Milvum Engineering
Services Ltd
71-75 Shelton Street
London WC2H 9JQ

t: +44 7472 611560
e: contact@milvumgroup.com

www.milvumgroup.com

GROUND MOVEMENT ASSESSMENT

IMPACTS RELATING TO THE ROUNDHOUSE

100 CHALK FARM ROAD
LONDON
NW1 8EH

Ref: MES/2411/REG048
Rev: 1
Date: November 2024
Prepared: Giulia Forlati BEng MEng PhD
Reviewed: Corrado Candian MEng CEng MICE
Approved: Graham Kite BSc MSc DIC FGS

Table of Contents

1.0 Executive Summary ..... - 2 -
2.0 Introduction ..... - 3 -
2.1 Assessment Methodologies ..... - 3 -
2.2 Assessment Quality Control ..... - 3 -
2.3 Reference Material ..... - 3 -
2.4 Current and Proposed Development ..... - 3 -
2.5 Roundhouse ..... - 5 -
3.0 Ground Conditions ..... - 8 -
4.0 Ground Movement Assessment ..... - 9 -
4.1 Ground Movements generated by the Proposed Development ..... - 9 -
4.2 Estimates of Ground Movement ..... - 10 -
5.0 Conclusions and Recommendations ..... - 12 -
5.1 Impact Assessment ..... - 12 -
5.2 Mitigation Measures ..... - 12 -
5.3 Survey and Monitoring ..... - 12 -
Appendix 1 Site Plans and Development Proposals ..... - 1 -
Appendix 2 XDisp Plots ..... - 2 -
Appendix 3 Disclaimer ..... - 3 -

1.0 Executive Summary

At the request of Regal London, a Ground Movement Assessment (the assessment) has been carried out to assess the potential impacts to the Roundhouse due to the proposed development woks at 100 Chalk Farm Road, London, NW1 8EH (the site). All assessments and calculations have been checked by a Chartered Civil Engineer (CEng MICE) specialising in geotechnical engineering.

The site is located on the southern side of Chalk Farm Road in the London Borough of Camden. The Roundhouse is a Grade II Listed theatre structure immediately adjacent to the western boundary of the site. The redevelopment involves the demolition of the existing buildings within the footprint of the site and the construction of new multi-storey buildings. The development will be supported by piled foundations. Retaining walls will be formed by contiguous piling along all boundaries.

The assessment is considered to be conservative, presenting an overestimate of ground movements. The contractor's construction sequence allows for contingency propping, if determined to be necessary by the movement monitoring during the works. The modelling makes no allowance for mitigation measures and is therefore considered to provide a reasonably conservative assessment of the movements and impacts.

With appropriate sequencing and control of the proposed works, impacts are predicted to be Category 0 (Negligible) in accordance with the Burland Scale.

No adverse impacts are predicted. Notwithstanding this, proposed contingency mitigation measures comprise:

- Monitoring of the Roundhouse, highway and piled wall / wall capping beam during construction to establish ground movements at and adjacent to the Roundhouse.
- Comparison of monitoring results with model predictions.
- Implementation of contingency measures, if required, to maintain movements and resultant impacts to within predicted limits.
- Provision of pre- and post-construction condition surveys.

2.0 Introduction

At the request of Regal London, a Ground Movement Assessment (the assessment) has been carried out to assess the potential impacts to the Roundhouse due to the proposed development woks at 100 Chalk Farm Road, London, NW1 8EH (the site).

This report is based on site-specific ground investigations and geotechnical assessment undertaken by Geo-Environmental Services Limited in July 2024.

2.1 Assessment Methodologies

Ground movement analyses has been completed in accordance with the guidance provided in CIRIA C760 utilising the Oasys programme XDisp. Using the data from these analyses, an assessment has been made of the potential impact in accordance with the Burland Scale.

It is intended that this report is submitted to the Party Wall Engineers who may rely on this report for the purposes of approval of the proposed scheme for which the report is prepared for.

2.2 Assessment Quality Control

Each calculation and element of the assessment has been checked by an appropriately experienced Chartered Civil Engineer (CEng MICE) specialising in geotechnical engineering.

2.3 Reference Material

A review of the existing site investigation data, interpretative geotechnical assessments, proposed development plans, construction sequencing and structural drawings has been undertaken, along with relevant design guidance:

- Geotechnical Design Report (ref GE22556/GDR/JUL24 V1.0) dated 17 July 2024 by Geo-Environmental Services Limited (GESL);
- Structural Engineering Drawings (Rev P2) dated 16 August by HDR Consulting Ltd;
- Basement Impact Assessment (ref 10685-PF-ZZ-XX-RP-C-005, Rev 02, Suit S1) dated January 2024 by Pell Frischmann;
- C760 Guidance on Embedded Retaining Wall Design, CIRIA, 2017;
- Predictions of Party Wall Movements Using CIRIA Report C580, Ball, Langdon and Crieghton, 2014.

A conservative approach to the assessment has been implemented, adopting current best practice.

2.4 Current and Proposed Development

It is proposed to redevelop the site at 100 Chalk Farm Road, London NW1 8EH. The redevelopment involves the demolition of the existing buildings within the footprint of the site (1 to 5-storeys) and the construction of new multistorey buildings.

The Roundhouse is a Grade II Listed theatre and performance arts space of 3 to 4 storeys on Chalk Farm Road immediately adjacent to the western boundary of the site.

The site is located at approximate National Grid reference TQ 28300 84300. It is bounded by Chalk Farm Road (A502) to the north, the car park and supermarket to the east, the North London Line (Network Rail) to the south, and the Roundhouse to the west.

The site ground level is sloping downwards from south to north, with the elevation dropping from about 33.0mOD adjacent to the railway lines to 28.5mOD along Chalk Farm Road. The vegetated area over the easternmost part of the site is relatively flat with an average elevation of about 29.5mOD. The site is currently occupied by the following:

- 1-storey office building adjacent to the Roundhouse.
- 5-storey office building on piles fronting onto Chalk Farm Road.
- 3-storey office building (including 1-level basement) adjacent to the North London Line.
- 2-storey car parking area (including 1-level basement) adjacent to the North London Line.

A site location plan is presented in Figure 1.

It is proposed that the basement will occupy the majority of the site demise. The development will be supported by a piled foundation. Retaining walls will be formed by contiguous piling.

The proposed basement slab level level is at approximately 24.5mOD with formation level at 23.8mOD; along the boundary with the Roundhouse, with ground level at approximately 28.5mOD, approximately 4.7m of soils will require retaining (including excavation to formation levels). The retaining wall to the Roundhouse will remain stiffly propped at all stages of the work, both in the temporary and permanent cases.

Structural drawings of the proposed development are presented in Appendix 1, with extracts within Figures 2, 3 and 4. The proposed construction sequence is:

- Demolish existing structures.
- Install piled retaining walls from current ground levels.
- Cast capping beams to piled retaining walls.
- Install bearing piles.
- Install temporary propping at approximately 28.5mOD.
- Complete excavation to formation level (23.8mOD), adding additional props on a contingency basis if required to maintain ground / structural movements within required tolerances.
- Cast raft slabs and liner walls.
- Sequentially install ground floor slab and remove temporary props.
- Construct cores and superstructure.

Contiguous piling of 12m pile lengths, 600mm diameter at 750mm centre to centre is proposed along the western (Roundhouse) boundary. Bearing piles are proposed at 600mm and 750mm diameter.

For the purposes of conservative assessment, the total retained height of soils along the western boundary is taken as 5.0m.

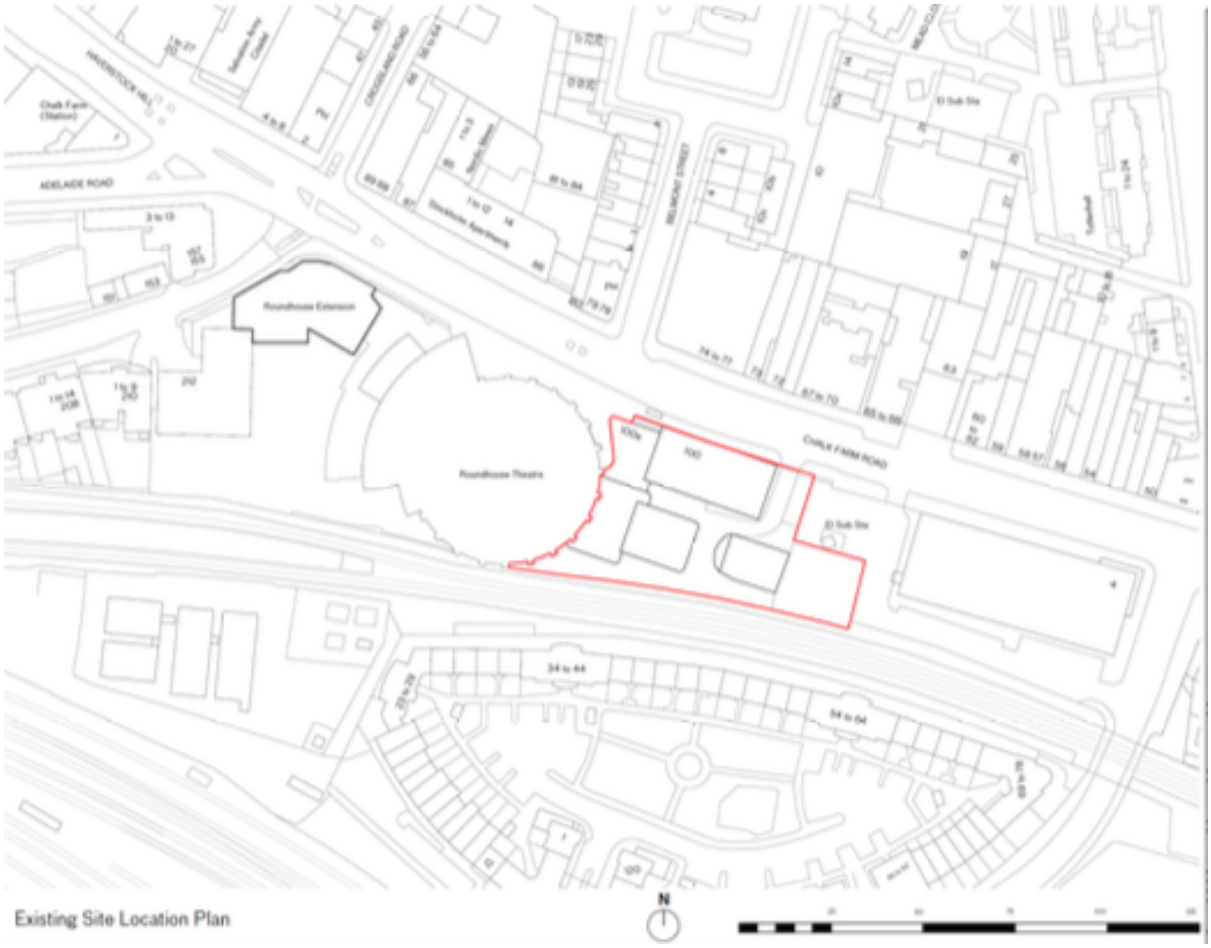


Figure 1: Site Location Plan

2.5 Roundhouse

The Roundhouse is indicated relative to the site and the proposed construction in Figures 2, 3 and 4.

The Roundhouse is understood to have shallow foundations and for the purposes of conservative assessment a foundation level of 28.50mOD has been adopted (ground level at Chalk Farm Road).

The closest parts of the Roundhouse structure are at an offset of 1.69m from the outside of individual bearing piles and 1.95m from the end of the proposed retaining wall along the southern boundary. The proposed retaining wall along the western boundary, running from the rail lines to Chalk Farm Road, varies from 3.8m to >6.0m offset from the Roundhouse.

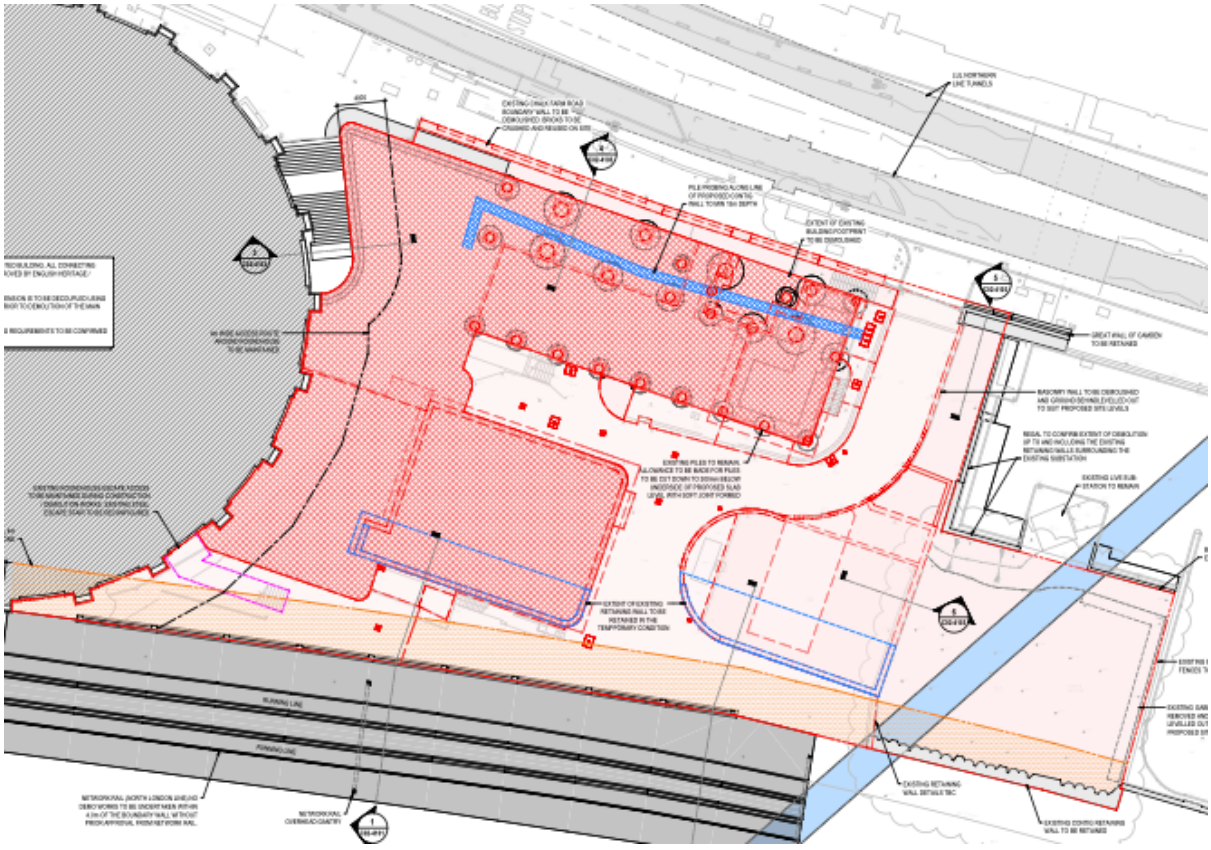


Figure 2: Site Plan – Roundhouse on Western Boundary (left of plan)

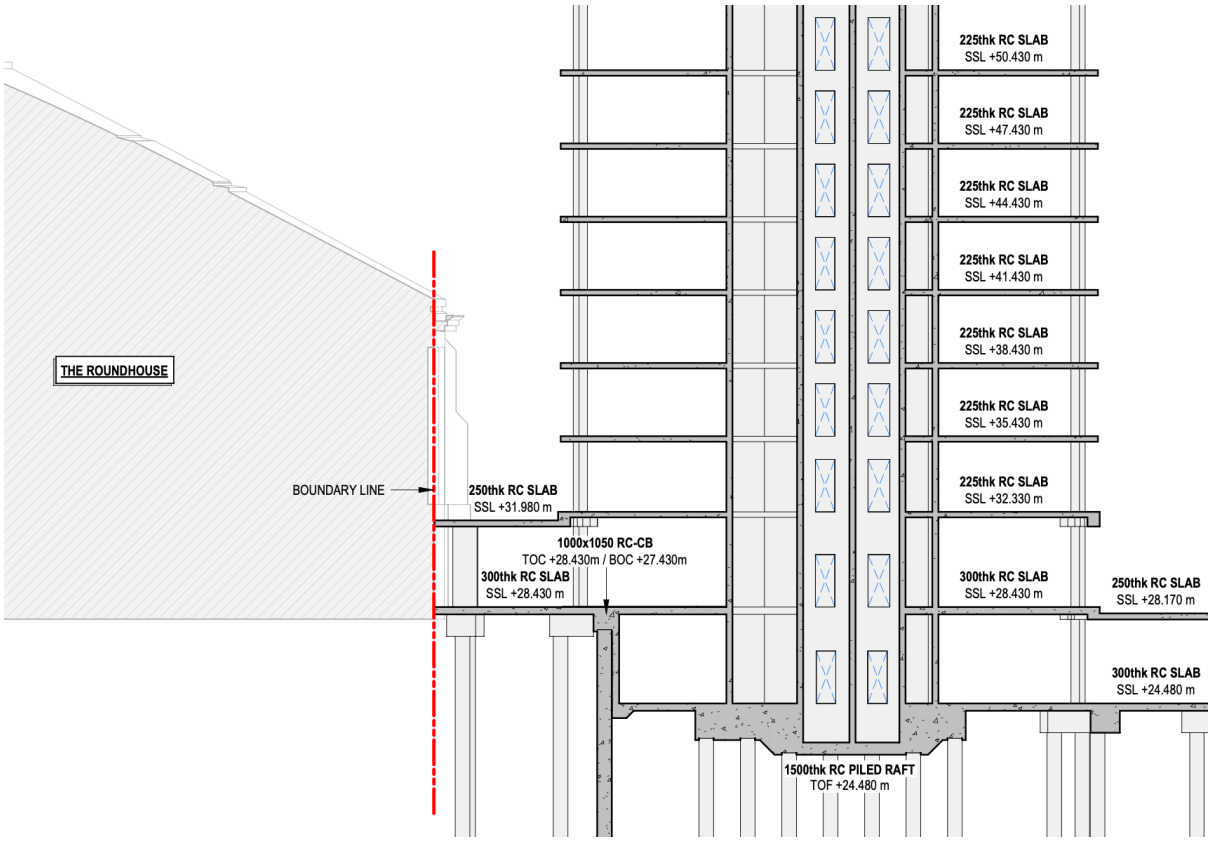


Figure 3: Cross-Section of the Proposed Development (View South)

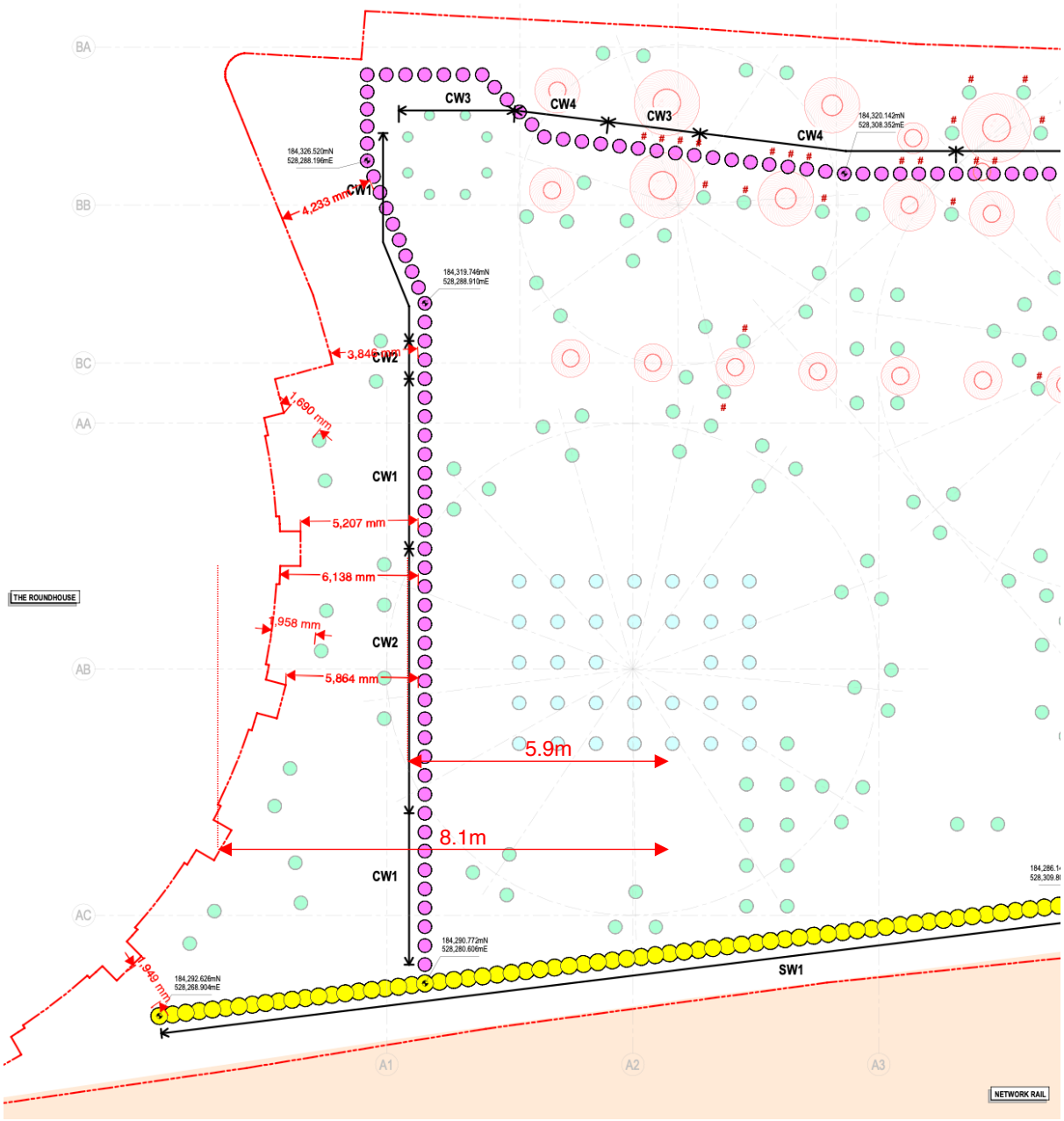


Figure 4: Roundhouse Relative to the Proposed Development (Western Site Boundary)
(note: the yellow piled wall on the southern boundary is proposed as contiguous, not secant as currently shown).

3.0 Ground Conditions

The ground conditions and geotechnical parameters have been assessed by GESL and the piling contractor, Central Piling. In summary, the ground conditions comprise Made Ground overlying London Clay.

Based on experience of similar projects in London, the soil parameters derived by Central Piling are considered suitable for the retaining wall calculations and use in the GMA. For the purposes of this assessment, the following simplified stratigraphy was adopted:

- Made Ground 33.0mOD to 29.5mOD
- London Clay Formation 29.5mOD to -15.0mOD
- Rigid Boundary -15.0mOD

Characteristic soil parameters and groundwater conditions adopted for retaining wall calculations are as follows:

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Left side	Soil types Right side
1	33.00	1 Made Ground	1 Made Ground
2	29.50	2 London Clay undr.	2 London Clay undr.

SOIL PROPERTIES

-- Soil type -- No.	Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Made Ground	18.00	10000	0.640	NC (0.250)	0.416 (1.522)	2.738 (4.527)	3.000d
2	London Cl.. (29.50)	19.00	39000 (3510)	1.000	OC (0.490)	1.000 (2.389)	1.000 (2.390)	65.00u (5.850)
3	London Cl.. (29.50)	19.00	31200 (2808)	1.000	OC (0.250)	0.416 (1.522)	2.738 (4.528)	5.000d

Additional soil parameters associated with Ka and Kp

------- Soil type ------- No.	Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Made Ground	21.00	0.670	0.00	21.00	0.670	0.00
2	London Clay undr.	0.00	0.500	0.00	0.00	0.500	0.00
3	London Clay drained	21.00	0.670	0.00	21.00	0.670	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Left side	Right side
Initial water table elevation	23.80	23.80

Automatic water pressure balancing at toe of wall : No

Water press. profile no.	Left side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	Right side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2
1	1	32.00	32.00	0.0	1	23.50	23.50	0.0

4.0 Ground Movement Assessment

4.1 Ground Movements generated by the Proposed Development

Typically, the following construction processes are likely to give rise to ground movements:

1. Installation of basement retaining walls.
2. Excavation of the basement.

The GMA primarily adopts an assessment based on CIRIA C760 (and its predecessor C580) which considers movements due to installation of the basement retaining walls and excavation of the basement. This is considered pertinent since the proposed embedded piled retaining walls have not been designed for axial loading along their full lengths (only at isolated locations), and therefore are not subject to long term settlement of any significance and will contain any heave / settlements generated during the excavation and construction process. Its further noted that, due to piling being undertaken at ground level in advance of basement construction, the bearing piles will further mitigate against significant heave being generated during excavation.

The C760 assessed movements have been plotted in Oasys XDisp against the geometry of the site and neighbouring Roundhouse to assess the impacts (movements / strains).

C760 GMA

Based on the guidance provided in CIRIA C760, ground movements resulting from installation of a contiguous piled retaining wall and excavation in front of the wall have been estimated. The C760 guidance is considered relevant to the site, given that it is based on numerous case studies on the behaviour of embedded retaining walls in London (ie with piles embedded in the stiff, over consolidated London Clay).

For movement due to retaining wall installation, the magnitudes of the movements are dependent on the total wall depth. Maximum vertical movements occur at the pile wall itself. C760 indicates movements will be 0.04% of the pile length, with negligible vertical movement at twice the pile length from the wall. On this basis, maximum vertical movements due to pile installation of <5mm are predicted with vertical movements extending to a maximum of 24m from the wall.

Anticipated maximum horizontal movements due to wall installation are 0.04% of the pile length, with negligible horizontal movement one and a half times the pile length from the wall. Maximum horizontal movements are therefore predicted to be <5mm with horizontal movements extending to a maximum of 18m from the wall.

For movements due to excavation in front of the retaining walls, the magnitudes of the movements are dependent on the excavation depth. Based on the Contractor adopting a stiffly propped method of excavation, C760 indicates maximum vertical movements of 0.10% of excavation depth. Negligible movement is experienced three and a half times excavation depth from the wall. Maximum vertical movements due to excavation of 12mm are predicted, extending <18m from the wall.

Anticipated maximum horizontal movement due to excavation are 0.15% of the excavation depth when stiffly propped, with negligible horizontal movements four times the excavation depth from the wall. Maximum horizontal movements are predicted to be <8mm, extending 20m from the wall.

The geometries of the site and Roundhouse have been imported into XDisp and ground movements modelled based on C580 (equivalent to C760). The displacement profiles assume greenfield movements and predict movements at ground level (28.5mOD).

4.2 Estimates of Ground Movement

Whilst the CIRIA C760 approach is considered conservative, it has been adopted as the underlying method of analysis precisely for this reason: the actual ground movements generated during the works should be less onerous than those predicted.

The displacement profiles and damage assessment derived using XDisp predict movements at ground level. In relation to the Roundhouse, the movements derived will be an overestimate, as foundations are located at a depth greater than street level.

The ground movements have been used to assess the resultant potential damage that may be experienced by the Roundhouse. The methodology proposed by Burland and Wroth, and later supplemented by the work of Boscardin and Cording, has been used, as described in CIRIA C760 (and preceding CIRIA publications). The 'Burland Scale' damage categories are presented in Table 1.

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

Table 1: Damage Categories on the Burland Scale

Based on the ground movements calculated, Category 0 (Negligible) damage is predicted in accordance with the Burland Scale.

Although not integral to the purpose of this assessment, it should be noted that during the construction works the adjacent structure, highways and retaining wall / capping beams will be monitored for movements as required by the Party Wall Agreement. The results of this monitoring provide a comprehensive feedback loop to the assessment models. This will allow mitigation actions to be implemented if movement trends indicate predicted impacts and structural movement tolerances could be exceeded.

5.0 Conclusions and Recommendations

This assessment has been undertaken to predict the likely ground movements around the proposed development and to estimate the resultant impacts on the Roundhouse. The assumptions and methodology are described in the preceding sections.

The assessment is considered to be conservative, presenting an overestimate of ground movements.

The calculations were checked by a Chartered Geotechncial Engineer.

5.1 Impact Assessment

Based on the ground movements calculated, Category 0 (Negligible) damage is predicted in accordance with the Burland Scale.

5.2 Mitigation Measures

The results predicted in the GMA are considered to represent an upper bound of theoretical movements. These movements should not be realised, and by adopting modern piling techniques and a suitable sequence of works, movements and resultant impacts should be less than predicted.

The sequence of works allows for small areas of excavation and construction to be active at any one time. This allows monitoring to be effectively used in both the area being actively constructed, and to plan and make additional contingency allowances for the future sequence, taking into account actual site conditions and lessons learned.

A contingency plan to provide additional propping will be required by the contractor. The additional props would be utilised where trends of movements indicate that additional structural support is required in the temporary case. The construction sequence will then be amended, in consultation with the Engineer, to allow permanent structural members to be constructed in an accelerated programme or out of sequence, to provide the additional support required.

The contractor will be required to submit a contingency action plan demonstrating that mitigation measures can be implemented within an agreed timeframe of any instruction by the Engineer / Main Contractor.

The assessment makes no allowance for these mitigation measures and is therefore considered to provide a reasonably conservative assessment of the movements and impacts.

5.3 Survey and Monitoring

It is proposed to undertake condition surveys, pre- and post-construction, together with monitoring during the works and until trends of movements have ceased.

At present, proposed control measures comprise:

- Pre-construction structural condition surveys.
- Monitoring of the Roundhouse, highways and piled retaining wall / wall capping beam during construction to establish ground movements at and adjacent to the Roundhouse.
- Comparison of monitoring results with model predictions.

- Implementation of additional propping, as required, to maintain movements and resultant impacts to within predicted limits.
- Post-construction monitoring until movements have ceased.
- Post-construction structural condition surveys.

A monitoring specification for the project has been prepared by HDR Consulting Ltd and should be referenced when reading this assessment. In summary, the monitoring specification covers the following elements.

Retaining Wall / Capping Beam

- Minimum 1no inclinometer to full depth of retaining wall.
- 3D Monitoring prisms at 5m centres (Capping Beam).

Road / Pavements

- Precise levelling points along near side and far side kerb line at 5m centres, extending 20m beyond site boundary in each direction.

Roundhouse

- 3D Monitoring prisms in pairs at high / low level and / or tiltmeters.

Frequency of Monitoring

- Baseline monitoring to be undertaken on a minimum of 3no occasions over a 4 week period prior to construction.
- During piling and excavation, monitoring to be twice weekly (automated monitoring to be continuous) until superstructure completed to ground floor level (GF slab cast).
- During superstructure construction, monitoring to be undertaken monthly.
- Post construction, monitoring to continue monthly until movement has ceased.

Trigger Values

Amber

- Road / Pavements – 7mm nearside / 3mm far side Chalk Farm Road
- Inclinometer – 8mm in any plane
- Capping beam – 7mm vertical / 8mm horizontal
- Roundhouse – 5mm vertical / 5mm horizontal

Red

- Road / Pavements – 10mm nearside / 5mm far side Chalk Farm Road
- Inclinometer – 12mm in any plane
- Capping beam – 10mm vertical / 12mm horizontal
- Roundhouse – 8mm vertical / 8mm horizontal

Actions

Amber

- Increase frequency of monitoring, assess potential causes, implement contingencies
- Alert Party Wall Engineers

Red

- Cease construction works, assess potential causes, implement further contingencies
- Engineer, Contractor and Party Wall Engineers to meet and discuss / agree actions

Appendix 1 Site Plans and Development Proposals

NORTH

LUL NORTHERN LINE

PILES IN CLOSE PROXIMTY TO RECORD PILE INFORMATION, MARKED # TO BE PROBED PRIOR TO COMMENCING PILING. RESULTS TO BE CONFIRMED TO THE ENGINEER

POSITION OF EXISTING BELL PILES TAKEN FROM RECORD INFORMATION. EXACT POSITION TO BE RECORDED AND RETURNED TO THE ENGINEER

LINE OF EXISTING THAMES WATER ASSET TAKEN FROM RECORD INFORMATION, EXACT POSITION UNVERIFIED

PILING NOTE:
PILING DEPTH WITHIN THAMES WATER EASEMENT TO BE MAX CIRCA 17m DEEP, BASE OF PILE TO NOT EXCEED +9.600m AOD

THE ROUNDHOUSE

NETWORK RAIL

CW1 CW2 CW3 CW4 CW5 CW6 SW1

184,326.520mN 528,288.196mE
184,320.142mN 528,308.352mE
184,313.776mN 528,330.553mE
184,319.746mN 528,288.910mE
184,303.274mN 528,327.541mE
184,293.745mN 528,317.678mE
184,286.147mN 528,309.807mE
184,284.946mN 528,317.380mE
184,282.951mN 528,326.777mE
184,290.772mN 528,280.606mE
184,292.626mN 528,268.904mE

4,233 mm
3,846 mm
1,690 mm
5,207 mm
6,138 mm
1,958 mm
5,864 mm
1,949 mm

10000
10000
TW ASSET
30/0

SECANT AND CONTIG PILING RETAINING WALLS
CHARACTERISTIC ACTIONS (kN/m UNO)

PILE WALL REFERENCE	BUILDING LOADS vDL	BUILDING LOADS vLL	WIND vWL	WIND hWL	EARTH PRESSURE vEL	EARTH PRESSURE hEL	NOTES
SW1 - 900Ø SECANT	315	200	-	-	+/-50	+/-50	SUBJECT TO NR SURCHARGE LOADS
CW1 - 750Ø CONTIG	375	150	-	-	+/-50	+/-50	
CW2 - 750Ø CONTIG	1000	500	-	-	+/-50	+/-50	COLUMN LOCATION, LOADS kN PER PILE
CW3 - 750Ø CONTIG	360	115	-	-	+/-50	+/-50	
CW4 - 750Ø CONTIG	950	450	-	-	+/-50	+/-50	COLUMN LOCATION, LOADS kN PER PILE
CW5 - 750Ø CONTIG	350	115	-	-	+/-50	+/-50	
CW6 - 750Ø CONTIG	175	110	-	-	+/-50	+/-50	

WORK IN PROGRESS

Autodesk Docs://11464-00 Chalk Farm Road/CHALF-HDR-M4-S-YY-XX-0200.rvt

cm 0 1 2 3 4 5 Plot Check v.24.2

LEGEND

- 450Ø / 600Ø CRANE BASE PILES
- 600Ø CORE A BEARING PILES
- 600Ø CORE C BEARING PILES
- 600Ø BLOCK D PILE RAFT BEARING PILES
- 600Ø INDEPENDANT PILECAP BEARING PILES
- 750Ø SECANT PILE WALL
- 600Ø CONTIG PILE WALL
- Fxx-Pxx PILE REFERENCE (FOUNDATION MARK - PILE MARK)

DRAWING TO BE READ IN CONJUNCTION WITH:

- CHALF-HDR-DR-C-YY-C00-2100 - SITE CONSTRAINTS
- CHALF-HDR-DR-C-YY-C02-2100 - SITE DEMOLITION
- CHALF-HDR-DR-S-YY-S11-2050 - SECANT & CONTIG PILE ARRANGEMENT
- CHALF-HDR-DR-S-YY-S11-2051 - SECANT & CONTIG PILE SCHEDULE
- CHALF-HDR-DR-S-YY-S11-2055 - BEARING PILE ARRANGEMENT
- CHALF-HDR-DR-S-YY-S11-2056 - BEARING PILE SCHEDULE
- CHALF-HDR-DR-S-YY-S11-2099 - FOUNDATION ARRANGEMENT, BASEMENT
- CHALF-HDR-DR-S-YY-S11-2100 - FOUNDATION ARRANGEMENT, GROUND FLOOR
- CHALF-HDR-DR-S-YY-S11-2101 - FOUNDATION ARRANGEMENT, 1st FLOOR

SECANT & CONTIG PILING ASSUMPTIONS

BELOW IS A SUMMARY OF INITIAL DESIGN ASSUMPTIONS:

- PILE TYPES BASED ON CFA
- SECANT WALL PILE DIAMETER = 750mm @ 1200 MALE c/c
- SECANT WALL HARD / FIRM
- CONTIG WALL PILE DIAMETER = 600mm @ 750 MALE c/c
- PILE LENGTH = 25m, EXCEPT WITHIN THAMES WATER EASEMENT, MAX LENGTH CIRCA 17m
- MAXIMUM WORKING LOAD = xxN
- FINAL DEISIGN OF PILE AND ALL ASSUMPTIONS ABOVE WILL BE SUBJECT TO REAPPRAISAL BY THE PILING CONTRACTOR TO ACHEIVE MOST ECONOMICAL DESIGN

REV	DATE	REVISION DESCRIPTION
P02	16/08/24	GMA & NETWORK RAIL FORM A ISSUE
P01	02/08/24	PRELIMINARY ISSUE

240 Blackfriars Road
London
SE1 8NW
United Kingdom

t: +44 (0)20 7429 3333
e: info@hdrinc.com
w: www.hdrinc.com

CLIENT: REGAL LONDON

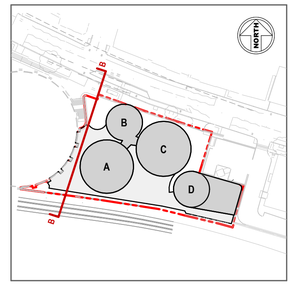
PROJECT: CHALK FARM ROAD, CAMDEN, LONDON

TITLE: PROPOSED WORKS
SECANT & CONTIG PILE ARRANGEMENT

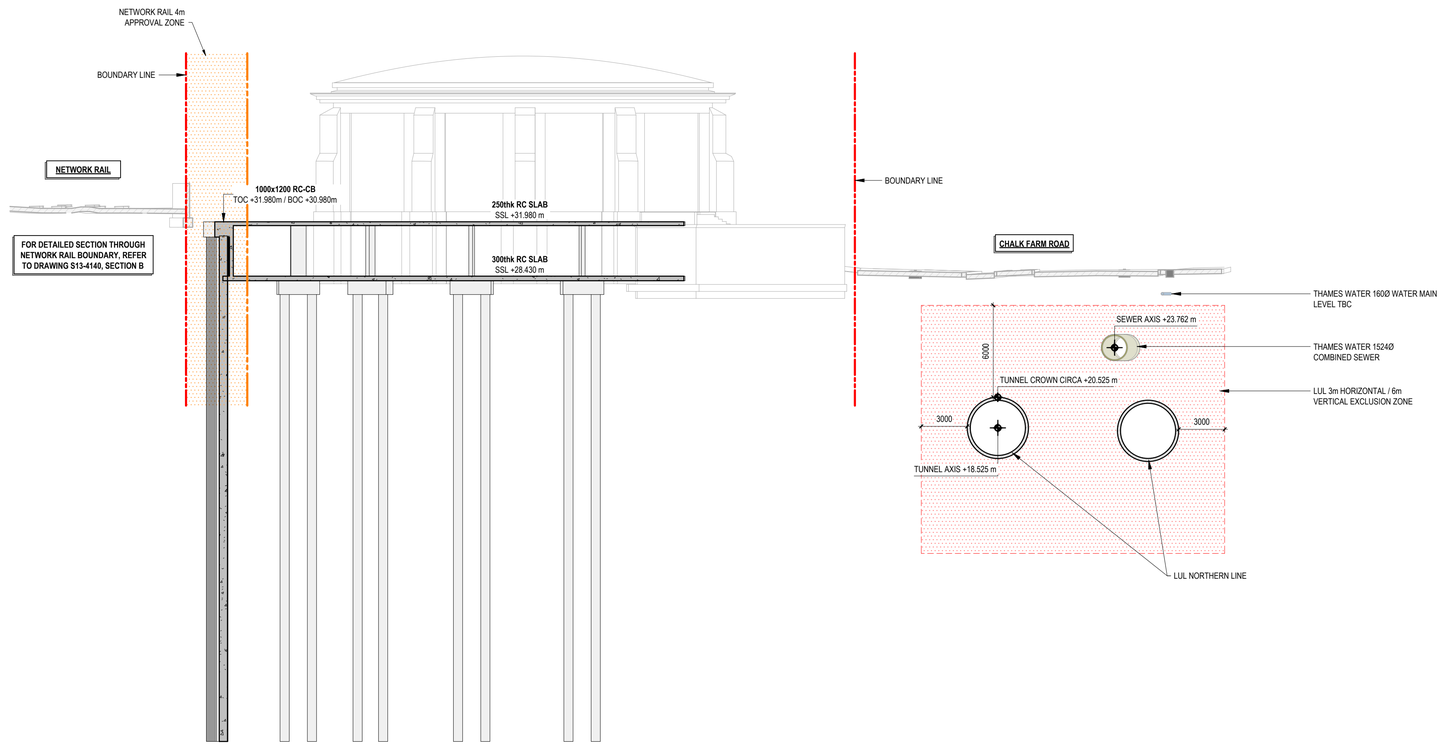
SUITABILITY STATUS: S3 - REVIEW & COMMENT

HDR NUMBER:	REV DRAWN BY:	REV CHKD/APPD BY:
10400799	CA	AB/PW
MODEL NAME:	REV DATE:	SCALE @ A1:
CHALF-HDR-M-S-YY-XX-0200	16/08/24	1:125 UNO

DRAWING NUMBER: CHALF-HDR-DR-S-YY-S11-2050 REVISION: P02



SECTION KEYPLAN



REV	DATE	REVISION DESCRIPTION
P01	16/08/24	GMA & NETWORK RAIL FORM A ISSUE

SUITABILITY STATUS:

S3 - REVIEW & COMMENT

240 Blackfriars Road
London
SE1 8NW
United Kingdom

t: +44 (0)20 7429 3333
e: info@hdrinc.com
w: www.hdrinc.com

CLIENT:

REGAL LONDON

PROJECT:

CHALK FARM ROAD, CAMDEN, LONDON

TITLE:

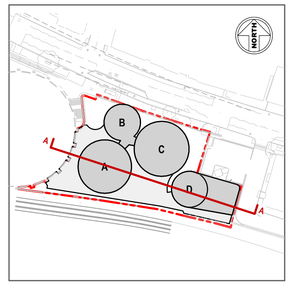
PROPOSED WORKS
SITE SECTION D

HDR NUMBER:	REV DRAWN BY:	REV CHKD/APPD BY:
10400799	CA	AB/PW
MODEL NAME:	REV DATE:	SCALE @ A1:
CHALF-HDR-M-S-YY-XX-0200	16/08/24	As indicated

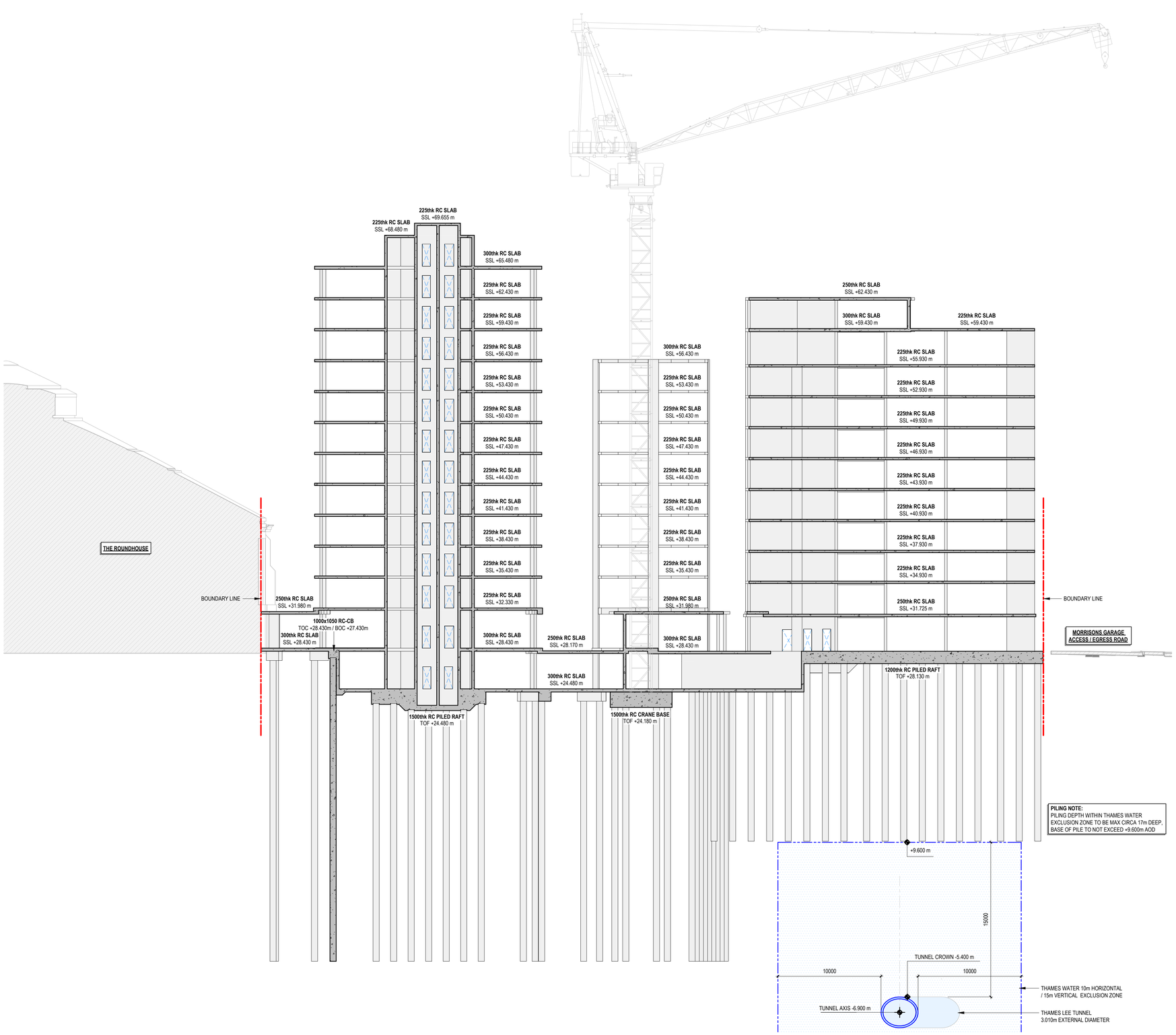
DRAWING NUMBER: **CHALF-HDR-DR-S-YY-S13-4102**

REVISION: **P01**

cm 0 1 2 3 4 5 Plot Check



SECTION KEYPLAN



P01 16/08/24 GMA & NETWORK RAIL FORM A ISSUE

REV DATE REVISION DESCRIPTION

SUITABILITY STATUS:

S3 - REVIEW & COMMENT

240 Blackfriars Road
London
SE1 8NW
United Kingdom

t: +44 (0)20 7429 3333
e: info@hdrinc.com
w: www.hdrinc.com

CLIENT:

REGAL LONDON

PROJECT:

CHALK FARM ROAD, CAMDEN, LONDON

TITLE:

PROPOSED WORKS
SITE SECTION A

HDR NUMBER:	REV DRAWN BY:	REV CHKD/APPD BY:
10400799	CA	AB/PW
MODEL NAME:	REV DATE:	SCALE @ A1:
CHALF-HDR-M-S-YY-XX-0200	16/08/24	As indicated

DRAWING NUMBER: REVISION

CHALF-HDR-DR-S-YY-S13-4101 **P01**

cm 0 1 2 3 4 5 Plot Check

Appendix 2 XDisp Plots

Oasys

MILVUM
ENGINEERINGSERVICES LTD

Roundhouse Chalk Farm Rd

Job No.	Sheet No.	Rev.

Drg. Ref.

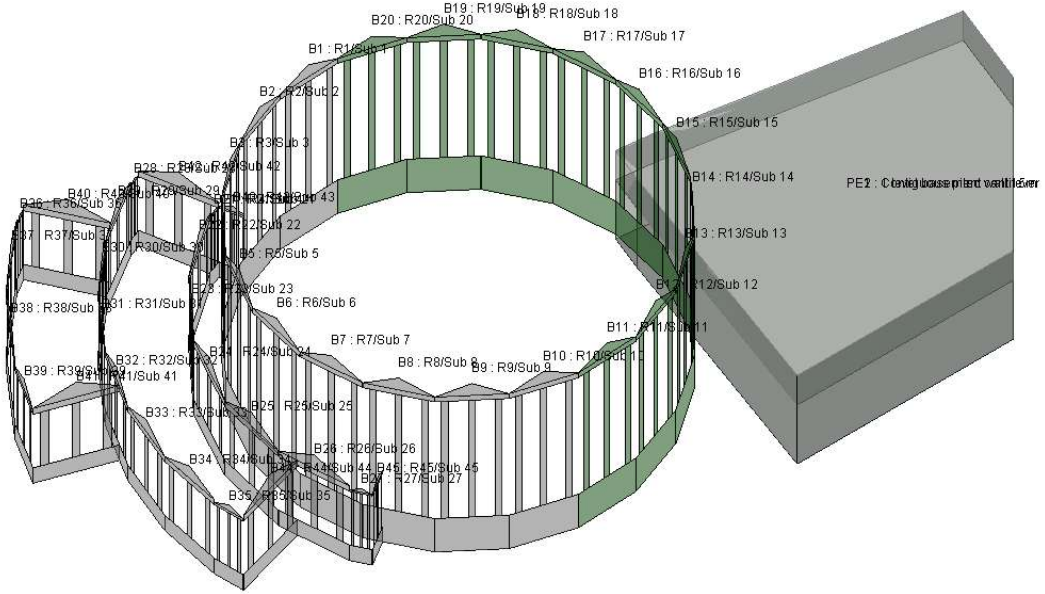
Made by	Date	Checked	Date
CC	21-Oct-2024		

RAW RESULTS

Legend

Excavation

Building Results
- < Sensitivity
- Cat. 0 (Negligible)
- Cat. 1 (Very Slight)
- Cat. 2 (Slight)
- Cat. 3 (Moderate)
- Cat. 4 (Severe)



Oasys

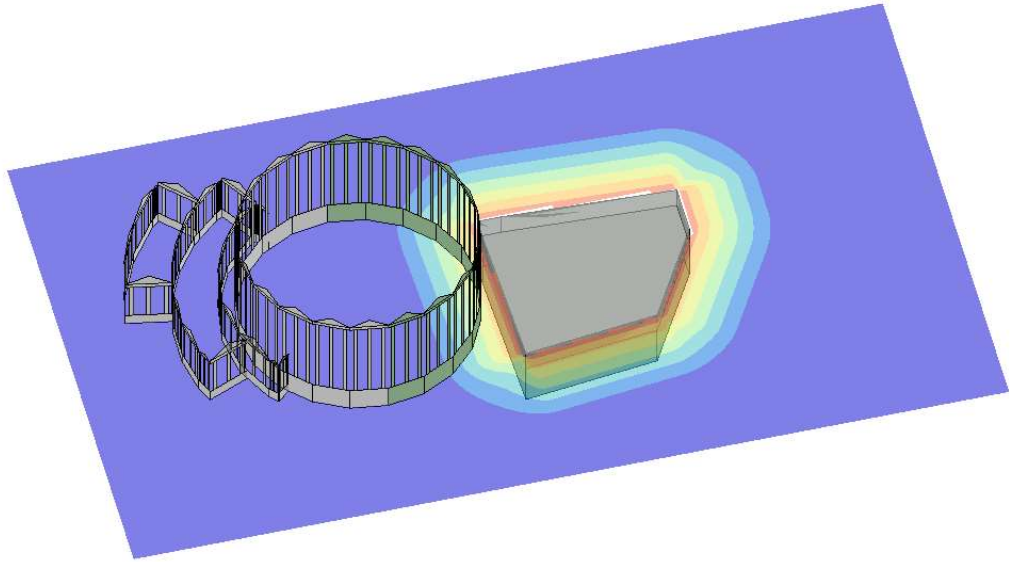
MILVUM
ENGINEERINGSERVICES LTD

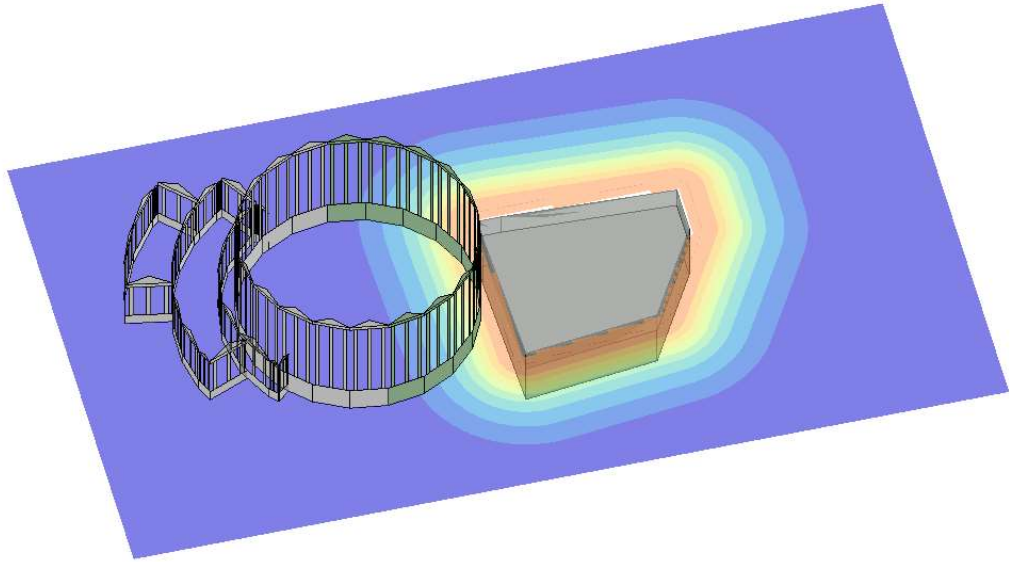
Roundhouse Chalk Farm Rd

Job No.	Sheet No.	Rev.

Drg. Ref.

Made by	Date	Checked	Date
CC	21-Oct-2024		




RAW RESULTS
Legend
Excavation
Building Results
< Sensitivity
Cat. 0 (Negligible)
Cat. 1 (Very Slight)
Cat. 2 (Slight)
Cat. 3 (Moderate)
Cat. 4 (Severe)
Displacement - Z - Elastic
0 : 1.000 mm
1.000 : 2.000 mm
2.000 : 3.000 mm
3.000 : 4.000 mm
4.000 : 5.000 mm
5.000 : 6.000 mm
6.000 : 7.000 mm
7.000 : 8.000 mm
8.000 : 9.000 mm
9.000 : 10.00 mm
Y
Z
X

Specific Building Damage Results - Critical Segments within Each Building

Stage: Ref.	Stage: Name	Specific Building: Ref.	Specific Building: Name	Parameter	Critical Sub-Building	Critical Segment	Start [m]	End [m]	Curvature	Max Slope	Max Settlement [mm]	Max Tensile Strain [%]	Min Radius of Curvature (Hogging) [m]	Min Radius of Curvature (Sagging) [m]	Damage Category
0	Base Model	0	R1	All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
		0	R2	All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
		0	R3	All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
		0	R4	All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
		0	R5	All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
		0	R6	All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
		0	R7	All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
		0	R8	All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
		0	R9	All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
		0	R10	All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
		0	R11	Max Slope	Sub 11	1	3.2479	4.0595	None	**199.72E-6**	0.36092	35.763E-9	-	-	0 (Negligible)
				Max Settlement	Sub 11	2	4.0595	8.1000	None	199.70E-6	**1.1676**	1.3232E-6	-	-	0 (Negligible)
				Max Tensile Strain	Sub 11	2	4.0595	8.1000	None	199.70E-6	1.1676	**1.3232E-6**	-	-	0 (Negligible)
				Min Radius of Curvature (Hogging)		-	-	-	-	-	-	-	-	-	-
				Min Radius of Curvature (Sagging)		-	-	-	-	-	-	-	-	-	-
		0	R12	Max Slope	Sub 12	4	6.1559	8.1000	None	**244.02E-6**	2.9003	0.047673	-	-	0 (Negligible)
				Max Settlement	Sub 12	4	6.1559	8.1000	None	244.02E-6	**2.9003**	0.047673	-	-	0 (Negligible)
				Max Tensile Strain	Sub 12	4	6.1559	8.1000	None	244.02E-6	2.9003	**0.047673**	-	-	0 (Negligible)
				Min Radius of Curvature (Hogging)		-	-	-	-	-	-	-	-	-	-
				Min Radius of Curvature (Sagging)		-	-	-	-	-	-	-	-	-	-
		0	R13	Max Slope	Sub 13	1	0.0	8.1000	None	**409.66E-6**	5.4188	0.033159	-	-	0 (Negligible)
				Max Settlement	Sub 13	1	0.0	8.1000	None	409.66E-6	**5.4188**	0.033159	-	-	0 (Negligible)
				Max Tensile Strain	Sub 13	1	0.0	8.1000	None	409.66E-6	5.4188	**0.033159**	-	-	0 (Negligible)
				Min Radius of Curvature (Hogging)		-	-	-	-	-	-	-	-	-	-
				Min Radius of Curvature (Sagging)		-	-	-	-	-	-	-	-	-	-
		0	R14	Max Slope	Sub 14	1	0.0	3.7188	None	**291.54E-6**	6.4925	0.014802	-	-	0 (Negligible)
				Max Settlement	Sub 14	2	3.7188	8.1000	None	291.54E-6	**7.7298**	0.015536	-	-	0 (Negligible)

Stage: Stage: Name Ref.	Specific Building: Ref.	Specific Building: Name	Parameter	Critical Sub-Building	Critical Segment	Start	End	Curvature	Max Slope	Max Settlement	Max Tensile Strain	Min Radius of Curvature (Hogging)	Min Radius of Curvature (Sagging)	Damage Category
			Max Tensile Strain	Sub 14	2	3.7188	8.1000	None	291.54E-6	7.7298	**0.015536**	-	-	0 (Negligible)
			Min Radius of Curvature (Hogging)		-	-	-	-	-	-	-	-	-	
			Min Radius of Curvature (Sagging)		-	-	-	-	-	-	-	-	-	
	0	R15	Max Slope	Sub 15	1	0.0	8.1000	None	**99.841E-6**	8.4616	0.0025119	-	-	0 (Negligible)
			Max Settlement	Sub 15	1	0.0	8.1000	None	99.841E-6	**8.4616**	0.0025119	-	-	0 (Negligible)
			Max Tensile Strain	Sub 15	1	0.0	8.1000	None	99.841E-6	8.4616	**0.0025119**	-	-	0 (Negligible)
			Min Radius of Curvature (Hogging)		-	-	-	-	-	-	-	-	-	
			Min Radius of Curvature (Sagging)		-	-	-	-	-	-	-	-	-	
	0	R16	Max Slope	Sub 16	1	0.0	8.1000	None	**67.140E-6**	8.4632	0.0012820	-	-	0 (Negligible)
			Max Settlement	Sub 16	1	0.0	8.1000	None	67.140E-6	**8.4632**	0.0012820	-	-	0 (Negligible)
			Max Tensile Strain	Sub 16	1	0.0	8.1000	None	67.140E-6	8.4632	**0.0012820**	-	-	0 (Negligible)
			Min Radius of Curvature (Hogging)		-	-	-	-	-	-	-	-	-	
			Min Radius of Curvature (Sagging)		-	-	-	-	-	-	-	-	-	
	0	R17	Max Slope	Sub 17	1	0.0	7.3799	None	**279.91E-6**	7.9639	0.0099917	-	-	0 (Negligible)
			Max Settlement	Sub 17	1	0.0	7.3799	None	279.91E-6	**7.9639**	0.0099917	-	-	0 (Negligible)
			Max Tensile Strain	Sub 17	2	7.3799	8.1000	None	277.36E-6	6.0808	**0.013733**	-	-	0 (Negligible)
			Min Radius of Curvature (Hogging)		-	-	-	-	-	-	-	-	-	
			Min Radius of Curvature (Sagging)		-	-	-	-	-	-	-	-	-	
	0	R18	Max Slope	Sub 18	1	0.0	8.1000	None	**420.70E-6**	5.8774	0.032984	-	-	0 (Negligible)
			Max Settlement	Sub 18	1	0.0	8.1000	None	420.70E-6	**5.8774**	0.032984	-	-	0 (Negligible)
			Max Tensile Strain	Sub 18	1	0.0	8.1000	None	420.70E-6	5.8774	**0.032984**	-	-	0 (Negligible)
			Min Radius of Curvature (Hogging)		-	-	-	-	-	-	-	-	-	
			Min Radius of Curvature (Sagging)		-	-	-	-	-	-	-	-	-	
	0	R19	Max Slope	Sub 19	1	0.0	2.7945	None	**273.71E-6**	3.1053	0.047037	-	-	0 (Negligible)
			Max Settlement	Sub 19	1	0.0	2.7945	None	273.71E-6	**3.1053**	0.047037	-	-	0 (Negligible)
			Max Tensile Strain	Sub 19	1	0.0	2.7945	None	273.71E-6	3.1053	**0.047037**	-	-	0 (Negligible)
			Min Radius of Curvature (Hogging)		-	-	-	-	-	-	-	-	-	
			Min Radius of Curvature (Sagging)		-	-	-	-	-	-	-	-	-	
	0	R20	Max Slope	Sub 20	2	4.0787	5.6845	None	**199.09E-6**	0.47304	1.3232E-6	-	-	0 (Negligible)
			Max Settlement	Sub 20	1	0.0	4.0787	None	199.04E-6	**1.2841**	4.4703E-6	-	-	0 (Negligible)
			Max Tensile Strain	Sub 20	1	0.0	4.0787	None	199.04E-6	1.2841	**4.4703E-6**	-	-	0 (Negligible)
			Min Radius of Curvature (Hogging)		-	-	-	-	-	-	-	-	-	
			Min Radius of Curvature (Sagging)		-	-	-	-	-	-	-	-	-	
	0	R21	All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
	0	R22	All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
	0	R23	All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
	0	R24	All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
	0	R25	All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
	0	R26	All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
	0	R27	All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
	0	R28	All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
	0	R29	All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											

Stage: Stage: Name Ref.	Specific Building: Ref.	Specific Building: Name	Parameter	Critical Sub-Building	Critical Segment	Start	End	Curvature	Max Slope	Max Settlement	Max Tensile Strain	Min Radius of Curvature (Hogging)	Min Radius of Curvature (Sagging)	Damage Category
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
	0	R30	All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
	0	R31	All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
	0	R32	All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
	0	R33	All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
	0	R34	All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
	0	R35	All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
	0	R36	All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
	0	R37	All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
	0	R38	All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
	0	R39	All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
	0	R40	All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
	0	R41	All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
	0	R42	All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
	0	R43	All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
	0	R44	All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											
			All vertical displacements are less than the limit sensitivity.											

Stage: Stage: Name Ref.	Specific Building: Ref.	Specific Building: Name	Parameter	Critical Sub-Building	Critical Start Segment	End	Curvature Max Slope	Max Settlement	Max Tensile Strain	Min Radius of Curvature (Hogging)	Min Radius of Curvature (Sagging)	Damage Category
	0	R45	All vertical displacements are less than the limit sensitivity.									
			All vertical displacements are less than the limit sensitivity.									
			All vertical displacements are less than the limit sensitivity.									
			All vertical displacements are less than the limit sensitivity.									
			All vertical displacements are less than the limit sensitivity.									

Appendix 3 Disclaimer

This report has been prepared by Milvum Engineer Services in its professional capacity as soil and groundwater specialists, with reasonable skill, care and diligence within the agreed scope and terms of contract and taking account of the manpower and resources devoted to it by agreement with its client, and is provided by Milvum Engineering Services solely for the use of its client (HDR Consulting Ltd / Regal London).

The advice and opinions in this report should be read and relied on only in the context of the report as a whole, taking account of the terms of reference agreed with the client. The findings are based on the information made available to Milvum Engineering Services at the date of the report (and will have been assumed to be correct) and on current UK standards, codes, technology and practices as at that time. They do not purport to include any manner of legal advice or opinion. New information or changes in conditions and regulatory requirements may occur in future, which will change the conclusions presented here.

This report is confidential to the client. The client may submit the report to regulatory bodies, where appropriate. Should the client wish to release this report to any other third party for that party's reliance, Milvum Engineering Services may, by prior written agreement, agree to such release, provided that it is acknowledged that Milvum Engineering Services accepts no responsibility of any nature to any third party to whom this report or any part thereof is made known. Milvum Engineering Services accepts no responsibility for any loss or damage incurred as a result, and the third party does not acquire any rights whatsoever, contractual or otherwise, against Milvum Engineering Services except as expressly agreed with Milvum Engineering Services in writing.

Network Rail may rely upon the content of this report for the purposes of assessing potential for impacts to their assets.