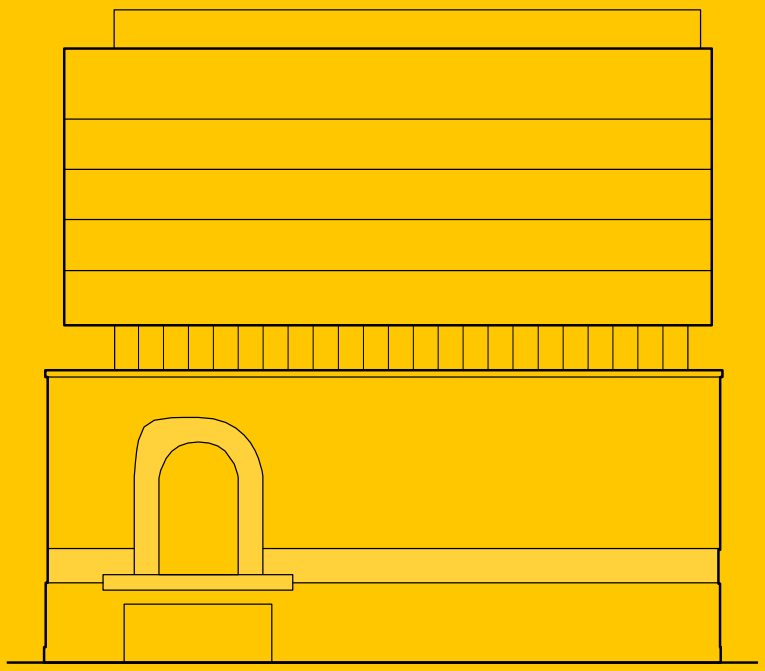

SAVILLE THEATRE

135 SHAFTESBURY AVENUE

BASEMENT IMPACT ASSESSMENT

3722-A2S-XX-XX-RP-Y-0001-04

A-SQUARED STUDIO ENGINEERS LTD

A-squared Studio

Saville Theatre

Basement Impact Assessment

April 2025

3722-A2S-XX-XX-RP-Y-0001-04

Project Name	Saville Theatre
Project Number	3722
Client	Yoo Capital Limited
Document Name	Basement Impact Assessment

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3722-A2S-XX-XX-RP-Y-0001-00	First Issue	-	00	JT	24.01.2025
3722-A2S-XX-XX-RP-Y-0001-01	Second Issue	Minor revision to proposed development detail	01	JT	31.01.2025
3722-A2S-XX-XX-RP-Y-0001-02	Third Issue	Minor revision to appended construction sequence drawings	02	JT	11.02.2025
3722-A2S-XX-XX-RP-Y-0001-03	Fourth Issue	Revision to address BIA audit and wall design now secant	03	JT	04.04.2025
3722-A2S-XX-XX-RP-Y-0001-04	Fifth Issue	Updated scheme drawings	04	JT	07.04.2025

Contents

Appendices

1. Non-Technical Summary

1.1.1. The site is located at Saville Theatre, 135 Shaftesbury Avenue, London, WC2H 8AH.

1.1.2. The site is currently occupied by a Grade II listed six- and seven-storey commercial building with a double-storey basement.

1.1.3. The island site is bound by Shaftesbury Avenue to the southeast, Stacey Street to the southwest, New Compton Street to the northwest and St Giles Passage to the northeast.

1.1.4. The site is located at the approximate National Grid Reference 529977E, 181149N and falls within the administrative boundaries of the London Borough of Camden.

1.1.5. The site is relatively flat across the entire footprint, with an approximate ground level between +22.50mOD and +23.00mOD.

1.1.6. The proposed commercial redevelopment comprises the extension of the existing two-storey basement to a five-storey basement while maintaining the existing basement footprint. The works will involve the partial demolition of the existing structure with partial retention of the building facades, followed by the construction of a five-storey vertical extension plus plant level on top of the existing building. The basement will extend to a depth of approximately 22.21m below ground level (the formation level of the new basement). The facades on the southeast (Shaftesbury Avenue), southwest (Stacey Street) and northeast (St Giles Passage) elevations will be fully retained, while the northwest (New Compton Street) elevation will be partially preserved. The proposed building loads will be supported by a suspended slab on pile foundations with steel plunge columns to support the top-down construction methodology.

1.1.7. The proposed earth retention system for the basement deepening comprises embedded pile walls.

1.1.8. A top-down construction sequence is proposed during the bulk excavation to the formation level. The perimeter basement slabs shall provide lateral restraint to the retaining wall during the excavation process, limiting lateral wall movements. The Preliminary Embedded Pile Wall Assessment highlights the requirement for the new perimeter B2 slab to be constructed prior to excavation to the B4 formation level. This shall ensure the horizontal deflections at the top of the wall remain within the allowable deflection limit proposed in the Buildings Damage Ground Movement Assessment.

1.1.9. The following assessments are presented in this Basement Impact Assessment:

- Screening.
- Scoping.
- Additional evidence / assessments (as required), including:
  - Hydrogeological assessment.
  - Building Damage Ground Movement Assessment.
  - Preliminary Thames Water Utilities Ground Movement Assessment.
  - Preliminary Embedded Pile Wall Assessment.
- Construction methodology and management plan.
- Architectural and structural drawings.
- Basement impact assessment.

1.1.10. Based on a review of the site-specific ground investigation and nearby historical BGS boreholes, the ground conditions in the area of the site are as follows:

- **Made Ground** to a depth of approximately 3.5m below ground level (bgl).
- **Lynch Hill Gravel Member** to a depth of approximately 4.7m bgl.
- **London Clay Formation** to a depth of approximately 34.4m bgl.

- **Lambeth Group** to a depth of approximately 47.0m bgl.
- **Thanet Formation** to a depth of approximately 55.5m bgl.
- The **White Chalk Subgroup** underlies the base of the Thanet Formation. The thickness and base of this stratum has not been proven; however, the strata below this are not considered to be of engineering significance to the scheme as the anticipated zone of influence of the proposed works will remain within the White Chalk Subgroup.

It is to be noted that the existing basement formation level is within the London Clay Formation.

1.1.11. The hydrogeological conditions in the area of the site, relevant to the proposed development, are anticipated to comprise:

- The Secondary 'A' Aquifer within the Lynch Hill Gravel Member is present surrounding the existing basement. The existing basement formation level is situated within the London Clay Formation, which is classified as an Unproductive Stratum, therefore a groundwater cut off is already in place for the proposed basement deepening. A groundwater table would not be expected to be present within the London Clay Formation, although pockets and partings of silt and fine sand can be water-bearing, particularly in regions of claystones.
- A hydrostatic porewater pressure distribution within the London Clay Formation.

1.1.12. The Basement Impact Assessment evaluates land stability and the potential effects of the proposed development on the neighbouring structures. Damage categories are expected to remain within Category 1 – Very Slight, as defined by the Burland Damage Scale. A preliminary ground movement assessment of the critical Thames Water assets has been conducted using traditional methods. The results indicate that the assets adjacent to the proposed basement exceed Thames Water's limiting strain criteria. However, a qualitative review highlights the conservatisms and limitations inherent in this approach. To address these issues, a more detailed and representative ground movement and impact assessment for Thames Water assets is required before the detailed design stage. This assessment will account for the favourable three-dimensional basement geometry and the complex construction sequence, which is not captured using traditional assessment methods.

1.1.13. The Basement Impact Assessment has identified that the existing basement and the proposed basement extension is underlain by the London Clay Formation, an Unproductive Stratum. Therefore, the cumulative impacts to groundwater flooding are negligible as the existing basement is already providing a groundwater cut-off.

2. Introduction

2.1. Overview

2.1.1. A-squared Studio Engineers Limited (A-squared) has been engaged by Yoo Capital Limited (Yoo Capital) to prepare a Basement Impact Assessment (BIA) for the proposed development at Saville Theatre, 135 Shaftesbury Avenue, London, WC2H 8AH (herein called the 'site').

2.1.2. The purpose of this assessment is to consider the potential effects of the proposed design on the local hydrology, geology, and hydrogeology, and to determine the potential impacts to neighbours and the wider environment.

2.1.3. The location of the proposed development is shown in Figure 2.1.

Figure 2.1 Location of the proposed development outlined in red

2.1.4. The development site is located within the jurisdiction of the London Borough of Camden.

2.1.5. The BIA adopts guidance from the 2018 Camden Planning Guidance: Basements and the ARUP Camden geological, hydrogeological and hydrological study, and comprises the following elements:

- Screening.
- Scoping.
- Additional evidence / assessments (as required), including:
  - Hydrogeological assessment.
  - Building Damage Ground Movement Assessment.
  - Thames Water Utilities Ground Movement Assessment.
  - Preliminary Embedded Pile Wall Assessment.
- Construction methodology and management plan.
- Architectural and structural drawings.
- Basement impact assessment.

2.2. Credentials

2.2.1. The BIA has been approved by Paul Smith. Paul is a Chartered Member of the Institution of Civil Engineers (MICE) with over 10 years of industry experience in geotechnical design and construction of ground engineering works. Paul has attained a post-graduate degree in Soil Mechanics (MSc DIC) from Imperial College London and a BEng in Civil Engineering.

2.2.2. The BIA has been reviewed by Adam Cadman. Adam is a Chartered Geologist, having 14 years of industry experience in engineering geology. Adam has a postgraduate MSc in Engineering Geology and BSc in Applied Geology.

2.3. Sources of Information

2.3.1. The following baseline data has been referenced to complete the BIA in relation to the proposed development:

- *Desk Study & Ground Investigation Report* prepared by Geotechnical & Environmental Associated Limited, dated 15 December 2017 (doc. ref. J17183 Issue 1).
- *Land Contamination Risk Management Preliminary Risk Assessment* prepared by Pell Frischmann Consultants Limited, dated 24 January 2024 (doc. ref. 105465-PEF-ZZ-XX-RP-GG-600001 rev P02).
- *Pile Loads* Mark-Up prepared by Elliott Wood Partnership Limited, dated 8 January 2025.
- *Existing loads (Based on assumptions)* prepared by Elliott Wood Partnership Limited, received 07 January 2025.
- Proposed scheme drawings prepared by Elliott Wood Partnership Limited, dated 21 January 2025 (doc. refs. 2111-EWP-ST-B4-DR-S-060000 WIP, B3-DR-S-070000 WIP, B2-DR-S-080000 WIP, B1-DR-S-090000 WIP, B1-DR-S-095000 WIP, B1-DR-S-097000 P01 WIP, 00-DR-S-100000 WIP).
- Proposed scheme drawings prepared by Elliott Wood Partnership Limited, dated June 2024 (doc. refs. 2240073-EWP-ZZ-B4-SK-S-0030 P2, B3-SK-S-0031 P1, B2-SK-S-0032 P1, B1-SK-S-0033 P1, 0G-SK-S-0034 to 0035 P1, 01-SK-S-0036 P1, 02-SK-S-0037 P1, 03-SK-S-0038 P1, 04-SK-S-0039 P1, 05-SK-S-0040 P1, 06-SK-S-0041 P1, 07-SK-S-0042 P1, 08-SK-S-0043 P1, 09-SK-S-0044 P1, 10-SK-S-0045 P1, 11-SK-S-0046 P1, ZZ-SK-S-0047 P1, XX-SK-S-0048 P1, XX-SK-S-0049 P1).
- *Proposed Sequence Sketches* prepared by Elliott Wood Partnership Limited, dated January 2025 (doc. ref. 2240073-EWP-ZZ-XX-S2-S-XXX P1).
- *Site Section – Existing Building* prepared by Elliott Wood Partnership Limited, dated January 2025 (doc. refs. 2240073-EWP-ZZ-XX-SK-S-0077 to 0078 P1).
- Existing building drawings prepared by Buckley Gray Yeoman Limited, dated May 2024 (doc. refs. 1232-PL-ES-01 to 02 P1).
- Existing building drawings prepared by DSDHA Limited, dated November 2024 (doc. refs. 125SA-DSD-ZZ-ZZ-DR-A-23001 to 23003 P01).
- Existing building drawings prepared by SPPARC Architecture LLP, dated May 2024 (doc. refs. 2111-SPP-ST-B2-DR-A-02-1001 P0.02, B1-DR-A-02-1002 P0.02, 0G-DR-A-02-1003 P0.02, 01-DR-A-02-1004 P0.02, 02-DR-A-02-1005 P0.02, 03-DR-A-02-1006 P0.02, 04-DR-A-02-1007 P0.02, 05-DR-A-02-1008 P0.02, RF-DR-A-02-1009 P0.02,ZZ-DR-A-02-0001 to 3004 P0.02).
- Archive drawings prepared by T.P. Bennett & Son, dated February 1930 (drawing nos. 20 to 52)
- Asset Location Search Sewer & Water Map prepared by Thames Water Utilities Limited, received January 2025 (doc. ref. ALS/ALS Standard/2021_4464529 pages 6 to 10).

2.4. Existing Development

2.4.1. The development is located at 135 Shaftesbury Avenue, London, WC2H 8AH.

2.4.2. The plot has approximate dimensions of 38m-long by 29m-wide.

2.4.3. The site is relatively flat across the entire footprint, with an approximate ground level between +22.50mOD and +23.00mOD.

2.4.4. The areas surrounding the site are generally flat at approximately the same level as the site.

2.4.5. The site is currently occupied by a Grade II listed six- and seven-storey commercial building with a double-storey basement. The existing basement extends to approximately 8.50m below ground level, at the level +14.25mOD.

2.4.6. The existing building is founded on a slab

2.4.7. slab at B2 level, with a reinforced concrete retaining wall to support the double-storey basement.

2.5. Neighbouring Properties and Infrastructure

2.5.1. The site is surrounded by various public roads, footpaths, buildings and underground assets.

2.5.2. Buildings, as shown in Figure 2.2, considered to be within the zone of influence of the proposed development works include:

- Nos 96 to 125 Shaftesbury Avenue to the southwest.
- Nos 115 to 119 Shaftesbury Avenue to the southwest.
- Nos 90 to 94 Charing Cross Road to the southwest.
- Nos 144 to 162 Shaftesbury Avenue to the southeast.
- No 164 Shaftesbury Avenue to the southeast.
- Earlham House to the southeast.
- 3-35 Earlham Street to the southeast.
- Mountbatten Hotel to the southeast.
- Gower Street Memorial Chapel to the east.
- Nos 15 to 31 Monmouth Street to the east.
- Nos 14 to 16 Monmouth Street to the east.
- Nos 166 to 170 Shaftesbury Avenue to the east.
- Nos 172 to 176 Shaftesbury Avenue to the northeast.
- Shaftesbury House to the northeast.
- Nos 167 to 177 Shaftesbury Avenue to the northeast.
- Nos 8 to 45 New Compton Street to the north.
- Pheonix Garen to the northwest.
- Nos 1 to 8 Phoenix Street to the northwest.

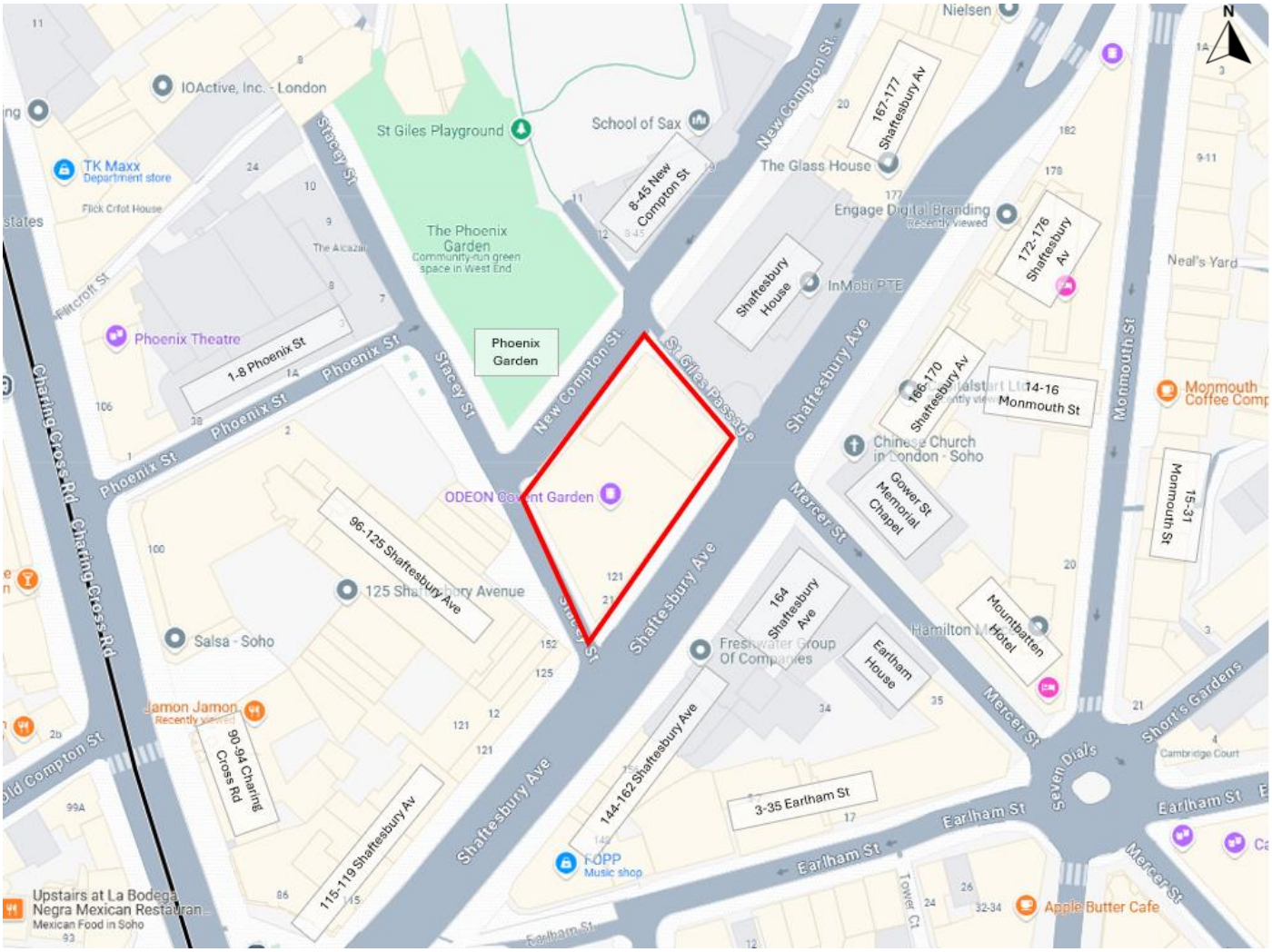

Figure 2.2 Markup of buildings within the zone of influence of the proposed works

2.5.3. Asset owners with existing underground services that may be impacted by the proposed development include, but not limited to, the following:

- London Borough of Camden and the Greater London Authority.
- Thames Water Utilities Ltd– clean and wastewater.
- Crossrail tunnel to the north of the site, an additional GMA may be required for this asset.
- Virgin Media Ltd and BT (BT Group Plc) – Telecoms.
- UK Power Networks Ltd and National Grid Electricity Transmissions Plc – Electricity distribution.

2.5.4. Asset protection teams for the assets listed under Section 2.5.3 will be engaged as the design of the proposed development progresses. Where necessary, separate Ground Movement Assessments (GMAs) will be prepared in order to meet design assurance requirements.

2.6. Proposed Development

2.6.1. Drawings of the proposed development are included in Appendix A.

2.6.2. The proposed commercial redevelopment comprises the extension of the existing two-storey basement to a five-storey basement while maintaining the existing basement footprint. The works will involve the partial demolition of the existing structure with partial retention of the building facades, followed by the construction of a five-storey vertical extension plus plant level on top of the existing building. The basement will extend to a depth of approximately 22.21m below ground level (the formation level of the new basement). The facades on the southeast (Shaftesbury Avenue), southwest (Stacey Street) and northeast (St Giles Passage) elevations will be fully retained, while the northwest (New Compton Street) elevation will be partially preserved. The proposed building loads will be supported by a suspended slab on pile foundations with steel plunge columns to support the top-down construction methodology. The proposed basement plan is presented in Figure 2.3 and Figure 2.4

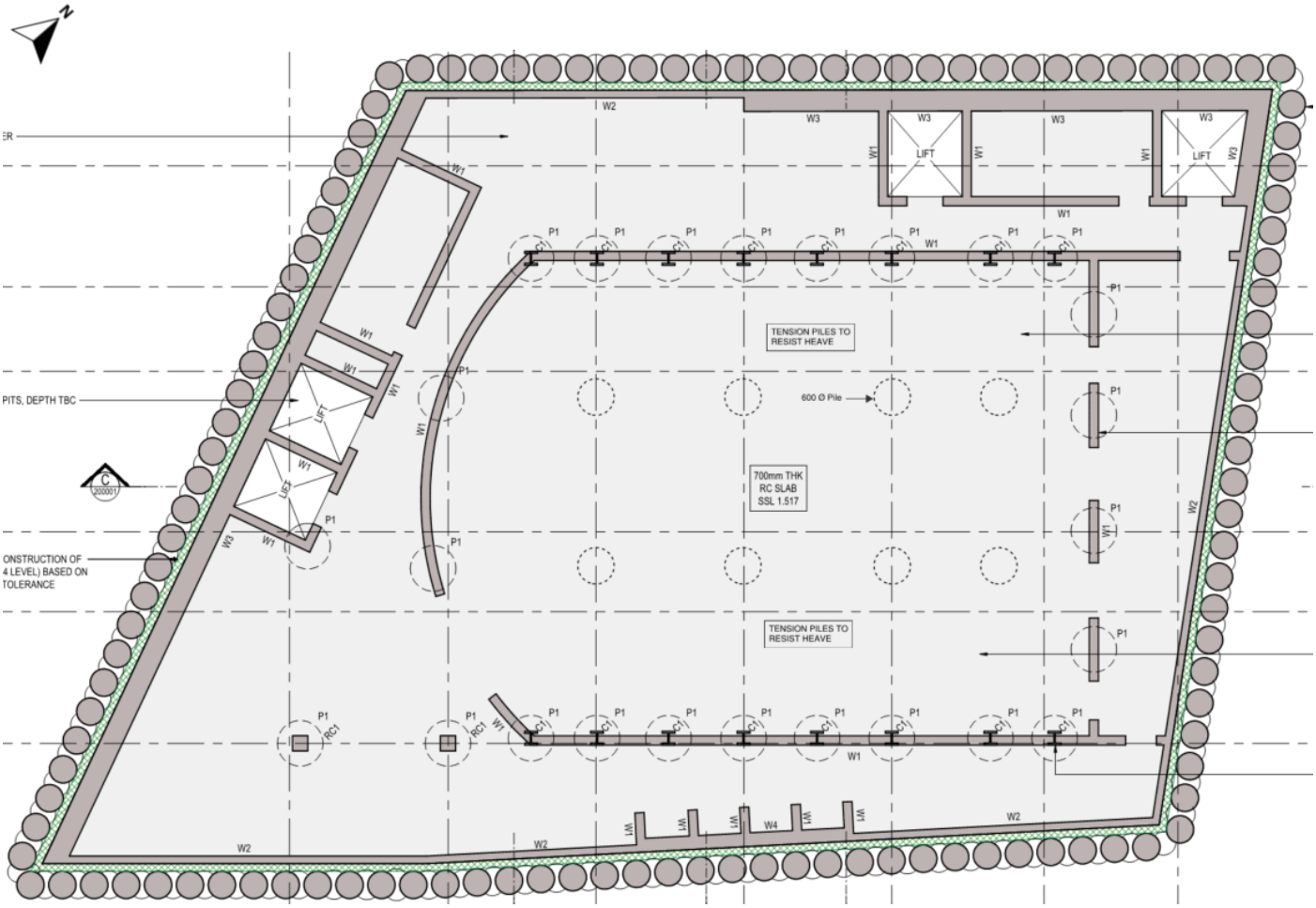

Figure 2.3 Proposed B4 level plan (source: *2111-EWP-ST-B4-DR-S-060000 WIP 21/05/2025*)

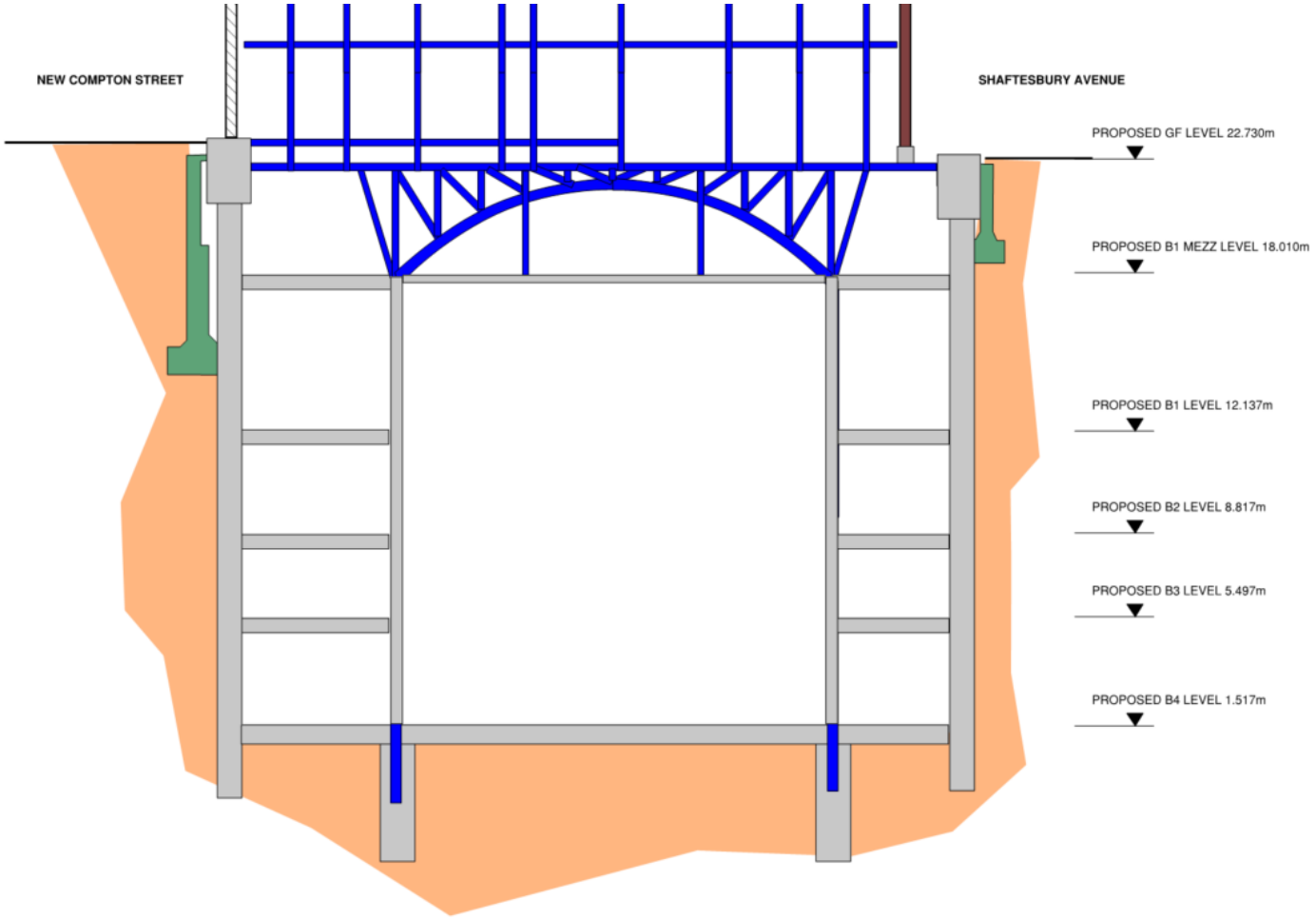

Figure 2.4 Proposed Basement Section (source: *Proposed Sequence Sketches prepared by Elliott Wood Partnership Limited, dated January 2025 (doc. ref. 2240073-EWP-ZZ-XX-S2-S-XXX P1*))

2.6.3. The existing double-storey basement is proposed to be deepened to five-storeys (22.21m bgl) as part of the development.

2.6.4. The basement perimeter is proposed to be retained by an embedded pile wall.

2.6.5. The building is to be founded on pile foundations, with steel plunge columns to support the top-down methodology.

2.6.6. A top-down construction sequence is proposed during the bulk excavation to the formation level. The basement slabs shall provide lateral restraint to the retaining wall during the excavation process, limiting lateral wall movements. Such measures will increase the system stiffness of the retaining walls and reduce the risk of adversely affecting neighbouring structures and third-party assets, due to excessive ground movement. The Preliminary Embedded Pile Wall Assessment highlights the requirement for the new perimeter B2 slab to be constructed prior to excavation to the B4 formation level. This shall ensure horizontal deflections at the top of the wall are at the allowable deflection limit proposed in the Buildings Damage GMA. The Buildings Damage GMA will define the limits of the lateral retaining wall deflection which must be adhered to.

2.6.7. The following construction sequence is envisaged for the works:

- Install pile wall through Shaftesbury Avenue vaults.
- Internally install temporary piles with plunge columns for Shaftesbury Avenue façade retention frames.
- Façade retention works to Shaftesbury Avenue, Stacey Street, St Giles Passage and New Compton Street.
- Install temporary propping frames below ground level and at existing B1 level.
- Demolish existing B1 slab.
- Install temporary piling platform to existing B1 level, removing the temporary propping frames in sequence.

- Commence piling works to the remaining elevations and construct capping beam.
- Remove temporary piling platform down to the proposed B1 Mezzanine level and install transfer arches. Support steel arches to steel plunge columns and connect to the capping beams.
- Construction of the proposed Ground Floor with required molehole.
- Demolish existing B2 slab.
- Excavate to proposed B1 level.
- Cast perimeter basement slabs at proposed B1 Mezzanine and B1 levels.
- Install temporary propping frame at proposed B1 level.
- Excavate to proposed B2 level.
- Construct proposed B2 perimeter slab.
- Excavate to proposed B4 level.
- Construct proposed B4 slab.
- Construct proposed B3 perimeter slab.
- Remove temporary propping frame at proposed B1 level.
- Construct proposed B1 Mezzanine slab.

3. Desk Study and Site Investigation

3.1. Desk Study

3.1.1. A desk study for the site was carried out by Geotechnical & Environmental Associated Limited (GEA). Details of the desk study are included in the *Desk Study & Ground Investigation Report*, dated 15 December 2017 (doc. ref. *J17183 Issue 1*).

3.1.2. The desk study and ground investigation report has been used to inform this BIA.

3.1.3. The relevant findings of the Desk Study are summarised below:

"The British Geological Survey (BGS) map of the area (Sheet 256) indicates the area surrounding the site to be underlain by Lynch Hill Gravel over London Clay.

GEA has previously carried out a ground investigation immediately to the northwest of the site. The investigation encountered Made Ground to depths of between 4.2 m and 4.5 m. Below this, the Lynch Hill Gravel typically comprised medium dense orange-brown slightly clayey and silty gravelly sand and extended to a depth of 5.20 m. The London Clay initially comprised soft becoming firm brown silty sandy clay and extended to a depth of 5.60 m, whereupon firm becoming very stiff brownish grey silty slightly sandy fissured clay was encountered and extended to a depth of 12.25 m. Very stiff brownish grey sandy fissured clay with partings of grey fine sand was then encountered and extended to the maximum depth investigated, of 15.00 m.

The findings of the previous ground investigation suggest that the existing 8.7 m deep basement extends through the Lynch Hill Gravel to found within the London Clay.

The London Clay is classified as an Unproductive Stratum, which refers to rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow, as defined by the Environment Agency (EA). The Lynch Hill Gravel is classified as a Secondary 'A' Aquifer, which refers to permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

Groundwater is likely to be present within the surrounding Lynch Hill Gravel and is also likely to flow in a southerly direction, towards the River Thames. A groundwater table would not be expected to be present within the London Clay, although this formation does include pockets and partings of silt and fine sand that can be water-bearing, particularly in the region of claystones. Published data indicates the horizontal permeability of the London Clay to generally range between 1 x 10^{-10} m/s and 1 x 10^{-8} m/s, with an even lower vertical permeability.

During the neighbouring ground investigation, groundwater was encountered as seepages at the base of the Made Ground and within the gravels, at depths of between 4.50 m and 4.80 m. Subsequent monitoring indicated groundwater to be at depths of between 4.30 m and 4.50 m. The findings of the neighbouring ground investigation suggests that groundwater is present within the Lynch Hill Gravel, through which the existing 8.7 m deep basement extends and founds within the relatively impermeable London Clay.

The nearest surface water feature is the River Thames, which is located 786 m to the southeast of the site. The site is not located in close proximity to any of the known Lost Rivers of London. The site is not at risk of flooding from rivers or sea, as defined by the Environment Agency. The site is located in an area identified as having a potential for groundwater flooding of property situated below the ground to occur. The site is not identified as being at risk of surface water flooding, although Shaftesbury Avenue is recorded as having a high risk. The site is not located within a source protection zone."

3.2. Site-specific Investigation

3.2.1. A site-specific ground investigation was carried out by GEA from October to November 2017. The findings of the site investigation have been included in Appendix B.

3.2.2. The ground investigation was undertaken from 11 October to 30 November 2017 and comprised the following:

1. One cable percussive borehole, drilled to a maximum depth of 35.00m bgl with associated in-situ testing and sampling.
2. One standpipe and one piezometer within the borehole to depth of 5.00m and 20.00m respectively.
3. Two subsequent groundwater monitoring visits.
4. One trial pit (abandoned).
5. Two horizontal concrete cores advanced within the existing basement to determine the composition and material properties of the retaining walls.
6. Geotechnical in-situ and laboratory testing.
7. Geo-environmental laboratory testing.
8. Groundwater and gas monitoring.

3.2.3. The locations of the ground investigation positions are presented Figure 3.1.

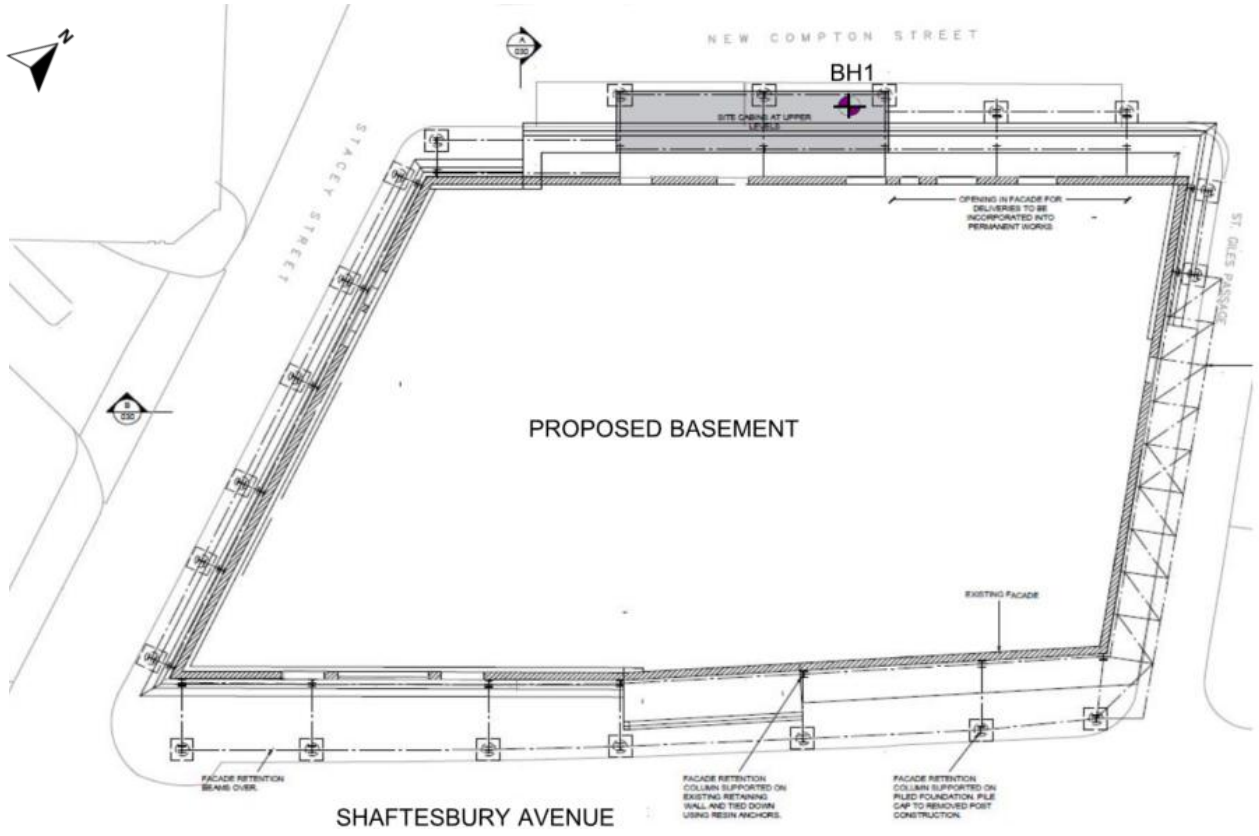

Figure 3.1 Ground investigation location (source: *J17183 Issue 1*)

3.2.4. The ground conditions encountered onsite are summarised in Table 3.1. The groundwater monitoring results are given in Table 3.2.

Table 3.1 Summary of the encountered geological profile

Stratum	Depth Encountered (m bgl)	Thickness (m)	Descriptions
Made Ground	0.00	3.50	Dark brown silty sandy very gravelly CLAY with brick and concrete fragments and occasional coal fragments.
Lynch Hill Gravel Member	3.50	1.20	Medium dense orange-brown coarse gravelly SAND with abundant fine to medium subangular to angular flint gravel.
London Clay Formation	4.70	29.70	Firm becoming very stiff dark brownish grey silty slightly sandy becoming very sandy CLAY.
Lambeth Group	34.40	>0.60 (NP)	Very stiff greenish grey and bluish grey mottled reddish brown and brown very silty, slightly sandy CLAY.

NP - thickness of stratum not proven

Table 3.2 Groundwater level monitoring results

Reference	Bottom of well (m bgl)	Depth to water (m bgl)	
		06/11/2017	30/11/2017
BH1 50mm standpipe	5.00	Not accessible	4.39
BH1 19mm piezometer	20.00	5.25	5.28

3.3. Nearby Historical Boreholes

3.3.1. The site-specific ground investigation extends to a maximum depth of 35.00m bgl. To determine the expected ground conditions beyond this depth, nearby historical boreholes from the BGS GeoIndex have been reviewed.

3.3.2. Based on a review of the nearby boreholes, *TQ38SW5470* and *TQ28SE2799*, the following strata expected below the base of the London Clay Formation are summarised in Table 3.3.

Table 3.3 Summary of the encountered geological profile from nearby historical boreholes

Stratum	Depth Encountered (m bgl)	Thickness (m)	Descriptions
Lambeth Group	30.15 to 33.20	16.85 to 19.55	Stiff to hard fissured brown mottled yellowish brown and bluish grey CLAY with beds of very dense greyish green mottled reddish brown fine to medium SAND. Sand beds are generally less than 1.0m thick.
Thanet Formation	38.20 to 47.00	3.95 to 7.50	Very dense dark grey silty fine and medium SAND. Basal bed of black brown angular to subangular fine to coarse flint GRAVEL, less than 500mm thick (Bullhead Beds).
Chalk Group	54.50 to 56.70	>2.40 (NP)	Extremely weak to very weak low density white CHALK.

4. Screening

4.1. Groundwater Flow Flowchart

	Question	Response	Details
1a.	Is the site located directly above an aquifer?	No	The existing basement formation level is underlain by the London Clay Formation; an Unproductive Stratum.
1b.	Will the proposed basement extend beneath the water table surface?	Yes	The water table surface is situated within the Lynch Hill Gravel Member, a Secondary 'A' Aquifer. The existing basement formation level is below the shallow aquifer and within the London Clay Formation. The proposed basement deepening will remain within the London Clay Formation.
2.	Is the site within 100m of a watercourse, well (used / disused) or potential spring line?	Yes	Correspondence from the Covent Garden Community Association suggest that according to a historical map from 1534, a watercourse previously existed in proximity to the site. The nearest surface water feature is the River Thames, located approximately 786m to the southeast of the site. The site is not located near any of the known Lost Rivers of London.
3	Is the site within the catchment of the pond chains on Hampstead Heath?	No	The site is not within the catchment of the pond chains on Hampstead Heath.
4.	Will the proposed basement development result in a change in the proportion of the hard surfaced / paved areas?	No	The basement extension will remain within the existing footprint and surrounding areas of hardstanding shown on the proposed scheme drawings.
5.	As part of the site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to the ground (e.g. via soakaways and / or SUDS)?	No	Impermeable areas (hardstanding/pavements/roofs) shall remain unchanged.
6.	Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to, or lower than, the mean water level in any local pond or spring line?	No	There are no local ponds or spring lines in proximity to the site. The London Clay is an Unproductive Stratum and therefore not able to support such features.

4.2. Land Stability Flowchart

	Question	Response	Details
1.	Does the existing site include slopes, natural or man-made, greater than 7 degrees (approximately 1 in 8)?	No	The site in its existing condition is generally flat.
2.	Will the proposed re-profiling or landscaping at the site change slopes at the property boundary to more than 7 degrees (approximately 1 in 8)?	No	Re-profiling / landscaping is not proposed.
3.	Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7 degrees (approximately 1 in 8)?	No	The surrounding land is generally flat.

	Question	Response	Details
4.	Is the site within a wider hillside setting in which the general slope is greater than 7 degrees (approximately 1 in 8)?	No	The site is not located within a wider hillside setting.
5.	Is the London Clay the shallowest strata at the site?	No	A review of the published/unpublished geological data has proven that the London Clay Formation is overlain by the Lynch Hill Gravel Member. However, the existing basement level is within the London Clay Formation and the shallowest stratum beneath the proposed basement is the London Clay Formation.
6.	Will any trees be felled as part of the development and/or are any works proposed within any tree protection zones where trees are to be retained?	No	No trees will be felled as part of the proposed development.
7.	Is there a history of seasonal shrink-swell subsidence in the local area and/or evidence of such effects at the site?	No	The Lynch Hill Gravel Member is the shallowest strata in the surrounding area and not susceptible to shrink-swell behaviour. There is no evidence of such effects at the site.
8.	Is the site within 100m of a watercourse or a potential spring line?	Yes	Correspondence from the Covent Garden Community Association suggest that according to a historical map from 1534, a watercourse previously existed in proximity to the site. The nearest surface water feature is the River Thames, located approximately 786m to the southeast of the site. The site is not located near any of the known Lost Rivers of London.
9.	Is the site within an area of previously worked ground?	No	The site is not located within an area of previously worked ground according to the BGS GeoIndex.
10.	Is the site within an aquifer? If so, will the proposed basement extend beneath the water table such that dewatering may be required during construction?	Yes	The site is situated within the Lynch Hill Gravel Member, a Secondary 'A' Aquifer. The existing basement formation level is below the shallow aquifer and within the London Clay Formation. The proposed basement deepening will remain within the London Clay Formation.
11	Is the site within 50m of the Hampstead Heath ponds	No	The site is not within 50m of the Hampstead Heath ponds.
12.	Is the site within 5m of a highway or pedestrian right of way?	Yes	The island site is bound by Shaftesbury Avenue to the southeast, Stacey Street to the southwest, New Compton Street to the northwest and St Giles Passage to the northeast. The basement will extend through the existing vaults beneath the pavements.
13.	Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	Yes	The site does not share any party walls with neighbouring properties. The proposed deepening of the basement will increase the foundation depth with neighbouring structures. The basement columns will be supported on bearing piles.
14.	Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines?	No	There is a Crossrail tunnel approximately 26m from the northern corner of the site. The crown depth is approximately 17.5m bgl (+5.5mOD)

4.3. Surface Flow and Flooding Flowchart

	Question	Response	Details
1.	Is the site within the catchment of the pond chains on Hampstead Heath?	No	The site is not within the catchment of the pond chains on Hampstead Heath.
2	As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route?	No	The basement extension will remain within the existing footprint and surrounding areas of hardstanding. Impermeable areas (hardstanding/pavements/roofs) shall remain unchanged, therefore no change to existing drainage route.
3.	Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas?	No	The basement extension will remain within the existing footprint and surrounding areas of hardstanding shown on the proposed scheme drawings.
4.	Will the proposed basement result in changes to the profile of the inflows (instantaneous and long-term) of surface water being received by adjacent properties or downstream watercourses?	No	The basement extension will remain within the existing footprint and surrounding areas of hardstanding. Impermeable areas (hardstanding/pavements/roofs) shall remain unchanged, therefore no change to the profile of the inflows.
5.	Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No	The basement extension will remain within the existing footprint and surrounding areas of hardstanding, therefore there will be no changes to the quality of the surface water.
6.	Is the site in an area identified to have surface water flood risk according to either the Local Flood Risk Management Strategy or the Strategic Flood Risk Assessment or is it at risk from flooding, for example because the proposed basement is below the static water level of nearby surface water feature?	No	Based on the Environment Agency Flood Map, the site is within Flood Zone 1. The current risk of surface water flooding is considered low. The risk of flooding from rivers and the sea is considered very low. The risk of flooding from groundwater and reservoirs is considered unlikely. The Camden flood event on 7th August 2002, detailed in the Arup study, revealed that even after torrential rainfall, the area and roads surrounding the site did not flood.

4.4. Non-Technical Summary of Screening Process

4.4.1. The screening process identifies the following issues to be carried forward to scoping for further assessment:

1. The site is within 100m of a watercourse.
2. The proposed basement will extend beneath the water table surface.
3. The site is located within an aquifer.
4. The site is within 5m of a highway or pedestrian right of way.
5. The proposed basement may significantly increase the differential depth of foundations relative to neighbouring properties.

4.4.2. The other potential concerns considered with the screening process have been demonstrated to be not applicable or not significant when applied to the proposed development.

5. Scoping

5.1. Groundwater Flow & Land Stability: The site is located within an aquifer, the proposed basement will extend beneath the water table surface and the site is located within 100m of a watercourse.

Hazards

5.1.1. The site is situated within the Lynch Hill Gravel Member, a Secondary 'A' Aquifer.

5.1.2. Correspondence from the Covent Garden Community Association suggest that according to a historical map from 1534, a watercourse previously existed in proximity to the site.

Potential Impacts

5.1.3. Alterations to the existing groundwater flow and land stability with the Lynch Hill Gravel Member and the previously existing watercourse in proximity to the site.

Mitigating Factors

5.1.4. The existing basement formation level is below the shallow aquifer and within the London Clay Formation. The proposed basement deepening will remain within the London Clay Formation.

5.1.5. The London Clay Formation is an Unproductive Stratum and cannot support a water table.

5.1.6. The proposed works will therefore not alter existing restrictions to groundwater present within the Lynch Hill Gravel Member or the existing watercourse in proximity to the site.

5.2. Land Stability: The site is within 5m of a highway or pedestrian right of way and proposed basement may significantly increase the differential depth of foundations relative to neighbouring properties.

Hazards

5.2.1. The proposed excavation is bound by Shaftesbury Avenue to the southeast, Stacey Street to the southwest, New Compton Street to the northwest, St Giles Passage to the northeast and associated footpaths.

5.2.2. There are several buildings within the zone of influence of the proposed works.

Potential Impacts

5.2.3. Collapse of the excavation and associated impact on the surrounding highways and foundations.

5.2.4. Damage to the road surface or buried services within the public road easement due to excessive ground movements.

5.2.5. Ground movements arising due to the construction and excavation of proposed basements may impact surrounding highways and neighbouring foundations.

Mitigating Factors

5.2.6. The proposed basement deepening is from a depth of ~5m into the London Clay Formation, which is not weathered and anticipated to be relatively stable.

5.2.7. Basements of similar depths and scale have been successfully constructed throughout London with similar geological conditions and urban settings.

5.2.8. The scheme basement design and temporary works proposals shall be developed in a robust fashion and in line with current industry best practice in order to limit the impact of ground movements resulting from basement construction.

5.2.9. The Ground Movement Assessment in in Section 6.2 identifies horizontal and vertical ground movement at the pavement edge along Shaftesbury Avenue. No specific highways impact assessment has been carried out to date. Ground movements will be monitored during works, and any superficial cracking in the pavement or highways may require repair.

Assessments and Further Actions

5.2.10. The site investigation has been reviewed and is considered to be sufficient to inform the BIA without the need for further ground investigation.

5.2.11. The Buildings Damage GMA produced as part of this BIA show that the impact of the proposed scheme on neighbouring structures within the zone of influence of the works, will be limited to Category 1 – Very Slight, in accordance with the Burland Damage Scale. All assessed facades and roads have been assumed to at ground level which is conservative.

5.2.12. A preliminary assessment of the Thames Water assets has been conducted using traditional methods. The results indicate that the critical assets adjacent to the proposed basement exceed Thames Water's limiting strain criteria. However, a qualitative review highlights the conservatisms and limitations inherent in this approach. To address these issues, a more detailed and representative ground movement and impact assessment for Thames Water assets is required before the detailed design stage. This assessment will account for the favourable three-dimensional basement geometry and the complex construction sequence.

6. Additional Assessments

6.1. Hydrogeological Assessment

6.1.1. The proposed basement deepening will remain within the footprint of the existing basement, which is founded in London Clay Formation. The extension to the B4 basement level also lies within the London Clay Formation, a geological formation classified as an Unproductive Stratum, meaning it does not significantly influence groundwater movement or storage.

6.1.2. As there are no changes proposed to the existing hydrogeological conditions, no additional hydrogeological assessments are required.

6.2. Building Damage Ground Movement Assessment

6.2.1. A detailed building damage ground movement assessment has been undertaken for the retained facades of the existing building and the facades of the adjacent properties to the proposed basement works.

6.2.2. The impact of the proposed works on the retained facades and the neighbouring properties has been assessed in detail, in accordance with typical industry thresholds and current best practice, with report reference *3722-A2S-XX-XX-RP-Y-0002*, provided in Appendix D.

6.2.3. A series of three-dimensional models of the proposed scheme have been developed in Oasys PDisp / XDisp software and combined by means of superposition to enable ground movement assessments to be carried out representing the various construction stages. The ground movement displacement fields have been separated into two groups (A and B) based on the approach followed, detailed below:

Group A – Unloading / Loading ground movements

A1. Building demolition and basement excavation (short-term).

A2. Building demolition, basement excavation and application of the proposed building loading (long-term).

Group B – CIRIA C760 - based ground movements

B1. Secant pile wall installation and basement excavation.

B2. Secant pile wall installation, basement excavation and application of the building loading (long-term).

6.2.4. The potential impact/damage induced on primary façade/wall elements of the buildings surrounding the proposed scheme have been evaluated based on the calculated ground movement fields. In total, 150No. façades of the existing retained building and of the neighbouring buildings were considered for the current study. The nomenclature and the locations of the building façades is shown in Figure 6.1 and Figure 6.2.

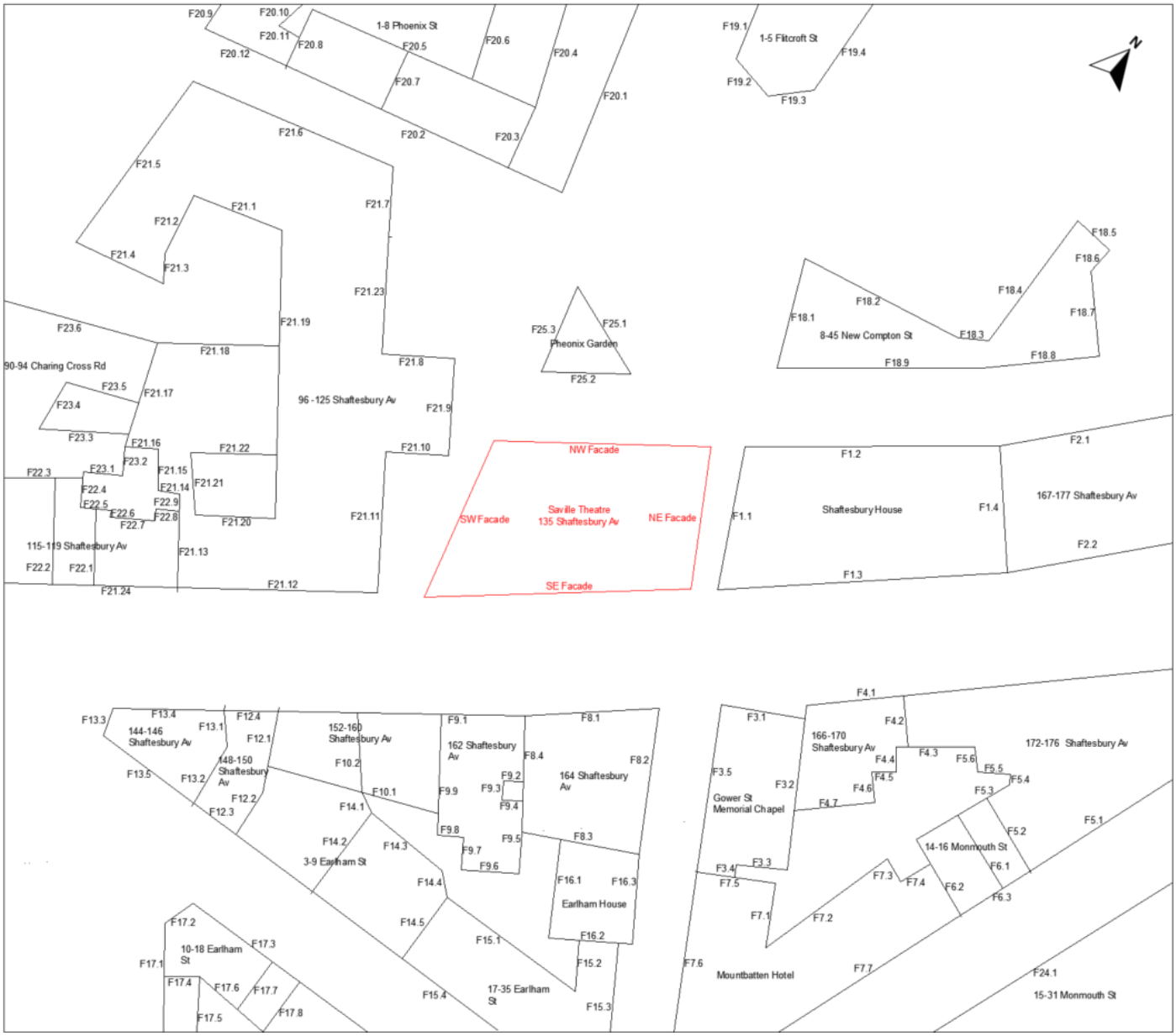

Figure 6.1 Summary of façade nomenclature location

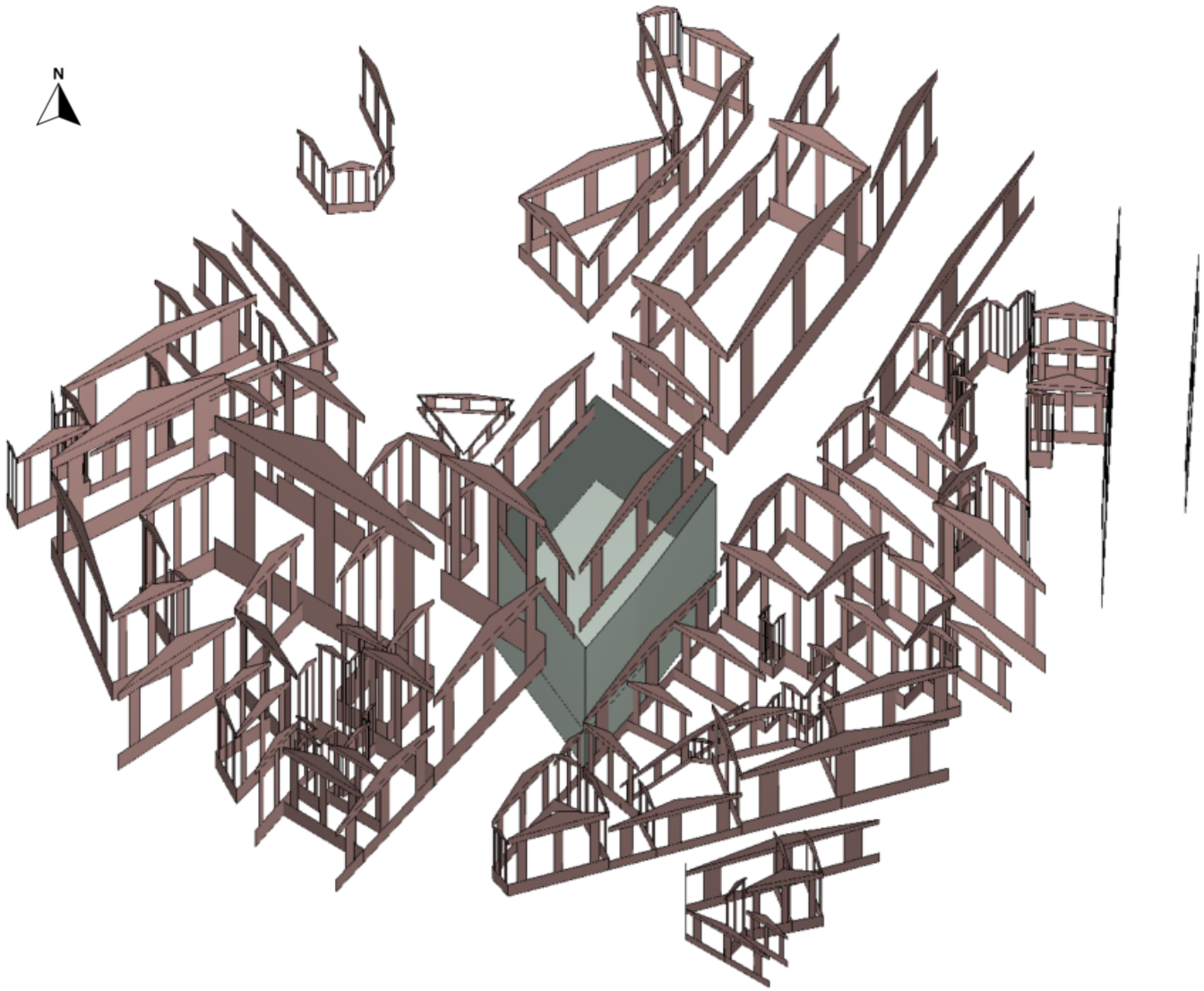

Figure 6.2 XDisp model geometry

6.2.5. The results of the assessment for the retained facades of the existing building, 135 Shaftesbury Avenue, are presented in Table 6.1. The results of the analyses show that all retained facades will fall within the acceptable damage classification according to the Burland assessment criteria (i.e. not exceeding *Category 1 – Very Slight*).

Table 6.1 Retained facades evaluated damage categories from XDisp

Façade Reference	Analysis Scenario			
	A1	A2	B1	B2
NE Façade	Category 0 (Negligible)	Category 1 (Very Slight)	Category 0 (Negligible)	Category 0 (Negligible)
SE Façade	Category 1 (Very Slight)	Category 1 (Very Slight)	Category 0 (Negligible)	Category 0 (Negligible)
SW Façade	Category 0 (Negligible)	Category 0 (Negligible)	Category 0 (Negligible)	Category 0 (Negligible)
NW Façade	Category 1 (Very Slight)	Category 1 (Very Slight)	Category 0 (Negligible)	Category 0 (Negligible)

6.2.6. The result for the neighbouring buildings indicates that the damage classification according to the Burland assessment criteria for the nearest masonry façades would be no greater than *Category 1 – Very Slight.*

6.2.7. Figure 6.3 to Figure 6.8 presents the vertical and horizontal displacements from the XDisp output as per the Groups outlined in 6.3.3.

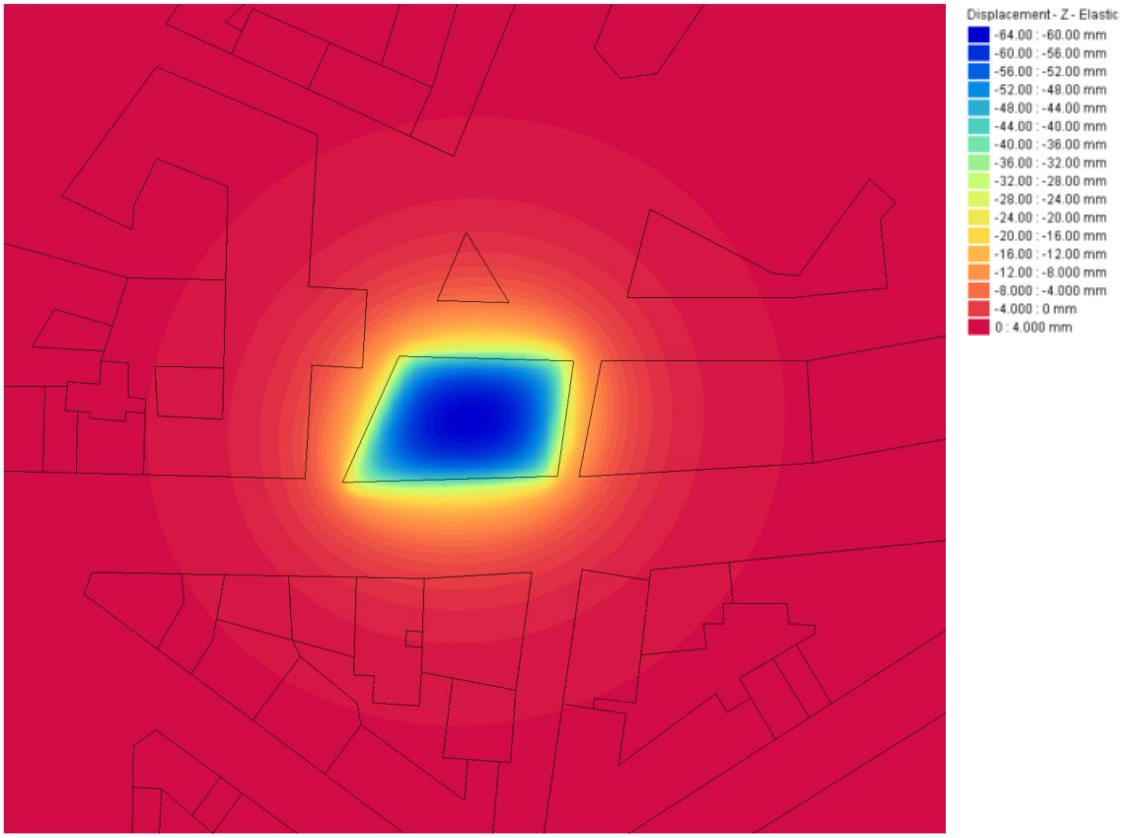

Figure 6.3 XDisp output A1 - Demolition & basement excavation (short-term) vertical displacement (-ve = upward movement, +ve = downward movement)

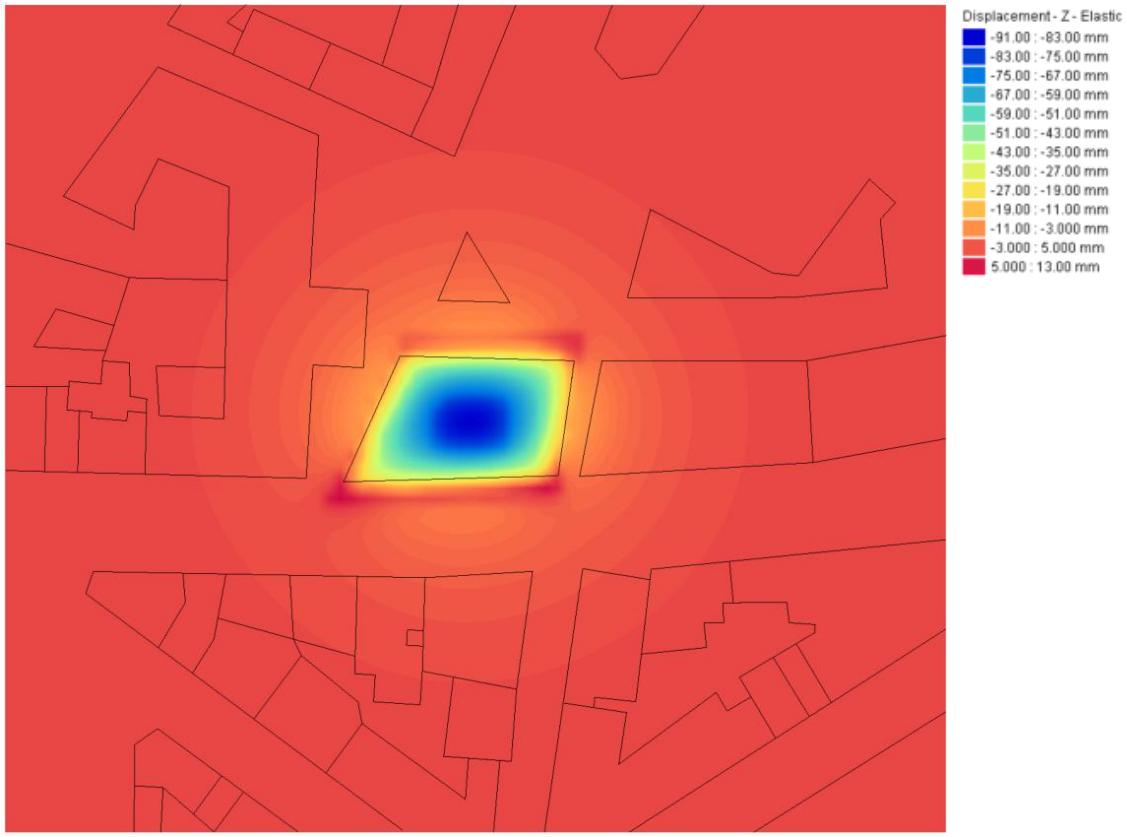

Figure 6.4 XDisp output A2 – Demolition, basement excavation & long-term building loading vertical displacement (-ve = upward movement, +ve = downward movement)

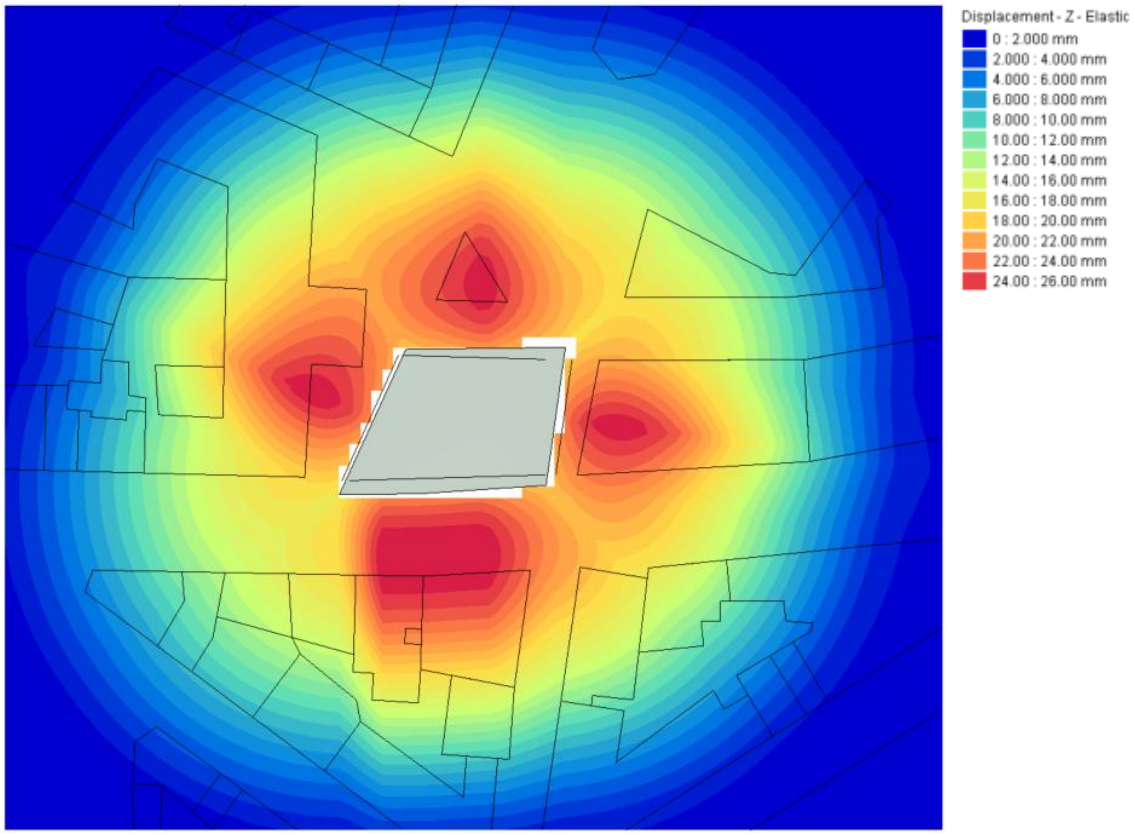

Figure 6.5 XDisp B1 – Wall installation & basement excavation (CIRIA curves) – vertical displacement (-ve = upward movement, +ve = downward movement)

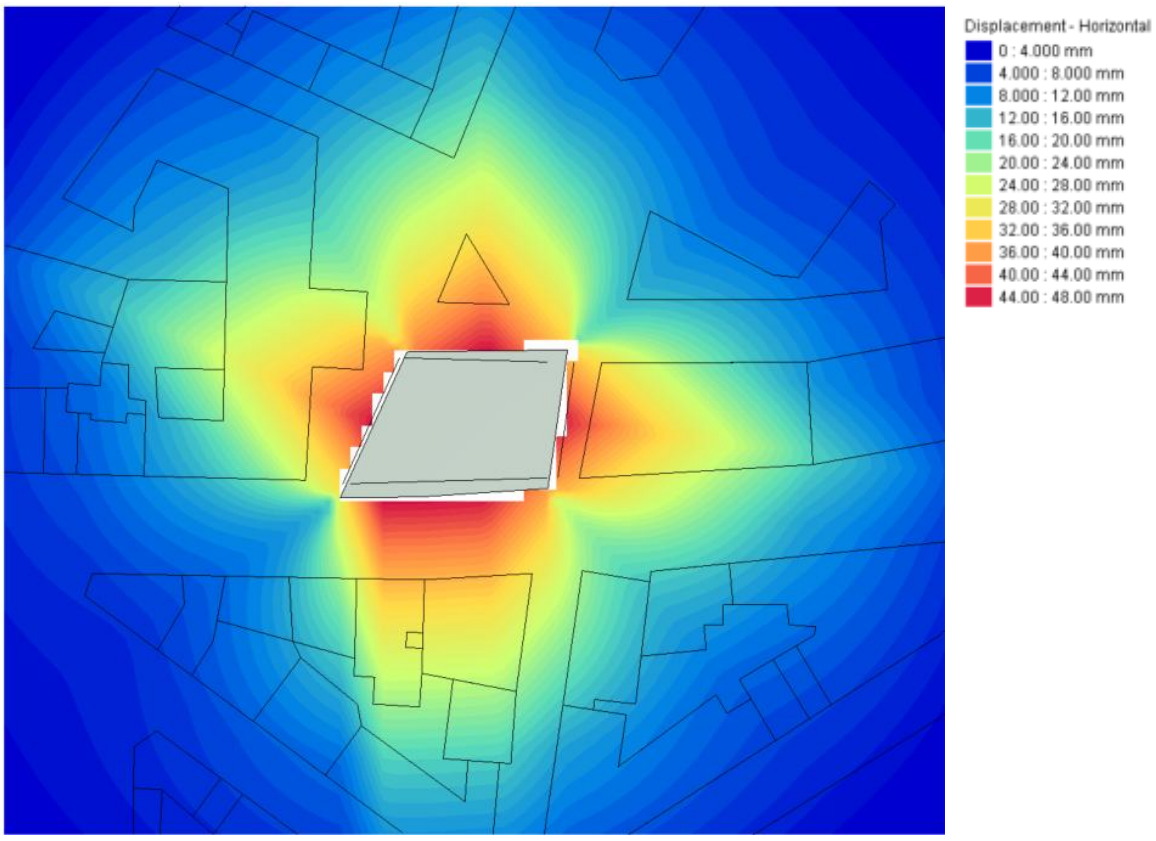

Figure 6.6 **XDisp B1 – Wall installation & basement excavation (CIRIA curves) – horizontal displacement (+ve = movement towards the dig)**

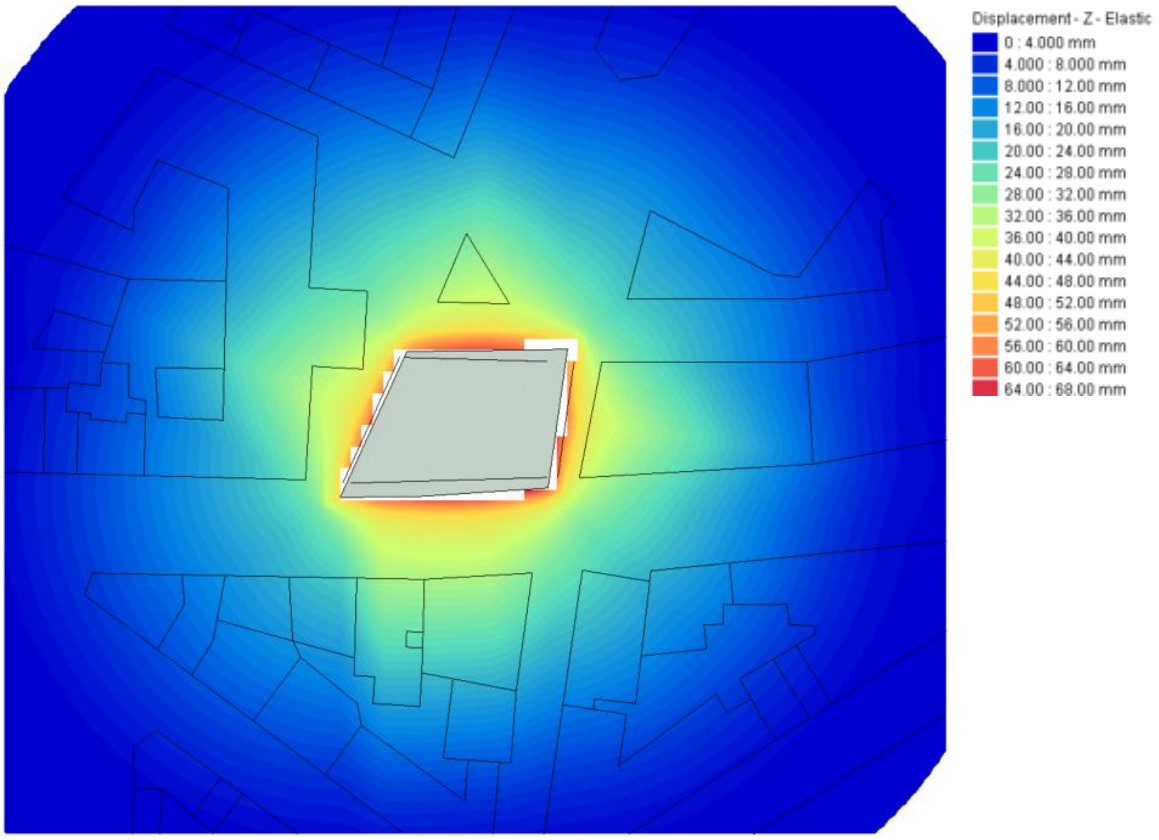

Figure 6.7 **XDisp B2 – Wall installation, basement excavation, building loading (long-term) – vertical displacement (-ve = upward movement, +ve = downward movement)**

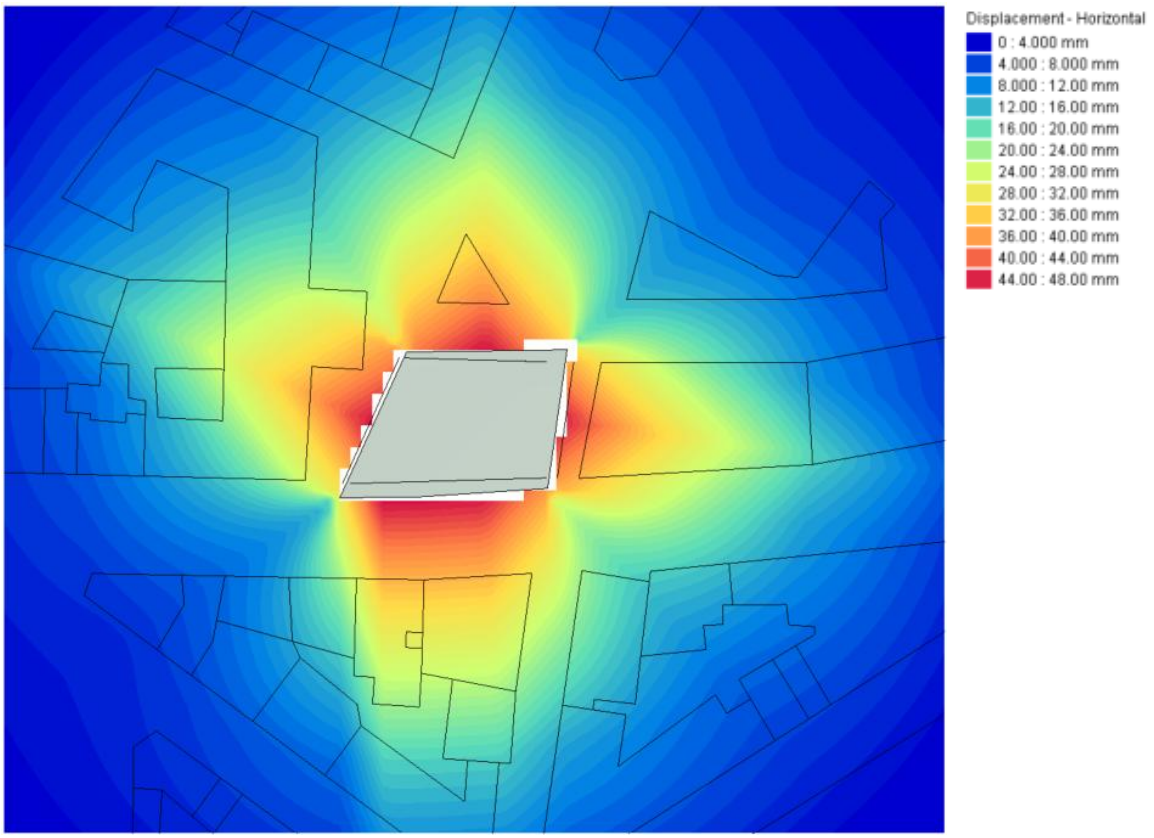

Figure 6.8 XDisp B2 – Wall installation, basement excavation, building loading (long-term) – horizontal displacement (+ve = movement towards the dig)

6.3. Preliminary Thames Water Utilities Ground Movement Assessment

6.3.1. A preliminary ground movement and impact assessment has been undertaken to estimate the potential impact of the proposed development works on the most critical Thames Water Utilities Ltd (TWUL) assets located directly adjacent to the site.

6.3.2. The assessment uses the commercially available software packages Oasys PDisp and XDisp. These packages consider the three-dimensional ground movement field induced by the proposed development and the use of conventional assessment adopting the CIRIA C760 ground movement curve data sets.

6.3.3. The GMA is based on *greenfield* ground movements and unlikely to be exceeded ground movements.

6.3.4. The ground conditions, load conditions, basement geometry, construction sequence and assessment methodology adopted within the building damage GMA has been utilised for the Thames Water GMA. Refer to document reference *3722-A2S-XX-XX-RP-Y-0002* for details.

6.3.5. A series of Thames Water utilities are present in proximity to the proposed development. These utilities comprise sewers and watermains of varying size and materials beneath the surrounding roads and pavements. Details relating to these surrounding utilities are shown Figure 6.9 and Figure 6.10.

6.3.6. The Thames Water sewers and watermains considered within this assessment are shown in Table 6.2. The positions of where these assets have been modelled are shown in Figure 6.11 and Figure 6.12.

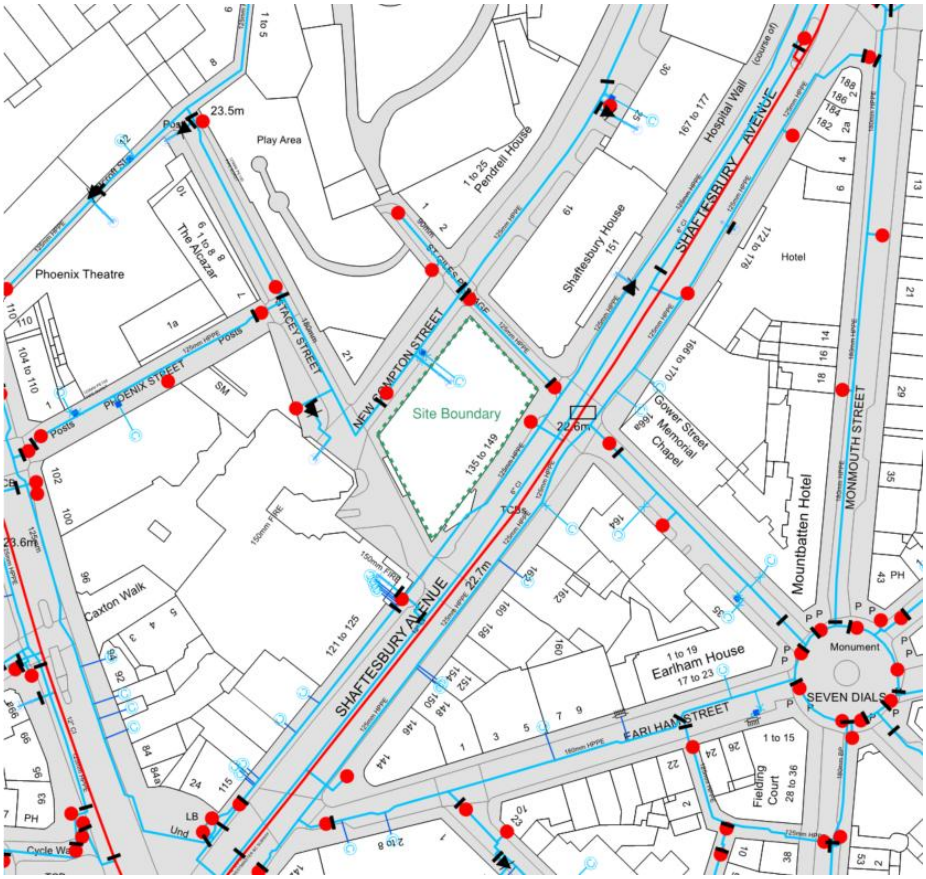

Figure 6.9 Surrounding Thames Water watermains (indicative site boundary shown by green outline)

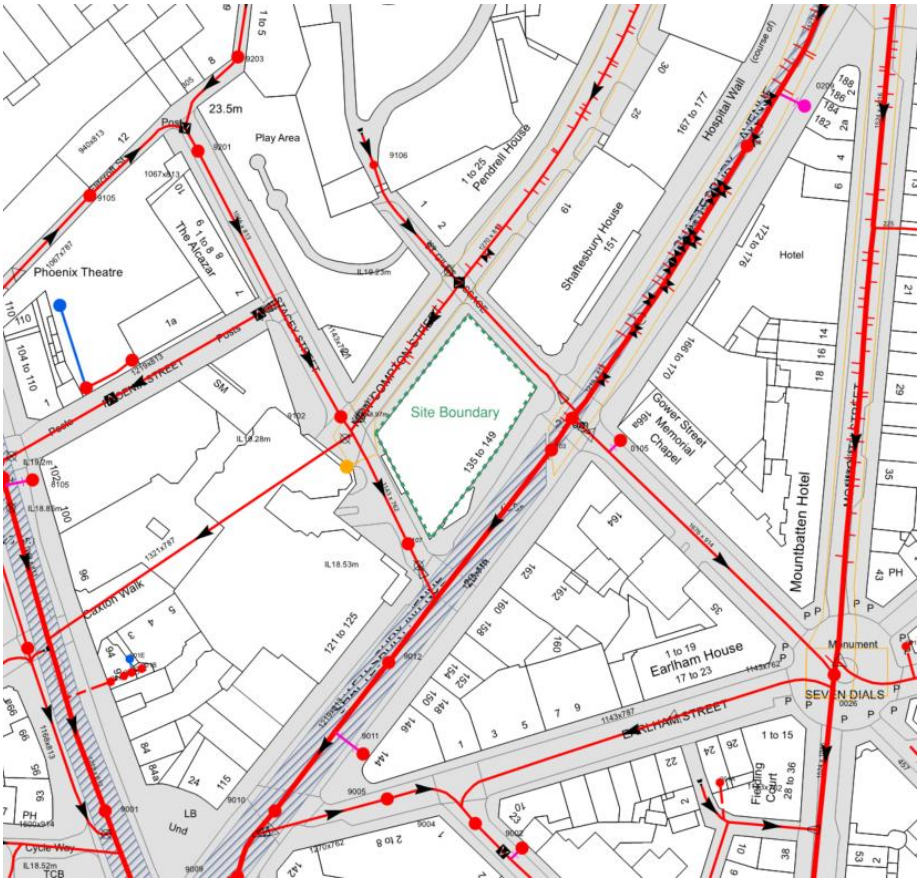

Figure 6.10 Surrounding Thames Water sewers (indicative site boundary shown by green outline)

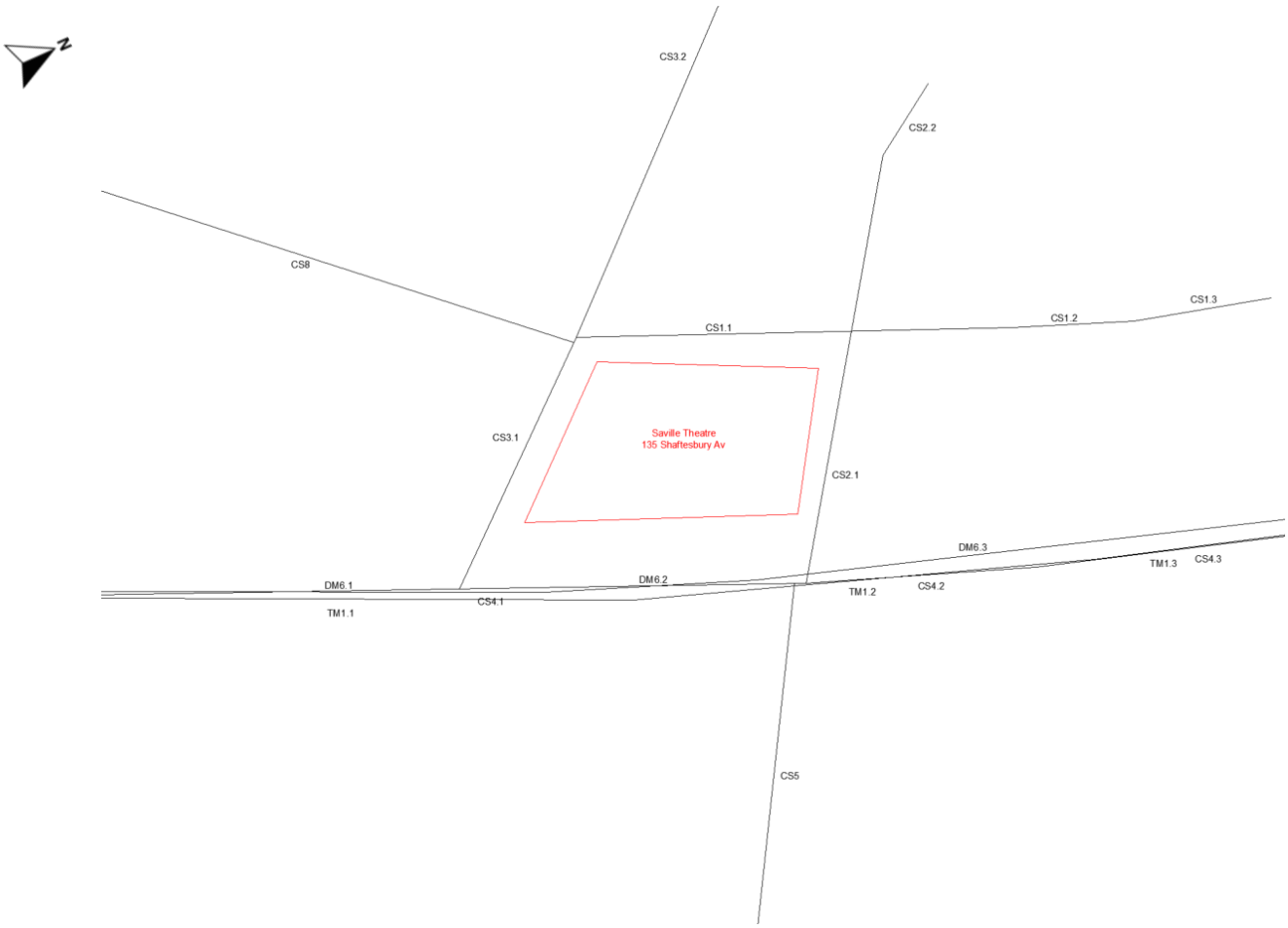

Figure 6.11 Nomenclature of critical Thames Water assets

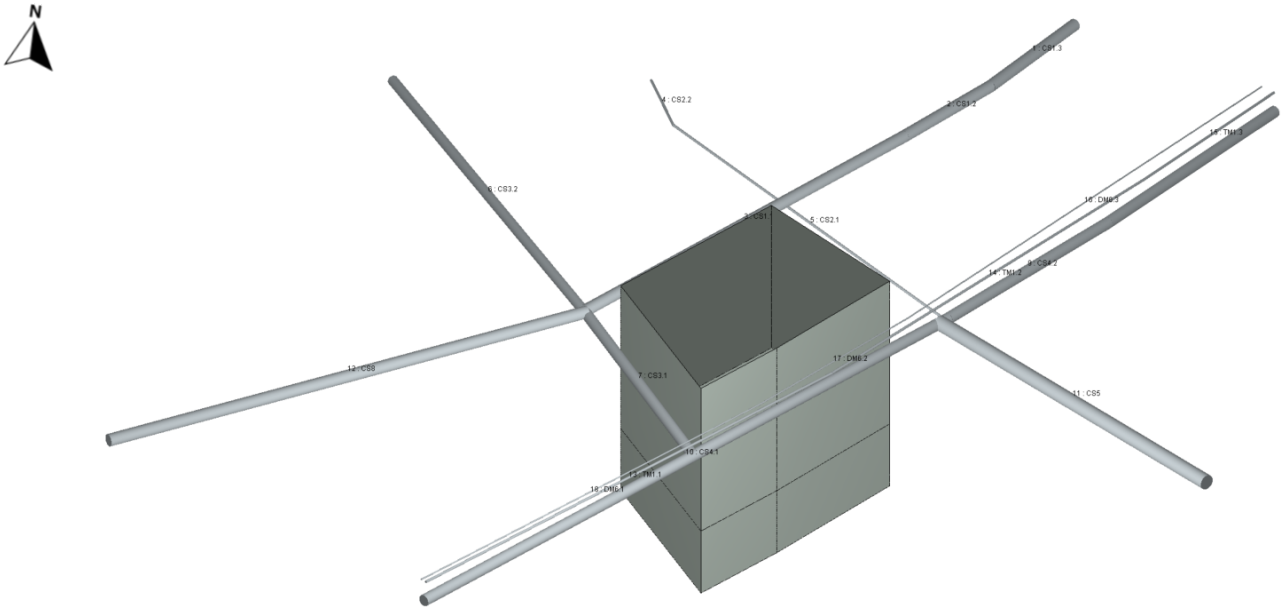

Figure 6.12 XDisp Thames Water asset input

Table 6.2 Critical Thames Water sewer and watermains names and dimensions

Asset Reference	Asset Type	Material	Asset Dimension (mm)	Assumed Wall Thickness (mm)	Axis Elevation (mOD)
CS1.1	Combined sewer	Masonry (assumed)	1270 x 813	200	+19.605
CS1.2	Combined sewer	Masonry (assumed)	1270 x 813	200	+19.865
CS1.3	Combined sewer	Masonry (assumed)	1270 x 813	200	+19.865
CS2.1	Combined sewer	Vitrified clay (assumed)	300	30	+18.44
CS2.2	Combined sewer	Vitrified clay (assumed)	300	30	+19.38
CS3.1	Combined sewer	Masonry (assumed)	1143 x 762	200	+19.10
CS3.2	Combined sewer	Masonry (assumed)	1016 x 813	200	+19.91
CS4.1	Combined sewer	Masonry (assumed)	1219 x 813	200	+18.74
CS4.2	Combined sewer	Masonry (assumed)	1219 x 813	200	+18.97
CS4.3	Combined sewer	Masonry (assumed)	1219 x 813	200	+18.97
CS5	Combined sewer	Masonry (assumed)	1676 x 914	200	+19.12
CS8	Combined sewer	Masonry (assumed)	1321 x 787	200	+19.94
TM1.1	Trunk main	Cast Iron	304	25	+21.83
TM1.2	Trunk main	Cast Iron	304	25	+21.83
TM1.3	Trunk main	Cast Iron	304	25	+21.83
DM6.1	Distribution main	Cast Iron	152	25	+21.83
DM6.2	Distribution main	Cast Iron	152	25	+21.83
DM6.3	Distribution main	Cast Iron	152	25	+21.83

6.3.7. Reasonable assumptions have been conservatively made for some of the utilities for which no information is available in relation to the material/construction. These assumptions are listed as per the below:

- All sewers and water pipes are assumed to be circular in cross section (in the case of oval-shaped cross-sections, the maximum dimension is considered).
- In the absence of information on materials used for the construction of utilities, HPPE has been assumed where connections to known HPPE utilities are shown and vitrified clay has been assumed for sewers with a diameter <750mm, except for sewers with a diameter >1.0m which are assumed to be masonry.
- In general, lining thicknesses have been assumed for the utilities where no information is available.
- No Thames Water assessment criteria available for HPPE pipes at the time of this Basement Impact Assessment.

6.3.8. The impact assessment on the Thames Water assets has been undertaken by focusing on the key deformation mechanisms and performance criteria applicable to the utility type noted, including:

- Tensile and compressive strains (induced by axial elongation and bending mechanisms).
- Joint rotation.
- Joint pull-out (assumed segment length 3m for all assets), not applicable for masonry assets.
- Vertical displacement.

6.3.9. A factor of 0.18 has been applied to the axial strains to model the soil/pipe interface where relevant.

6.3.10. The criteria presented in the Thames Water "Guidance for working near out assets" is used for the assessment, provided in Table 6.3.

Table 6.3 Thames Water assessment criteria, soil/pipe interaction factors, and flexural strain factors

Asset Type	Diameter (mm)	Tensile strain (με)	Compressive strain (με)	Joint pull-out (mm)	Joint rotation (deg)	Axial pull-out/strain reduction factor	Flexural Strain factor
Brick Sewer	N/A	500	N/A	N/A	N/A	1.0	2.0 (tension) 1.0 (compression)
Cast Iron	N/A	100	1200	3	0.18	0.18	1.0 (tension) 1.0 (compression)
Vitrified Clay	125 - 375	80	400	3	2.0	0.18	2.0 (tension) 1.0 (compression)

6.3.11. The output *greenfield* deflected profiles for multiple utilities include a series of sharp discontinuities which induce apparent exceedances of the limit strain criteria. These discontinuities are a consequence of the relatively simplistic analytical approach adopted and are considered unrealistic. Therefore, smoothing exercise has been undertaken, fitting Gaussian and polynomial relationship curves to the displacement profiles affected. The process has been carried out using an automated algorithm which eliminates the abrupt displacement changes but results in other oscillations as part of the polynomial function relationship (these may be neglected from an impact assessment perspective). The smoothed profiles have subsequently been imported into a new XDisp file in which the damage assessment is carried out.

6.3.12. The results of the smoothing exercise indicate that the critical assets adjacent to the proposed basement exceed Thames Water's limiting strain criteria.

6.3.13. A qualitative review highlights the conservatisms and limitations of the traditional analytical approach. The use of traditional methods, including the application of CIRIA C760 curves in conjunction with the complex construction sequence and existing double-storey basement, presents challenges in predicting realistic deflection profiles at the asset locations. This review suggests that the likely range of lateral deflections at asset levels is less than those predicted by the software tools used, namely WALLAP and Oasys XDisp.

6.3.14. It is recommended that a more detailed and representative ground movement and impact assessment for the Thames Water assets is conducted before the detailed design stage. This assessment should incorporate the favourable three-dimensional basement geometry and the complex construction sequence. Finite element analysis is considered an appropriate method for obtaining realistic ground movement predictions at asset levels. The qualitative review suggests that horizontal deflections at asset levels are expected to be significantly lower than those predicted by traditional methods.

6.3.15. A detailed ground movement assessment shall be submitted to the Thames Water asset protection team for their review.

6.3.16. The Thames Water asset protection team will need to be contacted, and the design team shall comply with their requirements with regard to any required assessment of the works impact on their assets.

6.4. Preliminary Embedded Pile Wall Assessment

6.4.1. A Preliminary Embedded Pile Assessment using the Geosolve software, WALLAP, has been undertaken and provided in Appendix E, report reference *3722-A2S-XX-XX-TN-Y-0001.*

6.4.2. The assessment shall verify the proposed pile diameter, pile spacing, and construction sequence for the construction of the basement box. It will also demonstrate that the preliminary design complies with the horizontal deflection limit at the top of the wall, as specified in the Building Damage GMA.

6.4.3. The assessment highlights the requirement for the new perimeter B2 slab to be constructed prior to the excavation to the B4 formation level. The proposed construction sequence shall ensure that the horizontal deflections at the top of the wall remain at the allowable deflection limit proposed in the Buildings Damage GMA.

7. Construction Methodology / Engineer Statements

7.1. Outline Temporary and Permanent Works Proposals

7.1.1. The basement box will be constructed adopting a top-down construction sequence. The basement slabs will provide lateral restraint to the pile wall, which in turn, will limit the lateral deflections of the wall during the bulk excavation to the formation level.

7.1.2. The proposed construction sequence, provided by Elliott Wood, is detailed in Appendix C. The Preliminary Embedded Pile Wall Assessment highlights the requirement for the new perimeter B2 slab to be constructed prior to the excavation to the B4 formation level. The proposed construction sequence shall ensure that the horizontal deflections at the top of the wall remain within the allowable deflection limit proposed in the Buildings Damage GMA.

7.1.3. Standard means and methods of excavation are expected to be suitable to excavate the basement, based upon the anticipated ground conditions.

7.1.4. The basement excavation will be supported by a perimeter secant pile retaining wall. The final details of this wall are subject to ongoing development.

7.1.5. Design of the retaining walls shall be carried out in accordance with the relevant Eurocodes, non-conflicting codes of practice, and associated design best practice. However, given the proximity of the proposed retaining wall to the public roads and neighbouring properties, the ground movement that may arise from installation of the retaining wall will need to be assessed.

7.2. Ground Movement Mitigation Measures

7.2.1. The following mitigation measures are proposed to reduce ground movements and damage:

7.2.2. A top-down construction sequence is proposed during the bulk excavation to the formation level. The basement slabs shall provide lateral restraint to the retaining wall during the excavation process, limiting lateral wall movements. Such measures will increase the system stiffness of the retaining walls and reduce the risk of adversely affecting neighbouring structures and third-party assets, due to excessive ground movement. The Preliminary Embedded Pile Wall Assessment highlights the requirement for the new perimeter B2 slab to be constructed prior to excavation to the B4 formation level to ensure horizontal deflections at the top of the wall remain within the allowable deflection limit proposed in the Buildings Damage Ground Movement Assessment. The Buildings GMA will define the limits of the lateral retaining wall deflection which must be adhered to.

7.2.3. Design details regarding minimum wall flexural stiffness, prop stiffness and arrangement, shall be defined as part of detailed design development and will take cognisance of the results of the scheme GMA.

- Design of the retaining wall and temporary propping measures shall be carried out in accordance with the relevant Eurocodes, non-conflicting codes of practice, and associated design best practice.
- Retaining wall construction is to be performed by an experienced ground engineering contractor.
- Frequent monitoring of neighbouring properties is to be carried out during excavation, to validate ground movement predictions against reality.
- Development of a monitoring-trigger-action plan that identifies trigger levels, responsible personnel, and actions to be followed in the event of a trigger level exceedance.
- Designated areas for stacking and storing materials behind the embedded retaining walls and temporary slopes should be identified. These should be located away from sensitive structures. The design of the retaining wall should incorporate

an appropriate surcharge load to the rear of the wall, to capture effects of stacking and storing materials, vehicle traffic, etc.

7.2.4. It is recommended that ground movement / earth retention system design and construction movement criteria are developed based on the results presented in the GMA report. This will enable the design of the retaining wall and any required temporary propping measures to be undertaken in a holistic fashion, ensuring ground movements are limited to no greater than that presented in the report.

7.2.5. Specific wall/façade deflection limits and trigger levels may also be developed as part of the scheme monitoring regime. Such limits and trigger levels should be coordinated with the scheme monitoring specification and monitoring action plan / emergency preparedness plan.

7.2.6. To minimise the risk of vibration-induced damage to neighbouring building foundations during basement construction, appropriate construction techniques should be employed in accordance with industry best practices. Should it be required, a vibration assessment can be undertaken and submitted alongside the contractor's methodology. Vibration monitoring should be implemented as part of the project Environmental Management Plan and in accordance with Thames Water asset protection requirements.

8. Basement Impact Assessment

8.1. General

8.1.1. The Conceptual Site Model (CSM) is described as below:

- The ground conditions of the site comprise Made Ground overlying the Lynch Hill Gravel Member, the London Clay Formation, the Lambeth Group, the Thanet Formation and the Chalk Group in sequence.
- Groundwater monitoring indicates groundwater is present within the Lynch Hill Gravel Member.
- The area surrounding the site is generally flat.
- The site is occupied by a Grade II listed six- and seven-storey commercial building with a double-storey basement. The finished floor level of the existing basement is approximately 7.88m bgl (+14.95mOD), within the London Clay Formation.
- The proposed commercial redevelopment comprises the extension of the existing two-storey basement to a five-storey basement while maintaining the existing basement footprint. The works will involve the partial demolition of the existing structure with partial retention of the building facades, followed by the construction of a five-storey vertical extension plus plant level on top of the existing building. The facades on the southeast (Shaftesbury Avenue), southwest (Stacey Street) and northeast (St Giles Passage) elevations will be fully retained, while the northwest (New Compton Street) elevation will be partially preserved.
- The excavation for the proposed basement will be supported by embedded piled walls. The basement will extend to a depth of approximately 22.21m bgl (+0.62mOD). A suspended slab on pile foundations, with steel plunge columns to support the top-down methodology, is currently proposed as the foundation system for the new building. Substructure and superstructure design is currently being developed at the time of carrying out this assessment.
- Foundation depths of the neighbouring buildings are assumed based on the existing and proposed sections provided by Elliott Wood. Pile foundations with underreams are shown for 125 Shaftesbury Avenue and a ground bearing slab is shown for 151 Shaftesbury Avenue. All neighbouring building facades have been assumed at the ground surface for the purposes of the GMA.
- The site is bound by four roads, Shaftesbury Avenue to the southeast, Stacey Street to the southwest, New Compton Street to the northwest and St Giles Passage to the northeast, which are directly adjacent to the proposed excavation. The proposed development may result in ground movements in the vicinity of the neighbouring properties and nearby roads. These ground movements will be managed by appropriate construction means and methods and controlled excavation operations.

8.2. Land Stability / Slope Stability

8.2.1. It is anticipated that all new substructure elements will be founded on competent strata in the London Clay Formation, the Lambeth Group and the Thanet Formation, which are considered be suitable for supporting foundation loads.

8.2.2. A detailed ground movement impact assessment has been performed for adjacent buildings / neighbouring structures. It has been concluded that impact of the works will be limited to a maximum damage classification of Category 1 – Very Slight, in accordance with the Burland scale. This has been concluded via a review of predicted ground movements resulting from the CIRIA C760 ground movement data sets.

8.2.3. A preliminary assessment of Thames Water assets has been conducted using traditional methods. The results indicate that the critical assets adjacent to the proposed basement exceed Thames Water's limiting strain criteria. However, a qualitative review highlights the conservatisms and limitations inherent in this approach. To address these issues, a more detailed and representative ground movement and impact assessment for Thames Water assets is required before the detailed design stage. This assessment will account for the favourable three-dimensional basement geometry and the complex construction sequence, which is not captured using traditional assessment methods.

8.2.4. The BIA has concluded that the risks to the adjacent properties and infrastructure (including ultimate and serviceability limit state considerations) are limited and will be mitigated in a reasonable fashion as part of design development.

8.3. Hydrogeology and Groundwater Flooding

8.3.1. The BIA has concluded that there is a very low risk of groundwater flooding.

8.3.2. No prevailing groundwater flow direction has been identified via the site-specific groundwater monitoring data set. The BIA has concluded that impacts to the wider hydrogeological environment and / or adjacent properties as a result of the proposed development will be limited.

8.4. Hydrology, Surface Water Flooding and Sewer Flooding

8.4.1. The BIA has concluded that there is a low risk of surface water flooding.

8.4.2. The BIA has concluded that there are no impacts to the wider hydrological environment.