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February 2021

4 MONTPELIER SQUARE,

LONDON, SW7 1JT

BASEMENT IMPACT ASSESSMENT

Prepared for

Ambra SRL

DOCUMENT CONTROL

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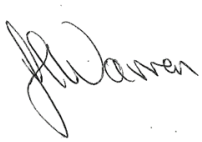	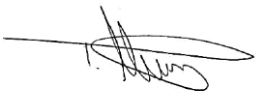
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1.0 INTRODUCTION

1.1 Project Objectives

The purpose of this assessment is to consider the effects of a proposed basement construction on the local slope stability, surface water and groundwater regime at the residential property at 4 Montpelier Square, London, SW7 1JT.

The recommendations and comments given in this report are based on the information contained from the sources cited and may include information provided by the Client and other parties, including anecdotal information. It must be noted that there may be special conditions prevailing at the site which have not been disclosed by the investigation and which have not been taken into account in the report. No liability can be accepted for any such conditions.

This report does not constitute a full environmental audit of either the site or its immediate environs.

1.2 Planning Policy Context

The Royal London Borough of Kensington and Chelsea's (RLBKC) polices on future developments in the borough are set out in the Council's Core Strategy (2010).

The Council adopted the Basements SPD on 14 April 2016. The Basements SPD provides more detailed guidance and advice on the adopted Local Plan Policy CL7: Basements.

This document requires proposed developments to mitigate against the effects of ground and surface water flooding and to include drainage systems that do not impact neighbouring property of the site or the water environment by way of changing the groundwater regime.

This report is intended to address the issues set out in the council's basement policy. It will review existing site investigation data and provide a preliminary assessment of the issues identified by the Site Analytical Services Limited screening process.

This report also provides an impact assessment of the geo-environmental impacts on adjacent structures and the surrounding area based on available site investigation data.

As part of this guidance a subterranean (groundwater) flow screening chart is provided which follows current planning procedure for basements and lightwells adopted by other London Borough's, including Camden, Westminster and Haringey. The completed chart in relation to this development is provided as Table 1, to this report.

1.3 Qualifications

The report has been prepared by Mr Thomas Murray, a Fellow of the Geological Society (FGS) and over 7 years' experience in Basement Impact Assessments.

2.0 SITE DETAILS

(National Grid Reference: TQ 274 295)

2.1 Site Location

The site is located on the eastern side and upper section of Montpelier Square, in Knightsbridge, Central London at approximate postcode SW7 1JT. The site is located opposite to a residential garden square (Montpelier Square) and is immediately bound by residential properties to the north, east and south. The site is rectangular in shape and covers an approximate area of 0.02 Hectares with the general area being under the authority of the City of Westminster.

The nearby surrounding areas to the site are mainly residential in all directions. Commercial properties are located nearby to the south-east, within 250m.

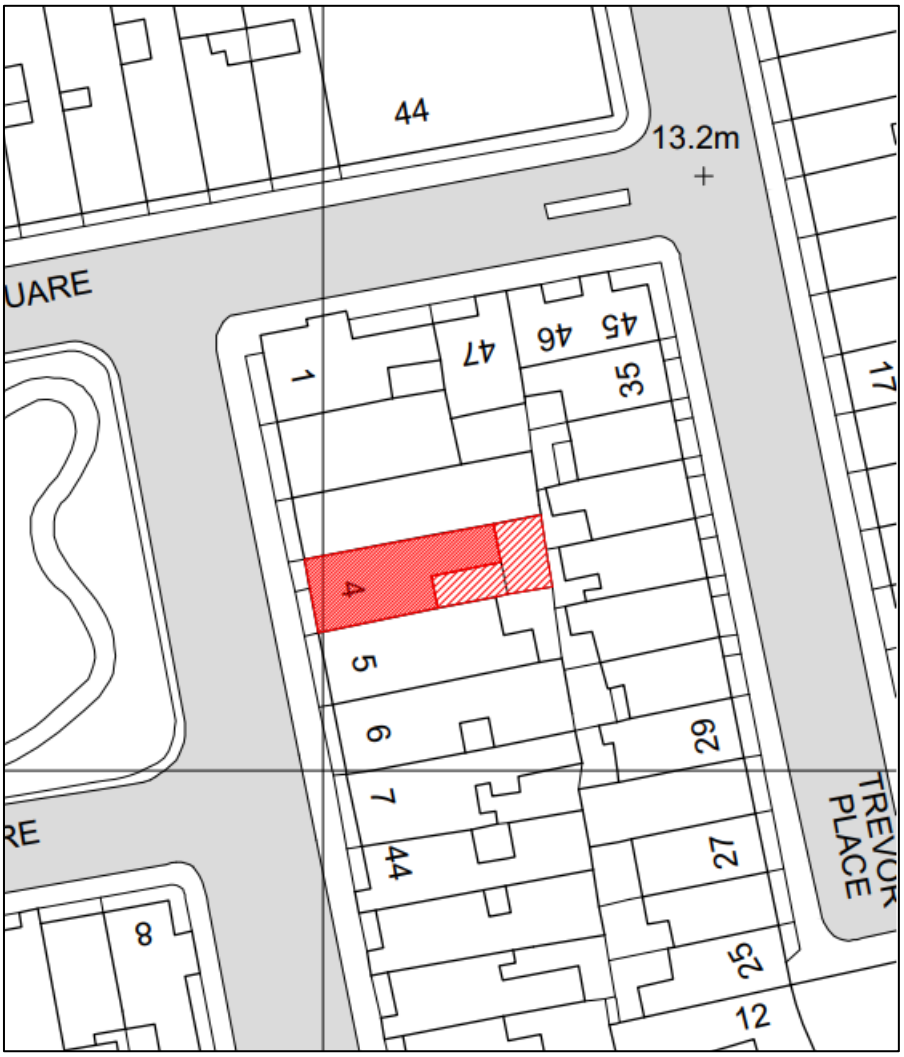

Figure 1. Site Location Plan

2.2 Site Layout and History

The site was attended on 21st January 2021 for the purposes of conducting the site walkover.

The site is accessed from Montpelier Square and comprises a terraced three storey residential property with an existing lower ground floor level.

The site is covered entirely in some form of hardstanding (buildings, footpaths, concrete, tarmac).

A tree is evident in the rear hard-landscaped garden area alongside a couple of potted plants.

From the site walkover there were no obvious potentially contaminating activities on the site.

From historical map evidence, it would appear that the site was first built on prior to 1869, with no changes taking place to the property since its construction. Garages have been present within 250m of the site.

2.3 Geology

The 1:50000 Geological Survey of Great Britain (England and Wales) covering the area (Sheet 256, 'North London', Solid and Drift Edition) indicates the site to be underlain Kempton Park Gravel Member with the London Clay Formation at depth.

The British Geological Survey maintains an archive of historical exploratory borehole logs throughout the UK. SAS Limited has searched the database and have found multiple boreholes located within 250m of the site. The closest is located 90m to the north-west of the site at 'South Lodge BH8' and shows 1.70m of Made Ground over 0.90m of sand and gravel in a matrix of brown and grey mottled sandy clay (Kempton Park Gravel Member) over stiff brown fissured clay, blue on fissures (London Clay Formation) to 12.00m.

- Kempton Park River Terrace Gravel: The Kempton Park Gravel Formation comprises fine to coarse grained silty occasionally clayey gravelly sand.

- London Clay Formation: The London Clay Formation comprises clay, silt and sand and at this site location a thickness of between 70m and 100m is likely.

- Deeper strata is not of interest for this study.

Figures 2 & 2a. Superficial and Bedrock geology of the Site (Ref. BGS Geoindex)

2.4 Hydrology and drainage

2.4.1 Rainfall and run-off

According to Mayes (1997) rainfall in the local area averages around 610mm and is significantly less than the national average of around 900mm.

Evapotranspiration is typically 450 mm/year resulting in about 160 mm/year as 'hydrologically effective' rainfall which is available to infiltrate into the ground or run-off as surface water flow.

According to publications regarding Lost Rivers of London (Barton, 1992) and (Talling, 2011), the site is not within 100m of a former river or watercourse with the closest being the River Westbourne (Serpentine) located 500m to the north-east of the site. The closest surface water feature is a small swimming pool located 161m to the north-east of the site.

Figure 3. Location of site relative to the 'Lost Rivers' of London (Source: Barton, 1992)

The area located immediately around the site is highly developed with more than 80% of the surface covered with hardstanding. Most of the rainfall in the area will run-off hard surface areas and be collected by the local sewer network.

2.4.2 Drainage

Surface drainage from the site is assumed to be directed to drains flowing downhill north to south along Montpelier Square.

2.4.3 Flood Risk

River or Tidal flooding

The site is currently not located within 1km of an area at risk from extreme flooding from rivers or sea without defences (Zone 2) or an area at risk from rivers or sea without defences (Zone 3).

Surface water flooding

According to Environment Agency Surface Water Flood maps of the area the site is at low risk from surface water flooding, but there is an area of moderate risk approximate 15m west of the site.

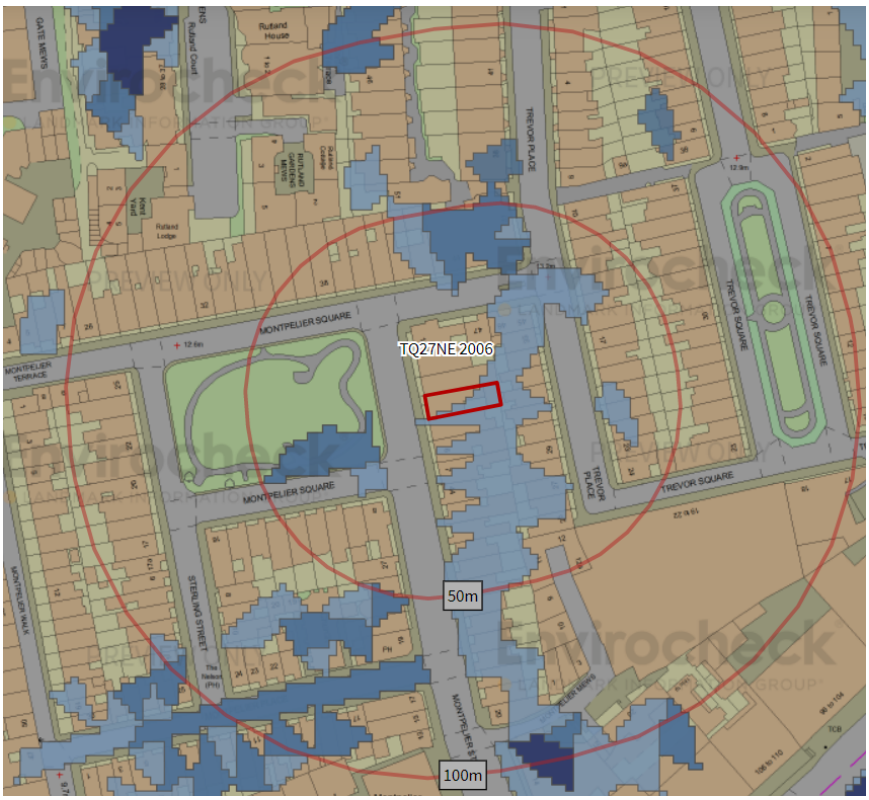

Figure 4. Extract from the Environment Agency's 'Risk of Flooding from Surface Water'. Ordnance Survey Crown copyright 2015. All rights reserved.

Sewer flooding

The London Regional Flood Risk Appraisal (2009) advises that foul sewer flooding is most likely to occur where properties are connected to the sewer system at a level below the hydraulic level of the sewage flow, which in general are often basement flats or premises in low lying areas. There is no record of sewer flooding having occurred at 4 Montpelier Square and therefore the risk of sewer flooding is considered low.

2.5 Hydrogeology

The Environment Agency Groundwater Protection Policy uses aquifer designations that are consistent with the Water Framework Directive. These designations reflect the importance of aquifers in terms of groundwater as a resource (drinking water supply) and also their role in supporting surface water flows and wetland ecosystems.

The superficial geology underlying the site (Kempton Park Gravel Member) has been classified as Secondary A Aquifer; 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. These are generally aquifers formerly classified as minor aquifers.

Groundwater levels within Kempton Park Gravel Member and across the site have been monitored as part of this study and the results are described in Section 4.0 below.

Other hydrogeological data obtained from the Phase 1 Preliminary Risk Assessment (PRA) (SAS Report Ref: 21/33098) for the site include:

- There are 2 Groundwater Source Protection Zones located within 1 kilometre of the site. A Zone II (Outer Protection Zone) is located on site and a Zone I (Inner Protection Zone) is located 87m to the south-east of the site.

- There are 33 water abstraction licences within 1 kilometre of the site, including 8 located within 250m.

2.6 Previous Reports

The results from a Phase 1 Preliminary Risk Assessment and Site Investigation are presented under separate cover in Site Analytical Services Limited reports (Project No's. 21/33098 and 21/33098-1), dated February 2021. The findings from these reports are described in this basement impact assessment.

2.7 Proposed Development

Proposals for the site include the construction of a single storey basement beneath the entire footprint of the property.

The proposed basement dig level is understood to be uniform at approximately 3.00m below the existing ground floor level.

2.8 Results of Basement Impact Assessment Screening

A screening process has been undertaken for the site and the results are summarised in Table 1 below:

Table 1: Summary of screening results

Item	Description	Response	Comment
Sub-terranean (Ground water Flow)	1a. Is the site located directly above an aquifer.	Yes	The Kempton Park Gravel Member below the site has been designated as a Secondary A aquifer; 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. These are generally aquifers formerly classified as minor aquifers.
	1b. Will the proposed basement extend beneath the water table surface.	Unknown – to be confirmed by Ground Investigation	Given the presence of an aquifer below the site it is possible that groundwater will be encountered during any excavations for the proposed basement, however this will be confirmed by the ground investigation.
	2. Is the site within 100m of a watercourse, well (used / disused) or potential spring line.	No	According to publications regarding Lost Rivers of London (Barton, 1992) and (Talling, 2011), the site is not within 100m of a former river or watercourse. The closest surface water feature is a small swimming pool located 161m to the north-east of the site.
	3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas.	No	The amount of hardstanding on-site is not expected to change.
	4. As part of 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	Existing drainage paths are to be utilised where possible. Whether soakaways/SUDS are used on the proposed development is to be confirmed (beyond the scope of this report). An appropriately qualified engineer should be engaged to ensure mandatory requirements are met.
	5. 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	According to publications regarding Lost Rivers of London (Barton, 1992) and (Talling, 2011), the site is not within 100m of a former river or watercourse. The closest surface water feature is a small swimming pool located 161m to the north-east of the site.

Slope Stability	1. Does the existing site include slopes, natural or man-made greater than 7 degrees (approximately 1 in 8)	No	The site is essentially flat.
	2. Will the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 7 degrees (approximately 1 in 8).	No	Re-profiling of landscaping at the site is not proposed.
	3. Does the development neighbor land, including railway cuttings and the like, with a slope greater than 7 degrees (approximately 1 in 8).	No	The surrounding area is essentially flat.
	4. Is the site within a wider hillside setting in which the general slope is greater than 7 degrees (approximately 1 in 8).	No	There is a general slope across the surrounding area from north-west to south-east towards the Thames Basin, but this is less than 1 in 8.
	5. Is the London Clay the shallowest strata at the site.	No	With reference to available BGS records, the soil stratum below the site is the Hackney River Terrace Gravel. The boundary to the underlying London Clay Formation is approximately 100m to the south and therefore the site is not considered to be close to this stratigraphic boundary.
	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	It is understood that no trees are to be felled as part of the 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 Kempton Park Gravel Member does not have potential for shrink-swell
	8. Is the site within 100m of a watercourse or a potential spring line.	No	According to publications regarding Lost Rivers of London (Barton, 1992) and (Talling, 2011), the site is not within 100m of a former river or watercourse. The closest surface water feature is a small swimming pool located 161m to the north-east of the site.
	9. Is the site within an area of previously worked ground.	No	According to the records held by the BGS the site is not underlain by any worked ground, made ground, infilled ground or landscaped ground
	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.	Unknown – to be confirmed by Ground Investigation	Given the presence of an aquifer below the site it is likely that groundwater will be encountered during any excavations for the proposed basement, however this will be confirmed by the ground investigation.

	11. Is the site within 5m of a highway or pedestrian right of way.	Yes	The site lies within 5m of Montpelier Square.
	12. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties.	Yes	The development will increase the depths of foundation at the site, although the foundation depths of adjacent properties are not known.
	13. Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines.	Unknown / outside scope of report	A full statutory service search was outside the scope of this report and may need to be completed prior to any excavations.
Surface Water and Flooding	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 amount of hardstanding on-site is not changing therefore surface water will not be impacted by the development.
	2. Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas.	No	The amount of hardstanding on-site is not expected to increase.
	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 amount of hardstanding on-site is not expected to increase with the basement level only constructed beneath the existing footprint.
	4. Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses.	No	The amount of hardstanding on-site is not expected to increase with the basement level only constructed beneath the existing footprint.
	5. Is the site in an area known to be at risk from surface water flooding.	Yes	According to Figure 4 from Environment Agency's 'Risk of Flooding from Surface Water' the area at a low risk from surface water flooding, but is not listed within the Critical Drainage Areas according to the RBKC portal.

The Screening Exercise has identified the following potential issues which will be carried forward to the Scoping Phase

Subterranean Groundwater Flow

- Is the site located directly above an aquifer.
- Will the proposed basement extend beneath the water table surface.

Slope Stability

- 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.
- Is the site within 5m of a highway or pedestrian right of way.
- Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties.

Surface water and flooding

- Is the site in an area known to be at risk from surface water flooding.

3.0 SCOPING PHASE

This purpose of the scoping phase is to assess in more detail the factors to be investigated in the impact assessment. Potential impacts are assessed for each of the identified impact factors and recommendations are stated.

A conceptual ground model is usually complied at the scoping stage however, because the ground investigation has already been undertaken for this project, the conceptual ground model including the findings of the ground investigation is described under Chapter 4.

Subterranean (Groundwater Flow)

Potential Issue (Screening Question)		Potential impacts and actions
1a	Is the site located directly above an aquifer?	**Potential impact**: Infiltration could be reduced. **Action**: Ground Investigation required, then review.
1b	Will the proposed basement extend beneath the water table surface?	**Potential impact:** Local restriction of groundwater flows (perched groundwater or below groundwater table). **Action:** Ground investigation required, the review.

Slope Stability

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?	**Potential impact:** Inadequate provision of dewatering can lead to collapse of excavations. Inappropriate dewatering can cause removal of fines and/or unacceptable increases ineffective stress, both of which can cause ground structures to settle. **Action:** Ground investigation required in order to enable a proper assessment of the appropriate forms of groundwater control.
11	Is the site within 5m of a highway or a pedestrian right of way?	**Potential impact:** Excavation of basement causes loss of support to footway/highway and damage to the services beneath them. **Action:** Ensure adequate temporary and permanent support by use of best practice working methods.
12	Will the proposed basement substantially increase the differential depth of foundations relative to neighbouring properties?	**Potential impact:** Loss of support to the ground beneath the foundations to the surrounding properties if basement excavations are inadequately supported. **Action:** Ensure adequate temporary and permanent support by use of best practice methods.

Subterranean (Surface Water Flooding)

Potential Issue (Screening Question)		Potential impacts and actions
5	Is the site in an area known to be at risk from surface water flooding.	**Potential impact**: Flooding occurs during the excavation of the basement get flooded following construction **Action**: A groundwater exception test should be carried out prior to any construction works.

These potential impacts have been further assessed through the ground investigation, as detailed in Section 4 below.

4.0 EXISTING SITE INVESTIGATION DATA

4.1 Records of site investigations

Ground conditions at the site were investigated by Site Analytical Services Limited in January and February 2021 (Report Reference 21/33098-1). The ground conditions revealed by the investigation are summarised in the following table.

Strata	Depth to top of strata (mbgl)	Depth to top of strata (mSD)	Depth to base of strata (mbgl)	Depth to base of strata (mSD)	Description
Made Ground	0.00	-	0.44 to 1.50	-3.29 to -4.44	Tiles or concrete over sandy clay containing brick fragments and occasional hardcore.
Kempton Park River Terrace Gravel	0.44 to 1.10	-3.29 to -3.95	4.50	-7.13	Firm sandy gravelly clay / Medium dense slightly gravelly fine to coarse sand.
London Clay Formation	4.50	-7.13	15.00 (maximum depth of drilling)	-17.93	Stiff silty sandy clay containing partings of silty fine sand and gypsum crystals.

Table 2: Summary of Ground Conditions in Exploratory Holes

Groundwater was not encountered in the borehole or trial pits and the material remained essentially dry throughout.

It must be noted that the speed of excavation is such that there may well be insufficient time for further light seepages of groundwater to enter the borehole and trial pits and hence be detected, particularly within more cohesive soils.

Groundwater was encountered at a depth of 4.05m below lower ground level (-6.98mSD) in Borehole 1 after a period of approximately four weeks.

Isolated pockets of groundwater may also be present perched within any less permeable material found at shallower depth on other parts of the site especially within any Made Ground.

It should be noted that the comments on groundwater conditions are based on observations made at the time of the investigation (January and February 2021) and that changes in the groundwater level could occur due to seasonal effects and also changes in drainage conditions.

5.0 FOUNDATION DESIGN

5.1 General

Proposals for the site include the construction of a single storey basement beneath the footprint of the property.

The proposed basement dig level is understood to be uniform at approximately 3.00m below the existing lower ground floor level (-5.93mSD).

5.2 Site Preparation Works

The main contractor should be informed of the site conditions and risk assessments should be undertaken to comply with the Construction Design Management (CDM) regulations. Site personnel are to be made aware of the site conditions. It is recommended that extensive searches of existing man-made services are undertaken over the site prior to final design works.

5.3 Conventional Spread Foundations

A result of the inherent variability of uncontrolled fill, (Made Ground) is that it is usually unpredictable in terms of bearing capacity and settlement characteristics. Foundations should therefore, be taken through any Made Ground and either into, or onto a suitable underlying natural stratum of adequate bearing characteristics.

Based on the ground and groundwater conditions encountered in the borehole, it could, in theory, be possible to support the proposed new development on conventional strip foundations taken down below the Made Ground and any weak superficial soils and placed in the natural stiff silty sandy gravelly clay deposits which occur at a depth of 1.40m across the site.

Using theory from Terzaghi (1943), strip foundations placed within natural soils may be designed to allowable net bearing pressures of approximately 130kN/m^2 at 3.00m depth below lower ground level (-5.93mSD) increasing to 170kN/m^2 at 3.50m depth below lower ground level (-6.43mSD) in order to allow for a factor of safety of 2.5 against general shear failure. The actual allowable bearing pressure applicable will depend on the form of foundation, its geometry and depth in accordance with classical analytical methods, details of which can be obtained from “Foundation Design and Construction”, Seventh Edition, 2001 by M J Tomlinson (see references) or similar texts.

Any soft or loose pockets encountered within otherwise competent formations should be removed and replaced with well compacted granular fill.

In addition, foundations may need to be taken deeper should they be within the zones of influence of both existing or recently felled trees and any proposed tree planting. The depth of foundation required to avoid the zone likely to be affected by the root systems of trees is shown in the recommendations given in NHBC Standards, Chapter 4.2, April 2010, “Building near Trees" and it is considered that this document is relevant in this situation.

5.4 Piled Foundations

In the event that the use of conventional spread foundations proves either impracticable or uneconomical due to the size and depth of foundation required, then a piled foundation will be required. In these ground conditions, it is considered that some form of bored and in-situ cast concrete piled foundation with reinforced concrete ground beams should prove satisfactory.

The construction of a piled foundation is a specialist activity and the advice of a reputable contractor, familiar with the type of soil and groundwater conditions encountered at this site should be sought prior to finalising the foundation design. The actual pile working load will depend on the particular type of pile chosen and method of installation adopted.

To achieve the full bearing value a pile should penetrate the bearing stratum by at least five times the pile diameter.

Where piles are to be constructed in groups the bearing value of each individual pile should be reduced by a factor of about 0.8 and a calculation made to check the factor of safety against block failure.

Driven piles could also be used and would develop much higher working loads approximately 2.5 to 3 times higher than bored piles of a similar diameter at the same depth. However, the close proximity of adjacent buildings will in all probability preclude their use due to noise and vibration.

5.5 Retaining Walls

5.5.1 General

Several methods of retaining wall construction could be considered. These may include retaining structures cast in an underpinning sequence, or the use of temporary or sacrificial works to facilitate the retaining structure's construction. The excavation of the basement must not compromise the integrity of adjacent structures.

The full design of temporary and permanent retaining structures is beyond the scope of this report. However, the following design parameters for each element of soil recorded in the relevant exploratory holes are provided in Table 3 below to assist the design of these structures.

Stratum	Depth to top (m)	Bulk Density (Mg/m3) (γ)	Effective Angle of Internal Friction (Φ)
River Terrace Gravel	0.44 to 1.10	2.00	28
London Clay Formation	4.50	2.00	21

Table 3: Retaining Wall Design Parameters

The designer should use these parameters to derive the active and passive earth pressure coefficients ka and kp. The determination of appropriate earth pressure coefficients, together with factors such as the pattern of the earth pressure distribution, will depend upon the type/geometry of the wall and overall design factors.

5.6 Basement Floor Slabs

Due to the presence of soils assessed to be of medium swelling and shrinkage potential below, it is recommended that ground slabs should be fully suspended.

Within the zone of influence of trees, either retained or removed, floor slabs should incorporate either underfloor voids or suitable depths of compressible material in accordance with NHBC requirements, for soils with high volume change potential.

5.7 Chemical Attack on Buried Concrete

The results show the soil samples tested to have water soluble sulphate contents of up to 0.24g/litre associated with near neutral to slightly alkaline pH values.

In these conditions, it is considered that deterioration of buried concrete due to sulphate or acid attack is unlikely to occur. The final design of buried concrete according to Tables C1 and C2 of BRE Special Digest 1:2005 should be in accordance with Class DS-1 conditions.

However, segregations of gypsum were noted within the London Clay Formation. Consequently, it is considered that any buried concrete at depth may be attacked by such sulphates in solution and that it would be prudent to design any such concrete in accordance with full Class DS-2 conditions.

6.0 BASEMENT IMPACT ASSESSMENT

6.1 Summary

The screening identified a number of potential impacts. The table below summarises the previously identified potential impacts and the additional information that is now available from the site investigation in consideration of each impact.

Potential Impact	Site Investigation conclusions	Impact sufficiently addressed without further justification?
The site is directly above an aquifer.	The most recent soils investigation has proven that the site lies above the Kempton Park Gravel Member. These are generally aquifers formerly classified as minor aquifers.	No – see below for further details.
The proposed basement extends beneath the water table surface.	The maximum proposed dig level for the basement excavation (understood to be -5.93mSD) lies above the minimum indicated groundwater level -6.89mSD in BH1 and therefore groundwater will not be affected by the development	Yes.
The site is within 5m of a highway or pedestrian right of way.	The proposed basement is not to be extended below Montpelier Square and therefore it is suggested that the impact on these access roads is likely to be minimal. There is nothing unusual in the proposed development that would give rise to any concerns with regard to the stability of public highways.	Yes.
The proposed basement will significantly increase the differential depth of foundations relative to neighbouring properties.	The development will result in the extension of the foundation depth of the basement relative to neighbouring properties.	No – see below for further details.
The site is in an area known to be at risk from surface water flooding.	There may a potential risk of surface water following the construction, however, as the basement is beneath the footprint of the building, it is unlikely.	No – see below for further details.

6.2 Outstanding Risks and Issues

The significant impacts which require further information have been described in detailed below in order to assess the likelihood of them occurring and the scope for reasonable engineering mitigation.

The site is located directly above an aquifer.

As proven from the site investigation, the site is underlain by aquifer sustaining Superficial (Drift) geology comprising permeable unconsolidated (loose) deposits. These deposits have been designated as Secondary A Class; 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. These are generally aquifers formerly classified as minor aquifers.

The Bedrock geology underlying the site (solid permeable formations) has been classified as Unproductive Strata; rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

Due care and attention should be paid to ensure that no contamination incidents occur as a result of the development. No change to the existing drainage arrangements is proposed and therefore existing rates of rainfall infiltration and groundwater recharge will remain unchanged.

The proposed basement will significantly increase the differential depth of foundations relative to neighbouring properties.

The excavation and construction of the basement at the site has the potential to cause some movements in the surrounding ground if not properly managed. However, it is understood that ground movements and/or instability will be managed through the proper design and construction of mitigation measures during the works. This will require close collaboration with the appointed contractor's temporary works coordinator.

The Party Wall Act (1996) will apply to this development because neighbouring houses lie within a defined space around the proposed building works. The party wall process should be followed and adhered to during this development.

A ground movement assessment was carried out at the site by Curtins under the instruction of Site Analytical Services Limited (Report Reference 077867-CUR-00-XX-RP-GE-001). The report is provided as Appendix B to this report and concludes that given good workmanship, including stiff bracing to the excavations, the level of damage to the surrounding properties is predicted to be 'very slight' or less. This conclusion assumes a high standard of workmanship and adequate propping of the basement excavation.

A monitoring plan should be set out at design stage and should include a monitoring strategy, instrumentation and monitoring plans and action plans. Trigger levels on movements will need to be defined. Precise levelling or reflective survey targets should be installed at the garden walls and neighbouring buildings. Monitoring should take place in advance of the proposed works as a base-line survey, during the works and for a period following the completion of the works, to understand the long term effects.

The site is in an area known to be at risk from surface water flooding.

Although the modelling of the site by the Environment Agency shows a 'Low' risk of flooding for No.4.

In applying the Exception Test and assessing the risk associated with surface water and sewer flooding the following is considered:

- The proposed basement construction does not change the impermeable proportion at the site (this remains essentially the same). As such, the basement will not have an adverse impact on the site's surface water run-off.

- The development will not intrude into the saturated part of the aquifer and will not obstruct it in any way. Therefore, it is anticipated that existing local groundwater flow paths, and groundwater storage, will not be significantly affected by the proposals.

- At the time of writing this report, the drainage details had not been finalised; however, it is our understanding that the drainage details will incorporate a pumping device to protect the property from sewer flooding.

The proposed development will not increase flood risk at the site or the surrounding area. Also, since the development is on already developed land, it will not adversely impact the Council's sustainability objectives.

7.0 BIA CONCLUSIONS

1. Proposals for the site include the construction of a single storey basement beneath the footprint of the property. The proposed basement dig level is understood to be uniform at approximately 3.00m (-5.93mSD) below the existing lower ground floor level.

2. Conditions at the site were investigated by Site Analytical Services Limited in January and February 2021 (SAS Report Reference 21/33098-1). The borehole revealed ground conditions that were generally consistent with the geological records and known history of the area and comprised up to 1.40m thickness of Made Ground, underlain by the Kempton Park Gravel Member with the London Clay Formation at depth.

3. As proven from the site investigation, the site is underlain by aquifer sustaining Superficial (Drift) geology comprising permeable unconsolidated (loose) deposits. The Bedrock geology underlying the site (solid permeable formations) has been classified as Unproductive Strata; rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

4. Water levels in the immediate vicinity of the property have been recorded below the level of the proposed basement and therefore the impact on the groundwater is likely to be minimal.

5. A monitoring plan will be set out at design stage and will include a monitoring strategy, instrumentation and monitoring plans and action plans.

6. The proposed development will not increase flood risk at the site or the surrounding area. Also, since the development is on already developed land, it will not adversely impact the Council's sustainability objectives.

7. The excavation and construction of the basement at the site has the potential to cause some movements in the surrounding ground if not properly managed. However, it is understood that ground movements and/or instability will be managed through the proper design and construction of mitigation measures during the works.

8.0 REFERENCES

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2. Environment Agency, 2006. Groundwater levels in the Chalk-Basal Sands Aquifer in the London Basin

3. British Standards Institution, 1999+A2. Code of Practice for Site Investigations, BS5930, BSI, London

4. British Standards Institution, 1986. Code of practice for foundations, BS 8004, BSI, London.

5. British Standards Institution, 2009. Code of Practice for Protection of Below Ground Structures Against Water from the Ground. BS 8102, BSI, London

6. CIRIA, 2000. Sustainable Urban Drainage Systems: Design Manual for England and Wales. CIRIA C522, Construction Industry Research and Information Association, London

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8. NHBC Standards, Chapter 4.1, "Land Quality - managing ground conditions", September 1999.

9. Mayles, J. 1997. Regional climates of the British Isles, p74: Average precipitation for the period 1961-1990 St James Park, London = 611mm. Routledge

10. NHBC Standards, Chapter 4.2, "Building near Trees", April 2010.

11. Environment Agency. (n.d.).Flood risk map. From http://maps.environment-agency.gov.uk/

9.0 APPENDIX A – GROUND INVESTIGATION FACTUAL REPORT

Factual Report on a
GEOTECHNICAL GROUND INVESTIGATION

Ref: 21/33098-1 | Date: February 2021

4 Montpelier Square
London
SW7 1JT

Prepared for:
Ambra SRL

DOCUMENT CONTROL

Project	4 Montpelier Square, London, SW7 1JT
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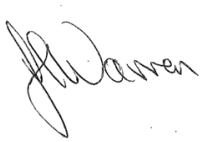	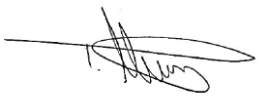	
Jim Warren MRSC Managing Director	Thomas Murray BSc (Hons) MSc FGS Geotechnical Engineer	Aubrey Davidson BSc MSc DIC Senior Environmental Engineer

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CONTENTS

1.0 Introduction

1.1 Outline and Limitations of Report

At the request of Ambra SRL, a ground investigation was carried out in connection with a proposed residential basement development at the above site. A Phase 1 Preliminary Risk Assessment (Desk Study) is presented under separate cover in Site Analytical Services Limited Report Reference 21/33098.

The information was required for the design and construction of foundations and infrastructure for the proposed development at the existing site which includes the construction of a single storey basement to 3.00m maximum depth beneath the footprint of the current property.

The recommendations and comments given in this report are based on the ground conditions encountered in the exploratory hole made during the investigation and the results of the tests made in the field and the laboratory. It must be noted that there may be special conditions prevailing at the site remote from the exploratory hole location which have not been disclosed by the investigation and which have not been taken into account in the report. No liability can be accepted for any such conditions.

2.0 Site Details

National Grid Reference: TQ – 274 295

2.1 Site Location

The site is located on the eastern side and upper section of Montpelier Square, in Knightsbridge, Central London at approximate postcode SW7 1JT. The site is located opposite to a residential garden square (Montpelier Square) and is immediately bound by residential properties to the north, east and south. The site is rectangular in shape and covers an approximate area of 0.02 Hectares with the general area being under the authority of the City of Westminster.

The nearby surrounding areas to the site are mainly residential in all directions. Commercial properties are located nearby to the south-east, within 250m.

2.2 Published Geology

The 1:50000 Geological Survey of Great Britain (England and Wales) covering the area indicates the site to be underlain by deposits of the Kempton Park Grave Member with the London Clay Formation at depth. A surface cover of Made Ground should also be expected.

3.0 Scope of Work

3.1 Site Works

The proposed scope of works was agreed by the client prior to the commencement of the investigations. To achieve this, the following works were undertaken:-

- The drilling of one continuous flight auger borehole to a depth of 15.00m below ground level (Borehole 1).
- The installation of a combined gas/groundwater monitoring standpipe to a depth of 7.00m depth in Borehole 1, together with four return monitoring visits.
- The excavation by hand of six trial pits, to 1.50m maximum depth to expose existing foundations on site (Trial Pits 1 to 6 inclusive).
- Sampling and in-situ testing as appropriate to the ground conditions encountered in the borehole and trial pits.
- Laboratory testing to determine the engineering properties of the soils encountered in the exploratory holes.

3.2 Ground Conditions

The approximate locations of the exploratory holes are illustrated on the site sketch plan, Figure 1 below.

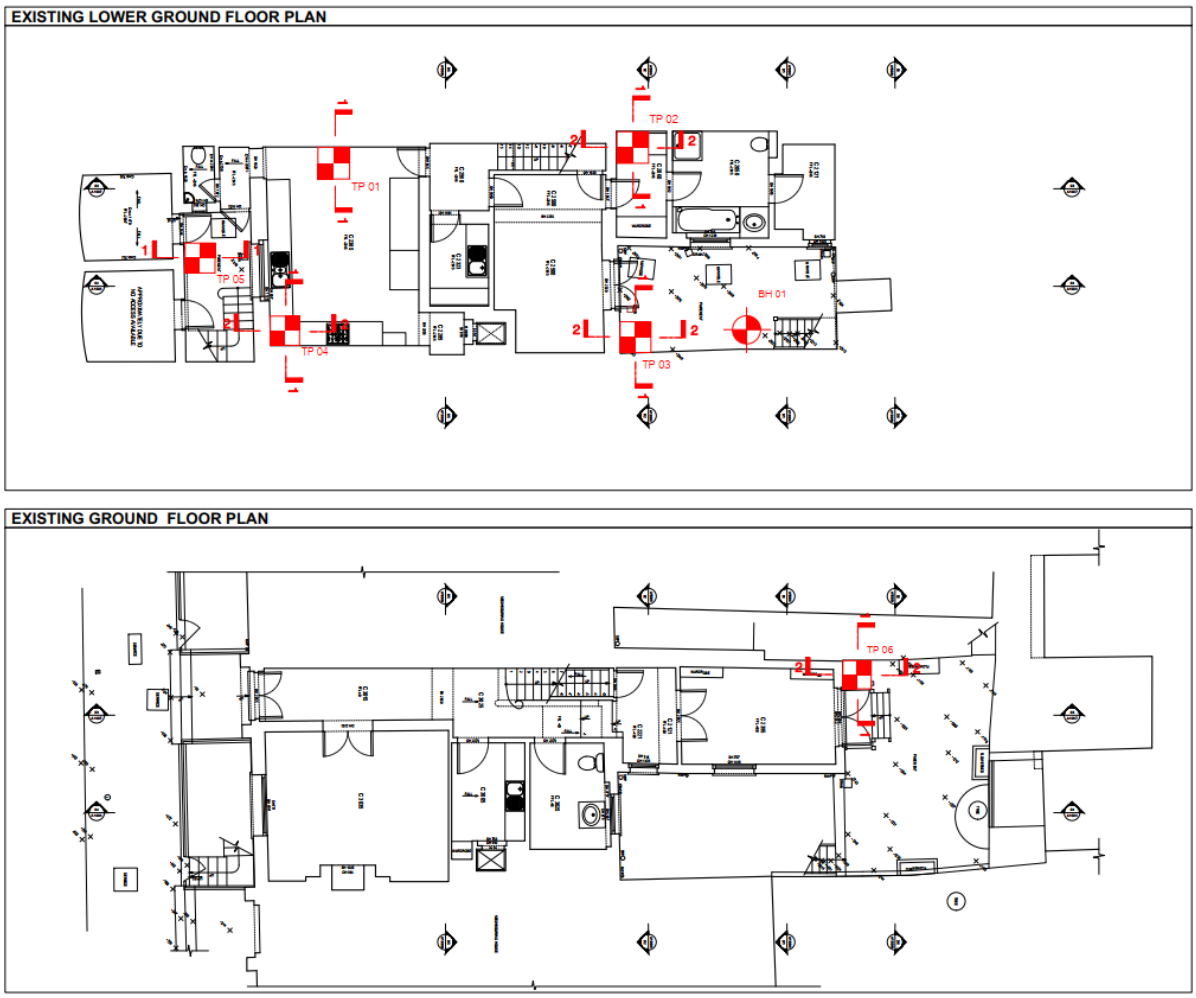


Figure 1. Site Sketch Plan

The borehole and trial pits revealed ground conditions that were generally consistent with the geological records and known history of the area and comprised Made Ground up to 1.10m in thickness resting on the Kempton Park River Terrace Gravel with the London Clay Formation at depth. Made Ground was also encountered to the base of Trial Pits 3 and 6 at 1.50m deep.

These ground conditions are summarised in the following table. For detailed information on the ground conditions encountered in the borehole and trial pits, reference should be made to the exploratory hole records presented in Appendix A.

Strata	Depth to top of strata (mbgl)	Depth to top of strata (mSD)	Depth to base of strata (mbgl)	Depth to base of strata (mSD)	Description
Made Ground	0.00	-	0.44 to 1.50	-3.29 to -4.44	Tiles or concrete over sandy clay containing brick fragments and occasional hardcore.
Kempton Park River Terrace Gravel	0.44 to 1.10	-3.29 to -3.95	4.50	-7.13	Firm sandy gravelly clay / Medium dense slightly gravelly fine to coarse sand.
London Clay Formation	4.50	-7.13	15.00 (maximum depth of drilling)	-17.93	Stiff silty sandy clay containing partings of silty fine sand and gypsum crystals.

Summary of Ground Conditions in Exploratory Holes

3.3 Groundwater

Groundwater was not encountered in the borehole or trial pits and the material remained essentially dry throughout.

It must be noted that the speed of excavation is such that there may well be insufficient time for further light seepages of groundwater to enter the borehole and trial pits and hence be detected, particularly within more cohesive soils.

Groundwater was encountered at a depth of 4.05m below ground level in Borehole 1 after a period of approximately four weeks.

Isolated pockets of groundwater may also be present perched within any less permeable material found at shallower depth on other parts of the site especially within any Made Ground.

It should be noted that the comments on groundwater conditions are based on observations made at the time of the investigation (January and February 2021) and that changes in the groundwater level could occur due to seasonal effects and also changes in drainage conditions.

3.4 Existing Foundations

Sketches of the foundations exposed in Trial Pits 1 to 6 inclusive are presented on the appropriate exploratory hole records presented in Appendix A and indicate that the existing walls of the building are supported on both brick and concrete foundations between 0.45m and >1.50m in thickness placed in the gravelly sand / silty sandy clay deposits.

4.0 In-Situ and Laboratory Tests

4.1 In-Situ Tests

In the essentially cohesive natural soils encountered at the site, in-situ shear vane tests were made at regular depth increments in order to assess the undrained shear strength of the materials. The results indicate that the natural soils are of a generally high strength in accordance with BS 5930 (2015).

The results of the in-situ tests are shown on the appropriate exploratory hole records contained in Appendix A.

Mackintosh Probe tests were made at regular depth increments in order to assess the relative density of the soils encountered in the borehole and trial pits. The results can be interpreted using the generally accepted correlation for Mackintosh Probe Tests which is as follows:

Mackintosh N75 X 0.38 = SPT 'N' Value

or

Mackintosh N300 X 0.1 = SPT 'N' Value

The results of the in-situ tests are shown on the appropriate exploratory hole records contained in Appendix A.

4.2 Classification Tests

Atterberg Limit tests were conducted on four selected samples taken from the cohesive portion of the natural soils in Borehole 1 and showed the samples tested to fall into Classes CL and CI according to the British Soil Classification System.

The results of the tests are presented on Table 1, contained in Appendix B.

4.3 Sulphate and pH Analyses

The results of the sulphate and pH analyses made on five soil samples are presented within the DETS Limited Report No: 21-00670, contained in Appendix B.

5.0 Ground Gas Assessment

5.1 Assessment of Gas Hazard

Borehole 1 was installed with a standpipe equipped with ground gas monitoring apparatus to a depth of approximately 7.0m below ground level.

The monitoring installation consisted of a 50mm diameter standpipe, which is in accordance with that prescribed to enable correlation with Gas Screening Values (GSVs) derived by CIRIA and the NHBC.

The installation consisted of 1m of plain pipe with a bentonite seal at the surface in order to prevent surface water ingress that could flood the response zone and to prevent atmospheric leakage/ingress. The standpipe was sealed with a bung and valve with a flush fitting stopcock cover.

The frequency of ground gas monitoring on-site was decided in line with recommendations by CIRIA to provide monitoring data sufficient to allow the prediction of worst-case conditions.

Based on a low generation potential and a low sensitivity development and monitoring which was undertaken during a range of climatic conditions, four monitoring visits at the site were considered appropriate.

Ground gas on-site was measured using an infrared landfill gas analyser. The results are presented in the gas tables, contained in Appendix B.

Atmospheric conditions and the results of the ground gas monitoring (maximum values) from all visits are presented below.

Date	Weather Conditions	Temperature (°C)	Pressure (mb)
21/02/21	Cloudy	+8.0	984
28/01/21	Cloudy	+13.0	999
04/02/21	Cloudy	+8.0	1007
11/02/21	Cloudy	+0.0	1025

Atmospheric Weather Conditions

BH	Flow (l/h)	CH_4 (%)	CO_2 (%)	VOC (ppm)	H_2S (ppm)	CO (ppm)
BH1	<0.1	<0.1	1.1	0.002	<0.1	<0.1

Gas Monitoring Results

Gas flow through soil occurs either by convection or by diffusion. Convection occurs when total gas pressure is not uniform throughout the system (i.e. when a total pressure gradient exists). Convective flow is in the direction in which total pressure decreases, because gases tend to move from regions of high pressure to regions of low pressure.

Diffusive flow of a gas is in the direction in which its concentration (partial pressure) decreases. The relative pressures recorded in the borehole were very low to negligible and therefore the potential for convective flow is considered to be low. Therefore, any gas flow would have to be via diffusion. This is corroborated by the trend of very low steady state flow rates (maximum of <0.1 l/hr), in many cases being below detection limits. In general, low concentrations of carbon dioxide were returned during the monitoring.

Hydrocarbon Vapours

The underlying made and natural ground across the site was found to be free from visual and olfactory indicators of volatile organic (e.g. hydrocarbon) contamination, which was corroborated by hydrocarbon analysis undertaken on each sample analysed.

As such, the probability for generation of VOC vapours from the underlying Made Ground and natural ground is considered to be low, which was verified by low VOC concentrations detected during gas monitoring.

CO and H_2S

There are currently no GSV for CO or H_2S. Thresholds are only available for occupational exposure limits (OEL). For H_2S, the OELST is 10ppm and OELLT is 5ppm. It should be noted that the OELLT is based upon an 8-hour exposure limit converted to an annual mean and the OELST is based upon 15 minute exposures converted to an annual mean. The concentrations of H_2S measured were below threshold values.

National Ambient Air Quality Standards (NAAQS) were developed by the US EPA under the Clean Air Act from 1990. The Clean Air Act primary standards to provide public health protection, including protecting the health of "sensitive" populations such as asthmatics, children, and the elderly. The EPA air quality standard is 9ppm CO average over 8 hours, not to be exceeded more than once a year. The concentrations of CO encountered did not exceed the EPA air quality standard.

CH_4 and CO_2 GSV

CIRIA (2007b) and NHBC (2007) provide assessments for CO_2 and CH_4 based upon GSV utilising flow rates and concentrations measured in appropriate standpipes. The GSVs within CIRIA (2007b) are based upon all buildings other than standard residential houses. The NHBC (2007) GSV are based upon standard residential houses with precast concrete floors (block and beam). As such, based upon the assumed end use of the site the GSV within the CIRIA guidance should be adopted. The thresholds for GSV based upon NHBC and CIRIA guidance are summarised below.

CIRIA		NHBC		
Classification	**GSV (CH_4 & CO_2)**	**Classification**	**GSV (CH_4)**	**GSV (CO_2)**
CS1	<0.07	Green	<0.13	<0.78
CS2	<0.70	Amber 1	<0.63	<1.60
CS3	<3.5	Amber 2	<1.60	<3.10
CS4	<15	Red	>1.60	>3.10
CS5	<70			
CS6	>70			

Thresholds for GSV

A summary of the monitoring results is provided below, which utilises the highest steady state concentration and highest flow rate at each location in order to adopt a worst-case scenario for the risk assessment.

BH	Flow (l/h)	CH_4 (%)	CO_2 (%)	VOC (ppm)	CH_4 GSV (l/hr)	CO_2 GSV (l/hr)	Characteristic Situation	NHBC Classification
BH1	<0.1	<0.1	1.1	0.002	<0.01	<0.01	**CS1**	**Green**

Summary of Monitoring Results

On-site monitoring has shown maximum emissions of methane in air of <0.1% and carbon dioxide in air of up to 1.1% recorded during the monitoring visits. The maximum borehole flow rate was <0.1 l/h.

As such the maximum Gas Screening Value for methane is <0.01 l/h and the maximum Gas Screening Value for carbon dioxide at site is <0.01 l/h. As such the worst-case value for the site would be <0.01 litres of gas per hour. This typically equates to a Characteristic Situation 1 which does not require gas protection measures.

6.0 Waste Acceptance Criteria Testing

6.1 Waste Acceptance Criteria Analysis

A sample was obtained from 0.25m depth below ground level in Borehole 1 made at the location indicated on the site sketch plan (Figure 1).

The sample selected for analysis was sub-contracted to DES Limited (a UKAS and MCERTS accredited laboratory) and their report is contained in Appendix B.

The sample was analysed using the Catwastesoil assessment tool, which concluded that the sample was not hazardous in nature.

The sample was analysed for Waste Acceptance Criteria ((WAC) testing in order to classify soils on-site for disposal purposes.

For the purpose of waste disposal, the soil sample would be classified as:

BH1 - 0.25m ***Inert Waste***

7.0 List of Appendices

Appendix A – Borehole / Trial Pit Logs

Appendix B – Laboratory Test & Gas/Groundwater Monitoring Data

8.0 References

1. British Standards Institution, 2015. Code of practice for foundations, BS 8004, BSI, London.

2. British Standards Institution, 1990. Methods for test for soils for civil engineering purposes, BS1377, BSI, London

3. British Standards Institution, 1994. Code of practice for earth retaining structures, BS8002, BSI, London

4. British Standards Institution, Code of Practice for Site Investigations, BS5930: 2015, BSI, London

5. British Standards Institution, 2004. Geotechnical Design, BS EN 1997-1 BSI, London

6. NHBC Standards, Chapter 4.1, "Land Quality - managing ground conditions", September 1999.

APPENDIX A

Borehole / Trial Pit Logs

Site Analytical Services Ltd.

Site	Borehole Number
4 MONTPELIER SQUARE, LONDON, SW7 1JT	BH1

Boring Method	Casing Diameter	Ground Level (mSD)	Client	Job Number
CONTINUOUS FLIGHT AUGER	100mm cased to 0.00m	-2.93	AMBRA SRL	2133098
	Location TQ274795	**Dates** 13/01/2021	**Engineer** ELLIOTTWOOD PARTNERSHIP LIMITED	**Sheet** 1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					-3.06	(0.13) 0.13	MADE GROUND: Thin black tiles over reinforced concrete		
0.25	D1					(0.37)	MADE GROUND: Brown sandy clay containing brick rubble and tiles		
0.50	D2				-3.43	0.50 (0.20)			
0.75	D3				-3.63	0.70 (0.30)	MADE GROUND: Brown silty sandy clay containing brick fragments		
1.00 1.00-1.30	D4 M1 90/300				-3.93	1.00 (0.60)	MADE GROUND: Loose, brown clayey fine to coarse grained sand containing brick fragments Soft, mottled grey brown slightly gravelly sandy CLAY		
1.50 1.50-1.80	D5 M2 53/300				-4.53	1.60	Firm, light yellow orange brown very sandy CLAY with fine to coarse grained sub-angular flint gravels appearing from 3.50m depth		
2.00 2.00	D6 V1 64								
2.50 2.50	D7 V2 62								
3.00 3.00	D8 V3 66					(2.60)			
3.50 3.50-3.64	D9 M3 100/140								
4.00 4.00-4.13	D10 M4 100/130				-7.13	4.20 (0.30)	Stiff, mottled brown silty sandy CLAY		
4.50 4.50	D11 V4 121				-7.43	4.50	Firm becoming stiff, dark grey very silty sandy CLAY. Becomes firm to stiff from 5.50m depth		
5.00 5.00	D12 V5 70								
6.00 6.00	D13 V6 130+								
7.00 7.00	D14 V7 130+					(5.50)			
8.00 8.00	D15 V8 130+								
9.00 9.00	D16 V9 130+								

Remarks
D= Disturbed Sample
M= Makintosh Probe-Blows/Penetration (mm)
V= Vane Test - Results in kPa
Groundwater was not encountered during boring/excavation
Excavating from 0.00m to 1.00m for 1 hour.

Scale (approx)	Logged By
1:50	EW

Figure No. 2133098.BH1

Site Analytical Services Ltd.

Site	Borehole Number
4 MONTPELIER SQUARE, LONDON, SW7 1JT	BH1

Boring Method	Casing Diameter	Ground Level (mSD)	Client	Job Number
CONTINUOUS FLIGHT AUGER	100mm cased to 0.00m	-2.93	AMBRA SRL	2133098
	Location TQ274795	**Dates** 13/01/2021	**Engineer** ELLIOTTWOOD PARTNERSHIP LIMITED	**Sheet** 2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
10.00 10.00	D17 V10 130+				-12.93	10.00	Stiff, dark grey very silty sandy CLAY		
11.00 11.00	D18 V11 130+								
12.00 12.00	D19 V12 130+					(5.00)			
13.00 13.00	D20 V13 130+								
14.00 14.00	D21 V14 130+								
15.00 15.00	D22 V15 130+				-17.93	15.00	Complete at 15.00m		

Remarks
D= Disturbed Sample
M= Makintosh Probe-Blows/Penetration (mm)
V= Vane Test - Results in kPa
Groundwater was not encountered during boring/excavation

Scale (approx)	Logged By
1:50	EW

Figure No. 2133098.BH1

Site Analytical Services Ltd.

Site	Borehole Number
4 MONTPELIER SQUARE, LONDON, SW7 1JT	BH1

Installation Type
Single Installation

Dimensions
Internal Diameter of Tube [A] = 50 mm
Diameter of Filter Zone = 100 mm

Client
AMBRA SRL

Job Number
2133098

Location
TQ274795

Ground Level (mOD)
-2.93

Engineer
ELLIOTTWOOD PARTNERSHIP LIMITED

Sheet
1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
			-3.93	1.00	Bentonite Seal
			-9.93	7.00	Slotted Standpipe
			-10.93	8.00	Bentonite Seal
			-17.93	15.00	General Backfill

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	Readings 10 min	Readings 15 min	Readings 20 min	Depth Sealed (m)

Groundwater Observations During Drilling

Date	Start of Shift Time	Start of Shift Depth Hole (m)	Start of Shift Casing Depth (m)	Start of Shift Water Depth (m)	Start of Shift Water Level (mOD)	End of Shift Time	End of Shift Depth Hole (m)	End of Shift Casing Depth (m)	End of Shift Water Depth (m)	End of Shift Water Level (mOD)

Instrument Groundwater Observations

Inst. [A] Type : Slotted Standpipe

Date	Instrument [A] Time	Instrument [A] Depth (m)	Instrument [A] Level (mOD)	Remarks

Remarks
Lockable cover set in cement

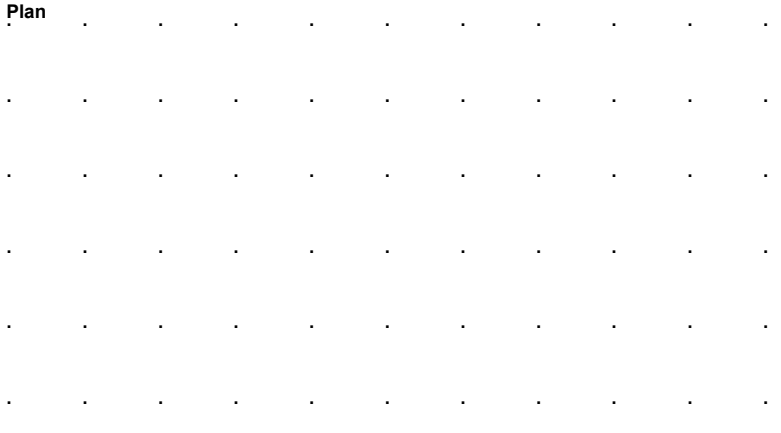
Site Analytical Services Ltd.

Site	Trial Pit Number
4 MONTPELIER SQUARE, LONDON, SW7 1JT	TP1

Excavation Method	Dimensions	Ground Level (mSD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 0.58m(D)	-2.85	AMBRA SRL	2133098
	Location	**Dates**	**Engineer**	**Sheet**
	TQ274795	13/01/2021	ELLIOTTWOOD PARTNERSHIP LIMITED	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				-2.95	0.10 (0.18)	MADE GROUND: Terracotta tiled floor over concrete		
0.25	D1			-3.13	0.28 (0.16)	MADE GROUND: Brick rubble and hardcore		
0.30	D2			-3.29	0.44 (0.14)	MADE GROUND: Brown fine to coarse grained sand containing brick fragments and roots		
0.45	D3			-3.43	0.58	Medium dense, yellow brown slightly gravelly fine to coarse grained SAND		
0.45-0.58	M1 100/130					Complete at 0.58m		

Plan



Remarks

D= Disturbed Sample
M= Makintosh Probe-Blows/Penetration (mm)
Groundwater was not encountered during boring/excavation

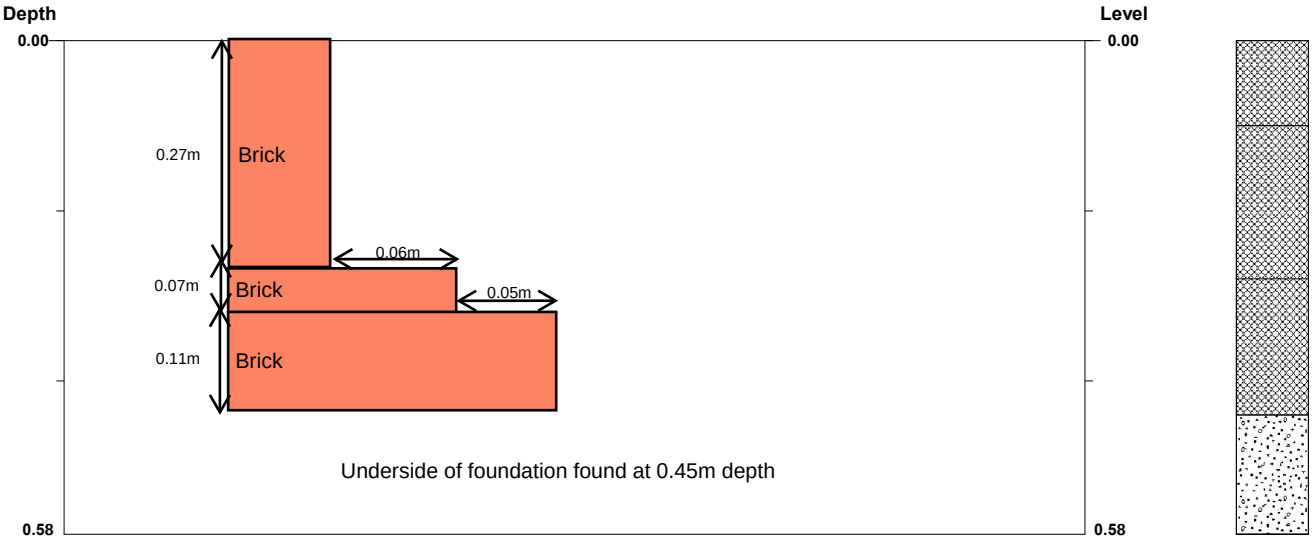
Scale (approx)	Logged By	Figure No.
1:50	EW	2133098.TP1

Site Analytical Services Ltd.

Site	Trial Pit Number
4 MONTPELIER SQUARE, LONDON, SW7 1JT	TP1

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 0.58m(D)	-2.85	AMBRA SRL	2133098

Orientation	Location	Dates	Engineer	Sheet
A / D / B / C	TQ274795	13/01/2021	ELLIOTTWOOD PARTNERSHIP LIMITED	1/1



Strata

Depth (m)	No.	Description
0.00-0.10	1	MADE GROUND: Terracotta tiled floor over concrete
0.10-0.28	2	MADE GROUND: Brick rubble and hardcore
0.28-0.44	3	MADE GROUND: Brown fine to coarse grained sand containing brick fragments and roots
0.44-0.58	4	Medium dense, yellow brown slightly gravelly fine to coarse grained SAND

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.30	D2	
0.45	D3	
0.45-0.58	M1 100/130	

Excavation Method:
HAND EXCAVATION

Shoring / Support:

Stability:

Backfill:

Remarks
D= Disturbed Sample
M= Makintosh Probe-Blows/Penetration (mm)
Groundwater was not encountered during boring/excavation

Logged By	: EW
Checked By	:
Figure No.	: 2133098.TP1

Site Analytical Services Ltd.

Site	Trial Pit Number
4 MONTPELIER SQUARE, LONDON, SW7 1JT	TP2A

Excavation Method	Dimensions	Ground Level (mSD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.20m(D)	-2.85	AMBRA SRL	2133098
	Location	**Dates**	**Engineer**	**Sheet**
	TQ274795	13/01/2021	ELLIOTTWOOD PARTNERSHIP LIMITED	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				-2.94	0.09	MADE GROUND: Concrete		
				-3.01	0.16	MADE GROUND: York stone		
0.25	D1				(0.54)			
0.50	D2					MADE GROUND: Brown sandy clay containing brick fragments		
0.75	D3			-3.55	0.70			
0.90	D4				(0.50)	Medium dense, mottled brown slightly gravelly fine to coarse grained SAND		
0.90-1.20	M1 150/300			-4.05	1.20			
						Complete at 1.20m		

Plan

Remarks

D= Disturbed Sample
M= Makintosh Probe-Blows/Penetration (mm)
Groundwater was not encountered during boring/excavation

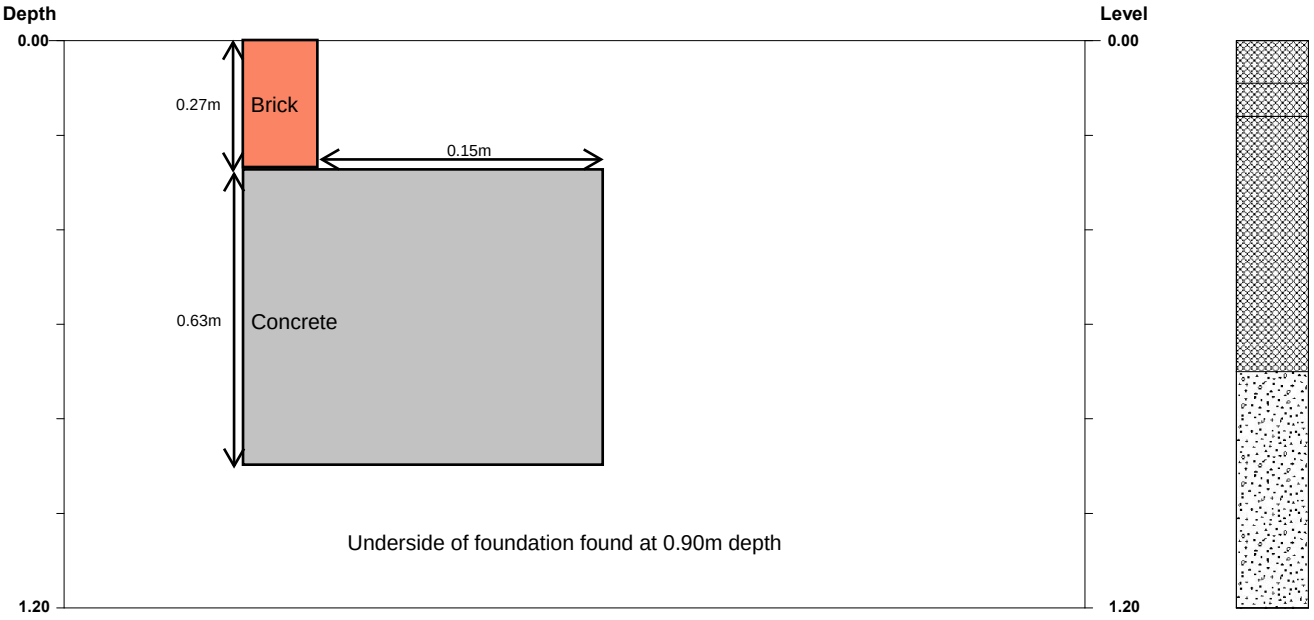
Scale (approx)	Logged By	Figure No.
1:50	EW	2133098.TP2A

Site Analytical Services Ltd.

Site	Trial Pit Number
4 MONTPELIER SQUARE, LONDON, SW7 1JT	TP2A

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 1.20m(D)	-2.85	AMBRA SRL	2133098

Orientation	Location	Dates	Engineer	Sheet
A / D B / C	TQ274795	13/01/2021	ELLIOTTWOOD PARTNERSHIP LIMITED	1/1



Strata

Depth (m)	No.	Description
0.00-0.09	1	MADE GROUND: Concrete
0.09-0.16	2	MADE GROUND: York stone
0.16-0.70	3	MADE GROUND: Brown sandy clay containing brick fragments
0.70-1.20	4	Medium dense, mottled brown slightly gravelly fine to coarse grained SAND

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.50	D2	
0.75	D3	
0.90	D4	
0.90-1.20	M1 150/300	

Excavation Method:

HAND EXCAVATION

Shoring / Support:

Stability:

Backfill:

Remarks

D= Disturbed Sample
M= Makintosh Probe-Blows/Penetration (mm)
Groundwater was not encountered during boring/excavation

Logged By : EW
Checked By :
Figure No. : 2133098.TP2A

Site Analytical Services Ltd.

Site	Trial Pit Number
4 MONTPELIER SQUARE, LONDON, SW7 1JT	TP2B

Excavation Method	Dimensions	Ground Level (mSD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.20m(D)	-2.85	AMBRA SRL	2133098
	Location	**Dates**	**Engineer**	**Sheet**
	TQ274795	13/01/2021	ELLIOTTWOOD PARTNERSHIP LIMITED	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				-2.94	0.09	MADE GROUND: Concrete		
				-3.01	0.16	MADE GROUND: York stone		
0.25	D1				(0.54)			
0.50	D2					MADE GROUND: Brown sandy clay containing brick fragments		
0.75	D3			-3.55	0.70			
0.90	D4				(0.50)	Medium dense, mottled brown slightly gravelly fine to coarse grained SAND		
0.90-1.20	M1 150/300			-4.05	1.20			
						Complete at 1.20m		

Plan

Remarks

D= Disturbed Sample
M= Makintosh Probe-Blows/Penetration (mm)
Groundwater was not encountered during boring/excavation

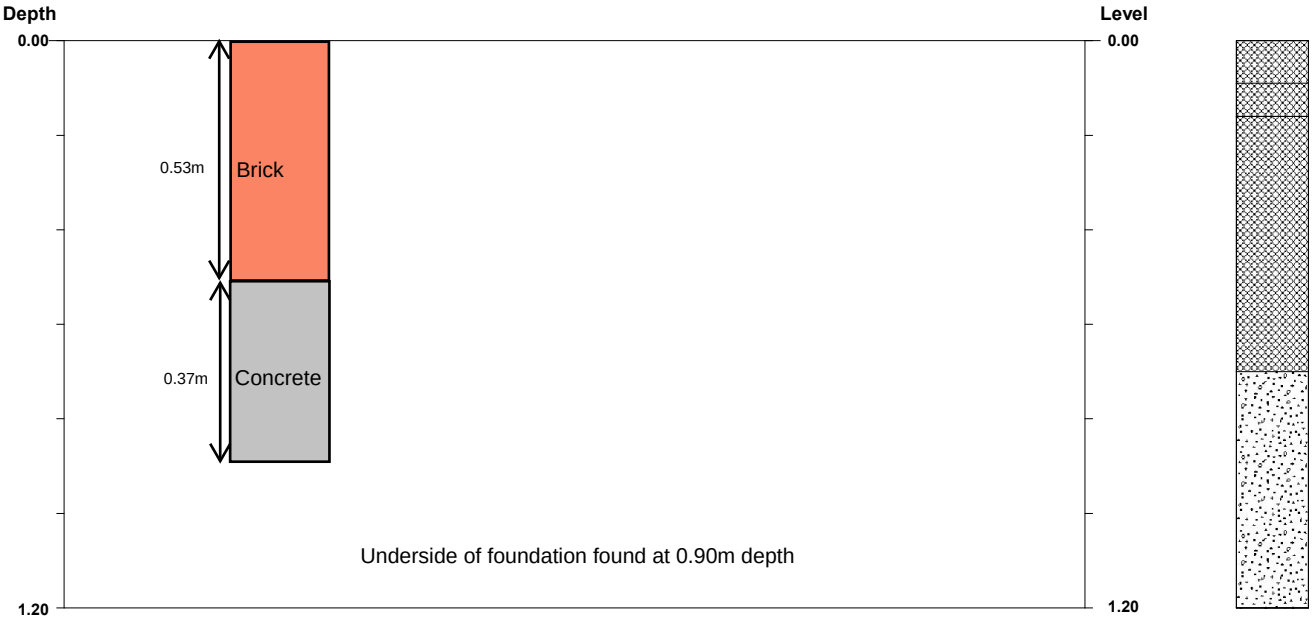
Scale (approx)	Logged By	Figure No.
1:50	EW	2133098.TP2B

Site Analytical Services Ltd.

Site	Trial Pit Number
4 MONTPELIER SQUARE, LONDON, SW7 1JT	TP2B

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 1.20m(D)	-2.85	AMBRA SRL	2133098

Orientation	Location	Dates	Engineer	Sheet
A / D B / C	TQ274795	13/01/2021	ELLIOTTWOOD PARTNERSHIP LIMITED	1/1



Strata

Depth (m)	No.	Description
0.00-0.09	1	MADE GROUND: Concrete
0.09-0.16	2	MADE GROUND: York stone
0.16-0.70	3	MADE GROUND: Brown sandy clay containing brick fragments
0.70-1.20	4	Medium dense, mottled brown slightly gravelly fine to coarse grained SAND

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.50	D2	
0.75	D3	
0.90	D4	
0.90-1.20	M1 150/300	

Excavation Method:

HAND EXCAVATION

Shoring / Support:

Stability:

Backfill:

Remarks

D= Disturbed Sample
M= Makintosh Probe-Blows/Penetration (mm)
Groundwater was not encountered during boring/excavation

Logged By : EW
Checked By :
Figure No. : 2133098.TP2B

Site Analytical Services Ltd.

Site	Trial Pit Number
4 MONTPELIER SQUARE, LONDON, SW7 1JT	TP3A

Excavation Method	Dimensions	Ground Level (mSD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.50m(D)	-2.94	AMBRA SRL	2133098
	Location	**Dates**	**Engineer**	**Sheet**
	TQ274795	12/01/2021	ELLIOTTWOOD PARTNERSHIP LIMITED	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				-2.95	0.01			
					(0.19)	MADE GROUND: Thin black tiles		
				-3.14	0.20			
0.25	D1					MADE GROUND: Concrete		
0.50	D2					MADE GROUND: Brown sandy clay containing brick rubble		
0.75	D3				(1.30)			
1.00	D4							
1.25	D5							
1.40	D6			-4.44	1.50			
						Complete at 1.50m		

Plan

Remarks

D= Disturbed Sample
Groundwater was not encountered during boring/excavation

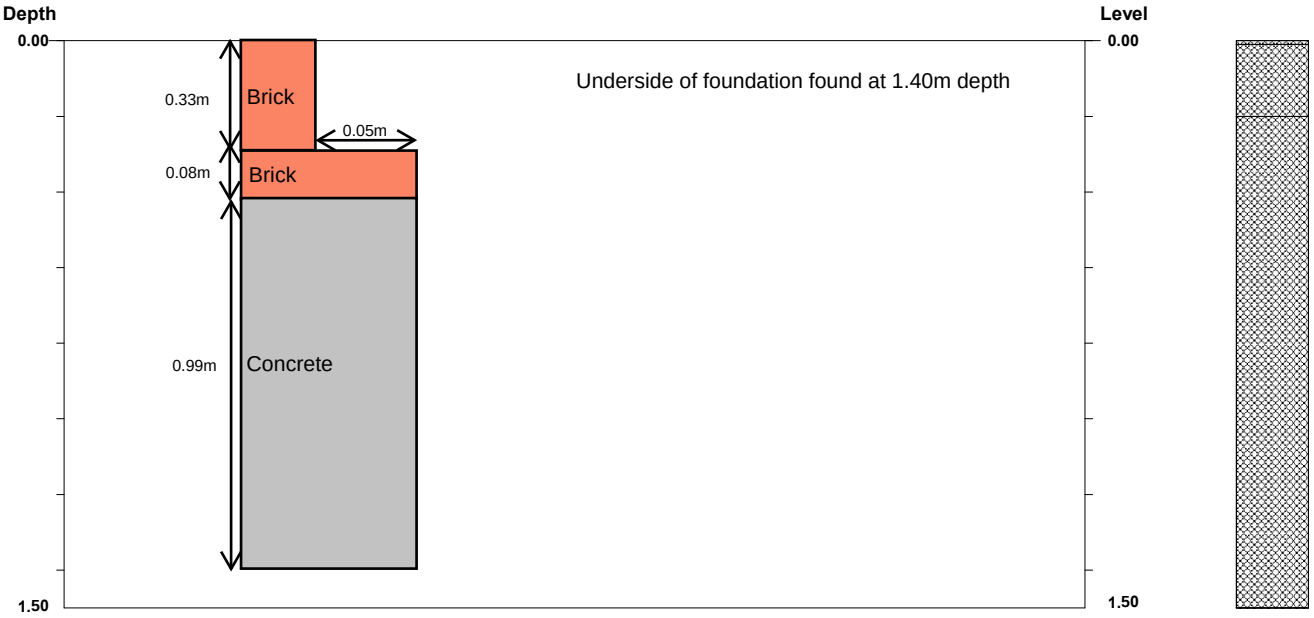
Scale (approx)	Logged By	Figure No.
1:50	EW	2133098.TP3A

Site Analytical Services Ltd.

Site	Trial Pit Number
4 MONTPELIER SQUARE, LONDON, SW7 1JT	TP3A

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 1.50m(D)	-2.94	AMBRA SRL	2133098

Orientation	Location	Dates	Engineer	Sheet
A / D / B / C	TQ274795	12/01/2021	ELLIOTTWOOD PARTNERSHIP LIMITED	1/1



Strata

Depth (m)	No.	Description
0.00-0.01	1	MADE GROUND: Thin black tiles
0.01-0.20	2	MADE GROUND: Concrete
0.20-1.50	3	MADE GROUND: Brown sandy clay containing brick rubble

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.50	D2	
0.75	D3	
1.00	D4	
1.25	D5	
1.40	D6	

Excavation Method:

HAND EXCAVATION

Shoring / Support:

Stability:

Backfill:

Remarks

D= Disturbed Sample

Groundwater was not encountered during boring/excavation

Logged By	: EW
Checked By	:
Figure No.	: 2133098.TP3A

Site Analytical Services Ltd.

Site	Trial Pit Number
4 MONTPELIER SQUARE, LONDON, SW7 1JT	TP3B

Excavation Method	Dimensions	Ground Level (mSD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.50m(D)	-2.94	AMBRA SRL	2133098
	Location	**Dates**	**Engineer**	**Sheet**
	TQ274795	12/01/2021	ELLIOTTWOOD PARTNERSHIP LIMITED	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				-2.95	0.01			
					(0.19)	MADE GROUND: Thin black tiles		
				-3.14	0.20			
0.25	D1					MADE GROUND: Concrete		
0.50	D2					MADE GROUND: Brown sandy clay containing brick rubble		
0.75	D3				(1.30)			
1.00	D4							
1.25	D5							
1.40	D6			-4.44	1.50			
						Complete at 1.50m		

Plan

Remarks

D= Disturbed Sample
Groundwater was not encountered during boring/excavation

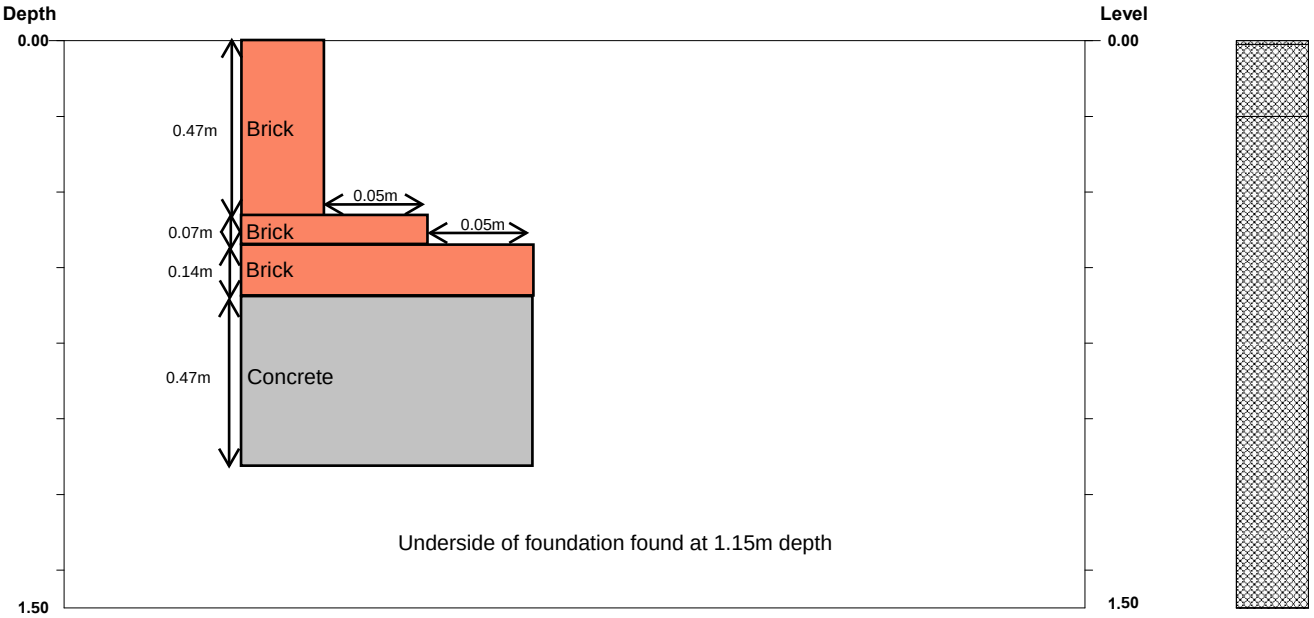
Scale (approx)	Logged By	Figure No.
1:50	EW	2133098.TP3B

Site Analytical Services Ltd.

Site	Trial Pit Number
4 MONTPELIER SQUARE, LONDON, SW7 1JT	TP3B

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 1.50m(D)	-2.94	AMBRA SRL	2133098

Orientation	Location	Dates	Engineer	Sheet
A / D B / C	TQ274795	12/01/2021	ELLIOTTWOOD PARTNERSHIP LIMITED	1/1



Strata

Depth (m)	No.	Description
0.00-0.01	1	MADE GROUND: Thin black tiles
0.01-0.20	2	MADE GROUND: Concrete
0.20-1.50	3	MADE GROUND: Brown sandy clay containing brick rubble

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.50	D2	
0.75	D3	
1.00	D4	
1.25	D5	
1.40	D6	

Excavation Method:

HAND EXCAVATION

Shoring / Support:

Stability:

Backfill:

Remarks

D= Disturbed Sample
Groundwater was not encountered during boring/excavation

Logged By	: EW
Checked By	:
Figure No.	: 2133098.TP3B

Site Analytical Services Ltd.

Site	Trial Pit Number
4 MONTPELIER SQUARE, LONDON, SW7 1JT	TP4A

Excavation Method	Dimensions	Ground Level (mSD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.50m(D)	-2.85	AMBRA SRL	2133098
	Location	**Dates**	**Engineer**	**Sheet**
	TQ274795	13/01/2021	ELLIOTTWOOD PARTNERSHIP LIMITED	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				-2.86	0.01			
					(0.19)	MADE GROUND: Thin black tiles		
				-3.05	0.20			
0.25	D1					MADE GROUND: Concrete		
0.50	D2				(0.90)	MADE GROUND: Brown sandy clay containing occasional brick fragments and roots		
0.75	D3							
1.00	D4			-3.95	1.10			
1.25	D5				(0.40)	Mottled brown grey sandy CLAY		
1.40	D6			-4.35	1.50			
						Complete at 1.50m		

Plan

Remarks

D= Disturbed Sample
Groundwater was not encountered during boring/excavation

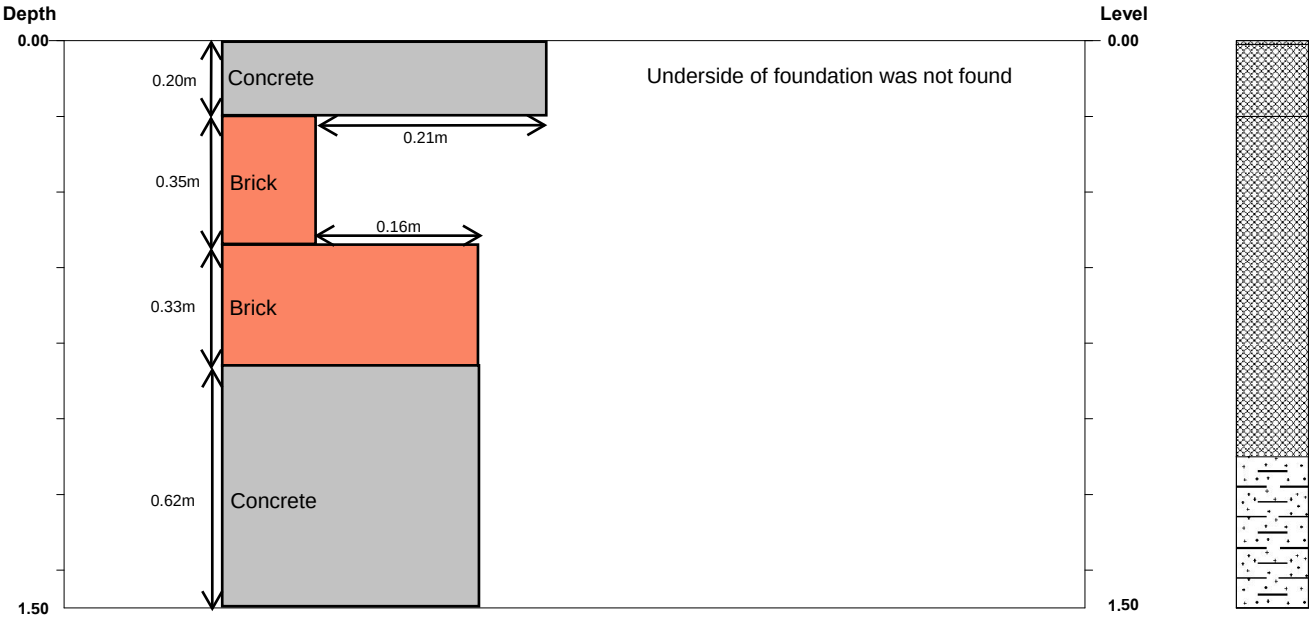
Scale (approx)	Logged By	Figure No.
1:50	EW	2133098.TP4A

Site Analytical Services Ltd.

Site	Trial Pit Number
4 MONTPELIER SQUARE, LONDON, SW7 1JT	TP4A

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 1.50m(D)	-2.85	AMBRA SRL	2133098

Orientation	Location	Dates	Engineer	Sheet
A / D / B / C	TQ274795	13/01/2021	ELLIOTTWOOD PARTNERSHIP LIMITED	1/1



Strata

Depth (m)	No.	Description
0.00-0.01	1	MADE GROUND: Thin black tiles
0.01-0.20	2	MADE GROUND: Concrete
0.20-1.10	3	MADE GROUND: Brown sandy clay containing occasional brick fragments and roots
1.10-1.50	4	Mottled brown grey sandy CLAY

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.50	D2	
0.75	D3	
1.00	D4	
1.25	D5	
1.40	D6	

Excavation Method:
HAND EXCAVATION

Shoring / Support:

Stability:

Backfill:

Remarks
D= Disturbed Sample
Groundwater was not encountered during boring/excavation

Logged By	: EW
Checked By	:
Figure No.	: 2133098.TP4A

Site Analytical Services Ltd.

Site	Trial Pit Number
4 MONTPELIER SQUARE, LONDON, SW7 1JT	TP4B

Excavation Method	Dimensions	Ground Level (mSD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.50m(D)	-2.85	AMBRA SRL	2133098
	Location	**Dates**	**Engineer**	**Sheet**
	TQ274795	13/01/2021	ELLIOTTWOOD PARTNERSHIP LIMITED	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				-2.86	0.01			
					(0.19)	MADE GROUND: Thin black tiles		
				-3.05	0.20			
0.25	D1					MADE GROUND: Concrete		
0.50	D2				(0.90)	MADE GROUND: Brown sandy clay containing occasional brick fragments and roots		
0.75	D3							
1.00	D4			-3.95	1.10			
1.25	D5				(0.40)	Mottled brown grey sandy CLAY		
1.40	D6			-4.35	1.50			
						Complete at 1.50m		

Plan

Remarks

D= Disturbed Sample
Groundwater was not encountered during boring/excavation

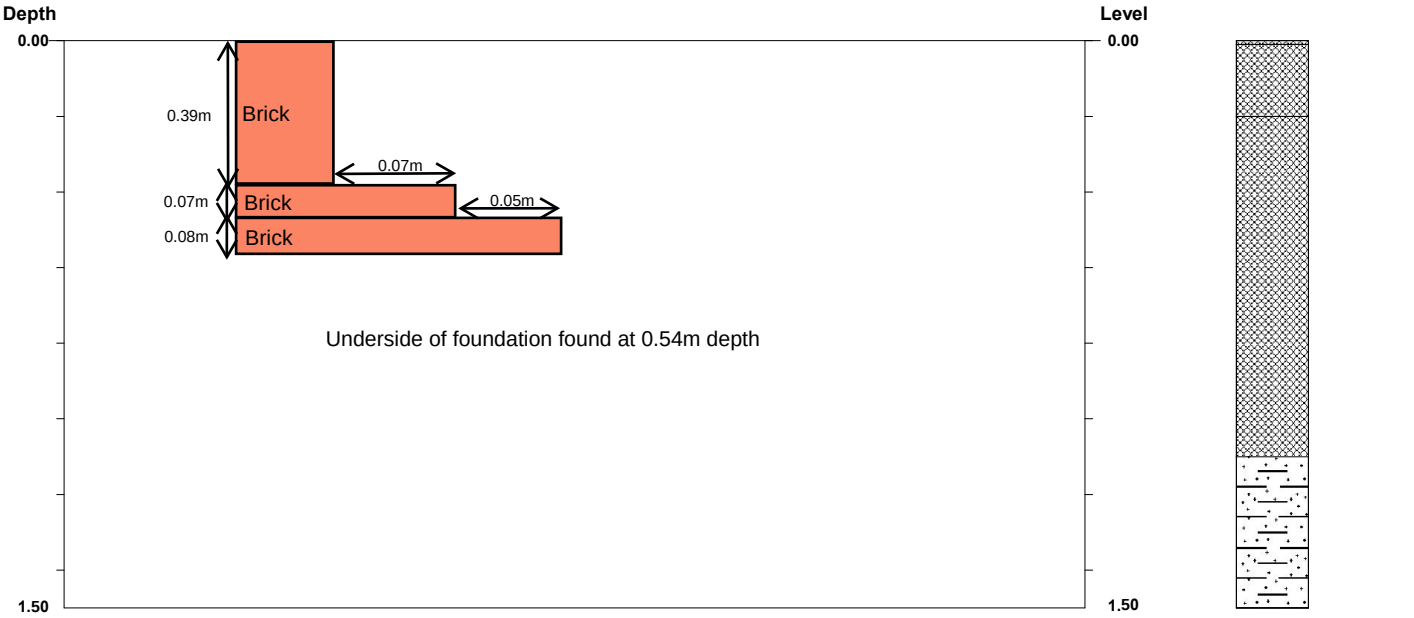
Scale (approx)	Logged By	Figure No.
1:50	EW	2133098.TP4B

Site Analytical Services Ltd.

Site	Trial Pit Number
4 MONTPELIER SQUARE, LONDON, SW7 1JT	TP4B

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 1.50m(D)	-2.85	AMBRA SRL	2133098

Orientation	Location	Dates	Engineer	Sheet
A / D / B / C	TQ274795	13/01/2021	ELLIOTTWOOD PARTNERSHIP LIMITED	1/1



Strata

Depth (m)	No.	Description
0.00-0.01	1	MADE GROUND: Thin black tiles
0.01-0.20	2	MADE GROUND: Concrete
0.20-1.10	3	MADE GROUND: Brown sandy clay containing occasional brick fragments and roots
1.10-1.50	4	Mottled brown grey sandy CLAY

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.50	D2	
0.75	D3	
1.00	D4	
1.25	D5	
1.40	D6	

Excavation Method:
HAND EXCAVATION

Shoring / Support:

Stability:

Backfill:

Remarks
D= Disturbed Sample
Groundwater was not encountered during boring/excavation

Logged By : EW
Checked By :
Figure No. : 2133098.TP4B

Site Analytical Services Ltd.

Site	Trial Pit Number
4 MONTPELIER SQUARE, LONDON, SW7 1JT	TP5

Excavation Method	Dimensions	Ground Level (mSD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 0.78m(D)	-2.85	AMBRA SRL	2133098
	Location	**Dates**	**Engineer**	**Sheet**
	TQ274795	12/01/2021	ELLIOTTWOOD PARTNERSHIP LIMITED	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				-2.86	0.01			
					(0.17)	MADE GROUND: Terracotta tiled floor over concrete		
				-3.03	0.18			
					(0.26)	MADE GROUND: Concrete		
0.25	D1			-3.29	0.44			
					(0.34)	MADE GROUND: Brown sandy clay containing brick rubble		
0.48	D2			-3.63	0.78			
0.48	V1 60					Firm, mottled grey brown slightly gravelly sandy CLAY		
0.48-0.78	M1 80/300					Complete at 0.78m		

Plan

Remarks

D= Disturbed Sample
M= Makintosh Probe-Blows/Penetration (mm)
V= Vane Test - Results in kPa
Groundwater was not encountered during boring/excavation

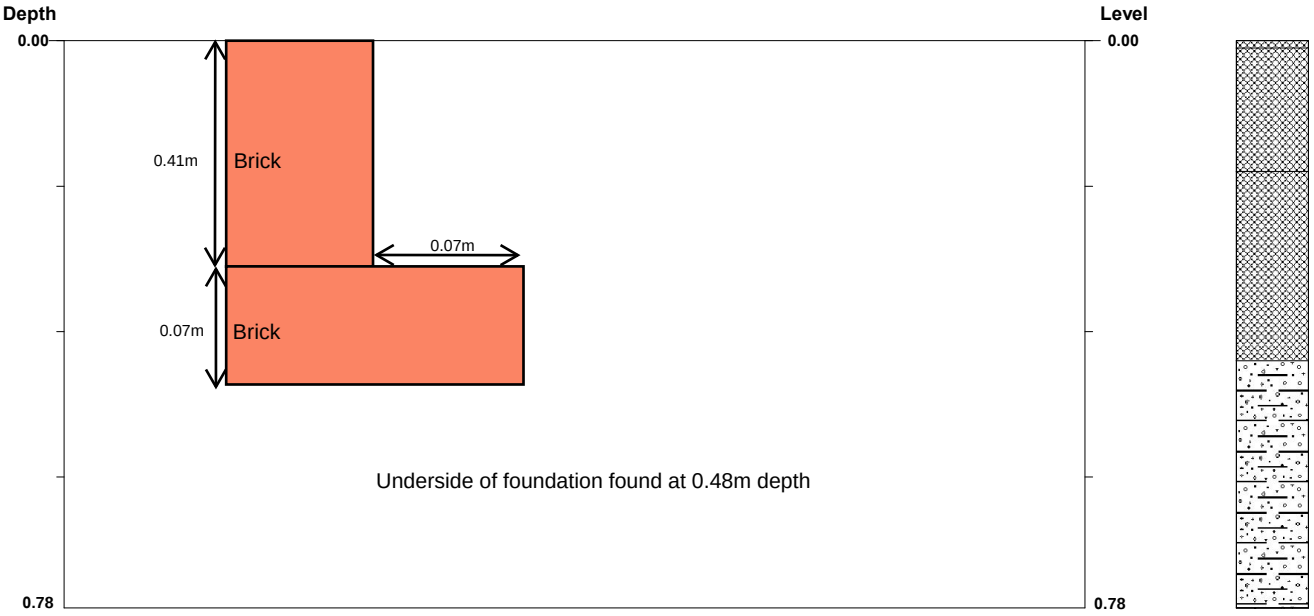
Scale (approx)	Logged By	Figure No.
1:50	EW	2133098.TP5

Site Analytical Services Ltd.

Site	Trial Pit Number
4 MONTPELIER SQUARE, LONDON, SW7 1JT	TP5

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 0.78m(D)	-2.85	AMBRA SRL	2133098

Orientation	Location	Dates	Engineer	Sheet
A / D / B / C	TQ274795	12/01/2021	ELLIOTTWOOD PARTNERSHIP LIMITED	1/1



Strata

Depth (m)	No.	Description
0.00-0.01	1	MADE GROUND: Terracotta tiled floor over concrete
0.01-0.18	2	MADE GROUND: Concrete
0.18-0.44	3	MADE GROUND: Brown sandy clay containing brick rubble
0.44-0.78	4	Firm, mottled grey brown slightly gravelly sandy CLAY

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.48	D2	
0.48	V1 60	
0.48-0.78	M1 80/300	

Excavation Method:

HAND EXCAVATION

Shoring / Support:

Stability:

Backfill:

Remarks

D= Disturbed Sample
M= Makintosh Probe-Blows/Penetration (mm)
V= Vane Test - Results in kPa
Groundwater was not encountered during boring/excavation

Logged By : EW
Checked By :
Figure No. : 2133098.TP5

Site Analytical Services Ltd.

Site	Trial Pit Number
4 MONTPELIER SQUARE, LONDON, SW7 1JT	TP6A

Excavation Method	Dimensions	Ground Level (mSD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.50m(D)	-1.18	AMBRA SRL	2133098
	Location	**Dates**	**Engineer**	**Sheet**
	TQ274795	13/01/2021	ELLIOTTWOOD PARTNERSHIP LIMITED	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				-1.19	0.01			
				-1.33	(0.14) 0.15	MADE GROUND: Thin black tiles		
0.25	D1					MADE GROUND: Sand and cement		
0.50	D2					MADE GROUND: Brown gravelly sandy clay containing brick rubble and numerous roots		
0.75	D3				(1.35)			
1.00	D4							
1.25	D5							
1.50	D6			-2.68	1.50	Complete at 1.50m		

Plan

Remarks

D= Disturbed Sample
Groundwater was not encountered during boring/excavation

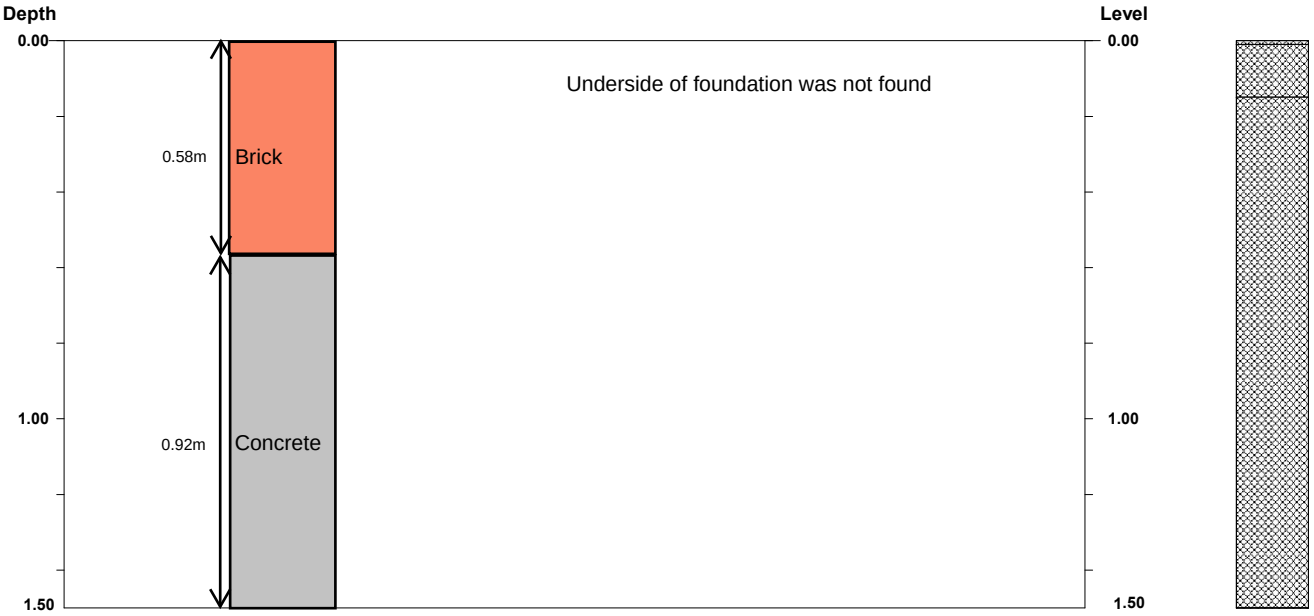
Scale (approx)	Logged By	Figure No.
1:50	EW	2133098.TP6A

Site Analytical Services Ltd.

Site	Trial Pit Number
4 MONTPELIER SQUARE, LONDON, SW7 1JT	TP6A

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 1.50m(D)	-1.18	AMBRA SRL	2133098

Orientation	Location	Dates	Engineer	Sheet
A / D / B / C	TQ274795	13/01/2021	ELLIOTTWOOD PARTNERSHIP LIMITED	1/1



Strata

Depth (m)	No.	Description
0.00-0.01	1	MADE GROUND: Thin black tiles
0.01-0.15	2	MADE GROUND: Sand and cement
0.15-1.50	3	MADE GROUND: Brown gravelly sandy clay containing brick rubble and numerous roots

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.50	D2	
0.75	D3	
1.00	D4	
1.25	D5	
1.50	D6	

Excavation Method:

HAND EXCAVATION

Shoring / Support:

Stability:

Backfill:

Remarks

D= Disturbed Sample

Groundwater was not encountered during boring/excavation

Logged By : EW

Checked By :

Figure No. : 2133098.TP6A

Site Analytical Services Ltd.

Site	Trial Pit Number
4 MONTPELIER SQUARE, LONDON, SW7 1JT	TP6B

Excavation Method	Dimensions	Ground Level (mSD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.50m(D)	-1.18	AMBRA SRL	2133098
	Location	**Dates**	**Engineer**	**Sheet**
	TQ274795	12/01/2021	ELLIOTTWOOD PARTNERSHIP LIMITED	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				-1.19	0.01			
				-1.33	(0.14) 0.15	MADE GROUND: Thin black tiles		
0.25	D1					MADE GROUND: Sand and cement		
0.50	D2					MADE GROUND: Brown gravelly sandy clay containing brick rubble and numerous roots		
0.75	D3				(1.35)			
1.00	D4							
1.25	D5							
1.50	D6			-2.68	1.50	Complete at 1.50m		

Plan

Remarks

D= Disturbed Sample
Groundwater was not encountered during boring/excavation

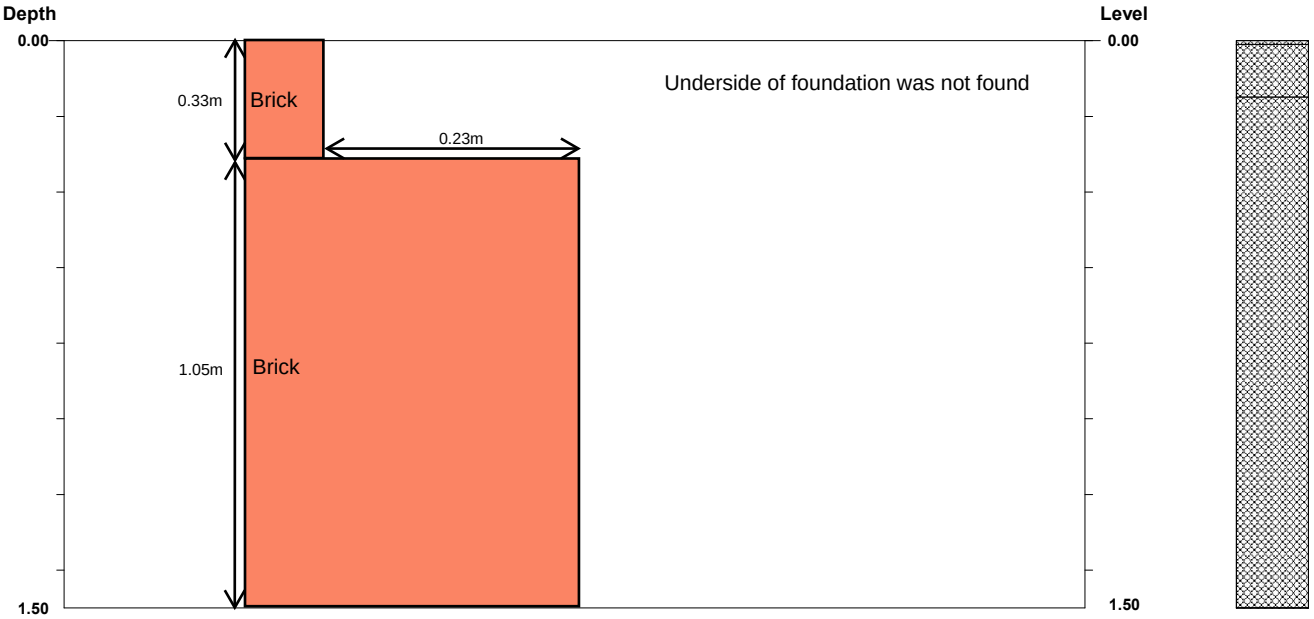
Scale (approx)	Logged By	Figure No.
1:50	EW	2133098.TP6B

Site Analytical Services Ltd.

Site	Trial Pit Number
4 MONTPELIER SQUARE, LONDON, SW7 1JT	TP6B

Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.30m(W) x 0.30m(L) x 1.50m(D)	-1.18	AMBRA SRL	2133098

Orientation	Location	Dates	Engineer	Sheet
A / D / B / C	TQ274795	12/01/2021	ELLIOTTWOOD PARTNERSHIP LIMITED	1/1



Strata

Depth (m)	No.	Description
0.00-0.01	1	MADE GROUND: Thin black tiles
0.01-0.15	2	MADE GROUND: Sand and cement
0.15-1.50	3	MADE GROUND: Brown gravelly sandy clay containing brick rubble and numerous roots

Samples and Tests

Depth (m)	Type	Field Records
0.25	D1	
0.50	D2	
0.75	D3	
1.00	D4	
1.25	D5	
1.50	D6	

Excavation Method:
HAND EXCAVATION

Shoring / Support:

Stability:

Backfill:

Remarks
D= Disturbed Sample
Groundwater was not encountered during boring/excavation

Logged By	: EW
Checked By	:
Figure No.	: 2133098.TP6B

APPENDIX B

Laboratory Test & Gas/Groundwater Monitoring Data

PLASTICITY INDEX & MOISTURE CONTENT DETERMINATIONS

BH/TP No.	Depth (m)	Natural Moisture (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 μm (%)	Modified Plasticity Index (%)	Class
BH1	1.00	25	42	20	22	100	22	CI
	2.00	25	42	22	20	100	20	CI
	3.00	18	29	17	12	100	21	CL
	4.00	12	37	15	22	80	18	CI

Table 1

GAS MONITORING
(1/4)

DATE: 21/01/2021

Weather Conditions:	Ground Conditions:	Temperature (°C):
Cloudy	Dry	8.0

Barometric Pressure (mbar):	Barometric Pressure Trend (24hr):	Ambient O2:
984		21.5%

Monitoring Point Location	Flow	Atmospheric Pressure (mbar)	Methane %	Carbon Dioxide %	Oxygen %	VOC (ppm)	Hydrogen Sulphide (ppm)	Carbon Monoxide (ppm)	Depth to water (bgl)	Depth to Base of well (bgl)
BH1	<0.1	984	<0.1	0.9	19.7	0.001	<0.1	<0.1	4.16	6.84

Table 2

GAS MONITORING
(2/4)

DATE: 28/01/2021

Weather Conditions:	Ground Conditions:	Temperature (°C):
Cloudy	Wet	13.0

Barometric Pressure (mbar):	Barometric Pressure Trend (24hr):	Ambient O2:
999		21.6%

Monitoring Point Location	Flow	Atmospheric Pressure (mbar)	Methane %	Carbon Dioxide %	Oxygen %	VOC (ppm)	Hydrogen Sulphide (ppm)	Carbon Monoxide (ppm)	Depth to water (bgl)	Depth to Base of well (bgl)
BH1	<0.1	999	<0.1	1.1	19.1	0.002	<0.1	<0.1	4.11	6.84

Table 2a

GAS MONITORING
(3/4)

DATE: 04/02/2021

Weather Conditions:	Ground Conditions:	Temperature (°C):
Cloudy	Dry	8.0

Barometric Pressure (mbar):	Barometric Pressure Trend (24hr):	Ambient O2:
1007		21.6%

Monitoring Point Location	Flow	Atmospheric Pressure (mbar)	Methane %	Carbon Dioxide %	Oxygen %	VOC (ppm)	Hydrogen Sulphide (ppm)	Carbon Monoxide (ppm)	Depth to water (bgl)	Depth to Base of well (bgl)
BH1	<0.1	1007	<0.1	0.6	20.5	0.000	<0.1	<0.1	4.07	6.84

Table 2b

GAS MONITORING
(4/4)

DATE: 11/.02/2021

Weather Conditions:	**Ground Conditions:**	**Temperature (°C)**:
Cold and Cloudy	Ice covered	0.0

Barometric Pressure (mbar):	**Barometric Pressure Trend (24hr):**	**Ambient O2:**
1025		21.4%

Monitoring Point Location	Flow	Atmospheric Pressure (mbar)	Methane %	Carbon Dioxide %	Oxygen %	VOC (ppm)	Hydrogen Sulphide (ppm)	Carbon Monoxide (ppm)	Depth to water (bgl)	Depth to Base of well (bgl)
BH1	<0.1	1025	<0.1	0.4	20.3	0.000	<0.1	<0.1	4.05	6.84

Table 2c

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Lenham Heath
Kent
ME17 2JN
t: 01622 850410

DETS Report No: 21-00670

Site Reference:	4 Montpelier Square
Project / Job Ref:	21/33098
Order No:	8138
Sample Receipt Date:	21/01/2021
Sample Scheduled Date:	21/01/2021
Report Issue Number:	1
Reporting Date:	27/01/2021

Authorised by:

Dave Ashworth
Technical Manager

Dates of laboratory activities for each tested analyte are available upon request.

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Soil Analysis Certificate						
DETS Report No: 21-00670	**Date Sampled**	13/01/21	13/01/21	13/01/21	13/01/21	13/01/21
Site Analytical Services Ltd	**Time Sampled**	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: 4 Montpelier Square	**TP / BH No**	BH1	BH1	BH1	BH1	BH1
Project / Job Ref: 21/33098	**Additional Refs**	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: 8138	**Depth (m)**	1.50	2.50	4.50	8.00	12.00
Reporting Date: 27/01/2021	**DETS Sample No**	521421	521422	521423	521424	521425

Determinand	Unit	RL	Accreditation					
pH	pH Units	N/a	MCERTS	7.9	7.3	7.6	7.9	8.0
W/S Sulphate as SO_4 (2:1)	mg/l	< 10	MCERTS	178	57	168	207	240
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	MCERTS	0.18	0.06	0.17	0.21	0.24

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C. The Samples Descriptions page describes if the test is performed on the dried or as-received portion
Subcontracted analysis (S)

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Soil Analysis Certificate - Sample Descriptions	
DETS Report No: 21-00670	
Site Analytical Services Ltd	
Site Reference: 4 Montpelier Square	
Project / Job Ref: 21/33098	
Order No: 8138	
Reporting Date: 27/01/2021	

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
521421	BH1	None Supplied	1.50	12.3	Brown sandy clay with stones
521422	BH1	None Supplied	2.50	13.8	Brown sandy clay
521423	BH1	None Supplied	4.50	14.8	Brown sandy clay
521424	BH1	None Supplied	8.00	19.5	Brown clay
521425	BH1	None Supplied	12.00	19.6	Brown clay

Moisture content is part of procedure E003 & is not an accredited test
Insufficient Sample I/S
Unsuitable Sample U/S

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Soil Analysis Certificate - Methodology & Miscellaneous Information
DETS Report No: 21-00670
Site Analytical Services Ltd
Site Reference: 4 Montpelier Square
Project / Job Ref: 21/33098
Order No: 8138
Reporting Date: 27/01/2021

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 – C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	Fraction Organic Carbon (FOC)	Determination of TOC by combustion analyser.	E027
Soil	D	Organic Matter (SOM)	Determination of TOC by combustion analyser.	E027
Soil	D	TOC (Total Organic Carbon)	Determination of TOC by combustion analyser.	E027
Soil	AR	Exchangeable Ammonium	Determination of ammonium by discrete analyser.	E029
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received

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DETS Report No: 21-00669

Site Reference:	4 Montpelier Square
Project / Job Ref:	21/33098
Order No:	8138
Sample Receipt Date:	21/01/2021
Sample Scheduled Date:	21/01/2021
Report Issue Number:	1
Reporting Date:	27/01/2021

Authorised by:

Dave Ashworth
Technical Manager

Dates of laboratory activities for each tested analyte are available upon request.

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Soil Analysis Certificate						
DETS Report No: 21-00669	**Date Sampled**	None Supplied				
Site Analytical Services Ltd	**Time Sampled**	None Supplied				
Site Reference: 4 Montpelier Square	**TP / BH No**	BH1				
Project / Job Ref: 21/33098	**Additional Refs**	None Supplied				
Order No: 8138	**Depth (m)**	0.25				
Reporting Date: 27/01/2021	**DETS Sample No**	521420				

Determinand	**Unit**	**RL**	**Accreditation**					
Asbestos Screen (S)	N/a	N/a	**ISO17025**	Not Detected				
pH	pH Units	N/a	**MCERTS**	11.2				
Total Cyanide	mg/kg	< 2	NONE	< 2				
Complex Cyanide	mg/kg	< 2	NONE	< 2				
Free Cyanide	mg/kg	< 2	NONE	< 2				
Total Sulphate as SO_4	mg/kg	< 200	**MCERTS**	2275				
Total Sulphate as SO_4	%	< 0.02	**MCERTS**	0.23				
W/S Sulphate as SO_4 (2:1)	mg/l	< 10	**MCERTS**	171				
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	**MCERTS**	0.17				
Sulphide	mg/kg	< 5	NONE	< 5				
Organic Matter	%	< 0.1	**MCERTS**	0.3				
Total Organic Carbon (TOC)	%	< 0.1	**MCERTS**	0.2				
Arsenic (As)	mg/kg	< 2	**MCERTS**	12				
W/S Boron	mg/kg	< 1	NONE	< 1				
Cadmium (Cd)	mg/kg	< 0.2	NONE	< 0.2				
Chromium (Cr)	mg/kg	< 2	**MCERTS**	19				
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2				
Copper (Cu)	mg/kg	< 4	**MCERTS**	25				
Lead (Pb)	mg/kg	< 3	**MCERTS**	1230				
Mercury (Hg)	mg/kg	< 1	**MCERTS**	< 1				
Nickel (Ni)	mg/kg	< 3	**MCERTS**	11				
Selenium (Se)	mg/kg	< 2	**MCERTS**	< 3				
Zinc (Zn)	mg/kg	< 3	**MCERTS**	89				
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2				

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C. The Samples Descriptions page describes if the test is performed on the dried or as-received portion
Subcontracted analysis (S)

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Soil Analysis Certificate - Speciated PAHs							
DETS Report No: 21-00669	**Date Sampled**	None Supplied					
Site Analytical Services Ltd	**Time Sampled**	None Supplied					
Site Reference: 4 Montpelier Square	**TP / BH No**	BH1					
Project / Job Ref: 21/33098	**Additional Refs**	None Supplied					
Order No: 8138	**Depth (m)**	0.25					
Reporting Date: 27/01/2021	**DETS Sample No**	521420					

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1				
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1				
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1				
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1				
Phenanthrene	mg/kg	< 0.1	MCERTS	< 0.1				
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1				
Fluoranthene	mg/kg	< 0.1	MCERTS	0.14				
Pyrene	mg/kg	< 0.1	MCERTS	0.12				
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	< 0.1				
Chrysene	mg/kg	< 0.1	MCERTS	< 0.1				
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1				
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1				
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	< 0.1				
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	< 0.1				
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1				
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	< 0.1				
Coronene	mg/kg	< 0.1	NONE	< 0.1				
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	< 1.6				
Total WAC-17 PAHs	mg/kg	< 1.7	NONE	< 1.7				

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Soil Analysis Certificate - TPH CWG Banded						
DETS Report No: 21-00669	**Date Sampled**	None Supplied				
Site Analytical Services Ltd	**Time Sampled**	None Supplied				
Site Reference: 4 Montpelier Square	**TP / BH No**	BH1				
Project / Job Ref: 21/33098	**Additional Refs**	None Supplied				
Order No: 8138	**Depth (m)**	0.25				
Reporting Date: 27/01/2021	**DETS Sample No**	521420				

Determinand	Unit	RL	Accreditation					
Aliphatic >C5 - C6	mg/kg	< 0.01	NONE	< 0.01				
Aliphatic >C6 - C8	mg/kg	< 0.05	NONE	< 0.05				
Aliphatic >C8 - C10	mg/kg	< 2	MCERTS	< 2				
Aliphatic >C10 - C12	mg/kg	< 2	MCERTS	< 2				
Aliphatic >C12 - C16	mg/kg	< 3	MCERTS	< 3				
Aliphatic >C16 - C21	mg/kg	< 3	MCERTS	< 3				
Aliphatic >C21 - C34	mg/kg	< 10	MCERTS	< 10				
Aliphatic (C5 - C34)	mg/kg	< 21	NONE	< 21				
Aromatic >C5 - C7	mg/kg	< 0.01	NONE	< 0.01				
Aromatic >C7 - C8	mg/kg	< 0.05	NONE	< 0.05				
Aromatic >C8 - C10	mg/kg	< 2	MCERTS	< 2				
Aromatic >C10 - C12	mg/kg	< 2	MCERTS	< 2				
Aromatic >C12 - C16	mg/kg	< 2	MCERTS	< 2				
Aromatic >C16 - C21	mg/kg	< 3	MCERTS	< 3				
Aromatic >C21 - C35	mg/kg	< 10	MCERTS	< 10				
Aromatic (C5 - C35)	mg/kg	< 21	NONE	< 21				
Total >C5 - C35	mg/kg	< 42	NONE	< 42				

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Soil Analysis Certificate - BTEX / MTBE						
DETS Report No: 21-00669	**Date Sampled**	None Supplied				
Site Analytical Services Ltd	**Time Sampled**	None Supplied				
Site Reference: 4 Montpelier Square	**TP / BH No**	BH1				
Project / Job Ref: 21/33098	**Additional Refs**	None Supplied				
Order No: 8138	**Depth (m)**	0.25				
Reporting Date: 27/01/2021	**DETS Sample No**	521420				

Determinand	Unit	RL	Accreditation					
Benzene	ug/kg	< 2	MCERTS	< 2				
Toluene	ug/kg	< 5	MCERTS	< 5				
Ethylbenzene	ug/kg	< 2	MCERTS	< 2				
p & m-xylene	ug/kg	< 2	MCERTS	5				
o-xylene	ug/kg	< 2	MCERTS	< 2				
MTBE	ug/kg	< 5	MCERTS	< 5				

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Waste Acceptance Criteria Analytical Certificate - BS EN 12457/3

DETS Report No: 21-00669		**Date Sampled**	None Supplied		**Landfill Waste Acceptance Criteria Limits**		
Site Analytical Services Ltd		**Time Sampled**	None Supplied		**Inert Waste Landfill**	**Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Site Reference: 4 Montpelier Square		**TP / BH No**	BH1				
Project / Job Ref: 21/33098		**Additional Refs**	None Supplied				
Order No: 8138		**Depth (m)**	0.25				
Reporting Date: 27/01/2021		**DETS Sample No**	521420				
Determinand	**Unit**	**MDL**					
TOC[MU]	%	< 0.1	0.2		3%	5%	6%
Loss on Ignition	%	< 0.01	1.90		--	--	10%
BTEX[MU]	mg/kg	< 0.05	< 0.05		6	--	--
Sum of PCBs	mg/kg	< 0.1	< 0.1		1	--	--
Mineral Oil[MU]	mg/kg	< 10	< 10		500	--	--
Total PAH[MU]	mg/kg	< 1.7	< 1.7		100	--	--
pH[MU]	pH Units	N/a	11.2		--	>6	--
Acid Neutralisation Capacity	mol/kg (+/-)	< 1	< 1		--	To be evaluated	To be evaluated

Eluate Analysis	**2:1 mg/l**	**8:1 mg/l**		**Cumulative 10:1 mg/kg**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg (mg/kg)**		
Arsenic[U]	< 0.01	< 0.01		< 0.2	0.5	2	25
Barium[U]	< 0.02	< 0.02		< 0.1	20	100	300
Cadmium[U]	< 0.0005	< 0.0005		< 0.02	0.04	1	5
Chromium[U]	0.068	0.014		< 0.20	0.5	10	70
Copper[U]	0.07	0.03		< 0.5	2	50	100
Mercury[U]	< 0.0005	< 0.0005		< 0.005	0.01	0.2	2
Molybdenum[U]	0.050	0.009		0.1	0.5	10	30
Nickel[U]	< 0.007	< 0.007		< 0.2	0.4	10	40
Lead[U]	< 0.005	< 0.005		< 0.2	0.5	10	50
Antimony[U]	< 0.005	< 0.005		< 0.05	0.06	0.7	5
Selenium[U]	< 0.005	< 0.005		< 0.05	0.1	0.5	7
Zinc[U]	< 0.005	< 0.005		< 0.2	4	50	200
Chloride[U]	26	7		90	800	15000	25000
Fluoride[U]	1.6	0.7		7.9	10	150	500
Sulphate[U]	93	17		242	1000	20000	50000
TDS	196	144		1491	4000	60000	100000
Phenol Index	< 0.01	< 0.01		< 0.5	1	-	-
DOC	19	12.2		128	500	800	1000
Leach Test Information							
Sample Mass (kg)	0.19						
Dry Matter (%)	93.3						
Moisture (%)	7.2						
Stage 1							
Volume Eluate L2 (litres)	0.34						
Filtered Eluate VE1 (litres)	0.17						

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C. The Samples Descriptions page describes if the test is performed on the dried or as-received portion
Stated limits are for guidance only and DETS Ltd cannot be held responsible for any discrepencies with current legislation
M Denotes MCERTS accredited test
U Denotes ISO17025 accredited test

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Soil Analysis Certificate - Sample Descriptions	
DETS Report No: 21-00669	
Site Analytical Services Ltd	
Site Reference: 4 Montpelier Square	
Project / Job Ref: 21/33098	
Order No: 8138	
Reporting Date: 27/01/2021	

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
^ 521420	BH1	None Supplied	0.25	6.7	Brown sandy clay with stones and concrete

Moisture content is part of procedure E003 & is not an accredited test
Insufficient Sample I/S
Unsuitable Sample U/S
^ no sampling date provided; unable to confirm if samples are within acceptable holding times

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Maidstone
Kent ME17 2JN
Tel : 01622 850410

4480

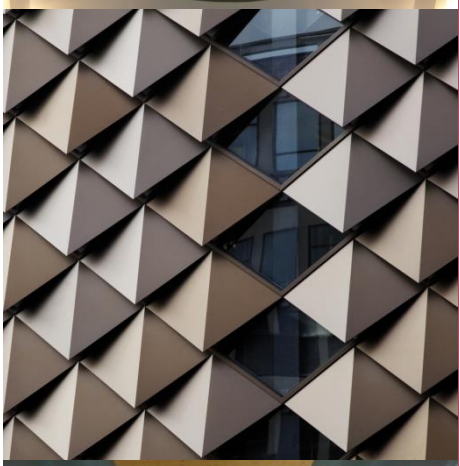
Soil Analysis Certificate - Methodology & Miscellaneous Information
DETS Report No: 21-00669
Site Analytical Services Ltd
Site Reference: 4 Montpelier Square
Project / Job Ref: 21/33098
Order No: 8138
Reporting Date: 27/01/2021

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 – C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	Fraction Organic Carbon (FOC)	Determination of TOC by combustion analyser.	E027
Soil	D	Organic Matter (SOM)	Determination of TOC by combustion analyser.	E027
Soil	D	TOC (Total Organic Carbon)	Determination of TOC by combustion analyser.	E027
Soil	AR	Exchangeable Ammonium	Determination of ammonium by discrete analyser.	E029
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received

Parameter	Matrix Type	Suite Reference	Expanded Uncertainity Measurement	Unit
TOC	Soil	BS EN 12457	13.49	%
Loss on Ignition	Soil	BS EN 12457	17	%
BTEX	Soil	BS EN 12457	14	%
Sum of PCBs	Soil	BS EN 12457	23	%
Mineral Oil	Soil	BS EN 12457	9	%
Total PAH	Soil	BS EN 12457	20	%
pH	Soil	BS EN 12457	0.399	Units
Acid Neutralisation Capacity	Soil	BS EN 12457	18	%
Arsenic	Leachate	BS EN 12457	16.63	%
Barium	Leachate	BS EN 12457	14.29	%
Cadmium	Leachate	BS EN 12457	14.44	%
Chromium	Leachate	BS EN 12457	18.06	%
Copper	Leachate	BS EN 12457	21.27	%
Mercury	Leachate	BS EN 12457	24.13	%
Molybdenum	Leachate	BS EN 12457	12.55	%
Nickel	Leachate	BS EN 12457	20.08	%
Lead	Leachate	BS EN 12457	13.43	%
Antimony	Leachate	BS EN 12457	18.85	%
Selenium	Leachate	BS EN 12457	18.91	%
Zinc	Leachate	BS EN 12457	13.71	%
Chloride	Leachate	BS EN 12457	16	%
Fluoride	Leachate	BS EN 12457	19.4	%
Sulphate	Leachate	BS EN 12457	19.63	%
TDS	Leachate	BS EN 12457	12	%
Phenol Index	Leachate	BS EN 12457	14	%
DOC	Leachate	BS EN 12457	10	%
Clay Content	Soil	BS 3882: 2015	15	%
Silt Content	Soil	BS 3882: 2015	14	%
Sand Content	Soil	BS 3882: 2015	13	%
Loss on Ignition	Soil	BS 3882: 2015	17	%
pH	Soil	BS 3882: 2015	0.399	Units
Carbonate	Soil	BS 3882: 2015	16	%
Total Nitrogen	Soil	BS 3882: 2015	12	%
Phosphorus (Extractable)	Soil	BS 3882: 2015	24	%
Potassium (Extractable)	Soil	BS 3882: 2015	20	%
Magnesium (Extractable)	Soil	BS 3882: 2015	26	%
Zinc	Soil	BS 3882: 2015	14.9	%
Copper	Soil	BS 3882: 2015	16	%
Nickel	Soil	BS 3882: 2015	17.7	%
Available Sodium	Soil	BS 3882: 2015	23	%
Available Calcium	Soil	BS 3882: 2015	23	%
Electrical Conductivity	Soil	BS 3882: 2015	10	%

10.0 APPENDIX B – GROUND MOVEMENT ASESSMENT



4 Montpelier Square, SW7

Ground Movement Assessment

Curtins Ref: 077867-CUR-00-XX-RP-GE-001

Revision: 00

Issue Date: 15 February 2021

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This report has been prepared for the sole benefit, use, and information for the client. The liability of Curtins Consulting Limited with respect to the information contained in the report will not extend to any third party.

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Table of Contents

Appendices

1.0 Introduction

1.1 Brief

Curtins have been commissioned by Site Analytical Services Limited (SASL) to complete a Ground Movement Assessment (GMA) in connection with a proposed residential development at 4 Montpelier Square, London, SW7. The location of the site is detailed on Figure 1-1. The purpose of this assessment is to determine what effects the proposed permanent basement construction may have on permanent structures surrounding the site.

Figure 1-1 *Assessment Location Plan.*

A site-specific Ground Investigation has previously been carried out by SASL in January 2021 at the site. Groundwater monitoring was undertaken for a period of approximately two weeks following the intrusive works. The ground investigation was designed by SASL and results have been used in the derivation of parameters utilised in this assessment. Curtins cannot be held responsible for any inaccuracy in the factual data provided.

It is understood that this report will be included as part of a Basement Impact Assessment (BIA) to be submitted to the Westminster City Council by the client.

The work contained in this GMA aims to satisfy the relevant elements of Westminster City Council Basement Development in Westminster Supplementary Planning Document namely the requirement of an *'An assessment of movements expected and how these will affect adjoining or adjacent properties. This needs to include both short term and long-term effects. The design and construction should aim to limit damage to all buildings to a maximum of Category 2 as set out in CIRIA Report 580'.*

1.2 Development Proposals

The new development includes the remodelling of the existing terraced building, adding an additional storey, and an extension to the rear. A new basement level is proposed within the plan area of the existing building.

Based on the proposed architectural drawings contained within Appendix A It is understood that the proposed excavation level is to be taken as 3.00m below the existing lower ground floor level (i.e. 6m below current ground floor level or 7.2m AOD) as detailed in Figure 1-2 below.

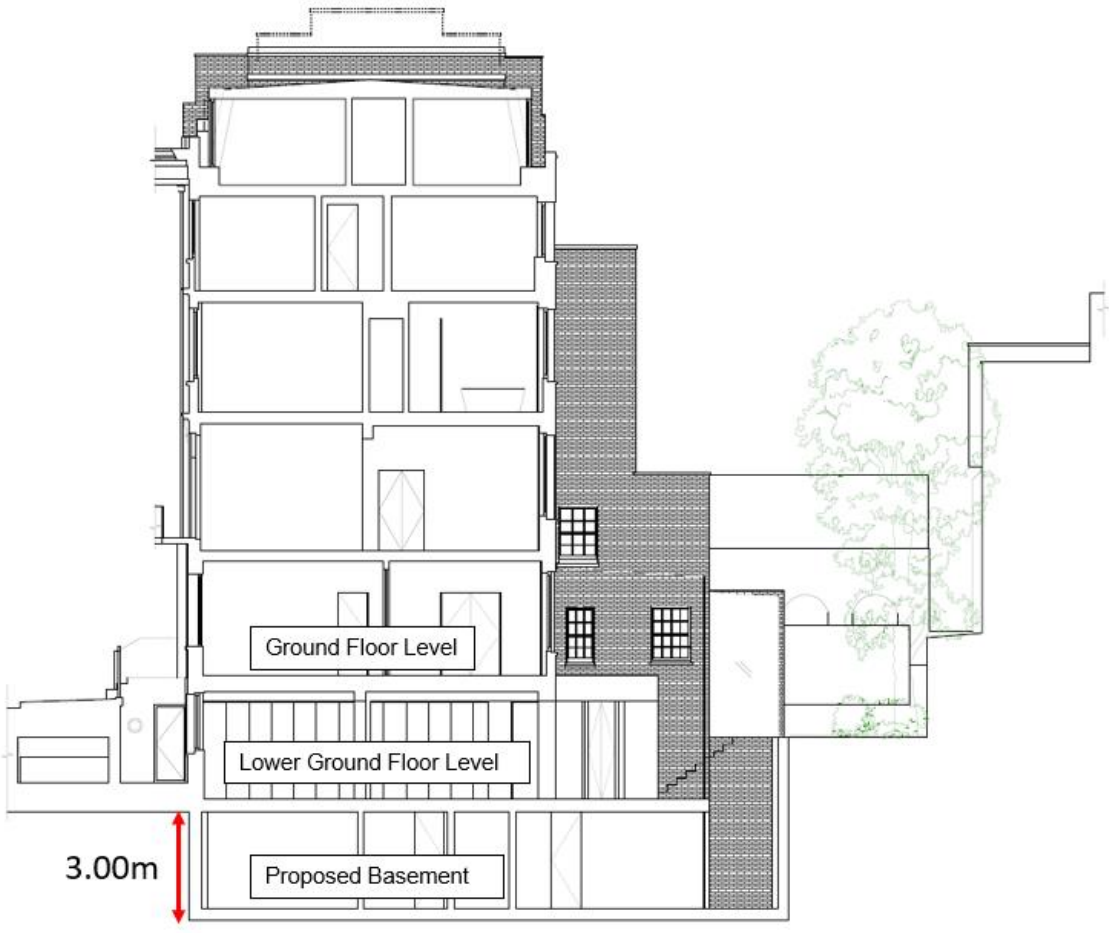

Figure 1-2. *Summary of Proposed Development*

1.3 Limitations

The conclusions and recommendations made in this report are made on the basis of the site-specific ground investigations undertaken by SASL undertaken in January and February 2021. The ground investigation was designed by SASL and the results of the work should be viewed in the context of the range of data sources consulted and the information provided along with the number of locations where the ground was sampled. No liability can be accepted for inaccuracies in the factual data, information in other data sources or conditions not revealed by the sampling or testing.

The effect of the proposed construction on existing subterranean assets (including services and tunnels) is outside the scope of this report.

It should be noted that the movements described in this report are indicative only for the purposes of providing pre-planning guidance with regards to the development and should not be relied upon for detailed design. It is anticipated the actual movement observed on site will be heavily affected by the level of workmanship and therefore should be reviewed at detailed design following discussions with the structural engineer and appointed contractor.

2.0 Baseline Conditions

2.1 Site Description

The site is located on the eastern side of Montpelier Square in Knightsbridge, North London, SW7 1JT and comprises a five-storey residential building including an existing lower ground floor level. The site is bound by residential properties to the north, south and east.

The site covers an area of approximately 0.03 hectares and the general area is under the authority of the Westminster City Council.

The site is at a level of approximately 13.2m AOD from available topographical information online.

2.2 Geology

The 1:50000 Geological Survey of Great Britain (England and Wales) covering the area (1) indicates the site to be underlain by the Kempton Park Gravel with the London Clay Formation at depth.

A historical borehole from the British Geological Survey (Ref. TQ27NE510, available online: http://mapapps.bgs.ac.uk/geologyofbritain3d/) located approximately 130m to the south east of the site recorded 3.56m of Kempton Park Gravel underlain by London Clay to 62m with the Lambeth Group, Thanet Sands and Chalk below proven to at least 167m.

3.0 Ground Investigation

A site-specific Ground Investigation was undertaken by SASL at the site in January 2021 with groundwater monitoring carried out in February 2021.

The investigation comprised the following:

- The drilling of one continuous flight auger borehole to 15.00m below ground level (Borehole 1)
- The excavation of six trial pits to 1.50m maximum depth to expose existing foundations at the site (Trial Pits 1 to 6).
- The installation of groundwater monitoring standpipes within the borehole;
- Sampling and in-situ testing as appropriate to the ground conditions encountered in the borehole and trial pit;
- Laboratory testing to determine the engineering properties of the soils encountered in the exploratory holes;
- Factual reporting on the results of the investigation.

The factual SASL Ground Investigation data is included within the SASL Factual report (Appendix B).

3.1 Encountered Ground Conditions

A summary of the ground conditions encountered as part of the SASL investigations undertaken within the site area is presented in Table 3-1 below.

Table 3-1 *Summary of Ground Conditions Encountered*

Stratum	Proven depth to top of strata		Depth to base of strata		General Description
	m BGL	m SD	m BGL	m SD	
Made Ground	0.00	-1.18 to -2.94	0.44 to 1.50m	-3.29 to -4.44	Tiling over silty sandy CLAY with brick fragments.
Kempton River Terrace Gravel	0.44 to 1.10m	-3.29 to 3.95	4.50	-7.13	Soft becoming firm silty sandy CLAY grading to a medium dense gravely fine SAND locally
London Clay Formation	4.50	-7.13	>15.00*	-17.93*	Firm becoming stiff silty sandy CLAY

Notes - **Maximum thickness of London Clay Formation not proven*

<u>Groundwater</u>

Groundwater was not encountered in the borehole/trial pits and the excavations remains essentially dry throughout. Please refer to the SASL Factual Report (Appendix C) for further details and clarifications.

The borehole was equipped with water-monitoring standpipe piezometers. The response zone was from 1-7m depth in the borehole.

Subsequent monitoring of the standpipe, from January to February 2021 indicated groundwater levels of between 4.05 to 4.07m bgl.

3.2 In Situ and Laboratory Testing

A summary of laboratory and in-situ test results undertaken within the geological strata encountered during the SASL ground investigation is presented below. Further detailed results are available in the SASL Factual Report (Appendix C).

Mackintosh Probe Testing

Mackintosh Probe tests were undertaken at regular depth increments in order to assess the relative density of the soils encountered in BH1 and the trial pits.

By comparison of the SPT results from nearby investigations carried out by Curtins with the Mackintosh Probe results from BH1 it was found that a reasonable correlation between the two tests can be had by taking $N_{300}/10$ = SPT'N' (where N_{300} is the number of blows of the Mackintosh probe hammer required to advance the probe 300mm).

Hand Vane Testing

Hand Vane Testing were carried at regular depth increments within BH1 whilst a single test was carried out in TP5.

Undrained shear strengths ranged from 60kPa to 66kPa in the cohesive River Terrace Gravel corresponding to medium strength material in accordance with BS 5930:2015+2020 (2) whilst shear strengths in the underlying London Clay ranged from 70kPa to >130kPa (the limit of the equipment) corresponding to medium to high strength material.

4.0 Prediction of Ground Movements and Damage Assessment

4.1 Introduction

In connection with the proposed basement construction, a ground movement and damage assessment has been undertaken at the site. The purpose of this assessment is to determine the effects of the proposed basement excavation upon neighbouring structures.

The calculations provided are specific to the proposed development and the advice herein should be reviewed if the development proposals are amended.

4.2 Ground Model

Based on the borehole and trial pitting information, the ground conditions at the site were found to comprise Made Ground, up to 1.0m thickness, overlying the Kempton Park Gravel and London Clay Formation, extending to depth. The Kempton Park Gravel (KPG) and London Clay Formation have been modelled together for the purposes of this analyses due to the cohesive natural of the KPG found in the borehole; this is considered to be conservative. Further assumptions in relation to strata elevations and stiffness parameters adopted in the analyses carried out are summarised in Table 4-1. An ordnance datum has been used for the analyses rather than the site datum provided in order to allow correlations to nearby historical borehole records.

Undrained behaviour has been assumed for the London Clay stratum during building demolition and basement excavation (short-term unloading stages), while drained properties have been assigned to the London Clay following building construction and application of the proposed loading (long-term loading stage). All strata have been modelled as linear elastic materials in the Oasys Pdisp analyses carried out.

The ground model adopted for the assessment is presented in Table 4 1.

Table 4-1 *Summary of Ground Model (Levels in m AOD)*

Stratum	Top of stratum (mOD)	Unit Weight (kN/m3)	Undrained Stiffness, Eu (MPa)[1]	Drained Stiffness, E' (Mpa)[1]
Made Ground	+13.20	18	-	10
Kempton Park Gravel / London Clay Formation	+12.20	20	$30 + 4.17z$[2]	$24 + 3.33z$[2]

[1] Stiffness values have been assessed using the following correlations: $E_u = 500C_u$, $E' = 0.8E_u$

[2] z is depth below top of the Kempton Park Gravel / London Clay

[3] Rigid boundary assumed at -70mOD in the Pdisp models

4.3 Impact Assessment Details

The impact assessment of the proposed works on a number of buildings located in the vicinity of the site has been undertaken using a combination of proprietary spreadsheets and the commercially available software Oasys Pdisp and Xdisp, which consider the three-dimensional ground movement field induced by the works.

Ground movements will arise as a result of various mechanisms which are mobilised as part of the construction works for the proposed scheme. The proposed basement excavation process will induce ground movements arising from the overburden removal. The permanent condition loading will reinstate a portion of the removed overburden load, yielding settlements across the foundation system. The induced ground movements will extend over a given zone of influence surrounding the building/basement footprint.

A series of three-dimensional models of the proposed scheme have been developed in Oasys Pdisp and Xdisp and combined by means of superposition, in order to enable ground movement assessments to be carried out representing the various construction stages. The analyses evaluate ground movements at four key stages of the proposed construction, as follows:

- 3m deep excavation unloading, inducing heave
- Underpinning installation from 3.0 to 6.0m below existing ground level (bgl).
- Basement excavation from 3.0 to 6.0mbgl
- Proposed building construction (long term)

A representative geometry of the excavation and surrounding buildings is presented in Figure 4-1.

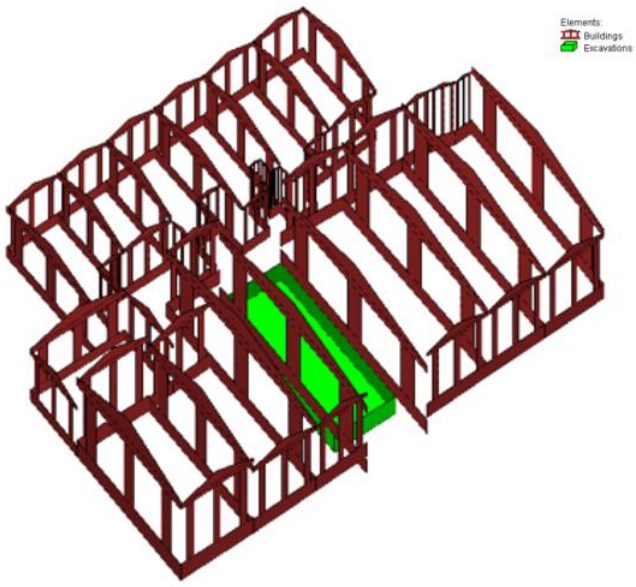

Figure 4-1 Indicative plot of Oasys Xdisp model

Each neighbouring building façade/wall is assumed to behave as an equivalent beam subjected to bending/shear and extension/compression deformation mechanisms, based on the evaluated *greenfield* ground movements, as outlined previously.

The façades/walls of concern are shown in Figure 4-2, including the wall nomenclature/reference system adopted. The arrangement is based on the currently available survey information and presents an array of façades running both perpendicular and parallel to the proposed lower ground floor boundaries (covering the key deformation mechanisms). In total, 55 façades of the neighbouring buildings have been considered for the current study and these are grouped in the following manner:

- MS3-1 to MS3-4: 3 Montpelier Square
- MS2-1 to MS2-3: 2 Montpelier Square
- MS1-1 to MS1-3: 1 Montpelier Square
- MS47-1 to MS47-3: 47 Montpelier Square
- TP35-1 to TP35-5: 35 Trevor Place
- TP34-1 to TP34-3: 34 Trevor Place
- TP33-1 to TP33-5: 33 Trevor Place
- TP32-1 to TP32-8: 32 Trevor Place
- TP31-1 to TP31-6: 31 Trevor Place
- TP30-1 to TP30-3: 30 Trevor Place
- MS7-1 to MS47-6: 7 Montpelier Square
- MS6-1 to MS6-3: 6 Montpelier Square
- MS5-1 to MS5-3: 5 Montpelier Square

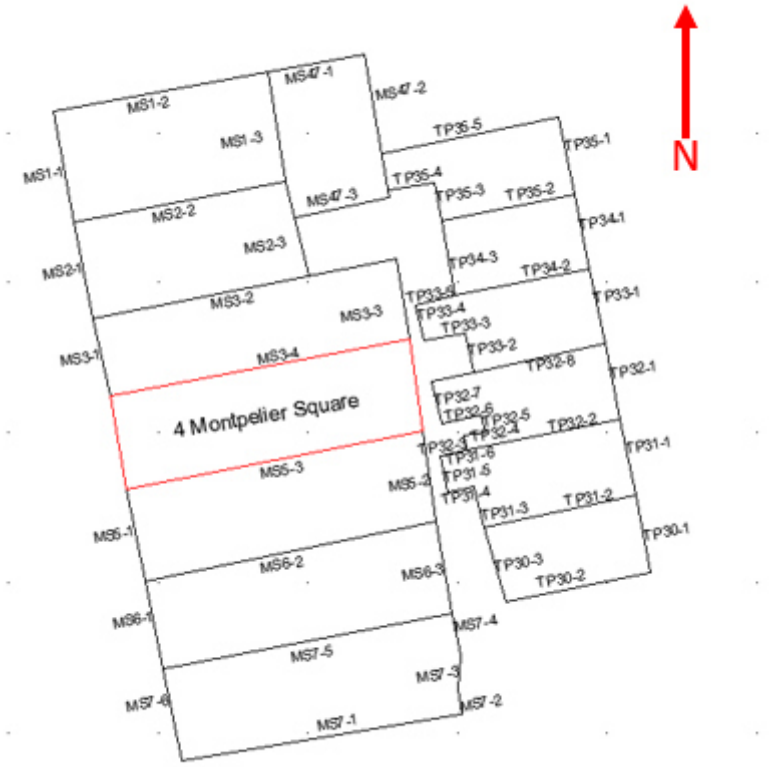

Figure 4-2 Simplified scheme and nomenclature for each building façade/wall element

Tensile strains induced within the building walls have been evaluated based on the deflection ratios Δ/L and horizontal extension mechanisms estimated from the analyses. The assessment considers the well-established Burland (1977) (3) damage classification method, as presented and summarised in Figure 4-3 and Figure 4-4 below. This method involves a relatively simple but robust means of assessment, which is widely adopted and is considered to comprise an industry standard/best practice basis for impact assessments of this typology.

Potential damage categories are directly related to the tensile strains induced by the proposed construction stages, arising from a combination of direct tension and bending induced tensile mechanisms. The evaluated damage categories correspond to an unlikely to be exceeded scenario (on the basis of the data sets adopted and *greenfield* assumptions).

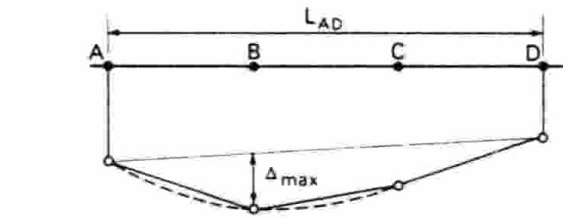

Figure 4-3 Definition of relative deflection Δ and deflection ratio Δ/L

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

After Burland et al. 1977 (3), Boscardin and Cording 1989 (4), and Burland 2001 (5)

Figure 4-4 Building damage classification – relationship between category of damage and limiting strain ε_{lim}

4.4 Construction Stage Analyses

A number of analyses have been carried out in order to evaluate the incremental ground movements induced by individual construction stages. The results of these analyses have subsequently been combined in order to provide an indication of the cumulative effect of different construction activities.

The following analyses have been carried out:

- **Pdisp 01 ST** – proposed basement excavation, i.e., an unloading pressure of 60kPa has been modelled at the proposed basement formation level, representing the removal of 3m of overburden (short term conditions).
- **Pdisp 02 LT** – proposed buildings construction (long term conditions). A uniformly distributed loading of 123kPa has been applied at formation level (6mbgl) of the proposed basement, while

40kPa have been applied on the lower ground floor slab (3mbgl). It is worth noting that the analysis conservatively ignores that a significant portion of the proposed loading (i.e. the existing building loading) is already present across the site, in order to maximise the predicted ground settlements.

- **Xdisp 01** – Underpinning works.
- **Xdisp 02** – Basement excavation.

In addition to the effects arising from basement excavation, the ground movement effects associated with the underpins installation have also been considered. The following CIRIA C760 normalised ground movement curves were adopted to assess ground movements due to retention system installation and excavation works:

- *Underpin*: Installation of planar diaphragm wall in stiff clay. Vertical displacements have been scaled, in order to achieve a maximum settlement equal to 5mm, considered appropriate to mimic the underpinning works.
- *Excavation to formation*: Excavation in front of a high stiffness wall in stiff clay.

It is assumed that the underpins will be adequately restrained horizontally, by means of temporary propping, during the proposed excavation works.

Given the excavation depth and the proximity to buildings, it is assumed that suitable construction controls and temporary works, including rigorous monitoring methodologies, will be implemented during the underpin installation and basement excavation works on site, to reduce the overall impact of the development.

4.5 Combined Analyses

Incremental displacements resulting from the individual construction stage analyses presented in the previous section have been appropriately combined in order to obtain the cumulative effect of different construction activities.

The following combined analyses have been carried out in Xdisp, importing results from individual stage analyses, in order to simulate the ground movements occurring following underpin installation, basement excavation and in the long term.

- **Xdisp Excavation Unloading (Short Term)** – model based on results from Pdisp 01 ST.
- **Xdisp Underpinning –** model based on results from Xdisp 01.
- **Xdisp Underpinning and Excavation** – model based on results from Xdisp 01 + Xdisp 02.
- **Xdisp Building Loading** – model based on results from Xdisp 01 + Xdisp 02 + Pdisp 02 LT.

4.6 Results

Contour plots showing distributions of horizontal and vertical ground movements in the area surrounding the proposed development site are presented in Appendix D.

A building impact/damage assessment has been undertaken, assuming the existing buildings walls/façades to behave as equivalent beams subject to a combination of bending, shear and axial extension/compression mechanisms, resulting from the *greenfield* ground movements evaluated.

The existing buildings walls/façades have heights from of 9m to 14m. The impact assessment has been carried out following the Burland (1997) (6) damage classification method, based on the tensile strains occurring within the wall elements as a result of the above-mentioned mechanisms.

Potential damage falling within the *Negligible* and *Very Slight* categories has been evaluated for all buildings considered, for all construction stages analysed. The results of the assessment are presented in Table 4-1. The results presented in this table represent the worst-case output arising from all analysis runs, and only present values for a damage category greater than *Category 0 - Negligible*.

Table 4-2 *Evaluated damage categories extracted from Xdisp*

Façade Reference	Stage		
	Xdisp Excavation Unloading	Xdisp Underpinning + Excavation	Xdisp Building Loading
MS3-3	Category 0 – Negligible	Category 1 – Very Slight	Category 0 – Negligible
MS3-4	Category 0 – Negligible	Category 1 – Very Slight	Category 0 – Negligible
TP33-3	Category 0 – Negligible	Category 1 – Very Slight	Category 1 – Very Slight
TP32-6	Category 0 – Negligible	Category 1 – Very Slight	Category 1 – Very Slight
TP32-8	Category 0 – Negligible	Category 1 – Very Slight	Category 1 – Very Slight
MS5-2	Category 0 – Negligible	Category 1 – Very Slight	Category 1 – Very Slight
MS5-3	Category 0 – Negligible	Category 0 – Negligible	Category 1 – Very Slight

The assessment presented herein is based on the assumption that the building structures surrounding the proposed development footprint are in a good state. Any existing defects may be exacerbated by the ground movements. The project team should review the conditions of the existing buildings, in order to ensure that the assumption is suitable.

The assessment is dependent and reliant on the works being undertaken by an experienced contractor, high quality workmanship, and appropriate supervision of construction means and methods by experienced personnel.

It is recommended that this report is reviewed and understood in full by the project team and major stakeholders. Where significant changes are made to items such as construction sequencing, temporary propping arrangements and scheme design the engineer should thoroughly review the

discrepancy and evaluate any potential impacts on ground movement and building damage. If necessary, the building damage categories should be re-evaluated.

It is critical that the permanent and temporary works designs are carried out in a coordinated manner, ensuring compatibility between performance specified elements (designed by specialist contractors) and permanent works elements (designed by the Structural Engineer), with the aim to ensure that such designs are in alignment with the assumptions/findings of the GMA and overall design intent.

5.0 Conclusions

A Ground Movement Assessment has been carried out for 4 Montpelier Square, London SW7 to assist with pre-planning document submissions to the Westminster City Council.

Providing that appropriate consideration is given to the detailed design of the basement in order to limit future movement, that good workmanship and construction sequences are used with appropriate support during excavations and that groundwater management is employed, then the proposed basement construction is unlikely to cause significant damage to the surrounding structures. Based on the predicted ground movements, the adjacent structures are expected to be within the CIRIA C760 Damage Category 1 (very slight).

Groundwater has been recorded approximately 1m below the proposed basement level but it would be prudent to continue to monitor the existing installed standpipe for as long as possible in order to determine equilibrium level and the extent of any seasonal groundwater variations. Trial excavations to the proposed basement depth should be carried by the main contractor to confirm the stability of the soil and to further investigate the presence of any groundwater inflows. The contractor should demonstrate adequate control measures to ensure any risks from groundwater are properly mitigated.

Early movement monitoring of the boundary walls to the neighbouring buildings is recommended during the construction stage and trigger levels should be set in order to protect the neighbouring properties as a precautionary measure. A specification for movement monitoring should be incorporated into the final construction scheme for the proposed development to monitor the adjacent properties and establish the extent of any future potential movement to the building. Any temporary and permanent works should be designed to limit eventual movement.

6.0 References

1 ***British Geological Survey Sheet 270, 'South London', Solid and Drift Edition***

2 ***BS 5930:2015+A1:2020 Code of practice for ground investigations. British Standards***

3 ***Burland, J., Broms, B. and de Mello, V. 1977. Behaviour of foundations and structures. Proc. 9th ICSMFE, State of-the-art Vol., 495-546***

4 ***Boscardin, M. D., & Cording, E. J. (1989). Building response to excavation-induced settlement. Journal of Geotechnical Engineering, 115, 1-21. doi:10.1061/(asce)0733-9410(1989)115:1(1)***

5 ***Burland, J.B. 2001. Building Response to Tunnelling: Case Studies from Construction of the Jubilee Line Extension. Report number: CIRIA Special Publication 200***

6 ***Burland, J. B. (1997). Assessment of risk of damage to buildings due to tunnelling and excavation. In K. Ishihara (Ed.), Earthquake geotechnical engineering. Rotterdam: Balkema.***

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8 ***Stroud, M. A. 1989. The Standard Penetration Test. Thomas Telford***

9 ***Handbook of Geotechnical Investigation and Design Tables, Look 2007***

10 ***CIRIA Report 760 Guidance on embedded retaining wall design. CIRIA 2017***

11 ***Tomlinson, 2001. Foundation Design and Construction***

12 ***Bowles, J. 2001. Foundation Analysis and Design Fifth Edition***

14 ***Peck.R,B. et al. Foundation Engineering. 1953***

15 ***Stroud and Butler, The Standard Penetration Test and the Engineering Properties of Glacial Materials, 1975 Conf. of the Midlands Geotechnical Society.***

16 ***ICE manual of geotechnical engineering (2012), Volume II***

Appendices

Appendix A – Development Plans

Appendix B – Site Investigation Factual Report

Appendix C – Structural Engineer Loads

Appendix D – Ground Movement Contour Plots

Appendix A Development Plans