



A-squared Studio

Twickenham Riverside TW1 3SD

Basement Impact Assessment (BIA)

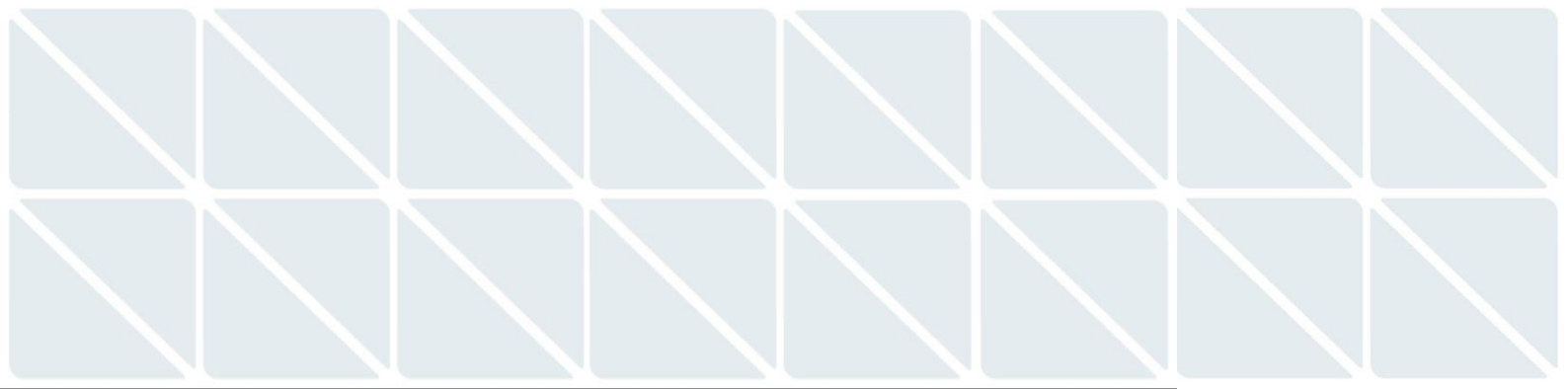
Incorporating:

Screening Assessment

Groundwater and Throughflow Flooding Assessment

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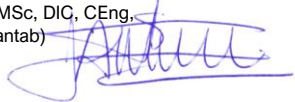
One Westminster Bridge Rd
London, SE1 7XW


020 7620 2868
contact@a2-studio.com
www.a2-studio.com

Prepared by


Qi Cheng Sia
MEng(Hons)

Graduate Engineer

Checked by

A. Nikolic
BEng(Hons), MSc, DIC, CEng,
MICE, MSt(Cantab)

Director

P. Smith
BEng(Hons), MSc, DIC, CEng, MICE
Associate


Approved by

T. Suckling
Eur Ing BEng (Hons) MSc CEng FICE FGS MIEAust
CPEng

Director

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Appendix B: Desk Study & Ground Investigation Report – GEA

Appendix C: Phase 1 and 2 Site Investigation Report – GEO

Appendix D: Flood Risk Assessment and SuDs Report



1. Non-Technical Summary

- 1.1.1. The development site is located at Twickenham Riverside, Twickenham, TW1 3SD.
- 1.1.2. The site is occupied by three commercial buildings, each of two storeys, with associated car park and Diamond Jubilee Gardens. The buildings can be accessed via King Street to the north, whilst the car park is accessed by Water Lane to the east and Delivery road to the west. The site is bounded to the north by King Street, to the east by Water Lane, to the south by the rear of the river wall adjacent to the Thames and to the west by Wharf Lane.
- 1.1.3. The site falls gently to the south east toward the car park entrance from 7.5mOD in the north to 4.1mOD in the southeast. The site is elevated from street level by approximately up to 2m, which lies at 5.5mOD.
- 1.1.4. It is understood that the proposed development works comprise the demolition of all existing buildings and structures followed by the construction of a new mixed use development. The overall site footprint currently includes 1A, 1B King Street and 2/4 Water Lane, the remaining former swimming building at the corner of the Water Lane, The Embankment and the river facing parcel of land on The Embankment in front of the Diamond Jubilee Gardens. The proposed development comprises of plant and back of house at lower ground floor level, flexible commercial and office space at ground floor level and residential units in the floors above. A new public square and areas of public realm will also be developed within the site. Some landscaping to the south of Diamond Jubilee Gardens and reconfiguration of the roads surrounding the site is also proposed.
- 1.1.5. At this time, it is proposed that the elevated site will be supported by a combination of reinforced concrete retaining wall sections, with a maximum height of 2.5m, and profiled landscaping where the elevated height is minimal at the north east part of the site adjacent to the King Street.
- 1.1.6. The following assessments are presented in the current document:
- Screening.
 - Scoping.
 - Additional evidence/assessments (as required), including:
 - Ground movement assessment (GMA).
 - Hydrogeological assessment.
 - Construction methodology and management plan.
 - Architectural and structural drawings.
 - Basement Impact Assessment (BIA).
- 1.1.7. The site falls gently to the southwest toward the car park entrance from 7.5mOD in the north to 4.1mOD in the southeast. The site is elevated from street level by approximately up to 2m, which lies at 5.5 mOD.
- 1.1.8. Based on a review of BGS data and local ground investigation data, the ground conditions beneath the site are anticipated to comprise:
- Made Ground: approximately extending to depths of between 0.6m and 1.7m (6.4mOD and 5.3mOD). The made ground typically comprised dark brown silty slightly sandy gravelly clay with fragments of brick, slate concrete, tarmac, ash and coal.
 - Kempton Park Gravel: typically comprised a medium dense becoming dense greyish light brown slightly gravelly fine to coarse grained subrounded to subangular sand to depths of 4.9m and 5.8m (2.1mOD and 1.8mOD).
 - London Clay Formation: comprised firm becoming stiff, medium strength becoming very high strength fissured dark grey silty clay with occasionally partings of fine sand and selenite crystals to the full depth that was investigated of 25m (-18mOD).
- 1.1.9. The hydrogeological conditions at the site, relevant to the proposed development, are anticipated to comprise:
- Local, potentially finite, bodies of water within the Made Ground and superficial deposits.
 - A hydrostatic pore water pressure distribution within the London Clay Formation.
- 1.1.10. The BIA has assessed land stability, and the impacts of the proposed development on neighbouring structures will need to be limited to Category 1 – Very Slight, in accordance with the Burland Scale.



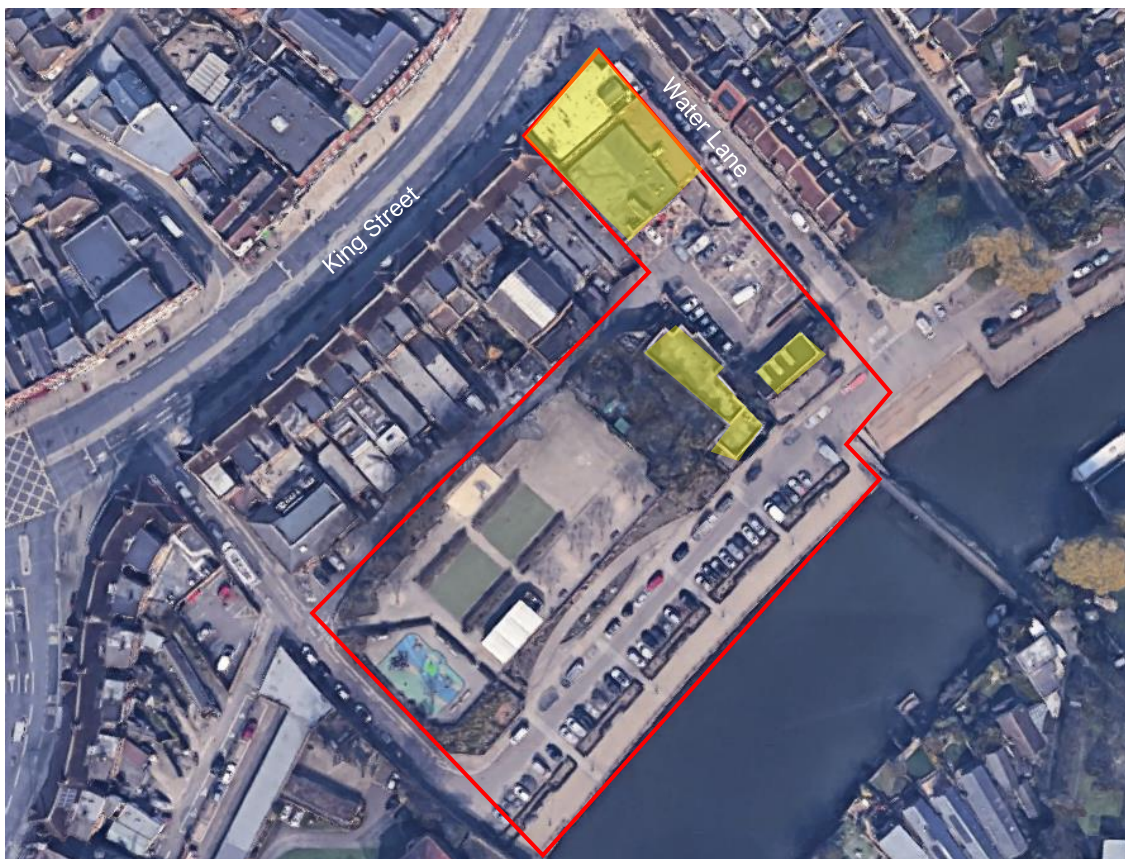
- 1.1.11. The BIA has concluded that there will be very low risk to the development and/or neighbouring properties associated with the risk of land and slope instability.
- 1.1.12. According to the Environment Agency (EA), the site is not within a groundwater protection zone. The site is not in an area at potential risk of groundwater flooding at the surface. However, the lower part of the site toward the south is located in an Flood Zone 3 area which indicates a higher likelihood (>1%) of flooding, discounting any flood defences implemented. Water Lane is noted to be at low risk from surface water flooding. Hence it has been concluded that there is a low risk of groundwater flooding.



2. Introduction

2.1. Overview

- 2.1.1. A-squared Studio Engineers Ltd (A-squared) has been engaged by Webb Yates Engineers Ltd to prepare a Basement Impact Assessment (BIA) for the proposed development works at Twickenham Riverside, TW1 3SD.
- 2.1.2. The purpose of this assessment is to consider the potential effects of the proposed development 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.



Approximate site boundary marked in red. Existing buildings to be demolished highlighted in yellow. Image courtesy of Google.

Figure 2.1 Location of the proposed development

- 2.1.4. The development site is located within the jurisdiction of the London Borough of Richmond upon Thames.
- 2.1.5. The BIA has followed guidelines developed by both the London Borough of Richmond upon Thames and Camden, which are considered to represent current industry best practice.
- 2.1.6. The BIA comprises the following elements:
- Screening.
 - Scoping.
 - Additional evidence/assessments (as required), including:
 - Ground movement assessment (GMA).
 - Hydrogeological assessment.
 - Construction methodology and management plan.
 - Architectural and structural drawings.
 - Basement Impact Assessment.



2.2. Credentials

- 2.2.1. The BIA has been reviewed by Alex Nikolic. Alex is a Chartered Member of the Institution of Civil Engineers (MICE) with 20 years of industry experience in geotechnical design and construction of ground engineering works. Alex has attained post-graduate qualifications, including a Master of Science in Soil Mechanics (MSc DIC) from the Imperial College London and a Master of Studies (MSt Cantab) in Sustainable Development from the University of Cambridge. Alex was formerly the Director of Ground Engineering at Buro Happold.
- 2.2.2. The BIA has been approved by Tony Suckling. Tony is a Chartered Fellow of the Institution of Civil Engineers (FICE) and a Fellow of the Geological Society (FGS). Tony has a Master of Science (MSc) in Geotechnical Engineering from City University. Tony is a Registered Ground Engineering Professional (RoGEP) with almost 30 years of industry experience in geotechnical design and construction of ground engineering works. Tony has previously held the position of Technical Director for Balfour Beatty Ground Engineering Ltd. Tony has been a past Chairman of the Federation of Piling Specialists Technical Committee and a Board Member of the Deep Foundation Institute Europe. Tony was part of the steering group for CIRIA C760 Guidance on Embedded Retaining Wall Design.

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* produced by Geotechnical & Environmental Associates Ltd (GEA), dated November 2017 (ref: J17205).
 - *Phase 1 and Phase 2 – Site Investigation Report* produced by Geosphere Environmental, dated Dec 2020, (ref: 4955,GI/GROUND/ PC,SG,JD,08-12-20/V3)
 - *Flood Risk Assessment and SuDS Report – J3932-02-S2 Twickenham Riverside* produced by Webb Yates Ltd, dated Dec 2020.
 - Structural sketches prepared by Webb Yates Ltd.
 - Public domain geological mapping from British Geological Society Geology of Britain Viewer and Borehole Viewer.
 - Flood map for planning – Environmental Agency.

2.4. Existing Development

- 2.4.1. The development site is located in Twickenham, some 500m south of Twickenham Railway Station and 25m north of the River Thames.
- 2.4.2. The site falls gently to the southeast toward the car park entrance from 7.5mOD in the north to 4.1mOD in the southeast. The site is built up from the surrounding street level (5.5mOD) by up to 2m, with the level difference generally increasing toward the River Thames (i.e. site level approximately at-grade to the north).
- 2.4.3. The site is occupied by three commercial buildings, each of two storeys, with associated car park on the northernmost side of the site. Besides these three properties the site is generally covered by hard-standing to the east and the Diamond Jubilee Gardens to the west (see Figure 2.2).

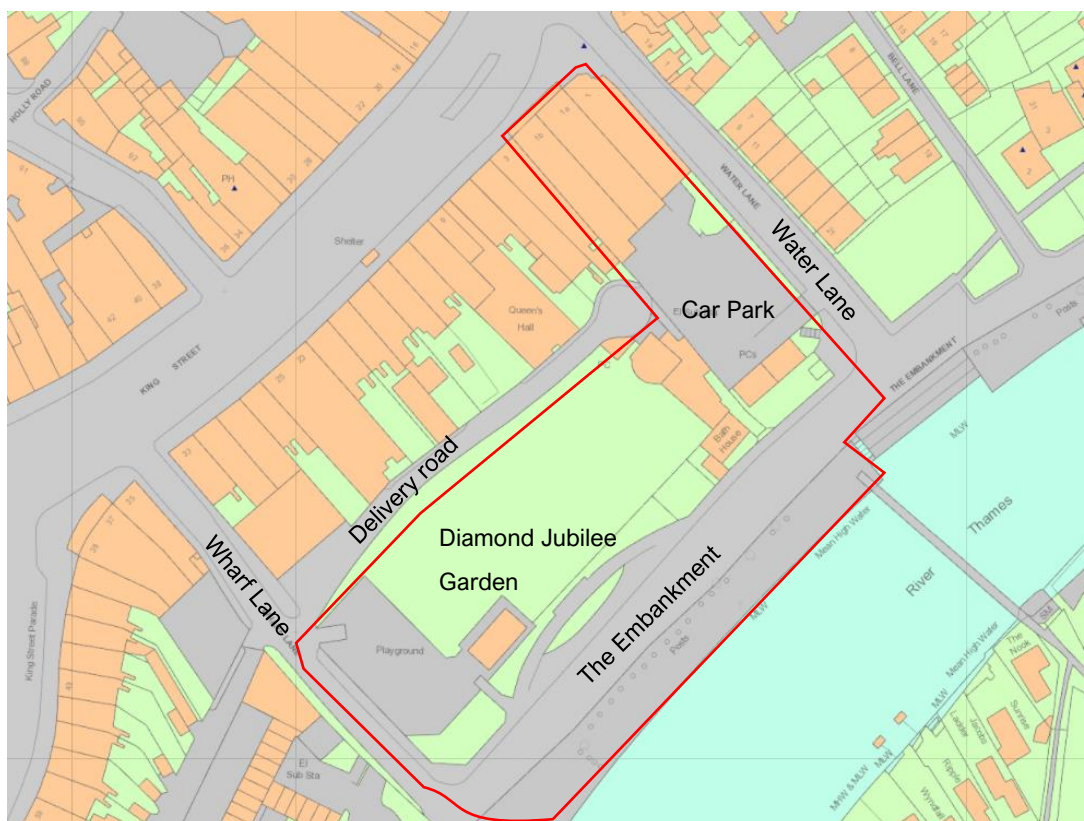


Figure 2.2 Existing structures on site (Historic England)

2.4.4. The proposed basement is envisaged to be supported by a 0.5m to 1m thick monolithic raft foundation. Foundation systems for structures built at ground level are assumed to be piled at this stage.

2.5. Neighbouring Properties and Infrastructure

2.5.1. The site is bounded by King Street at the northernmost extent, Delivery Road over the remaining northern boundary, Water Lane to the north-east and The Embankment to the south. Wharf Lane runs adjacent to the south western site boundary.

2.5.2. The site is surrounded by various mixed use buildings and the River Thames to the south. The closest buildings to the site include 5 King Street.

2.5.3. There are no listed buildings within the zone of influence of the proposed development, the only listed item that is in close proximity to the site is the listed telephone kiosk located at the junction of King Street and Water Lane.

2.5.4. There are several trees located on site surrounding the Diamond Jubilee Gardens.

2.5.5. Third party asset owners with existing underground services that may be impacted by the proposed development include the following:

- London Borough of Richmond upon Thames.
- Thames Water.
- BT (BT Group Plc) – Telecoms.
- UK Power Networks Ltd – Electricity distribution.
- National Grid Gas Plc – Gas.

2.5.6. Asset protection teams for the assets listed under 2.5.5 will be engaged as the design of the proposed development progresses.



2.6. Proposed Development

- 2.6.1. The existing and proposed development sketches / drawings are included in Appendix A.
- 2.6.2. The proposed development at Twickenham Riverside comprises demolition of the existing buildings on site and construction of new mixed used buildings with associated landscaping, as shown in Figure 2.3.
- 2.6.3. The proposed basement / lower ground floor footprint is shown as a green hatched line on Figure 2.3. It can be seen that the footprint of the basement makes up only a small proportion of the overall development footprint. The basement is likely to extent to circa 4m below existing site ground level.
- 2.6.4. The proposed development works propose to adopt a series reinforced concrete retaining wall sections with sheet piles local to the Delivery Road side of the basement, in order retain the elevated ground level at this boundary (Delivery Road level approximately equal to site level).
- 2.6.5. The existing and proposed development is shown in the plan views below as Figure 2.3.

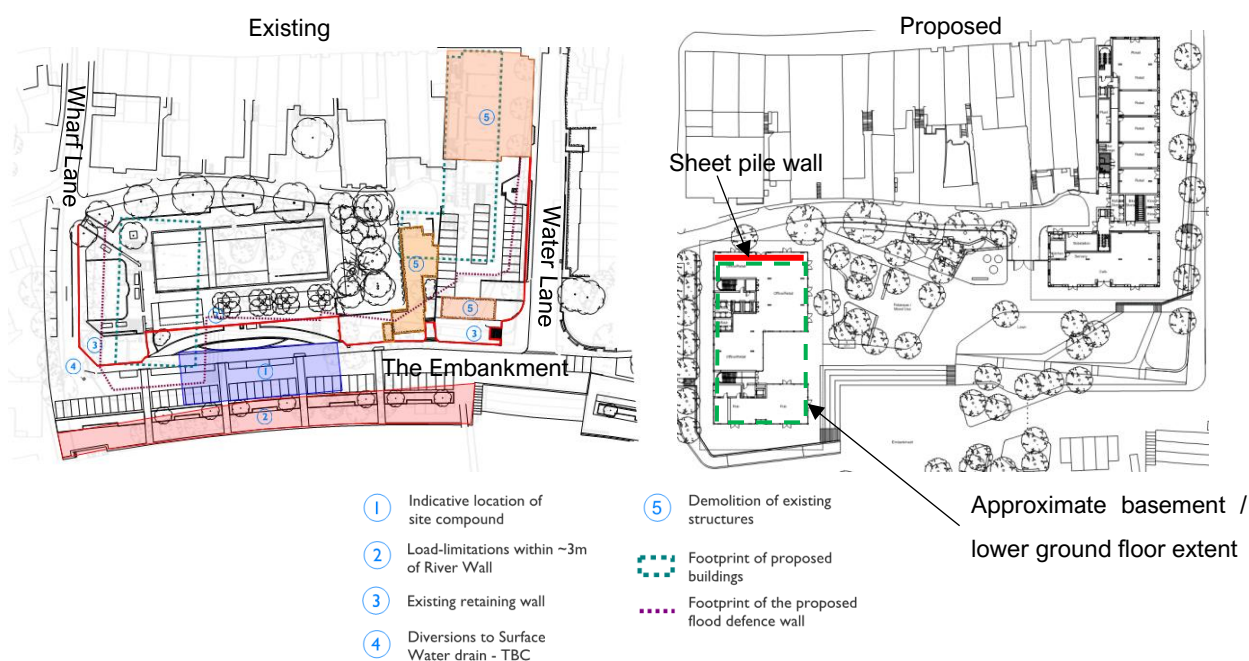


Figure 2.3 Existing and proposed development on site

- 2.6.6. The basement is currently proposed to be formed in the granular River Terrace Deposits, above the water table. This is likely to be viable in the anticipated ground conditions, subject to detailed temporary and permanent works design checks.
- 2.6.7. A plan view of the proposed retaining wall systems around the site boundary is presented below in Figure 2.4. Note again that the site is generally elevated above the surrounding ground level and as a result the primary function of these structures is to retain the ground forming the development site.

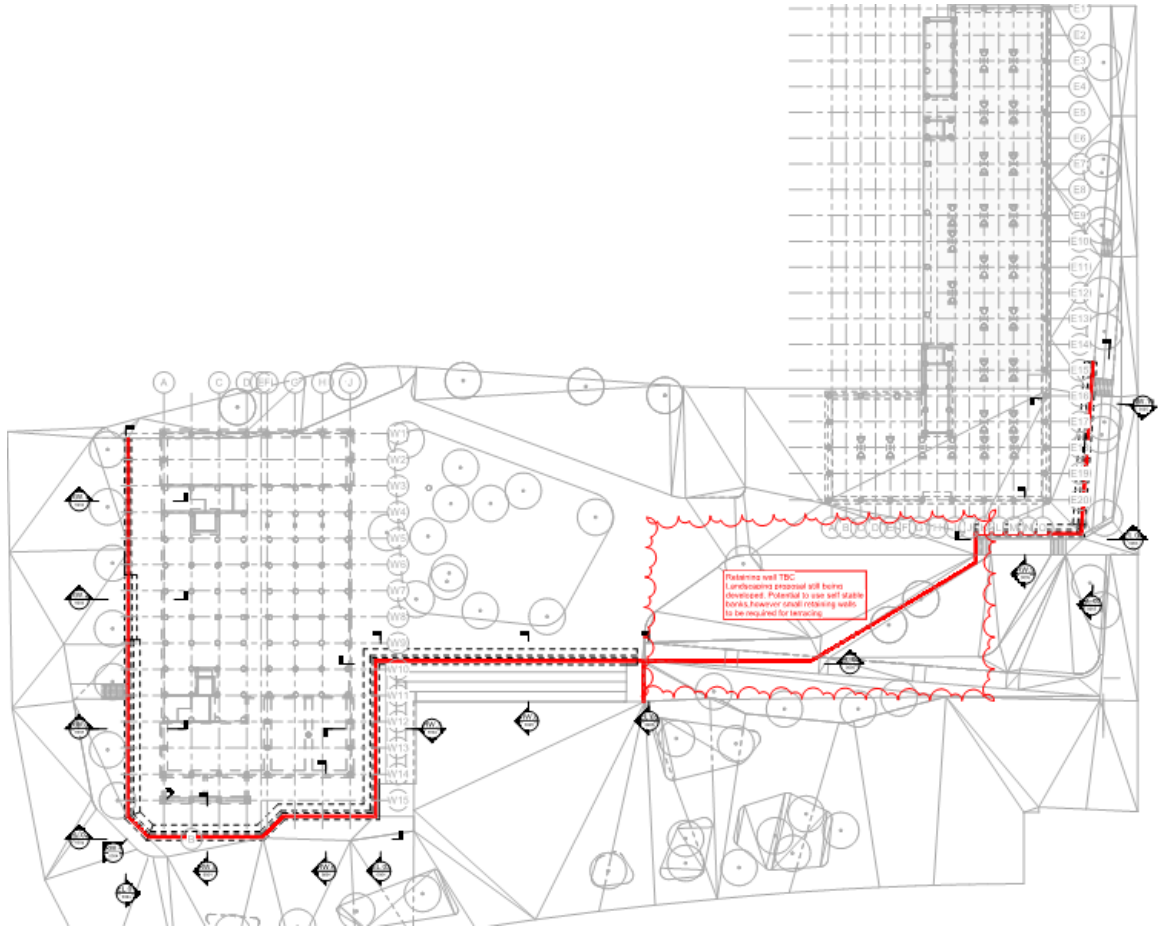


Figure 2.4 Indicative plan view of alignment of retaining wall systems around the site boundary

2.6.8. Based on a review of the current design proposals, the earth retention systems adopted around the site boundary will consist of profiled landscaping and up to 2.9m high reinforced concrete retaining wall sections. Indicative sections of the proposed permanent works retention systems are shown in Figure 2.5.

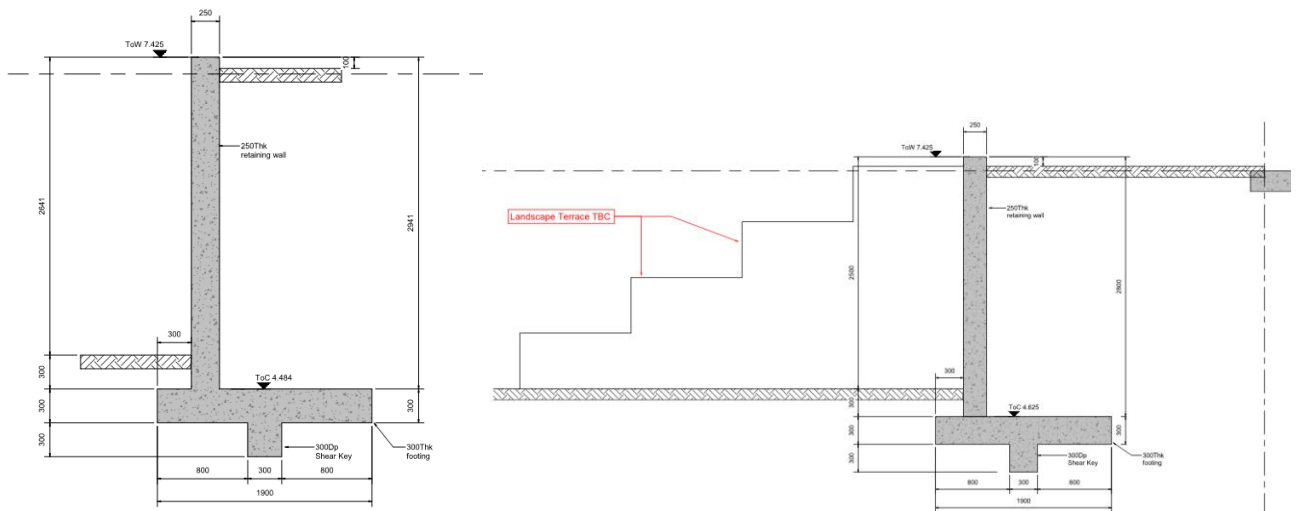


Figure 2.5 Indicative sections of the proposed retention systems

2.6.9. Groundwater has been recorded at depths of between 4.1m and 4.9m below ground level. The formation level of the proposed basement is about 4m below ground level which means that the basement is likely to be within the medium dense gravely sand of the Kempton Park Gravel. Groundwater will not be encountered during excavation provided the design



formation level of the basement is kept shallower than the measured water table, at present this is understood to be the design intent.

- 2.6.10. It is noted that groundwater was encountered at shallower depth within BH2 of the Geosphere (2020) works, however this borehole was drilled from a considerably lower elevation, in the parking bays adjacent to the River Thames. The proposed basement formation level will not extend down to this elevation.
- 2.6.11. At this stage the scheme foundation design is still subject to ongoing development, however it is envisaged that the proposed structures will be supported by a combination of piled foundations and a monolithic raft within the basement footprint.
- 2.6.12. The proposed works currently will be constructed with the following key sequence:
- Demolition of existing structures.
 - Sheet piling required to the north of the Wharf Lane building where the retained trees are in close proximity to the site.
 - Reduced level dig – batter back free edge to enable basement construction.
 - Temporary works to enable piling platform at Water Lane building ground floor level.
 - Existing retaining wall on the south side facing the Thames to be demolished.
 - Existing swimming pool located at the centre of the Diamond Jubilee Garden broken out to enable the site landscaping.
 - Piling of the Water Lane building.
 - Piling of the Wharf Lane building.
 - Installation of piles for flood defence wall to avoid surcharging the existing sewer located in close proximity to the site.
 - Construction of the cantilevering flood defence wall at the south of the site facing the Thames.
 - Construction of the basement for Wharf Lane building and ground floor slab for Water Lane building.
 - Backfill and compact ground around the retaining walls and basement.
 - Construction of superstructure.
- 2.6.13. The proposed retaining walls should be well propped during construction in order to limit ground movements as much as possible, particularly on sensitive sections of site boundary.
- 2.6.14. It is considered that the proposed excavation works are sufficiently offset such as to avoid adverse impact on neighbouring properties.



3. Desk Study

- 3.1.1. A previous Desk Study has been undertaken by Geotechnical & Environmental Associates Ltd (GEA) for the project. The purpose of the GEA report was to provide and assess environmental and historical baseline information and data for the preliminary assessment of the contamination risk to the site. Investigation of the soil properties beneath the site was performed to obtain key geotechnical parameters and the report was produced in Nov 2017. This site investigation provided only partial coverage of the current site footprint (toward the east side).
- 3.1.2. The latest Phase 1 and 2 site investigation works were carried out by Geosphere Environmental (GEO) and the report comprises a desk study and site investigation work data review; it was produced in Dec 2020. The purpose of the GEO report was to assess both geo-environmental and geotechnical data to provide information regarding the site and also the remaining proposed site footprint that was not covered in the GEA site investigation scope.
- 3.1.3. Both sets of ground investigation data and findings have been used to inform the content of this BIA.



4. Screening

4.1. Subterranean (Groundwater) Flow, Screening Flowchart

Question	Response	Details
1a. Is the site located directly above an aquifer?	Yes	The site is underlain by the Kempton Park Gravels above the London Clay Formation. The Kempton Park Gravels are classified as a Secondary 'A' Aquifer. The London Clay is classified as an Unproductive stratum
1b. Will the proposed basement extend beneath the water table surface?	No	The ground investigation recorded water table at between circa 4.1m and 4.9m below ground level. This is below the anticipated basement excavation which is proposed to around 4m below ground level.
2. Is the site within 100m of a watercourse, well (used / disused) or potential spring line?	Yes	The site is located adjacent to the River Thames (circa 30m offset).
3. Will the proposed basement development result in a change in the proportion of the hard surfaced / paved areas?	No	Basement to be formed within area of existing hardstanding footprint following site clearance.
4. 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	The proposed development is expected to maintain the existing surface water discharge conditions.
5. Is the shallowest geological strata at the site London Clay?	No	The site is underlain by the Kempton Park Gravels then the London Clay Formation.

4.2. Stability Screening Flow Chart

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 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	The proposed development involves some local landscaping / profiling at the boundary which is anticipated to have a negligible impact on its surroundings.
3. Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7 degrees (approximately 1 in 8)?	No	Adjacent properties have a similar flat topography to the site.
4. 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?	Yes	Some trees will be felled in the Diamond jubilee Garden to form the new proposed landscaping. Some work will be performed in close proximity to existing trees that are to be retained as part of the proposed development, in these areas, sheet piling is proposed to protect the trees during construction.
5. Is the site within an area of previously worked ground?	No	BGS 1:50,000 geological mapping does not show the site to be located in an area of previously worked ground. Historical maps do not show any evidence of worked ground. Available borehole data also does not show a significant thickness of made ground at the site.



Question	Response	Details
6. Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines?	No	The site is not understood to be over or within the exclusion zone of any tunnels / railway lines etc.
7. Will the proposed subsurface structure extend significantly deeper underground compared to the foundations of the neighbouring properties.	No	<p>The proposed Wharf Lane building will have a basement with a formation level at circa 4mbgl.</p> <p>Given that the site footprint is generally elevated with respect to the surrounding streets, the basement excavation is unlikely to undermine adjacent structures by any significant margin.</p>
8. Is the site within 5m of a highway or pedestrian right of way?	Yes	The site is within 5m of highways or pedestrian rights of way across much of its perimeter.

4.3. Surface Water and Flooding Screening Flowchart

Question	Response	Details
1. 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 existing route is expected to be incorporated into the scheme.
2. Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas?	No	The proposed development on site will be within the existing building and hard surface footprints. The proposed basement will likely have minimal change in impermeable area coverage on the site.
3. 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 proposed basement is not anticipated to change the surface water discharged from the property.
4. Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No	No change in surface water quality is anticipated.
5. 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?	Yes	<p>Based on the Environment Agency Flood Map, the site is partially within Flood Zone 3b and Flood zone I. Current risk of flooding from rivers or seas is classified as High in the Flood risk assessment.</p> <p>The site risk of flooding from groundwater is considered negligible and the Phase I Strategic Flood Risk Assessment (SFRA) shows that the site is not situated in an area subject to groundwater flooding.</p>

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:

- The site is located directly above an aquifer.
- Some trees will be felled as part of the proposed development on site.
- The site is within 5m of a highway or pedestrian right of way.
- The site is within an area that has a high risk of river or sea flooding.



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

5. Scoping

5.1. Groundwater: Site is located directly above an aquifer.

Hazards

- 5.1.1. Groundwater ingress during excavation works, leading to the requirement for pumping to keep the excavation dry in the temporary condition.
- 5.1.2. Restriction of groundwater flow through the secondary aquifer due to the new basement.

Potential Impacts

- 5.1.3. Ground movements associated with water table draw-down and / or damming effects.

Mitigating Factors

- 5.1.4. The proposed basement depth has considered the groundwater table depth measurements provided in the ground investigation reporting. Current proposals ensure that the basement will be formed above the water table, thereby avoiding water inflow to the basement and water table draw-down.
- 5.1.5. As the basement will be formed above the water table, a full groundwater cut-off piled wall is not considered to be required. Groundwater will therefore be permitted to flow around and under the proposed basement, via the remaining Kempton Park Gravels.
- 5.1.6. No basements have been identified adjacent to the proposed.

5.2. Stability: Trees will be felled as part of the proposed works.

Hazards

- 5.2.1. Shrink/swell behaviour of underlying cohesive soil masses due to the removal of trees.
- 5.2.2. Increased surface water run-off into the local drainage system due to a reduction in uptake from vegetation.

Potential Impacts

- 5.2.3. Additional ground movements from shrink/swell may cause damage to the neighbouring structures.
- 5.2.4. Properties downstream of the development may be subject to increased surface overland flow.

Mitigating Factors

- 5.2.5. Near-surface deposits are generally anticipated to comprise granular Made Ground and Lynch Hill Gravels, which are not expected to heave or settle significantly due to the tree removal.
- 5.2.6. Any potential changes to the surface water run-off volume are anticipated to be captured by the proposed drainage scheme.



Assessments and Further Actions

5.2.7. The composition of the near-surface deposits should be confirmed during site-specific ground investigation.

5.3. **Stability: proposed basement excavation is adjacent to public highways and neighbouring structures.**

Hazards

5.3.1. Excavations will be carried out adjacent to public highways and neighbouring structures.

Potential Impacts

5.3.2. Collapse of the excavation and associated impact on surrounding assets.

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

5.3.4. Ground movements arising due to construction and excavation activities may damage nearby properties.

Mitigating Factors

5.3.5. Deposits underlying the development are largely natural and anticipated to be relatively stable, i.e. Kempton Park Gravels and London Clay Formation.

5.3.6. Several basements of similar depth and scale have been successfully constructed throughout London within similar geological conditions and urban settings.

5.3.7. The impact on the public highway is limited given the proposed basement is unlikely to undermine the existing road level because the current site is at higher elevation (~2m) to the street level.

5.4. **Surface water and Flooding: The site is identified to have rivers or seas flooding risk**

Hazards

5.4.1. Flooding of the development due to numerous sources, including fluvial, pluvial and sewer and climate change.

Potential Impacts

5.4.2. Inundation of the proposed development affecting the safety of residents and the public using the area.

5.4.3. Increased risk of flooding of adjacent properties due to loss of flood plain storage associated with the proposed development.

Mitigating Factors

5.4.4. The site is identified to be in an area of low risk for surface water flooding.

5.4.5. The proposed development is “water compatible” within Flood Zone 3b and all other buildings are located in Flood Zone 1 protected by the flood defence structures. This is compatible with the sequential test, National planning policy framework (NPPF) guidance and the (London Borough Richmond Upon Thames (LBRuT) Local Plan.



- 5.4.6. The proposed development includes relocation of flood defence structures. The proposed flood defence structures will be designed to the TE2100 level or greater of 6.9m. The design allows essential maintenance and upgrades to be carried out in the future.
- 5.4.7. To ensure no increase in flood risk for the area, new flood wall location and proposed design shall be assessed to ensure there is no loss of flood storage currently on site or elsewhere along the river. The proposed development should also assess and minimise the impact of flood risk to the neighbouring properties.
- 5.4.8. A Flood Emergency Plan shall be provided for the site. The plan shall be in accordance with the LBRuT document: Guidance on Producing a Flood Emergency Plan.
- 5.4.9. A Flood Risk Activity Permit is required from the EA and all works to the flood defence line will be in accordance with the EA's flood defence guidance and specification.



6. Site Investigation

Site-specific ground investigation works have been undertaken in by both GEA and GEO in 2017 and 2020, respectively. Details of the ground investigation findings are presented in the *Factual Report* (as referenced in Section 1 and included as Appendix B and C).

The primary purpose of the ground investigation works was to manage and mitigate the Client's geotechnical risk profile associated with the proposed redevelopment of the site. The aims of the ground investigations were thus to:

- Develop and refine the existing ground model regarding the types and spatial extent of soils.
- Assess the engineering performance of the soil deposits to enable recommendations of suitable parameters for geotechnical design.
- Identify geotechnical and geo-environmental hazards and evaluate any potential risks with regards to both design and construction.

The scope of the GEA (2017) investigation may be summarised with the following key elements and features:

- 2 no. 25m deep restricted access cable percussive borehole from the ground floor.
- 3 no. up to 4m and 5m by a Terrier rig.
- Standard penetration tests (SPTs) carried out at regular intervals within the boreholes to provide quantitative data on the strength of the soils.
- Groundwater and ground gas monitoring.
- In-situ and laboratory geotechnical testing.

The scope of the GEO (2020) investigation may be summarised with the following key elements and features:

- 2 no. 25m deep exploratory holes using cable percussion techniques.
- 4 no. hand tool dug trial pit extending to depths ranging from 0.2m and 1.2mbgl.
- 2 no. machine excavated trial pits extending to depths ranging from 2.2m and 2.3.
- 2 no. dual-pipe ground gas/groundwater well pipes within two boreholes.
- 10 no. small diameter exploratory holes using windowless sampler methods extending to depths up to 1.4mbgl.
- Associated soil logging, sampling and in-situ testing within each exploratory hole.

6.1. Ground Model

A summary of the ground conditions encountered during the intrusive investigation is presented in Table 6.1 below. Superficial Kempton Park Gravels are present below the site from approximately 0.6mbgl to 5.7mbgl, beyond which London Clay is present, the base of which was not proven.

The ground conditions were found to comprise the following (in order succession):

- Made Ground: Dark brown silty slightly sandy gravelly clay with fragments of brick, slate, concrete, tarmac, ash, and coal.
- Kempton Park Gravels – Medium dense becoming dense greyish light brown slightly gravelly fine to coarse grained subrounded to subangular sand.
- London Clay Formation – Firm to becoming stiff, medium strength becoming very high strength fissured dark grey silty clay with occasional partings of fine sand and selenite crystals.



Table 6.1 Summary of the encountered geological profile – GEA 2017

Stratum	Elevation at top of stratum (mOD)	Depth to top of stratum (mbgl)	Typical thickness range (m)
Made Ground	7.00 to 7.75	0.00	0.60 to 1.70
Kempton Park Gravels	5.30 to 6.40	1.10 to 1.40	4.00
London Clay	2.00	5.00 to 5.75	Not proven (>20.00)

Table 6.2 Summary of the encountered geological profile - GEO 2020

Stratum	Elevation at top of stratum (mOD)	Depth to top of stratum (mbgl)	Typical thickness range (m)
Made Ground	5.00 to 8.10	0.00	1.00 to 1.70
Kempton Park Gravels	4.00 to 6.40	1.00 to 1.70	2.60 to 3.80
London Clay	1.40 to 2.30	3.60 to 5.50	Not proven (>20.00)



7. Additional Assessments

7.1. Thames Water Preliminary Ground Movement Assessment

7.1.1. 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.

7.2. Buildings Ground Movement Assessment

7.2.1. A full ground movement impact assessment for adjacent properties is not considered a requirement for this scheme, due to the significant offset between the proposed basement works and adjacent / neighbouring properties.

7.2.2. The impact of the proposed works on the neighbouring properties has been assessed in an outline fashion, in general accordance with typical industry thresholds and current best practice.

7.2.3. Much of the perimeter of the basement walls will be formed at a greater elevation than the surrounding street levels (i.e. the extent to which the basement walls retain the surrounding streets is very much limited), therefore the influence / impact of ground movements beyond the site footprint will be very low.

7.2.4. A conventional assessment adopting the CIRIA C760 ground movement curve data sets indicates that the damage classification for the nearest masonry façade would be no greater than *Category 1 – Very Slight*, which is generally accepted by local authorities and party wall representatives.

8. Construction Methodology / Engineer Statements

8.1. Outline Temporary and Permanent Works Proposals

8.1.1. It is currently understood that at this stage to construct the basement using a bottom-up methodology.

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

8.1.3. The basement excavation will be restrained by retaining walls. The final arrangement is subject to ongoing design development.

8.1.4. 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.

8.1.5. The north side of the proposed building located adjacent to the Wharf Lane will have a line of Sheet piles wall to protect the retained trees adjacent to the delivery road. However, given the close proximity of the proposed sheet piling wall to the public highway, the ground movement that may arise from installation of the sheet pile wall will need to be assessed.

8.2. Ground Movement Mitigation Measures

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

- 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 to be performed by an experienced ground engineering contractor.
- Frequent monitoring of neighbouring properties 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 retaining wall 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.

8.3. Control of Construction Works

- 8.3.1. Following the selection of a Principal Contractor, a Construction Method Statement should be developed, which will cover the items outlined in this section in detail.
- 8.3.2. Work method statements and logistics strategies shall be developed for the main stages of the construction works, outlining the means and methods of safely carrying out the works. Key risks and associated mitigation measures shall also be detailed.
- 8.3.3. Details of all temporary works required should be developed to ensure that structural stability is maintained throughout the demolition and excavation works.
- 8.3.4. Construction traffic management plans and environmental considerations for the site, including site waste management and noise / vibration / dust mitigation, should also be developed.
- 8.3.5. A detailed structural monitoring strategy should also be developed to control construction works and maintain movements / damage impacts that are within the predicted limits and tolerances. This should include the following:
- A structural monitoring layout plan of instrumentation / survey points / critical sections.
 - Programme / frequency of monitoring.
 - Trigger values derived for each of the structures within the zone of influence of the proposed works.
 - Contingency actions and project team lines of responsibility.



9. Basement Impact Assessment

9.1. General

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

- The ground conditions of the site generally comprise Made Ground overlying the Kempton Park Gravels and then the London Clay Formation.
- The site and the general surrounding areas are relatively flat. The site has an external elevation of approximately +7.0mOD that is at a higher elevation approximately 2m higher than the surrounding street level.
- A perched groundwater table is anticipated to be present within the Kempton Park Gravels based on the groundwater monitoring data at around 2.6mOD.

9.1.2. It is understood that the proposed development works comprise the demolition of all existing buildings and structures followed by the construction of a new mixed use development. The overall site footprint currently includes 1A, 1B King Street and 2/4 Water Lane, the remaining former swimming building at the corner of the Water Lane, The Embankment and the river facing parcel of land on The Embankment in front of the Diamond Jubilee Gardens.

9.1.3. The proposed development comprises of plant and back of house at lower ground floor level, flexible commercial and office space at ground floor level and residential units in the floors above. A new public square and areas of public realm will also be developed within the site. Some landscaping to the south of Diamond Jubilee Gardens.

9.2. Land Stability / Slope Stability

9.2.1. It is assumed that all new substructure elements will be founded on competent strata, such as the London Clay Formation and Kempton Park Gravels, which are considered to be suitable for supporting foundation loads.

9.2.2. The project team shall liaise with Thames Water and adhere to the requirements of their asset protection team.

9.2.3. An outline assessment of the likely impact of ground movements on adjacent / neighbouring structures has been performed. It has been concluded that impact 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.

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

9.3. Hydrology and Groundwater Flooding

9.3.1. The BIA has concluded that there is a low risk of groundwater flooding due to the proposed development.

9.3.2. The BIA has concluded that the proposed basement retaining wall will not cut off any prevailing groundwater flow that may currently pass through the permeable Kempton Park Gravels, as it is not embedded within the London Clay Formation. The groundwater monitoring data suggested that the groundwater is showing a sign of flowing towards the River Thames.



9.4. Hydrology, Surface Water Flooding and Sewer Flooding

- 9.4.1. The BIA has concluded that risk is limited relating to potential surface water flooding. However, part of the site is within the Flood Zone 3b. The site is within the High risk of Rivers or Seas Flooding.
- 9.4.2. For further details of the proposed scheme flood risk mitigation measures reference should be made to the scheme Flood Risk Assessment report, provided in Appendix D.

Appendix A: Existing and Proposed Development Drawings

Appendix B: Desk Study & Ground Investigation Report – GEA

Appendix C: Phase 1 and 2 Site Investigation Report – GEO

Appendix D: Flood Risk Assessment and SuDs Report



A-squared Studio

A-squared Studio Engineers Limited

One Westminster Bridge Rd
London, SE1 7XW

020 7620 2868
contact@a2-studio.com
www.a2-studio.com

