	19.45000 -0.40481 0.36894 1.6061	- - *
31.00000	-6.00000	19.45000 -0.30371 0.27680 1.4583	- - *
32.00000	-6.00000	19.45000 -0.20494 0.18679 1.3105	- - *
33.00000	-6.00000	19.45000 -0.10776 0.098214 1.1626	- - *
34.00000	-6.00000	19.45000 -0.0090991 0.0083879 0.96263	- - *
35.00000	-6.00000	19.45000 0.0 0.0 0.76729	- - *
36.00000	-6.00000	19.45000 0.0 0.0 0.58891	- - *
37.00000	-6.00000	19.45000 0.0 0.0 0.42587	- - *
38.00000	-6.00000	19.45000 0.0 0.0 0.27665	- - *
39.00000	-6.00000	19.45000 0.0 0.0 0.13983	- - *
40.00000	-6.00000	19.45000 0.0 0.0 0.01442	- - *
-10.00000	-5.00000	19.45000 0.035416 0.018008 1.0424	- - *
-9.00000	-5.00000	19.45000 0.17583 0.089408 1.2207	- - *
-8.00000	-5.00000	19.45000 0.31821 0.16180 1.3990	- - *
-7.00000	-5.00000	19.45000 0.46416 0.23601 1.5772	- - *
-6.00000	-5.00000	19.45000 0.61529 0.31286 1.7555	- - *
-5.00000	-5.00000	19.45000 0.77245 0.39462 1.9389	- - *
-4.00000	-5.00000	19.45000 0.91222 0.52286 2.1814	- - *
-3.00000	-5.00000	19.45000 1.0387 0.67801 2.5053	- - *
-2.00000	-5.00000	19.45000 1.1417 0.86546 2.9124	- - *
-1.00000	-5.00000	19.45000 1.2055 1.0896 3.3893	- - *
0.00000	-5.00000	19.45000 1.2072 1.3510 3.9031	- - *
1.00000	-5.00000	19.45000 1.1166 1.6400 4.3975	- - *
2.00000	-5.00000	19.45000 0.90264 1.9284 4.9382	- - *
3.00000	-5.00000	19.45000 0.55207 2.1623 5.4580	- - *
4.00000	-5.00000	19.45000 0.096801 2.2748 5.9323	- - *
5.00000	-5.00000	19.45000 0.0 2.2782 6.6790	- - *
6.00000	-5.00000	19.45000 0.0 2.2782 6.6790	- - *
7.00000	-5.00000	19.45000 0.0 2.2782 6.6790	- - *
8.00000	-5.00000	19.45000 0.0 2.2782 6.6790	- - *
9.00000	-5.00000	19.45000 0.0 2.2782 6.6790	- - *
10.00000	-5.00000	19.45000 0.0 2.2782 6.6790	- - *
11.00000	-5.00000	19.45000 0.0 2.2782 6.6790	- - *
12.00000	-5.00000	19.45000 0.0 2.2782 6.6790	- - *
13.00000	-5.00000	19.45000 0.0 2.2782 6.6790	- - *
14.00000	-5.00000	19.45000 0.0 2.2782 6.6790	- - *
15.00000	-5.00000	19.45000 0.0 2.2782 6.6790	- - *
16.00000	-5.00000	19.45000 0.0 2.2782 6.6790	- - *
17.00000	-5.00000	19.45000 0.0 2.2782 6.6790	- - *
18.00000	-5.00000	19.45000 0.0 2.2782 6.6790	- - *
19.00000	-5.00000	19.45000 0.0 2.2782 6.6790	- - *
20.00000	-5.00000	19.45000 -0.46734 2.1965 5.7400	- - *
21.00000	-5.00000	19.45000 -0.84325 1.9816 5.2224	- - *
22.00000	-5.00000	19.45000 -1.0845 1.6991 4.7685	- - *
23.00000	-5.00000	19.45000 -1.1976 1.4071 4.2137	- - *
24.00000	-5.00000	19.45000 -1.2117 1.1390 3.6304	- - *
25.00000	-5.00000	19.45000 -1.0912 0.99453 3.2170	- - *
26.00000	-5.00000	19.45000 -0.96075 0.87562 2.7250	- - *
27.00000	-5.00000	19.45000 -0.83712 0.76294 2.3527	- - *
28.00000	-5.00000	19.45000 -0.71956 0.65580 2.0807	- - *
29.00000	-5.00000	19.45000 -0.60732 0.55351 1.8986	- - *
30.00000	-5.00000	19.45000 -0.49963 0.45536 1.7408	- - *
31.00000	-5.00000	19.45000 -0.39573 0.36067 1.5930	- - *
32.00000	-5.00000	19.45000 -0.29487 0.26874 1.4452	- - *
33.00000	-5.00000	19.45000 -0.18998 0.15793 1.2153	- - *
34.00000	-5.00000	19.45000 -0.086748 0.065822 0.99941	- - *
35.00000	-5.00000	19.45000 0.0 0.0 0.80453	- - *
36.00000	-5.00000	19.45000 0.0 0.0 0.62833	- - *
37.00000	-5.00000	19.45000 0.0 0.0 0.46867	- - *
38.00000	-5.00000	19.45000 0.0 0.0 0.32365	- - *
39.00000	-5.00000	19.45000 0.0 0.0 0.19158	- - *
40.00000	-5.00000	19.45000 0.0 0.0 0.070976	- - *
-10.00000	-4.00000	19.45000 0.10667 0.054239 1.1331	- - *
-9.00000	-4.00000	19.45000 0.24788 0.12604 1.3113	- - *
-8.00000	-4.00000	19.45000 0.39188 0.19926 1.4896	- - *
-7.00000	-4.00000	19.45000 0.54026 0.27471 1.6679	- - *
-6.00000	-4.00000	19.45000 0.69463 0.35320 1.8462	- - *
-5.00000	-4.00000	19.45000 0.85662 0.43557 2.0244	- - *
-4.00000	-4.00000	19.45000 1.0278 0.52262 2.2026	- - *
-3.00000	-4.00000	19.45000 1.2072 0.62035 2.3799	- - *
-2.00000	-4.00000	19.45000 1.3492 0.80519 2.5286	- - *
-1.00000	-4.00000	19.45000 1.4588 1.0380 2.6792	- - *
0.00000	-4.00000	19.45000 1.5079 1.3283 2.8414	- - *
1.00000	-4.00000	19.45000 1.4516 1.6784 3.0085	- - *
2.00000	-4.00000	19.45000 1.2282 2.0656 3.1807	- - *
3.00000	-4.00000	19.45000 0.78227 2.4151 3.3588	- - *
4.00000	-4.00000	19.45000 0.14038 2.5970 3.5424	- - *
5.00000	-4.00000	19.45000 0.0 2.6026 3.7321	- - *
6.00000	-4.00000	19.45000 0.0 2.6026 3.9282	- - *
7.00000	-4.00000	19.45000 0.0 2.6026 4.1304	- - *
8.00000	-4.00000	19.45000 0.0 2.6026 4.3386	- - *
9.00000	-4.00000	19.45000 0.0 2.6026 4.5526	- - *
10.00000	-4.00000	19.45000 0.0 2.6026 4.7721	- - *
11.00000	-4.00000	19.45000 0.0 2.6026 4.9968	- - *
12.00000	-4.00000	19.45000 0.0 2.6026 5.2265	- - *
13.00000	-4.00000	19.45000 0.0 2.6026 5.4611	- - *
14.00000	-4.00000	19.45000 0.0 2.6026 5.7015	- - *



Job No.	Sheet No.	Rev.
Dr. Ref.		
Made by MC	Date 11-Mar-2016	Checked

Type/No.	Coordinates	Displacements	Angle of Line to x Axis
Name	Dist.	x y z x y z	Horizontal displacement Horizontal displacement
	6.00000	10.00000 19.45000	Point lies within an excavation.
	7.00000	10.00000 19.45000	Point lies within an excavation.
	8.00000	10.00000 19.45000	Point lies within an excavation.
	9.00000	10.00000 19.45000	Point lies within an excavation.
	10.00000	10.00000 19.45000	Point lies within an excavation.
	11.00000	10.00000 19.45000	Point lies within an excavation.
	12.00000	10.00000 19.45000	Point lies within an excavation.
	13.00000	10.00000 19.45000	Point lies within an excavation.
	14.00000	10.00000 19.45000	Point lies within an excavation.
	15.00000	10.00000 19.45000	Point lies within an excavation.
	16.00000	10.00000 19.45000	Point lies within an excavation.
	17.00000	10.00000 19.45000	Point lies within an excavation.
	18.00000	10.00000 19.45000	Point lies within an excavation.
	19.00000	10.00000 19.45000	Point lies within an excavation.
	20.00000	10.00000 19.45000	Point lies within an excavation.
	21.00000	10.00000 19.45000	Point lies within an excavation.
	22.00000	10.00000 19.45000	Point lies within an excavation.
	23.00000	10.00000 19.45000	-2.3567 0.0 14.921 - - -
	24.00000	10.00000 19.45000	-2.0233 0.0 10.994 - - -
	25.00000	10.00000 19.45000	-1.6900 0.0 7.7600 - - -
	26.00000	10.00000 19.45000	-1.3567 0.0 5.1973 - - -
	27.00000	10.00000 19.45000	-1.0233 0.0 3.2598 - - -
	28.00000	10.00000 19.45000	-0.690000 0.0 1.8775 - - -
	29.00000	10.00000 19.45000	-0.35667 0.0 0.95637 - - -
	30.00000	10.00000 19.45000	-0.023333 0.0 0.37831 - - -
	31.00000	10.00000 19.45000	0.0 0.0 0.093403 - - -
	32.00000	10.00000 19.45000	0.0 0.0 0.0 - - -
	33.00000	10.00000 19.45000	0.0 0.0 0.0 - - -
	34.00000	10.00000 19.45000	0.0 0.0 0.0 - - -
	35.00000	10.00000 19.45000	0.0 0.0 0.0 - - -
	36.00000	10.00000 19.45000	0.0 0.0 0.0 - - -
	37.00000	10.00000 19.45000	0.0 0.0 0.0 - - -
	38.00000	10.00000 19.45000	0.0 0.0 0.0 - - -
	39.00000	10.00000 19.45000	0.0 0.0 0.0 - - -
	40.00000	10.00000 19.45000	0.0 0.0 0.0 - - -
	-10.00000	11.00000 19.45000	0.0 0.0 0.0 - - -
	-9.00000	11.00000 19.45000	0.0 0.0 0.0 - - -
	-8.00000	11.00000 19.45000	0.0 0.0 0.0 - - -
	-7.00000	11.00000 19.45000	0.0 0.0 0.074901 - - -
	-6.00000	11.00000 19.45000	0.0 0.0 0.33045 - - -
	-5.00000	11.00000 19.45000	0.31764 -0.019251 0.87469 - - -
	-4.00000	11.00000 19.45000	0.64976 -0.039379 1.7478 - - -
	-3.00000	11.00000 19.45000	0.98187 -0.059507 3.0679 - - -
	-2.00000	11.00000 19.45000	1.3140 -0.079635 4.9312 - - -
	-1.00000	11.00000 19.45000	1.6461 -0.099164 7.4103 - - -
	0.00000	11.00000 19.45000	1.9782 -0.11989 10.554 - - -
	1.00000	11.00000 19.45000	2.3103 -0.14002 14.386 - - -
	2.00000	11.00000 19.45000	Point lies within an excavation.
	3.00000	11.00000 19.45000	Point lies within an excavation.
	4.00000	11.00000 19.45000	Point lies within an excavation.
	5.00000	11.00000 19.45000	Point lies within an excavation.
	6.00000	11.00000 19.45000	Point lies within an excavation.
	7.00000	11.00000 19.45000	Point lies within an excavation.
	8.00000	11.00000 19.45000	Point lies within an excavation.
	9.00000	11.00000 19.45000	Point lies within an excavation.
	10.00000	11.00000 19.45000	Point lies within an excavation.
	11.00000	11.00000 19.45000	Point lies within an excavation.
	12.00000	11.00000 19.45000	Point lies within an excavation.
	13.00000	11.00000 19.45000	Point lies within an excavation.
	14.00000	11.00000 19.45000	Point lies within an excavation.
	15.00000	11.00000 19.45000	Point lies within an excavation.
	16.00000	11.00000 19.45000	Point lies within an excavation.
	17.00000	11.00000 19.45000	Point lies within an excavation.
	18.00000	11.00000 19.45000	Point lies within an excavation.
	19.00000	11.00000 19.45000	Point lies within an excavation.
	20.00000	11.00000 19.45000	Point lies within an excavation.
	21.00000	11.00000 19.45000	Point lies within an excavation.
	22.00000	11.00000 19.45000	Point lies within an excavation.
	23.00000	11.00000 19.45000	-2.3567 0.0 14.921 - - -
	24.00000	11.00000 19.45000	-2.0233 0.0 10.994 - - -
	25.00000	11.00000 19.45000	-1.6900 0.0 7.7600 - - -
	26.00000	11.00000 19.45000	-1.3567 0.0 5.1973 - - -
	27.00000	11.00000 19.45000	-1.0233 0.0 3.2598 - - -
	28.00000	11.00000 19.45000	-0.690000 0.0 1.8775 - - -
	29.00000	11.00000 19.45000	-0.35667 0.0 0.95637 - - -
	30.00000	11.00000 19.45000	-0.023333 0.0 0.37831 - - -
	31.00000	11.00000 19.45000	0.0 0.0 0.093403 - - -
	32.00000	11.00000 19.45000	0.0 0.0 0.0 - - -
	33.00000	11.00000 19.45000	0.0 0.0 0.0 - - -
	34.00000	11.00000 19.45000	0.0 0.0 0.0 - - -
	35.00000	11.00000 19.45000	0.0 0.0 0.0 - - -
	36.00000	11.00000 19.45000	0.0 0.0 0.0 - - -
	37.00000	11.00000 19.45000	0.0 0.0 0.0 - - -
	38.00000	11.00000 19.45000	0.0 0.0 0.0 - - -
	39.00000	11.00000 19.45000	0.0 0.0 0.0 - - -
	40.00000	11.00000 19.45000	0.0 0.0 0.0 - - -
	-10.00000	12.00000 19.45000	0.0 0.0 0.0 - - -
	-9.00000	12.00000 19.45000	0.0 0.0 0.0 - - -
	-8.00000	12.00000 19.45000	0.0 0.0 0.0 - - -
	-7.00000	12.00000 19.45000	0.0 0.0 0.065827 - - -
	-6.00000	12.00000 19.45000	0.0 0.0 0.30871 - - -
	-5.00000	12.00000 19.45000	0.29752 -0.018031 0.83361 - - -
	-4.00000	12.00000 19.45000	0.62963 -0.038159 1.6833 - - -
	-3.00000	12.00000 19.45000	0.96174 -0.058287 2.9733 - - -
	-2.00000	12.00000 19.45000	1.2939 -0.078416 4.8014 - - -
	-1.00000	12.00000 19.45000	1.6260 -0.098544 7.2415 - - -
	0.00000	12.00000 19.45000	1.9581 -0.11867 10.344 - - -
	1.00000	12.00000 19.45000	2.2902 -0.13880 14.134 - - -
	2.00000	12.00000 19.45000	Point lies within an excavation.
	3.00000	12.00000 19.45000	Point lies within an excavation.
	4.00000	12.00000 19.45000	Point lies within an excavation.
	5.00000	12.00000 19.45000	Point lies within an excavation.
	6.00000	12.00000 19.45000	Point lies within an excavation.
	7.00000	12.00000 19.45000	Point lies within an excavation.
	8.00000	12.00000 19.45000	Point lies within an excavation.
	9.00000	12.00000 19.45000	Point lies within an excavation.
	10.00000	12.00000 19.45000	Point lies within an excavation.
	11.00000	12.00000 19.45000	Point lies within an excavation.
	12.00000	12.00000 19.45000	Point lies within an excavation.
	13.00000	12.00000 19.45000	Point lies within an excavation.
	14.00000	12.00000 19.45000	Point lies within an excavation.
	15.00000	12.00000 19.45000	Point lies within an excavation.
	16.00000	12.00000 19.45000	Point lies within an excavation.
	17.00000	12.00000 19.45000	Point lies within an excavation.
	18.00000	12.00000 19.45000	Point lies within an excavation.
	19.00000	12.00000 19.45000	Point lies within an excavation.
	20.00000	12.00000 19.45000	Point lies within an excavation.
	21.00000	12.00000 19.45000	Point lies within an excavation.
	22.00000	12.00000 19.45000	Point lies within an excavation.
	23.00000	12.00000 19.45000	-2.3567 0.0 14.921 - - -
	24.00000	12.00000 19.45000	-2.0233 0.0 10.994 - - -
	25.00000	12.00000 19.45000	-1.6900 0.0 7.7600 - - -
	26.00000	12.00000 19.45000	-1.3567 0.0 5.1973 - - -
	27.00000	12.00000 19.45000	-1.0233 0.0 3.2598 - - -
	28.00000	12.00000 19.45000	-0.690000 0.0 1.8775 - - -
	29.00000	12.00000 19.45000	-0.35667 0.0 0.95637 - - -
	30.00000	12.00000 19.45000	-0.023333 0.0 0.37831 - - -
	31.00000	12.00000 19.45000	0.0 0.0 0.093403 - - -
	32.00000	12.00000 19.45000	0.0 0.0 0.0 - - -
	33.00000	12.00000 19.45000	0.0 0.0 0.0 - - -
	34.00000	12.00000 19.45000	0.0 0.0 0.0 - - -
	35.00000	12.00000 19.45000	0.0 0.0 0.0 - - -
	36.00000	12.00000 19.45000	0.0 0.0 0.0 - - -
	37.00000	12.00000 19.45000	0.0 0.0 0.0 - - -
	38.00000	12.00000 19.45000	0.0 0.0 0.0 - - -
	39.00000	12.00000 19.45000	0.0 0.0 0.0 - - -
	40.00000	12.00000 19.45000	0.0 0.0 0.0 - - -
	-10.00000	13.00000 19.45000	0.0 0.0 0.0 - - -
	-9.00000	13.00000 19.45000	0.0 0.0 0.0 - - -
	-8.00000	13.00000 19.45000	0.0 0.0 0.0 - - -
	-7.00000	13.00000 19.45000	0.0 0.0 0.057402 - - -



GEA LIMITED
(GEOTECHNICAL & ENV ASSOC) J13022A

Job No. Sheet No. Rev.

7 Branch Hill, London, NW3 7LT
Ground Movement Assessment
Piling, Underpinning and excavation Phase

Dr. Ref.

Made by Date Checked
MC 11-Mar-2016

Table with columns: Type/No., Name, Dist., Coordinates (x, y, z), Displacements (x, y, z), Horizontal displacement, Horizontal displacement, Angle of Line to x Axis. The table contains 32 rows of data points with various numerical values and some descriptive text like 'Point lies within an excavation.'



GEA LIMITED (GEOTECHNICAL & ENV ASSOC) J13022A

7 Branch Hill, London, NW3 7LT
Ground Movement Assessment
Piling, Underpinning and excavation Phase

Job No.	Sheet No.	Rev.
Drg. Ref.		
Made by	Date	Checked
MC	11-Mar-2016	

Type/No.	Coordinates			Displacements			Angle of Line to x Axis			
Name	Dist.	x	y	z	x	y	z	Horizontal displacement	Horizontal displacement	
Line 9	Line 9	37.50000	0.25000	19.00000	0.0	0.0	0.28637	0.0	0.0	254.80 *
	0.95336	37.25000	-0.67000	19.00000	0.0	0.0	0.36675	0.0	0.0	254.80 *
	1.9067	37.00000	-1.59000	19.00000	0.0	0.0	0.44163	0.0	0.0	254.80 *
	2.8601	36.75000	-2.51000	19.00000	0.0	0.0	0.50747	0.0	0.0	254.80 *
	3.8134	36.50000	-3.43000	19.00000	0.0	0.0	0.56103	0.0	0.0	254.80 *
	4.7668	36.25000	-4.35000	19.00000	0.0	0.0	0.59942	0.0	0.0	254.80 *
	5.7202	36.00000	-5.27000	19.00000	0.0	0.0	0.62025	0.0	0.0	254.80 *
	6.6735	35.75000	-6.19000	19.00000	0.0	0.0	0.62165	0.0	0.0	254.80 *
	7.6269	35.50000	-7.11000	19.00000	0.0	0.0	0.60230	0.0	0.0	254.80 *
	8.5803	35.25000	-8.03000	19.00000	0.0	0.0	0.55656	0.0	0.0	254.80 *
	9.5336	35.00000	-8.95000	19.00000	0.0	0.0	0.46957	0.0	0.0	254.80 *
Line 10	Line 10	35.00000	-9.00000	19.00000	0.0	0.0	0.46283	0.0	0.0	164.69 *
	0.87092	34.16000	-8.77000	19.00000	0.0	0.0	0.61799	0.0	0.0	164.69 *
	1.7418	33.32000	-8.54000	19.00000	0.0	0.0	0.77314	0.0	0.0	164.69 *
	2.6128	32.48000	-8.31000	19.00000	0.0	0.0	0.92829	0.0	0.0	164.69 *
	3.4837	31.64000	-8.08000	19.00000	-0.056088	0.051118	1.0834	0.067596	-0.034491	164.69 *
	4.3546	30.80000	-7.85000	19.00000	-0.15756	0.14360	1.2386	0.18989	-0.096889	164.69 *
	5.2255	29.96000	-7.62000	19.00000	-0.26036	0.23729	1.3938	0.31378	-0.16011	164.69 *
	6.0964	29.12000	-7.39000	19.00000	-0.36537	0.33300	1.5489	0.44034	-0.22468	164.69 *
	6.9674	28.28000	-7.16000	19.00000	-0.47348	0.43152	1.7041	0.57063	-0.29116	164.69 *
	7.8383	27.44000	-6.93000	19.00000	-0.58555	0.53267	1.8592	0.70570	-0.36008	164.69 *
	8.7092	26.60000	-6.70000	19.00000	-0.70248	0.64023	2.0475	0.84662	-0.43199	164.69 *

* Result includes imported displacement(s).

Specific Building Damage Results - Horizontal Displacements

Structure: 5 Upper Terrace | Sub-structure: North Wall

Dist.	Coordinates			Displacements			Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
	x	y	z	x	y	z	[mm]	[mm]
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]	[mm]
0.0	23.70000	15.95000	19.45000	-1.9379	-0.79280	-1.2193	1.7022 d	
1.0381	23.94000	16.96000	19.45000	-1.2370	-1.3478	-1.5973	0.89192 d	
2.0762	24.18000	17.97000	19.45000	-0.81510	-1.2742	-1.4282	0.49843 d	
3.1144	24.42000	18.98000	19.45000	-0.54729	-1.0465	-1.1446	0.29053 d	
4.1525	24.66000	19.99000	19.45000	-0.35167	-0.76651	-0.82704	0.16494 d	
5.1906	24.90000	21.00000	19.45000	-0.19389	-0.46389	-0.49617	0.081490 d	
6.2287	25.14000	22.01000	19.45000	-0.05843	-0.14969	-0.15913	0.022215 d	
7.2669	25.38000	23.02000	19.45000	0.0	0.0	0.0	0.0 d	
8.3050	25.62000	24.03000	19.45000	0.0	0.0	0.0	0.0 d	
9.3431	25.86000	25.04000	19.45000	0.0	0.0	0.0	0.0 d	
10.381	26.10000	26.05000	19.45000	0.0	0.0	0.0	0.0 d	

d - Displacements include imported displacements.

Structure: 5 Upper Terrace | Sub-structure: East Wall

Dist.	Coordinates			Displacements			Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
	x	y	z	x	y	z	[mm]	[mm]
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]	[mm]
0.0	26.10000	26.10000	19.45000	0.0	0.0	0.0	0.0 d	
1.3065	27.35000	25.72000	19.45000	0.0	0.0	0.0	0.0 d	
2.6130	28.60000	25.34000	19.45000	0.0	0.0	0.0	0.0 d	
3.9195	29.85000	24.96000	19.45000	0.0	0.0	0.0	0.0 d	
5.2259	31.10000	24.58000	19.45000	0.0	0.0	0.0	0.0 d	
6.5324	32.35000	24.20000	19.45000	0.0	0.0	0.0	0.0 d	
7.8389	33.60000	23.82000	19.45000	0.0	0.0	0.0	0.0 d	
9.1454	34.85000	23.44000	19.45000	0.0	0.0	0.0	0.0 d	
10.452	36.10000	23.06000	19.45000	0.0	0.0	0.0	0.0 d	
11.758	37.35000	22.68000	19.45000	0.0	0.0	0.0	0.0 d	
13.065	38.60000	22.30000	19.45000	0.0	0.0	0.0	0.0 d	

d - Displacements include imported displacements.

Structure: 5 Upper Terrace | Sub-structure: South Wall

Dist.	Coordinates			Displacements			Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
	x	y	z	x	y	z	[mm]	[mm]
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]	[mm]
0.0	38.60000	22.25000	19.45000	0.0	0.0	0.0	0.0 d	
0.97015	38.36000	21.31000	19.45000	0.0	0.0	0.0	0.0 d	
1.9403	38.12000	20.37000	19.45000	0.0	0.0	0.0	0.0 d	
2.9105	37.88000	19.43000	19.45000	0.0	0.0	0.0	0.0 d	
3.8806	37.64000	18.49000	19.45000	0.0	0.0	0.0	0.0 d	
4.8508	37.40000	17.55000	19.45000	0.0	0.0	0.0	0.0 d	
5.8209	37.16000	16.61000	19.45000	0.0	0.0	0.0	0.0 d	
6.7911	36.92000	15.67000	19.45000	0.0	0.0	0.0	0.0 d	
7.7612	36.68000	14.73000	19.45000	0.0	0.0	0.0	0.0 d	
8.7314	36.44000	13.79000	19.45000	0.0	0.0	0.0	0.0 d	
9.7015	36.20000	12.85000	19.45000	0.0	0.0	0.0	0.0 d	

d - Displacements include imported displacements.

Structure: 5 Upper Terrace | Sub-structure: West Wall

Dist.	Coordinates			Displacements			Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
	x	y	z	x	y	z	[mm]	[mm]
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]	[mm]
0.0	36.20000	12.80000	19.45000	0.0	0.0	0.0	0.0 d	
1.2879	34.95000	13.11000	19.45000	0.0	0.0	0.0	0.0 d	
2.5757	33.70000	13.42000	19.45000	0.0	0.0	0.0	0.0 d	
3.8636	32.45000	13.73000	19.45000	0.0	0.0	0.0	0.0 d	
5.1515	31.20000	14.04000	19.45000	0.0	0.0	0.0	0.0 d	
6.4393	29.95000	14.35000	19.45000	-0.040000	0.0	0.038824	0.0096283 d	
7.7272	28.70000	14.66000	19.45000	-0.45667	0.0	0.44324	0.10992 d	
9.0151	27.45000	14.97000	19.45000	-0.87333	0.0	0.84766	0.21022 d	
10.303	26.20000	15.28000	19.45000	-1.29000	0.0	1.2521	0.31051 d	
11.591	24.95000	15.59000	19.45000	-1.7048	0.0	1.6390	0.47374 d	
12.879	23.70000	15.90000	19.45000	-1.9734	-0.71761	1.7427	1.1715 d	

d - Displacements include imported displacements.

Structure: 6 Branch Hill | Sub-structure: North 1

Dist.	Coordinates			Displacements			Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
	x	y	z	x	y	z	[mm]	[mm]
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]	[mm]
0.0	26.60000	-6.65000	19.00000	-0.70768	0.64497	0.43463	0.85317 d	
1.0577	26.88000	-5.63000	19.00000	-0.78302	0.71364	0.48090	0.94400 d	
2.1155	27.16000	-4.61000	19.00000	-0.86078	0.78451	0.52866	1.0377 d	
3.1732	27.44000	-3.59000	19.00000	-0.94117	0.85777	0.57803	1.1347 d	
4.2309	27.72000	-2.57000	19.00000	-1.0244	0.93362	0.62914	1.2350 d	
5.2887	28.00000	-1.55000	19.00000	-1.1107	1.0122	0.68212	1.3390 d	

d - Displacements include imported displacements.

Structure: 6 Branch Hill | Sub-structure: East 1

Dist.	Coordinates			Displacements			Horizontal displacement	Horizontal displacement
	x	y	z	x	y	z	displacement	displacement
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]	[mm]



GEA LIMITED
(GEOTECHNICAL & ENV ASSOC) J13022A

Job No.	Sheet No.	Rev.
Dr. Ref.		
Made by MC	Date 11-Mar-2016	Checked

7 Branch Hill, London, NW3 7LT
Ground Movement Assessment
Piling, Underpinning and excavation Phase

along the Line		perpendicular to Line	
[m]	[mm]	[m]	[mm]
0.0	28.00000	-1.50000	19.00000
0.45122	28.44000	-1.60000	19.00000
0.90244	28.88000	-1.70000	19.00000
1.3537	29.32000	-1.80000	19.00000
1.8049	29.76000	-1.90000	19.00000
2.2561	30.20000	-2.00000	19.00000

d - Displacements include imported displacements.

Structure: 6 Branch Hill | Sub-structure: North 2

Dist.	Coordinates			Displacements			
	x	y	z	x	y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	30.20000	-1.95000	19.00000	-0.72896	0.53713	0.28604	0.85911
0.77795	30.44000	-1.21000	19.00000	-0.70243	0.43544	0.19749	0.80250
1.5559	30.68000	-0.47000	19.00000	-0.64489	0.32883	0.11384	0.71488
2.3338	30.92000	0.27000	19.00000	-0.55840	0.22685	0.043516	0.60115
3.1118	31.16000	1.01000	19.00000	-0.44844	0.13830	-0.0067880	0.46924
3.8897	31.40000	1.75000	19.00000	-0.32326	0.069794	-0.033337	0.32902

d - Displacements include imported displacements.

Structure: 6 Branch Hill | Sub-structure: East 2

Dist.	Coordinates			Displacements			
	x	y	z	x	y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	31.40000	1.80000	19.00000	-0.31600	0.066431	-0.32272	-0.010947
0.62817	32.01000	1.65000	19.00000	-0.28142	0.059813	-0.28756	-0.0091171
1.2563	32.62000	1.50000	19.00000	-0.24728	0.053060	-0.25280	-0.0075235
1.8845	33.23000	1.35000	19.00000	-0.21363	0.046222	-0.21848	-0.0061265
2.5127	33.84000	1.20000	19.00000	-0.18044	0.039331	-0.18461	-0.0048939
3.1409	34.45000	1.05000	19.00000	-0.14768	0.032401	-0.15114	-0.0037991
3.7690	35.06000	0.90000	19.00000	-0.11525	0.025437	-0.11799	-0.0028198
4.3972	35.67000	0.75000	19.00000	-0.083071	0.018432	-0.085069	-0.0019376
5.0254	36.28000	0.60000	19.00000	-0.051011	0.011373	-0.052251	-0.0011368
5.6535	36.89000	0.45000	19.00000	-0.018938	0.0042409	-0.019403	-404.01E-6
6.2817	37.50000	0.30000	19.00000	0.0	0.0	0.0	0.0

d - Displacements include imported displacements.

Structure: 6 Branch Hill | Sub-structure: South

Dist.	Coordinates			Displacements			
	x	y	z	x	y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	37.50000	0.25000	19.00000	0.0	0.0	0.0	0.0
0.95336	37.25000	-0.67000	19.00000	0.0	0.0	0.0	0.0
1.9067	37.00000	-1.59000	19.00000	0.0	0.0	0.0	0.0
2.8601	36.75000	-2.51000	19.00000	0.0	0.0	0.0	0.0
3.8134	36.50000	-3.43000	19.00000	0.0	0.0	0.0	0.0
4.7668	36.25000	-4.35000	19.00000	0.0	0.0	0.0	0.0
5.7202	36.00000	-5.27000	19.00000	0.0	0.0	0.0	0.0
6.6735	35.75000	-6.19000	19.00000	0.0	0.0	0.0	0.0
7.6269	35.50000	-7.11000	19.00000	0.0	0.0	0.0	0.0
8.5803	35.25000	-8.03000	19.00000	0.0	0.0	0.0	0.0
9.5336	35.00000	-8.95000	19.00000	0.0	0.0	0.0	0.0

d - Displacements include imported displacements.

Structure: 6 Branch Hill | Sub-structure: West

Dist.	Coordinates			Displacements			
	x	y	z	x	y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	35.00000	-9.00000	19.00000	0.0	0.0	0.0	0.0
0.87092	34.16000	-8.77000	19.00000	0.0	0.0	0.0	0.0
1.7418	33.32000	-8.54000	19.00000	0.0	0.0	0.0	0.0
2.6128	32.48000	-8.31000	19.00000	0.0	0.0	0.0	0.0
3.4837	31.64000	-8.08000	19.00000	-0.056088	0.051118	0.067596	-0.034491
4.3546	30.80000	-7.85000	19.00000	-0.15756	0.14360	0.18989	-0.096889
5.2255	29.96000	-7.62000	19.00000	-0.26036	0.23729	0.31378	-0.16011
6.0964	29.12000	-7.39000	19.00000	-0.36537	0.33300	0.44034	-0.22468
6.9674	28.28000	-7.16000	19.00000	-0.47348	0.43152	0.57063	-0.29116
7.8383	27.44000	-6.93000	19.00000	-0.58555	0.53367	0.70570	-0.36008
8.7092	26.60000	-6.70000	19.00000	-0.70248	0.63023	0.84662	-0.43199

d - Displacements include imported displacements.

Specific Building Damage Results - Vertical Displacements

Structure: 5 Upper Terrace | Sub-structure: North Wall

Dist.	Coordinates			Displacements
	x	y	z	
[m]	[m]	[m]	[mm]	
Vertical Offset 1				
0.0	23.70000	15.95000	19.45000	7.6078
1.0381	23.94000	16.96000	19.45000	5.2166
2.0762	24.18000	17.97000	19.45000	2.8137
3.1144	24.42000	18.98000	19.45000	2.5094
4.1525	24.66000	19.99000	19.45000	1.4991
5.1906	24.90000	21.00000	19.45000	0.79979
6.2287	25.14000	22.01000	19.45000	0.35442
7.2669	25.38000	23.02000	19.45000	0.10390
8.3050	25.62000	24.03000	19.45000	0.0095374
9.3431	25.86000	25.04000	19.45000	0.0
10.381	26.10000	26.05000	19.45000	0.0

d - Displacements include imported displacements.

Structure: 5 Upper Terrace | Sub-structure: East Wall

Dist.	Coordinates			Displacements
	x	y	z	
[m]	[m]	[m]	[mm]	
Vertical Offset 1				
0.0	26.10000	26.10000	19.45000	0.0
1.3065	27.35000	25.72000	19.45000	0.0
2.6130	28.60000	25.34000	19.45000	0.0
3.9195	29.85000	24.96000	19.45000	0.0
5.2259	31.10000	24.58000	19.45000	0.0
6.5324	32.35000	24.20000	19.45000	0.0
7.8389	33.60000	23.82000	19.45000	0.0
9.1454	34.85000	23.44000	19.45000	0.0
10.452	36.10000	23.06000	19.45000	0.0
11.758	37.35000	22.68000	19.45000	0.0
13.065	38.60000	22.30000	19.45000	0.0

d - Displacements include imported displacements.



Job No.	Sheet No.	Rev.
Dr. Ref.		
Made by MC	Date 11-Mar-2016	Checked

7 Branch Hill, London, NW3 7LT
 Ground Movement Assessment
 Piling, Underpinning and excavation Phase

Dist. Coordinates Displacements
 [m] x [m] y [m] z [mm]

Structure: 5 Upper Terrace | Sub-structure: South Wall

Dist. Coordinates Displacements
 [m] x [m] y [m] z [mm]

Vertical Offset 1
 0.0 38.60000 22.25000 19.45000 0.0 d
 0.97015 38.36000 21.31000 19.45000 0.0 d
 1.9403 38.12000 20.37000 19.45000 0.0 d
 2.9105 37.88000 19.43000 19.45000 0.0 d
 3.8806 37.64000 18.49000 19.45000 0.0 d
 4.8508 37.40000 17.55000 19.45000 0.0 d
 5.8209 37.16000 16.61000 19.45000 0.0 d
 6.7911 36.92000 15.67000 19.45000 0.0 d
 7.7612 36.68000 14.73000 19.45000 0.0 d
 8.7314 36.44000 13.79000 19.45000 0.0 d
 9.7015 36.20000 12.85000 19.45000 0.0 d
 d - Displacements include imported displacements.

Structure: 5 Upper Terrace | Sub-structure: West Wall

Dist. Coordinates Displacements
 [m] x [m] y [m] z [mm]

Vertical Offset 1
 0.0 36.20000 12.80000 19.45000 0.0 d
 1.2879 34.95000 13.11000 19.45000 0.0 d
 2.5757 33.70000 13.42000 19.45000 0.0 d
 3.8636 32.45000 13.73000 19.45000 0.0 d
 5.1515 31.20000 14.04000 19.45000 0.061868 d
 6.4393 29.95000 14.35000 19.45000 0.40116 d
 7.7272 28.70000 14.66000 19.45000 1.1909 d
 9.0151 27.45000 14.97000 19.45000 2.5742 d
 10.303 26.20000 15.28000 19.45000 4.7617 d
 11.591 24.95000 15.59000 19.45000 5.5884 d
 12.879 23.70000 15.90000 19.45000 7.7383 d
 d - Displacements include imported displacements.

Structure: 6 Branch Hill | Sub-structure: North 1

Dist. Coordinates Displacements
 [m] x [m] y [m] z [mm]

Vertical Offset 1
 0.0 26.60000 -6.65000 19.00000 2.0574 d
 1.0577 26.88000 -5.63000 19.00000 2.2180 d
 2.1155 27.16000 -4.61000 19.00000 2.4170 d
 3.1732 27.44000 -3.59000 19.00000 2.6600 d
 4.2309 27.72000 -2.57000 19.00000 2.9522 d
 5.2887 28.00000 -1.55000 19.00000 3.2991 d
 d - Displacements include imported displacements.

Structure: 6 Branch Hill | Sub-structure: East 1

Dist. Coordinates Displacements
 [m] x [m] y [m] z [mm]

Vertical Offset 1
 0.0 28.00000 -1.50000 19.00000 3.3256 d
 0.45122 28.44000 -1.60000 19.00000 2.9143 d
 0.90244 28.88000 -1.70000 19.00000 2.5914 d
 1.3537 29.32000 -1.80000 19.00000 2.3156 d
 1.8049 29.76000 -1.90000 19.00000 2.0825 d
 2.2561 30.20000 -2.00000 19.00000 1.8875 d
 d - Displacements include imported displacements.

Structure: 6 Branch Hill | Sub-structure: North 2

Dist. Coordinates Displacements
 [m] x [m] y [m] z [mm]

Vertical Offset 1
 0.0 30.20000 -1.95000 19.00000 1.8835 d
 0.77795 30.44000 -1.21000 19.00000 1.7034 d
 1.5559 30.68000 -0.47000 19.00000 1.4857 d
 2.3338 30.92000 0.27000 19.00000 1.2357 d
 3.1118 31.16000 1.01000 19.00000 0.96581 d
 3.8897 31.40000 1.75000 19.00000 0.68500 d
 d - Displacements include imported displacements.

Structure: 6 Branch Hill | Sub-structure: East 2

Dist. Coordinates Displacements
 [m] x [m] y [m] z [mm]

Vertical Offset 1
 0.0 31.40000 1.80000 19.00000 0.66950 d
 0.62817 32.01000 1.65000 19.00000 0.60315 d
 1.2563 32.62000 1.50000 19.00000 0.56005 d
 1.8845 33.23000 1.35000 19.00000 0.52611 d
 2.5127 33.84000 1.20000 19.00000 0.49342 d
 3.1409 34.45000 1.05000 19.00000 0.45988 d
 3.7690 35.06000 0.90000 19.00000 0.42560 d
 4.3972 35.67000 0.75000 19.00000 0.39069 d
 5.0254 36.28000 0.60000 19.00000 0.35523 d
 5.6535 36.89000 0.45000 19.00000 0.31930 d
 6.2817 37.50000 0.30000 19.00000 0.28296 d
 d - Displacements include imported displacements.

Structure: 6 Branch Hill | Sub-structure: South

Dist. Coordinates Displacements
 [m] x [m] y [m] z [mm]

Vertical Offset 1
 0.0 37.50000 0.25000 19.00000 0.28637 d
 0.95336 37.25000 -0.67000 19.00000 0.36875 d
 1.9067 37.00000 -1.59000 19.00000 0.44163 d
 2.8601 36.75000 -2.51000 19.00000 0.50747 d
 3.8134 36.50000 -3.43000 19.00000 0.56103 d
 4.7668 36.25000 -4.35000 19.00000 0.59942 d
 5.7202 36.00000 -5.27000 19.00000 0.62025 d
 6.6735 35.75000 -6.19000 19.00000 0.62165 d
 7.6269 35.50000 -7.11000 19.00000 0.60230 d
 8.5803 35.25000 -8.03000 19.00000 0.55656 d
 9.5336 35.00000 -8.95000 19.00000 0.46957 d
 d - Displacements include imported displacements.

Structure: 6 Branch Hill | Sub-structure: West

Dist. Coordinates Displacements
 [m] x [m] y [m] z [mm]



7 Branch Hill, London, NW3 7LT
Ground Movement Assessment
Piling, Underpinning and excavation Phase

Dist. Coordinates Displacements
[m] x y z z
[m] [m] [m] [mm]

Vertical Offset 1

0.0	35.00000	-9.00000	19.00000	0.46283	d
0.87092	34.16000	-8.77000	19.00000	0.61799	d
1.7418	33.32000	-8.54000	19.00000	0.77314	d
2.6128	32.48000	-8.31000	19.00000	0.92829	d
3.4837	31.64000	-8.08000	19.00000	1.0834	d
4.3546	30.80000	-7.85000	19.00000	1.2386	d
5.2255	29.96000	-7.62000	19.00000	1.3938	d
6.0964	29.12000	-7.39000	19.00000	1.5489	d
6.9674	28.28000	-7.16000	19.00000	1.7041	d
7.8383	27.44000	-6.93000	19.00000	1.8592	d
8.7092	26.60000	-6.70000	19.00000	2.0145	d

d - Displacements include imported displacements.

Specific Building Damage Results - All Segments

Structure: 5 Upper Terrace | Sub-structure: North Wall

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]			[m]	
0.0	1	0.0	7.2669	Hogging	0.025871	0.016780	0.033920	364.18E-6	0.0023042	889.09	0 (Negligible)

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 5 Upper Terrace | Sub-structure: East Wall

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]			[m]	
0.0											

All settlements are less than the Settlement Trough Limit Sensitivity.
Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 5 Upper Terrace | Sub-structure: South Wall

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]			[m]	
0.0											

All settlements are less than the Settlement Trough Limit Sensitivity.
Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 5 Upper Terrace | Sub-structure: West Wall

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]			[m]	
0.0	1	6.4393	3.3534	Hogging	0.016451	0.031402	0.037519	-313.92E-6	-0.0016980	2719.1	0 (Negligible)
	2	9.7928	0.72084	Sagging	0.021827	0.031005	0.041066	-313.92E-6	-0.0016980	12041.	0 (Negligible)
	3	10.514	2.2864	Hogging	0.025427	0.018412	0.035034	-300.35E-6	-0.0016692	819.40	0 (Negligible)

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 6 Branch Hill | Sub-structure: North 1

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]			[m]	
0.0	1	0.0	5.2000	Hogging	0.0026410	0.0046741	0.0057036	-50.087E-6	-327.93E-6	19002.	0 (Negligible)

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 6 Branch Hill | Sub-structure: East 1

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]			[m]	
0.0	1	0.0	2.2000	Hogging	0.0069979	0.021571	0.023335	-237.41E-6	911.29E-6	2066.0	0 (Negligible)

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 6 Branch Hill | Sub-structure: North 2

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]			[m]	
0.0	1	0.0	3.8000	Sagging	0.0020907	-0.0083241	0.0020676	113.84E-6	360.98E-6	15559.	0 (Negligible)

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 6 Branch Hill | Sub-structure: East 2

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]			[m]	
0.0	1	0.0	2.4498	Hogging	898.50E-6	0.0054990	0.0056289	-55.958E-6	105.62E-6	14734.	0 (Negligible)
	2	2.4498	3.7502	Sagging	67.246E-6	0.0049458	0.0049751	-53.919E-6	57.856E-6	538120.	0 (Negligible)

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Structure: 6 Branch Hill | Sub-structure: South

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]			[m]	
0.0	1	0.0	9.5000	Sagging	0.0023325		0.0023065	0.0	91.244E-6	19836.	0 (Negligible)

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

7 Branch Hill, London, NW3 7LT
Ground Movement Assessment
Piling, Underpinning and excavation Phase

Vertical Offset from Line for Vertical Movement	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement	Maximum Gradient of Vertical Displacement	Min. Radius of Curvature	Damage Category
---	---------	-------	--------	-----------	------------------	---------------------------	---------------------	---	---	--------------------------	-----------------

Structure: 6 Branch Hill | Sub-structure: West

Vertical Offset from Line for Vertical Movement	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement	Maximum Gradient of Vertical Displacement	Min. Radius of Curvature	Damage Category
Calculations		[m]	[m]		[%]	[%]	[%]			[m]	
0.0	1	0.0	6.0965	Sagging	0.0	0.0072230	0.0072233	-149.57E-6	-178.15E-6	91.244E+6	0 (Negligible)
	2	6.0965	2.6035	Hogging	838.95E-6	0.015547	0.015676	-161.78E-6	-216.14E-6	18250.	0 (Negligible)

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Specific Building Damage Results - Critical Values for All Segments within Each Sub-Structure

Structure: 5 Upper Terrace | Sub-structure: North Wall

Vertical Offset from Line for Vertical Movement	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement	Maximum Gradient of Vertical Displacement	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
Calculations	[%]	[%]		[mm]	[%]			[m]	[m]	
0.0	0.025871	0.016780	0.0023042	7.6078	0.033920	364.18E-6	0.0023042	889.09	-	0 (Negligible)

Structure: 5 Upper Terrace | Sub-structure: East Wall

Vertical Offset from Line for Vertical Movement	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement	Maximum Gradient of Vertical Displacement	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
Calculations	[%]	[%]		[mm]	[%]			[m]	[m]	
0.0										

Structure: 5 Upper Terrace | Sub-structure: South Wall

Vertical Offset from Line for Vertical Movement	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement	Maximum Gradient of Vertical Displacement	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
Calculations	[%]	[%]		[mm]	[%]			[m]	[m]	
0.0										

Structure: 5 Upper Terrace | Sub-structure: West Wall

Vertical Offset from Line for Vertical Movement	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement	Maximum Gradient of Vertical Displacement	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
Calculations	[%]	[%]		[mm]	[%]			[m]	[m]	
0.0	0.025427	0.031402	-0.0016980	7.6070	0.041066	-313.92E-6	-0.0016980	819.40	12041.0	0 (Negligible)

Structure: 6 Branch Hill | Sub-structure: North 1

Vertical Offset from Line for Vertical Movement	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement	Maximum Gradient of Vertical Displacement	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
Calculations	[%]	[%]		[mm]	[%]			[m]	[m]	
0.0	0.0026410	0.0046741	-327.93E-6	3.2700	0.0057036	-50.087E-6	-327.93E-6	19002.	-	0 (Negligible)

Structure: 6 Branch Hill | Sub-structure: East 1

Vertical Offset from Line for Vertical Movement	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement	Maximum Gradient of Vertical Displacement	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
Calculations	[%]	[%]		[mm]	[%]			[m]	[m]	
0.0	0.0069979	0.021571	911.29E-6	3.3256	0.023335	-237.41E-6	911.29E-6	2066.0	-	0 (Negligible)

Structure: 6 Branch Hill | Sub-structure: North 2

Vertical Offset from Line for Vertical Movement	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement	Maximum Gradient of Vertical Displacement	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
Calculations	[%]	[%]		[mm]	[%]			[m]	[m]	
0.0	0.0020907	-0.0083241	360.98E-6	1.8835	0.0020676	113.84E-6	360.98E-6	-	15559.0	0 (Negligible)

Structure: 6 Branch Hill | Sub-structure: East 2

Vertical Offset from Line for Vertical Movement	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement	Maximum Gradient of Vertical Displacement	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
Calculations	[%]	[%]		[mm]	[%]			[m]	[m]	
0.0	898.50E-6	0.0054990	105.62E-6	0.66950	0.0056289	-55.958E-6	105.62E-6	14734.	538120.0	0 (Negligible)

Structure: 6 Branch Hill | Sub-structure: South

Vertical Offset from Line for Vertical Movement	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement	Maximum Gradient of Vertical Displacement	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
Calculations	[%]	[%]		[mm]	[%]			[m]	[m]	
0.0	0.0023325		91.244E-6	0.62158	0.0023065	0.0	91.244E-6	-	19836.0	0 (Negligible)

Structure: 6 Branch Hill | Sub-structure: West

Vertical Offset from Line for Vertical Movement	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement	Maximum Gradient of Vertical Displacement	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
Calculations	[%]	[%]		[mm]	[%]			[m]	[m]	
0.0										



7 Branch Hill, London, NW3 7LT
Ground Movement Assessment
Piling, Underpinning and excavation Phase

Drq. Ref.

Made by
MC

Date
11-Mar-2016

Checked

Vertical Offset from Line for Vertical	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement	Maximum Gradient of Vertical Displacement	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
0.0	838.95E-6	0.015547	-216.14E-6	2.0455	0.015676	-161.78E-6	-216.14E-6	18250.	91.244E+6	0 (Negligible)

Specific Building Damage Results - Critical Segments within Each Structure

Structure Name	Parameter	Critical Sub-Structure	Critical Segment	Start	End	Curvature	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
5 Upper Terrace	Maximum Slope	North Wall		[m]	[m]							
	Maximum Settlement	North Wall		1	0.0	7.2669	Hogging	0.0023042		7.6078	0.033920	889.09 - 0 (Negligible)
	Max. Tensile Strain	West Wall		2	9.7928	10.514	Sagging	0.0016980	4.8969	0.041066		12041.0 (Negligible)
	Min. Radius of Curvature (Hogging)	West Wall		3	10.514	12.800	Hogging	0.0016692	7.6070	0.035034	819.40	- 0 (Negligible)
	Min. Radius of Curvature (Sagging)	West Wall		2	9.7928	10.514	Sagging	0.0016980	4.8969	0.041066		12041.0 (Negligible)
6 Branch Hill	Maximum Slope	East 1		1	0.0	2.2000	Hogging	911.29E-6	3.3256	0.023335	2066.0	- 0 (Negligible)
	Maximum Settlement	East 1		1	0.0	2.2000	Hogging	911.29E-6	3.3256	0.023335	2066.0	- 0 (Negligible)
	Max. Tensile Strain	East 1		1	0.0	2.2000	Hogging	911.29E-6	3.3256	0.023335	2066.0	- 0 (Negligible)
	Min. Radius of Curvature (Hogging)	East 1		1	0.0	2.2000	Hogging	911.29E-6	3.3256	0.023335	2066.0	- 0 (Negligible)
	Min. Radius of Curvature (Sagging)	North 2		1	0.0	3.8000	Sagging	360.98E-6	1.8835	0.0020676		15559.0 (Negligible)

Specific Building Damage Results - All Combined Segments

Structure: 5 Upper Terrace | Sub-structure: North Wall

Vertical Offset from Line for Vertical Movement Calculations	Combined Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Damage Category
[m]	[m]	[m]	[m]		[%]	[%]	[%]	
No structures have segments combined.								

Structure: 5 Upper Terrace | Sub-structure: East Wall

Vertical Offset from Line for Vertical Movement Calculations	Combined Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Damage Category
[m]	[m]	[m]	[m]		[%]	[%]	[%]	
No structures have segments combined.								

Structure: 5 Upper Terrace | Sub-structure: South Wall

Vertical Offset from Line for Vertical Movement Calculations	Combined Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Damage Category
[m]	[m]	[m]	[m]		[%]	[%]	[%]	
No structures have segments combined.								

Structure: 5 Upper Terrace | Sub-structure: West Wall

Vertical Offset from Line for Vertical Movement Calculations	Combined Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Damage Category
[m]	[m]	[m]	[m]		[%]	[%]	[%]	
No structures have segments combined.								

Structure: 6 Branch Hill | Sub-structure: North 1

Vertical Offset from Line for Vertical Movement Calculations	Combined Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Damage Category
[m]	[m]	[m]	[m]		[%]	[%]	[%]	
No structures have segments combined.								

Structure: 6 Branch Hill | Sub-structure: East 1

Vertical Offset from Line for Vertical Movement Calculations	Combined Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Damage Category
[m]	[m]	[m]	[m]		[%]	[%]	[%]	
No structures have segments combined.								

Structure: 6 Branch Hill | Sub-structure: North 2

Vertical Offset from Line for Vertical Movement Calculations	Combined Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Damage Category
[m]	[m]	[m]	[m]		[%]	[%]	[%]	
No structures have segments combined.								

Structure: 6 Branch Hill | Sub-structure: East 2

Vertical Offset from Line for Vertical Movement Calculations	Combined Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Damage Category
[m]	[m]	[m]	[m]		[%]	[%]	[%]	
No structures have segments combined.								

Structure: 6 Branch Hill | Sub-structure: South

Vertical Offset from Line for Vertical Movement Calculations	Combined Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Damage Category
[m]	[m]	[m]	[m]		[%]	[%]	[%]	
No structures have segments combined.								

Job No.	Sheet No.	Rev.
J13022A		
Drg. Ref.		
Made by MC	Date 11-Mar-2016	Checked

Offset from Line for Vertical Movement Calculations	Segment	Ratio	Horizontal Strain	Tensile Strain
[m]	[m]	[m]	[%]	[%]

No structures have segments combined.

Structure: 6 Branch Hill | Sub-structure: West

Vertical Offset from Line for Vertical Movement Calculations	Combined Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Damage Category
[m]	[m]	[m]	[m]	[%]	[%]	[%]	[%]	

No structures have segments combined.

Geotechnical & Environmental Associates (GEA) is an engineer-led and client-focused independent specialist providing a complete range of geotechnical and contaminated land investigation, analytical and consultancy services to the property and construction industries.

We have offices at

Widbury Barn
Widbury Hill
Ware
Hertfordshire
SG12 7QE
tel 01727 824666
mail@gea-ltd.co.uk

Church Farm
Gotham Road
Kingston on Soar
Notts
NG11 0DE
tel 01509 674888
midlands@gea-ltd.co.uk

Enquiries can also be made on-line at

www.gea-ltd.co.uk

where information can be found on all of the services that we offer.

