



GEOSPHERE ENVIRONMENTAL

REPORT NUMBER: 4822,GI_GAR/GROUND/SG,GF/07-09-20/V1

SITE: Garrick House, Adelphi Crescent, Hornchurch

DATE: 07/09/2020



EXECUTIVE SUMMARY

Project Description	Geosphere Environmental Ltd was commissioned by Wareham and Associates Ltd to undertake a Ground Investigation for a number of proposed lift structures at Garrick House, Adelphi Crescent, Hornchurch.
Site Location / Description	The subject site was situated on Adelphi Crescent, Hornchurch, approximately 35m north west of Hornchurch High School. At the time of the site works the investigation site comprised a two-storey residential block associated with the Garrick House Sheltered Housing estate.
Site Works	Site works were carried out on 28 July 2020 and comprised the formation of 4 no. exploratory boreholes formed to depths of 2.00mbgl and 2.25mbgl and 2 no. hand excavated trial pits formed to depths of 1.35m and 1.40mbgl to expose the underside of foundations.
Ground Conditions	Ground conditions were recorded to comprise nominal thicknesses of topsoil and/or Made Ground, extending to depths ranging from 0.3m to 0.5m and was underlain by superficial clay/sandy clay Head deposits, extended to a maximum depth of 1.5mbgl. River Terrace Deposits, representing undifferentiated gravel members encountered underlying the Head Deposits, extended to the maximum depth of the investigation. Foundation exposure trial pits were excavated adjacent to the two-storey block, within the alcoves located east and west of the structure. Details of the existing foundations are provided within the foundation sketches provided within Appendix 5.
Laboratory Results	Results of chemical analysis indicates none of the contaminants to exceed the threshold for human health when compared with the screening values for residential end use with plant uptake. In the absence of any elevated concentrations of contaminants, the risk to the site is considered to be very low and it is envisaged that remediation of soils will not be required.
Geotechnical Appraisal	The site and ground conditions are considered suitable for the adoption of a conventional spread foundation bearing within the underlying superficial Head, where an NABP of 110kN/m² would be considered appropriate. However, given the presence of existing foundations, a minimum foundation depth of 1.2m is considered appropriate. In accordance with the BRE digest, a DS-1 Design Sulphate Class and an AC-1 ACEC classification may be assumed as a minimum for the design of concrete in contact with Made Ground and natural soils at the site.
This Executive Summary only provides a summary of the site data and its assessment. It does not provide a definitive engineering analysis and is for guidance only. It is recommended that the reader reviews the report in its entirety and any material referenced therein.	

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1. INTRODUCTION

Geosphere Environmental Ltd was commissioned by Wareham and Associates Ltd to undertake a Ground Investigation for a number of proposed lift structures at Garrick House, Adelphi Crescent, Hornchurch.

The primary objectives of this ground investigation were to:

- Assess the ground conditions at the site for use in the structural design of foundations;
- Assess the potential risk to human health and the environment based on the findings of the investigation.

These were achieved by:

- Undertaking an intrusive investigation of the site, based upon the scope provided by the client;
- Logging and sampling the soils on the site and noting any visual or olfactory evidence of contamination;
- Undertaking laboratory chemical analysis and geotechnical testing of selected soil samples to assess soil quality and ground conditions at the site.

Proposed Development Plans, drawing ref. 0139-ECD-03-00-DR-A-1200- and 0139-ECD-03-00-DR-A-1201-, dated January 2020, are provided within Appendix 3.

2. SITE SETTINGS

2.1 Site Description

The subject site was situated on Adelphi Crescent, Hornchurch, approximately 35m north west of Hornchurch High School, and may be located by National Grid Reference (NGR) TQ 52429 86833.

At the time of the site works, the investigation site comprised a two-storey residential block associated with the Garrick House Sheltered Housing estate. The specific investigation areas were located within two alcoves formed at the west and east ends of the block, which were soft surfaced and containing vegetation.

The surrounding area formed the residential gardens and continuation of housing blocks to Garrick House and included a number of mature trees, including Field Maple, Fir and Birch, in the west. Adelphi Crescent was located to the south east of the site.

A Site Location Plan and Site Plan are included as Drawing references 4822,GI_GAR/001/Rev0 and 0139-ECD-03-00-DR-A-1100-, respectively, within Appendix 3.

3. SITE WORKS

3.1 Methodology

This site investigation was carried out in accordance with the practices set out in BS 10175: 2011+A1:2013, (ref. **R.6**) and BS 5930: 2015 (ref. **R.7**). The location of exploratory holes has been planned, where possible, to give the best possible coverage for the proposed development of the scheme.

3.2 Scope

Site works were carried out on 28 July 2020 and comprised the following:

- Formation of 4 no. exploratory holes (WS01 to WS04), using Windowless Sampler techniques, formed to depths ranging from 2.00m to 2.25mbgl;
- Formation of 2 no. hand excavated trial pits (TP1 to TP2), formed to depths of 1.35m and 1.40mbgl to expose the underside of foundations;
- Associated soil logging, sampling and in-situ testing.

The target depth of the Window Sampler holes was 3.0m, although these refused at shallower depths, due to the density of the underlying soils.

3.3 Ground Conditions Encountered

The sequence and indicative thickness of the strata encountered are provided in Table 1 below:

Table 1 - Ground Conditions				
Strata	Depth Encountered (mbgl)		Strata Thickness (m)	Location and Composition
	From	To		
Topsoil	0.00	0.15 – 0.30	0.15 – 0.30	WS02 – WS04, TP1 and TP2 Typically, a dark brown slightly organic clay with varying amounts of sand, silt and flint/chert gravel.
Made Ground	0.00 – 0.15	0.35 – 0.50	0.20 – 0.40	WS01, WS02, TP1 and TP2 A dark brown clay with varying amounts of sand, concrete and brick gravel.
Superficial Soils (HEAD)	0.30 – 0.50	1.35 – 1.75	1.25 – 1.50 (where proven)	WS01, WS02 and TP1 An orange brown desiccated clay with varying amounts of flint and chert gravel WS03, WS04 and TP2 An orange brown very sandy clay/clay sand.
River Terrace Deposits (Undifferentiated Gravel Members)	1.55 – 1.75	2.00 – 2.25	Unproven	WS01 – WS04 Orange brown sand with varying amounts of flint gravel.

3.4 Existing Foundations

Foundation exposure trial pits were excavated adjacent to the two storey block, within the alcoves located east and west of the structure. The locations of foundation exposures are indicated within the Exploratory Hole Location Plan provided within Appendix 3.

Details of the existing foundations are provided within the foundation sketches provided within Appendix 5, with details of the soils encountered provided within Appendix 4. A summary of findings is provided below. Photographs of the foundations have been provided within Appendix 8.

TP1

The location of trial pit TP1, was situated mid-way along the western structural brick wall of the residential block, within the alcove. The wall extended up to two-storeys in height, although a window ledge was measured to be 1.74m above ground level. A concrete 'apron' was noted to form the ground level, which protruded from the structural wall by 300mm. A damp course was also noted to exist 150mm from the top of the concrete 'apron'.

The concrete 'apron' extended to a depth of approximately 0.4mbgl, where the foundation recessed towards the wall by 100mm (200mm from the external wall). The foundation was of concrete construction and extended to a depth of 1.2m bgl, whereby the foundation terminated on top of the cohesive Head soils.

In situ testing within the soils at this depth indicated a shear strength of 80kN/m², although the soils were noted to be very desiccated, i.e. higher than that under 'normal' moisture conditions.

TP2

The location of trial pit TP2, was situated mid-way along the eastern structural brick wall of the residential block, within the alcove. The wall extended up to two-storeys in height, although a window ledge was measured to be 1580mm above ground level. A concrete 'apron' was noted to form the ground level, which protruded from the structural wall by 310mm. A damp course was also noted to exist 130mm from the top of the concrete 'apron'. The thickness of the concrete 'apron' was measured to be 30mm.

Beneath the concrete 'apron' and the top of foundation was an area of mixed Made Ground Fill, which included a void. The Top of the foundation was noted to be 0.38mbgl. The foundation was of concrete construction and extended to a depth of 1.2mbgl, whereby the foundation terminated on top of the cohesive Head soils.

In situ testing within the soils at this depth indicated a shear strength of 55kN/m².

3.5 Visual and Olfactory Evidence of Contamination

With the exception of some anthropogenic masonry-type materials noted within the Topsoil and/or Made Ground, no other visual evidence of contamination was noted to exist. No olfactory evidence of contamination was noted within any of the exploratory holes.

3.6 Groundwater

No groundwater was noted to exist within any of the exploratory holes formed on the site.

4. LABORATORY TESTING

4.1 Methodology

Representative disturbed were taken at the depths shown on the exploratory hole records and despatched to the laboratory. The exploratory hole logs are included in Appendix 4.

Samples were collected for environmental purposes in amber glass jars and kept in a cool box with cooling aid.

Geotechnical samples were recovered in plastic bulk bags and air tight plastic pots.

In general, environmental samples were taken from the Topsoil and Made Ground as these soils were considered to represent likely sources of soil contamination. Geotechnical samples were taken to the guidance of BS 5930: 2015 (ref. R.7); every change in strata and 1.0m thereafter.

4.2 Environmental Testing Suite

4.2.1 Quality Control

The environmental laboratory used (Derwentside Environmental Testing - South) is an accredited laboratory by the United Kingdom Accreditation Service (UKAS), and at least 50% of individual parameters are from methods pending accreditation to the Environment Agency Monitoring Certification Scheme (MCERTS) for the range of analyses undertaken as part of this investigation. The MCERTS performance standard for the chemical testing of soil is an application of ISO 17025: 2005, specifically for the chemical testing of soil.

4.2.2 Environmental Testing Suite – Soils

The suite of chemical analyses was based upon observations of the recovered soils onsite. The chemical analyses were carried out on three samples of soil. The nature of the analyses is detailed below:

- Metals screen – arsenic, cadmium, chromium, lead, mercury, selenium, boron (water soluble), beryllium, copper, nickel, vanadium and zinc;
- Organic screen – total petroleum hydrocarbons (TPH) and polycyclic aromatic hydrocarbons (PAH) – USEPA 16 suite; monohydric phenols;
- Inorganics screen – cyanide (total), sulphate (water soluble);
- Others – pH, organic matter, asbestos.

A copy of the environmental laboratory test results is included in Appendix 6.

4.3 Geotechnical Testing

The geotechnical testing has been chosen based on the soils encountered during the site investigation and was undertaken in accordance with BS 1377 at a UKAS accredited laboratory.

The following tests were undertaken:

- Moisture content determination;
- Plasticity testing;
- Particle size distribution testing;
- pH and soluble sulphate testing of soils.

A copy of the geotechnical laboratory test results is included in Appendix 7.

5. RISK ASSESSMENT

5.1 Risk to Human Health

5.1.1 Methodology

The current guidance requires that a conceptual model be formulated, based upon the findings of the research. The conceptual model is limited at this stage to the identification and assessment of potential 'hazards', identified or suspected from the results of the research; the potential 'receptors' that may be affected and the anticipated 'pathways' to those receptors. The findings are summarised in the following subsections.

The guidance proposes a four-stage approach for the assessment of contamination and the associated risks. The four stages are listed below:

- Hazard Identification;
- Hazard Assessment;
- Risk Estimation;
- Risk Evaluation.

5.1.2 Soil Quality Screening Values

The results of the soil analyses have been compared to soil quality screening values where deemed applicable, such as:

- The LQM/CIEH S4ULs for Human Health Risk Assessment, (ref. **R.16**);
- Defra/CL:AIRE Final C4SLs, (ref. **R.15**).

The screening criteria used for the proposed development considers residential land-use with plant uptake as the most sensitive land use, with a Soil Organic Matter (SOM) content of 1%, based upon the results of laboratory analysis.

Where the concentrations reported by the laboratory analysis (and thus determined onsite) are at or below the respective screening concentrations, they are considered not to pose a risk and are removed from further consideration, unless otherwise stated in the following sections.

5.2 Elevated Soil Concentrations

The locations, depths and other relevant information of the elevated concentrations of the specific analytes are summarised below and assessed in more details where necessary/overleaf in Table 2:

Table 2 - Summary of Soil Analyses and Comparison with Current Screening Values

Analyte	Analyte Concentration Range (mg/kg)		Screening Value (mg/kg) for Land Use	Number of Elevated Concentrations
	Minimum	Maximum	Residential With Plant Uptake (1% SOM Assumed)	
Total Cyanide	<2	<2	5	0
Arsenic	5	13	37	0
Cadmium	<0.2	2	11	0
Chromium	12	19	910	0
Copper	8	28	2400	0
Lead	21	25	200	0
Mercury	<1	<1	1.2	0
Nickel	10	13	130	0
Zinc	37	74	3700	0
Asbestos	None of the samples screened for the presence of asbestos returned detectable amounts.			
Naphthalene	<0.1	<0.1	2.3	0
Acenaphthylene	<0.1	<0.1	170	0
Acenaphthene	<0.1	<0.1	210	0
Fluorene	<0.1	<0.1	170	0
Phenanthrene	<0.1	0.23	95	0
Anthracene	<0.1	<0.1	2400	0
Fluoranthene	<0.1	0.44	280	0
Pyrene	<0.1	0.35	620	0
Benzo(a)anthracene	<0.1	0.19	7.2	0
Chrysene	<0.1	0.21	15	0
Benzo(b)fluoranthene	<0.1	0.31	2.6	0
Benzo(k)fluoranthene	<0.1	<0.1	77	0
Benzo(a)pyrene	<0.1	0.18	2.2	0
Indeno(1,2,3-cd)pyrene	<0.1	0.15	27	0
Dibenzo(a,h)anthracene	<0.1	<0.1	0.24	0
Benzo(ghi)perylene	<0.1	<0.1	320	0
Extractable Petroleum Hydrocarbons (C10 - C40)	10	28	Screening values not provided due to low concentration	0

Results of chemical analysis indicates none of the contaminants to be beyond the threshold for human health.

5.2.1 Mitigating / Remedial Measures

Risks to humans include construction workers, site neighbours and end-users of the site. Theoretically, exposure to contaminants can take the form of direct contact with the skin, consumption of contaminants through transfer of contaminants to the food chain, or the inhalation of contaminants through wind-blown soils or vapours.

Where soils are covered with structures or permeant hardstanding, a pathway for contaminants to reach the end-user will be severed and therefore the risk will be low, whereas exposure of contaminants is at its highest in areas of proposed soft-scaping and therefore remediation of soils within these areas is likely to be required.

To reduce the risks of exposure and transfer of contaminants during construction, short-term mitigations measures should be adhered to and where applicable, be incorporated into the development Construction Phase Health and Safety Plan or similar document. In consideration of construction workers and the public during construction works, the soil data indicates elevated concentrations when compared to a more representative land-use scenario, thus qualitatively, a moderate risk exists during construction works and site neighbours. Standard good practices, i.e. the adoption of appropriate PPE, dust-suppression and wheel washing for vehicles leaving the site, should apply during any landscaping, soil movement and offsite disposal.

A discovery strategy should be implemented throughout the development of the site and any suspected contaminants subject to assessment by a suitably qualified and experience geo-environmental engineer. This may comprise of additional soil sampling and chemical analysis to quantify its suitability onsite and potential for remediation.

5.2.2 Asbestos

Results of asbestos screening did not indicate the presence of asbestos within the (Made Ground) soils. However, it is recommended that a discovery strategy is in place for potentially asbestos containing materials should they be encountered within the soils during the construction phase, due to the variable nature of Made Ground.

Any suspected asbestos encountered within the soils during the demolition and construction phase of the proposed development should be left in situ and temporarily fenced off, until its identification and removal/treatment has been established. Works in the immediate area of the suspected asbestos should cease during this period until a suitably qualified and authorised person has given permission for works to continue.

5.3 Risk to Controlled Waters

The risks to Controlled Waters have been assessed with respect to soil contamination only as groundwater analysis was outside the scope of this investigation.

Based upon the results of chemical analysis on soils, a source of elevated contaminants does not exist and therefore the risk to Controlled Waters, i.e. groundwater, is negligible.

5.4 Risk to Plants

A review of the commonly occurring phytotoxic chemicals boron, copper, nickel and zinc, has been undertaken based upon the now superseded ICRL guidance. Although the ICRL trigger threshold levels have been withdrawn, there are no equivalent guidance values for phytotoxicity.

Concentrations of metals were recorded at concentrations below the thresholds considered to have phytotoxic effects.

5.5 Risk to Services - Pipes

In the absence of a significant quantity of extractable petroleum hydrocarbons, the risk is considered to be very low and therefore standard PE pipe may be adopted.

While no specific protection is envisaged, It is advised that the UK Water Industry Research Guidance (ref. **R.11**) is adopted and consultation with the local water company is sought prior to laying any services.

6. GEOTECHNICAL APPRAISAL

It is understood that the proposed development of the site is to comprise lift structures within the alcoves located east and west of the two-storey housing structure.

Details regarding the proposed loads of the structure have not been provided, although plans indicate the structure to measure approximately 2.00m by 1.85m and shall be two storey's in height, therefore it has been assumed that a vertical load of 30kN/m² will be imposed upon foundations. This assumption is based on the lift structure to be of masonry construction.

6.1 Summary of Ground Conditions

Ground conditions were recorded to comprise nominal thicknesses of topsoil and/or Made Ground, extending to depths ranging from 0.3m to 0.5m and was underlain by superficial clay/sandy clay Head deposits, extended to a maximum depth of 1.5mbgl.

River Terrace Deposits, representing undifferentiated gravel members (Hackney, Boyn Hill and Black Park Gravel Members) were encountered underlying the Head Deposits, extended to the maximum depth of the investigation.

Groundwater was not encountered within any of the exploratory holes formed as part of the investigation.

6.2 Foundations

6.2.1 Ground Desiccation

Where soils are identified as being non-plastic, they are generally regarded as not having volume change potential and therefore not likely to induce any ground movements associated with changing soil moisture conditions. These soils include granular soils of the River Terrace Deposits (Undifferentiated Gravel Members.), located at depths ranging from 1.55m and 1.75m.

The results of geotechnical classification testing indicate the superficial Head soils to typically contain soils that are of low and intermediate plasticity and low to medium-volume change potential when comparing the recorded plasticity index with their modified plasticity index ($I'_p = I_p \times \% \text{ of material passing the } 425\mu\text{m sieve} / 100$).

It is likely that existing trees are to be retained, therefore foundations constructed in the vicinity will likely require extending to depth, due to the influence of trees and the resulting desiccation within cohesive soils which may cause soil instability related to changing soil moisture conditions. The guidance provided within BRE Digest 412 'Desiccation on clay soils' (ref. **R.3**) indicates that, for general guidance, the onset of desiccation occurs when the moisture content of a cohesive soil is lower than 0.4 times the liquid limit of that soil. Based upon the results of laboratory testing on samples taken within the cohesive Head soils, desiccation is largely present, therefore foundation will require extending to depth.

It is recommended that the advice of a qualified and experienced structural engineer is sought to confirm the requirement for any deeper foundation design (piles) based upon the influence of trees.

It is noted that the above is not applicable in the case of the adoption of a raft foundation, which may be designed to accommodate for changes in soil volume.

6.2.2 Foundation Options

The site and ground conditions are considered suitable for the adoption of a conventional spread foundation bearing within the underlying cohesive Head deposits.

A Net Allowable Bearing Pressure (NABP) of 110kN/m² would be considered appropriate within the Head Deposits, based on the results of in-situ testing. Should foundations require extending to the River Terrace Deposits due to the presence of desiccated soils and trees, the NABP may be increased significantly due to the high density of the material, although it is recommended limiting this to 200kN/m². The NABP, is the permissible strength of the soil above existing overburden pressure, which may be calculated on the basis of a soil density of 19kN/m³ (Head) or 23kN/m³ (River Terrace Deposits).

At the above NABP, settlements are unlikely to exceed in the region of 25mm. Settlements in granular materials are likely to comprise of immediate settlement whereas settlements in cohesive are likely to comprise of a small amount of immediate settlement and a larger amount of consolidation settlement, which will occur over a period of time. Where foundations cross from granular to cohesive materials, a nominal amount of reinforcement should be incorporated into the design to counter the effects of differential settlement.

Given the presence of existing foundations, it is recommended that foundations are extended to similar depths to prevent any additional load from impacting on existing structures. Therefore, a minimum foundation depth of 1.2m is considered appropriate.

In the presence of expansive soils, it is recommended that a nominal amount of void former is incorporated into the design of foundations to reduce the impact on foundations over time.

6.2.3 Excavations, Temporary Works and Groundwater Ingress

All excavations within the Made Ground must be assumed to be subject to short term instability. It is expected that excavations within the superficial Head soils will be stable in the short term. However, where excavations are required to remain stable in the medium or long term they should be suitably supported or side slopes battered back to a safe angle of repose.

Where personnel access is required to any excavation its stability should be assessed by a suitably qualified and experienced responsible person. For general guidance it is recommended that where access is required

to excavations greater than 1.2m depth excavations should be fully supported or side slopes battered back to a safe angle of repose.

Further guidance may be obtained from CIRIA document 97, 'Trenching Practice (ref. **R.12**).

Particular attention must be paid to ensuring the stability of adjacent structures during the excavation for foundations.

Groundwater was not encountered during the investigation and as such is not considered likely to be encountered during foundation and service run excavations in the short term.

6.3 Concrete Classification

The results of chemical tests within the Made Ground soils indicate a sulphate concentration of between 20mg/l and 80mg/l as a 2:1 water/soil extract. A pH value in the range of 5.8 to 8.9 was noted across all soils encountered.

In consideration of the previous usage of the site, it is recommended that brown-field conditions be assumed for the purposes of assessing the aggressive chemical environment for concrete classification (ACEC class). Given the presence of permeable natural soils, mobile conditions can also be reasonably assumed.

In accordance with the BRE digest, a DS-1 Design Sulphate Class and an AC-1 ACEC classification may be assumed as a minimum for the design of concrete in contact with Made Ground and natural soils at the site.

7. CONCLUSIONS AND RECOMMENDATIONS

Geosphere Environmental Ltd was commissioned by Wareham and Associates Ltd to undertake a Ground Investigation for a number of proposed lift structures at Garrick House, Adelphi Crescent, Hornchurch.

The subject site was situated on Adelphi Crescent, Hornchurch, approximately 35m north west of Hornchurch High School. At the time of the site works the investigation site comprised a two-storey residential block associated with the Garrick House Sheltered Housing estate.

Site works were carried out on 28 July 2020 and comprised the formation of 4 no. exploratory boreholes formed to depths of 2.00mbgl and 2.25mbgl and 2 no. hand excavated trial pits formed to depths of 1.35m and 1.40mbgl to expose the underside of foundations.

Ground conditions were recorded to comprise nominal thicknesses of topsoil and/or Made Ground, extending to depths ranging from 0.3m to 0.5m and was underlain by superficial clay/sandy clay Head deposits, extended to a maximum depth of 1.5m bgl. River Terrace Deposits, representing undifferentiated gravel members (Hackney, Boyn Hill and Black Park Gravel Members) were encountered underlying the Head Deposits, extended to the maximum depth of the investigation. Groundwater was not encountered within any of the exploratory holes formed as part of the investigation.

Foundation exposure trial pits were excavated adjacent to the two-storey block, within the alcoves located east and west of the structure. Details of the existing foundations are provided within the foundation sketches provided within Appendix 5.

Results of chemical analysis indicates none of the contaminants to be beyond the threshold for human health. In the absence of any elevated concentrations of contaminants, the risk to the site is considered to be very low and it is envisaged that remediation of soils will not be required. However, to reduce the risks of exposure and transfer of contaminants during construction, short-term mitigations measures should be adhered to and a discovery strategy should be implemented throughout the development of the site and any suspected contaminants subject to assessment.

The results of geotechnical classification testing indicate the superficial Head to typically contain soils that are of low to intermediate plasticity and low to medium volume change potential. The site and ground conditions are considered suitable for the adoption of a conventional spread foundation bearing within the underlying superficial Head, where an NABP of 110kN/m² would be considered appropriate. However, given the presence of existing foundations, a minimum foundation depth of 1.2m is considered appropriate. In the presence of expansive soils, it is recommended that a nominal amount of void former is incorporated into the design of foundations to reduce the impact on foundations over time.

In accordance with the BRE digest, a DS-1 Design Sulphate Class and an AC-1 ACEC classification may be assumed as a minimum for the design of concrete in contact with Made Ground and natural soils at the site.

APPENDICES

Appendix 1 – Report Limitations and Conditions

General Limitations and Exceptions

This report was prepared solely for our Client for the stated purposes only and is not intended to be relied on by any other party or for any other use. No extended duty of care to any third party is implied or offered.

Geosphere Environmental Ltd does not purport to provide specialist legal advice.

The Executive Summary, Conclusions and Recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon, until considered in the context of the whole report.

Interpretations and recommendations contained within the report represent our professional opinions, which were arrived at in accordance with currently accepted industry practices at the time of reporting and based upon current legislation in force at that time.

Environmental and Geotechnical Reporting (including Phase 1, Phase 2 and Site Walkovers) Limitations and Exceptions

The comments given in this report and the options expressed herein, are based upon the readily available information collated for the report and an assessment based upon the current guidance which for Phase 1 / Phase 2 report is guidance BS 10175: 2011+A1:2013 and BS 5930: 2015.

The report has been prepared in relation to the proposed end-use and should another end-use be intended, reassessment may be required.

No warranty is given as to the possibility of future changes in the condition of the site.

The opinions expressed cannot be absolute, due to the limitation of time and resources imposed by the agreed brief.

With regards to any aspect of land contamination referred to, this is limited to those aspects specifically stated and necessarily qualified. No liability shall be accepted for other aspects which may be the result of gradual or sudden pollution incidents, past or present land uses and the potential for associated contamination migration.

Any Desk Study Report / data has been produced largely from the information purchased from The Landmark Information Group. The information is not necessarily exhaustive and further information

relevant to the site may be available from other sources. The information purchased has been assumed to be correct and free from errors. However, there is the possibility that some data may be missing from the report including (but not limited to) unrecorded land uses both onsite and offsite or unrecorded pollution events. No attempt has been made to verify the information.

The accuracy of any map extracts cannot be guaranteed. It is possible that different conditions existed onsite, between and subsequent to the various map surveys provided.

Any site walkover undertaken is a snapshot of the site recording the visually evident conditions at the time of the walkover in the areas readily accessible. It is possible that after the walkover, the site was altered (for example by fly-tipping or groundworks) or before the walkover, the site conditions changed removing evidence of potentially contaminative features (such as oil tanks removed).

Any intrusive works only cover a tiny proportion of the site. Where exploratory holes are positioned by Geosphere Environmental Limited, they are located to give as good a coverage of the site as possible and to target features / proposed land use where applicable, whilst allowing for areas that cannot be accessed, Client requested locations and other site / time / budget constraints. Whilst assumptions may have been drawn between exploratory holes on the ground conditions and / or extent or otherwise of any contamination, this is for guidance only and no liability can be accepted on its accuracy.

Foundation design is outside of the remit of Geosphere Environmental Limited unless specifically stated and it is recommended that the services of foundation design specialists are sought as required. Any foundation appraisal contained within the report is limited to foundation optioneering.

Any conceptual site model is based upon the information available at the time of conducting this assessment and is an interpretive assessment of the conditions at the site. Redevelopment and / or further investigation of the site may reveal additional information and therefore alter the conceptual site model and the report conclusions.

Any infiltration testing results are considered to be representative of the ground conditions at the locations tested and at the time of testing. As well as lateral variation in ground conditions, seasonal changes in ground water level may affect the results.

Any post-fieldwork monitoring (including ground gas / groundwater) is a snapshot of the conditions at the time of monitoring.

Appendix 2 – References

- R.1. BRE Special Digest 1, 'Concrete in Aggressive Ground', 2005.
- R.2. BRE Digest 240, 'Low-rise Buildings on Shrinkable Clay Soils: Part 1', September 1993.
- R.3. BRE Digest 412 'Desiccation on Clay Soils', 1996.
- R.4. The Environmental Protection Act, Part IIA, Section 78, 1990.
- R.5. Environment Act 1995, Section 57, DoE 1995.
- R.6. British Standards Institute: BS 10175 'Investigation of Potentially Contaminated Sites', Code of Practice, BSI 2011+A2:2017.
- R.7. British Standards Institute: BS 5930 'Code of Practice for Ground Investigations', 2015.
- R.8. Asbestos: The Survey Guide, HSG 264, 2nd Edition, 2012.
- R.9. CL:AIRE 'Guidance on Comparing Soil Contamination Data with a Critical Concentration', The Chartered Institute of Environmental Health, May 2008.
- R.10. EIC/AGS/CL:AIRE. Soil Generic Assessment Criteria for Human Health Risk Assessment. Contaminated Land: Applications in Real Environments, London, UK, January 2010.
- R.11. Contaminated Land Assessment Guidance Protocols, Published by agreement between Water UK and the Home Builders Federation, Published by Water UK, January 2014.
- R.12. UKWIR 'Guidance for the Selection of Water Supply Pipes to be Used in Brownfield Sites, August 2010.
- R.13. CIRIA Report 97 (Second Edition) 'Trenching Practice', 2001.
- R.14. Environment Agency. Performance Standard for Laboratories Undertaking Chemical Testing on Soil, Version 4, March 2012.
- R.15. SP1010 – Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination, Final Project Report (Revision 2), Contaminated Land: Applications in Real Environments (CL:AIRE) September 2014. Appendix H – Lead.
- R.16. Land Quality Press, The LQM/CIEH S4ULs for Human Health Risk Assessment, 2015.

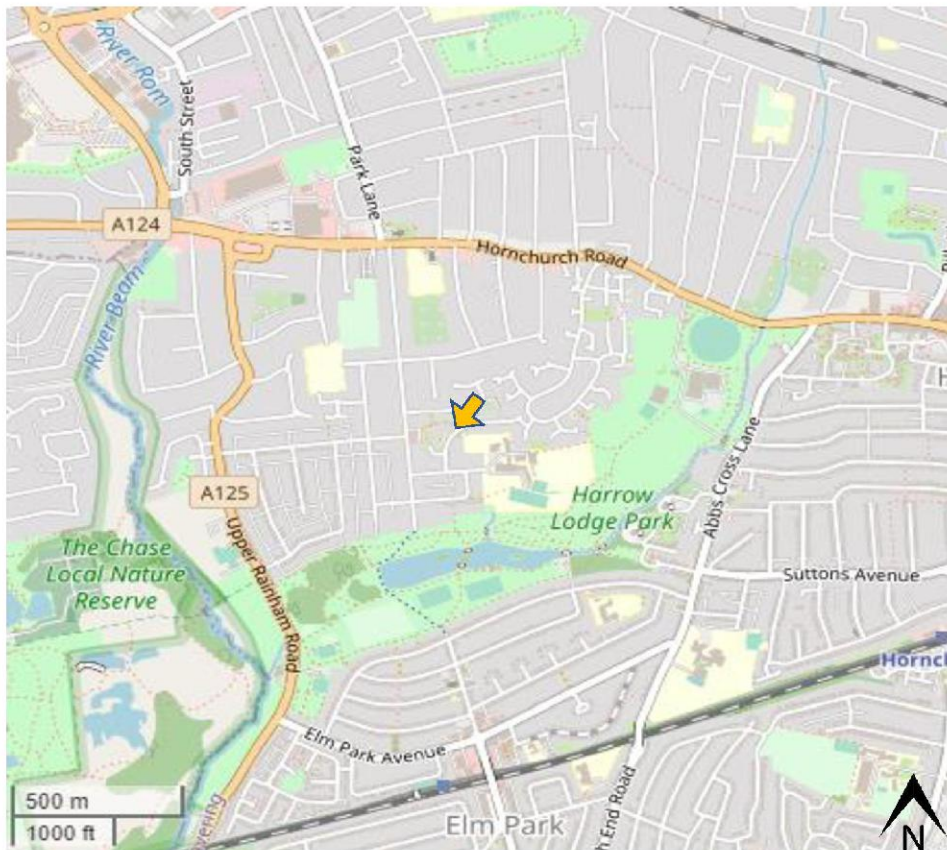
Appendix 3 – Drawings

Site Location Plan – Drawing ref. 4822,GI_GAR/001/Rev0

Location Plan – Drawing ref. 0139-ECD-03-00-DR-A-1100-

Proposed Development Plans – Drawing ref. 0139-ECD-03-00-DR-A-1200- and 0139-ECD-03-00-DR-A-1201-

Exploratory Hole Location Plan – Drawing ref. 4822,GI_GAR/002/Rev0



LEGEND



Site Location

SOURCE

© OpenStreetMap contributors

PROJECT

Garrick House, Adelphi Crescent, Hornchurch

TITLE

Site Location Plan

DRAWING NUMBER

4822_GI_GAR/001/Rev0

SCALE

As Marked

DATE

18/08/2020

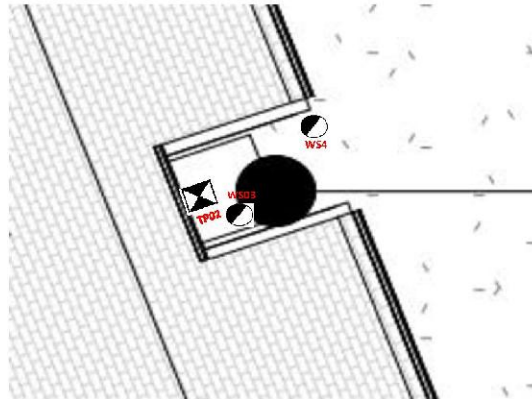
DRAWN BY

SG

CHECKED BY

GF

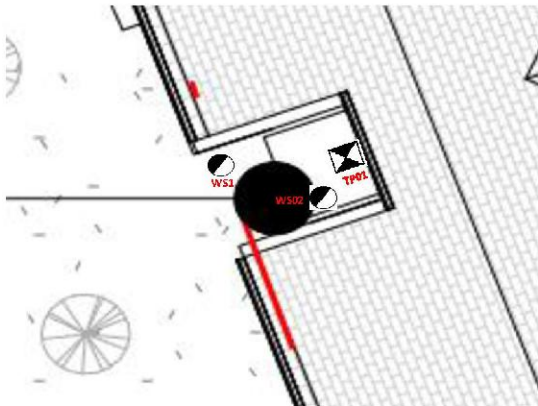
Eastern Alcove



LEGEND

-  Window Sample
-  Foundation Trial Pit

Western Alcove



SOURCE

Client provided background image

PROJECT

Garrick House, Adelphi Crescent, Hornchurch

TITLE

Exploratory Hole Location Plan

DRAWING NUMBER

4822_GI_GAR/002/Rev0

SCALE

NTS

DATE

24/08/2020

DRAWN BY

SG

CHECKED BY

GT

Appendix 4 – Exploratory Hole Logs

Windowless Sample Hole Logs
(WS1 to WS4)

Trial Pit Logs
(TP1 to TP2)

SE-A3SB-BETA-42213_34R 2C 38 E-3PJ GINTSTD AGS 8 - GJT 27/09/20

SE-A3S8H-BETA-49213, 3/4R 2C 08 12-3PJ GINTSTD AGS 87 GDT 27/09/20

SE-A3S8H-BETA-42213_34R-2008123PJ GINTSTD\GS8*_GDT 27/09/20



Geosphere Environmental Ltd
Unit 11, Brightwell Barns
Brightwell, Suffolk, IP10 0BJ
Telephone: 01603 298 076

TRIAL PIT LOG

Project Garrick House, Havering		Client Wareham & Associates Ltd		TRIAL PIT No TP01
Job No 4822, GI GAR	Date 28-07-20 28-07-20	Ground Level (m)	Coordinates ()	
Fieldwork By GEL		Logged By SG		Sheet 1 of 1

Depth	DESCRIPTION	Legend	Depth	No	Remarks/Tests
0.00-0.15	Dark grey organic CLAY with frequent fine roots. (TOPSOIL)				No groundwater encountered
0.15-0.35	MADE GROUND (Dark greyish brown slightly gravelly CLAY. Gravel is fine to coarse chert and concrete).				
0.35-1.35	Dark yellowish brown / orangish brown slightly sandy CLAY. Sand is fine. Gravel is fine subrounded flint and chert.				
END OF TRIAL PIT					

0.3



0.4

Shoring/Support: None
Stability: Stable

GEL\AS8\TP01\TP01_4822_GI GAR_20-08-20.DWG - JINT & TID AC83_1_32T_27/08/20

All dimensions in metres Scale 1:16.6666666666667	Method Trial Pit/trench	Plant Used HAND	Checked By SG
--	-------------------------	-----------------	------------------



Geosphere Environmental Ltd
Unit 11, Brightwell Barns
Brightwell, Suffolk, IP10 0BJ
Telephone: 01603 298 076

TRIAL PIT LOG

Project Garrick House, Havering		Client Wareham & Associates Ltd		TRIAL PIT No TP02
Job No 4822, GI GAR	Date 28-07-20 28-07-20	Ground Level (m)	Coordinates ()	
Fieldwork By GEL		Logged By SG		Sheet 1 of 1

Depth	DESCRIPTION	Legend	Depth	No	Remarks/Tests
0.00-0.15	MADE GROUND (Dark grey slightly silty slightly sandy organic CLAY with frequent fine to coarse angular to rounded concrete and chert gravel. Sand is fine).				No groundwater encountered
0.15-0.50	MADE GROUND (Light grey mottled dark brown gravelly clayey SAND / sandy CLAY. Sand is ??????. Gravel is fine to coarse angular to rounded concrete and chert).				
0.50-1.40	Dark orangish brown very sandy CLAY / very clayey SAND. Sand is fine.				
END OF TRIAL PIT					

GEL\AS8\TP02\TP02_4822_GI GAR_20-08-20.DWG - JINT & TD ACS 3, 1, 32T, 27/6/20

0.3



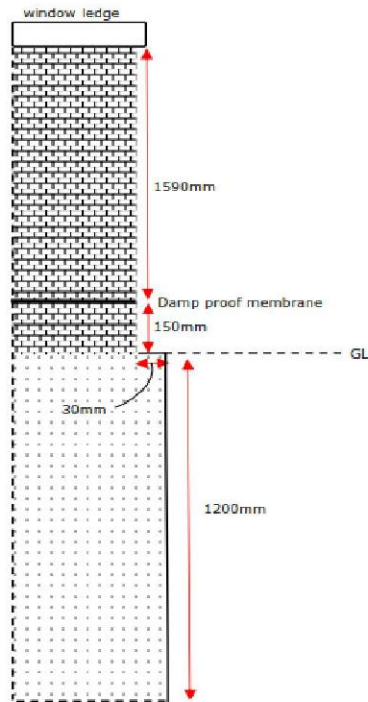
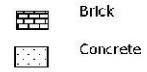
0.35

Shoring/Support: None
Stability: Stable

All dimensions in metres Scale 1:16.6666666666667	Method Trial Pit/trench	Plant Used HAND	Checked By SG
--	-------------------------	-----------------	------------------

Appendix 5 – Foundation Drawings

LEGEND



SOURCE

PROJECT

Garrick House, Adelphi Crescent, Homchurch

TITLE

TP01 Foundation Exposure

DRAWING NUMBER

4822_GI_GAR/003/Rev0

SCALE

nts

DATE

03/09/2020

DRAWN BY

AT

CHECKED BY

SG

LEGEND

-  Brick
-  Concrete

SOURCE

PROJECT

Garrick House, Adelphi Crescent, Hornchurch

TITLE

TP02 Foundation Exposure

DRAWING NUMBER

4822_GI_GAR/004/Rev0

SCALE

nts

DATE

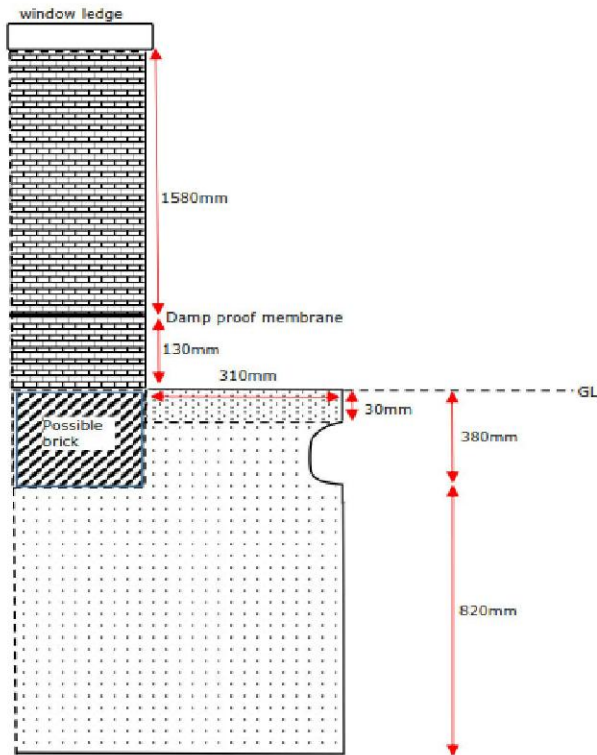
03/09/2020

DRAWN BY

AT

CHECKED BY

SG



Appendix 6 – Environmental Laboratory Test Results



Stephen Gilchrist
Geosphere Environmental Ltd
Brightwell Barns
Ipswich Road
Brightwell
Suffolk
IP10 0BJ

DETS Ltd
Unit 1
Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Kent
ME17 2JN
t: 01622 850410

DETS Report No: 20-08666

Site Reference: Garrick House, Haverling
Project / Job Ref: 4822.GI GAR
Order No: None Supplied
Sample Receipt Date: 04/08/2020
Sample Scheduled Date: 04/08/2020
Report Issue Number: 1
Reporting Date: 10/08/2020

Authorised by:

Kevin Old
General Manager

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

Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.



DETS Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410



Soil Analysis Certificate						
DETS Report No: 20-08666	Date Sampled	28/07/20	28/07/20	28/07/20		
Geosphere Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: Garrick House, Haverling	TP / BH No	W501	W501	W503		
Project / Job Ref: 4822_GI_GAR	Additional Refs	ENV1	ENV2	ENV3		
Order No: None Supplied	Depth (m)	0.15	0.40	0.20		
Reporting Date: 10/08/2020	DETS Sample No	490806	490807	490808		

Determinand	Unit	RL	Accreditation	Not Detected	Not Detected	Not Detected		
Asbestos Screen ⁽⁵⁾	N/a	N/a	ISO17025	Not Detected	Not Detected	Not Detected		
pH	pH Units	N/a	MCERTS	8.2	7.3	8.9		
Total Cyanide	mg/kg	< 2	NONE	< 2	< 2	< 2		
Complex Cyanide	mg/kg	< 2	NONE	< 2	< 2	< 2		
Free Cyanide	mg/kg	< 2	NONE	< 2	< 2	< 2		
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	68	69	76		
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	0.07	0.07	0.08		
Organic Matter	%	< 0.1	MCERTS	1	0.6	0.3		
Arsenic (As)	mg/kg	< 2	MCERTS	5	7	13		
Barium (Ba)	mg/kg	< 2.5	MCERTS	36	36	29		
Beryllium (Be)	mg/kg	< 0.5	MCERTS	< 0.5	< 0.5	< 0.5		
W/S Boron	mg/kg	< 1	NONE	< 1	< 1	< 1		
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	2	< 0.2	< 0.2		
Chromium (Cr)	mg/kg	< 2	MCERTS	17	19	12		
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2	< 2		
Copper (Cu)	mg/kg	< 4	MCERTS	28	12	8		
Lead (Pb)	mg/kg	< 3	MCERTS	25	23	21		
Mercury (Hg)	mg/kg	< 1	MCERTS	< 1	< 1	< 1		
Molybdenum (Mo)	mg/kg	< 1	MCERTS	< 1	< 1	< 1		
Nickel (Ni)	mg/kg	< 3	MCERTS	13	10	12		
Selenium (Se)	mg/kg	< 2	MCERTS	< 3	< 3	< 3		
Vanadium (V)	mg/kg	< 1	MCERTS	17	27	21		
Zinc (Zn)	mg/kg	< 3	MCERTS	71	37	57		
EPH (C10 - C40)	mg/kg	< 6	MCERTS	28	23	10		

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.
Subcontractor analysis ⁽⁵⁾



DETS Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410



Soil Analysis Certificate - Speciated PAHs						
DETS Report No: 20-08666	Date Sampled	28/07/20	28/07/20	28/07/20		
Geosphere Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: Garrick House, Havering	TP / BH No	W501	W501	W503		
Project / Job Ref: 4822_GI_GAR	Additional Refs	ENV1	ENV2	ENV1		
Order No: None Supplied	Depth (m)	0.15	0.10	0.20		
Reporting Date: 10/08/2020	DETS Sample No	490806	490807	490808		

Determinand	Unit	RL	Accreditation				
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Phenanthrene	mg/kg	< 0.1	MCERTS	< 0.1	0.23	< 0.1	
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	0.44	0.22	
Pyrene	mg/kg	< 0.1	MCERTS	< 0.1	0.35	0.17	
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	0.19	0.10	
Chrysene	mg/kg	< 0.1	MCERTS	< 0.1	0.21	0.13	
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	0.31	0.19	
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	0.18	0.12	
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	0.15	< 0.1	
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Total FPA-16 PAHs	mg/kg	< 1.6	MCERTS	< 1.6	2.1	< 1.6	



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Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410



Soil Analysis Certificate - Sample Descriptions

DETS Report No: 20-08666

Geosphere Environmental Ltd

Site Reference: Garrick House, Havering

Project / Job Ref: 4822_GI_GAR

Order No: None Supplied

Reporting Date: 10/08/2020

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
490806	WS01	ENV1	0.15	7	Brown sandy gravel with stones and concrete
490807	WS01	ENV2	0.10	5.5	Brown sandy clay with stones
490808	WS03	ENV1	0.20	2.3	Brown sandy gravel with concrete

Moisture content is part of procedure EN93 & is not an accredited test

Insufficient Sample ⁴⁰

Unsuitable Sample ¹⁰⁵



DETS Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410



Soil Analysis Certificate - Methodology & Miscellaneous Information

DETS Report No: 20-08666

Geosphere Environmental Ltd

Site Reference: Garrick House, Havering

Project / Job Ref: 4822_GI_GAR

Order No: None Supplied

Reporting Date: 10/08/2020

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	F012
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	L002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	F009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by addition of 1,5 diphénylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	F015
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	C015
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	F001
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	F022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	C023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	C020
Soil	AR	EPH (C10 - C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	F004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E001
Soil	AR	EPH TDXAS (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	F001
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	F000
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	F010
Soil	D	Loss on Ignition @ 450°C	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	C019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	C025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	F002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	F004
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	F002
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	C008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	F011
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	C021
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	F013
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	L014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	F018
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	F017
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 (all: 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 (all: C3-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	L001
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

Appendix 7 – Geotechnical Laboratory Test Results



TEST REPORT
ISSUED BY SOIL PROPERTY TESTING LTD
DATE ISSUED: 27/08/2020



0998

Contract	Garrick House, Havering	
Serial No.	37366_1	
Client:		
Geosphere Environmental Ltd Head Office Brightwell Barns Ipswich Road Brightwell Suffolk IP10 0BJ		Soil Property Testing Ltd 15, 16, 18 Halcyon Court, St Margaret's Way, Stukeley Meadows, Huntingdon, Cambridgeshire, PE29 6DG Tel: 01480 455579 Email: enquiries@soilpropertytesting.com Website: www.soilpropertytesting.com
Samples Submitted By: Geosphere Environmental Ltd Samples Labelled: Garrick House, Havering		Approved Signatories: ☒ J.C. Garner B.Eng (Hons) FGS Technical Director & Quality Manager ☐ S.P. Townend Chairman ☐ W. Johnstone Materials Lab Manager ☐ D. Sabnis Operations Manager 
Date Received: 14/08/2020	Samples Tested Between: 14/08/2020 and 27/08/2020	
Remarks: For the attention of Stephen Gilchrist Your Reference No: 4822,GI_GAR		
Notes: 1 All remaining samples or remnants from this contract will be disposed of after 21 days from today, unless we are notified to the contrary. 2 (a) UKAS - United Kingdom Accreditation Service. (b) Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. 3 Tests marked "NOT UKAS ACCREDITED" in this test report are not included in the UKAS Accreditation Schedule for this testing laboratory. 4 This test report may not be reproduced other than in full except with the prior written approval of the issuing laboratory.		



TEST REPORT

ISSUED BY SOIL PROPERTY TESTING LTD
DATE ISSUED: 27/08/2020



Contract		Garrick House, Havering																	
Serial No.		37366_1										Target Date		28/08/2020					
Scheduled By		Geosphere Environmental Ltd																	
SCHEDULE OF LABORATORY TESTS																			
Schedule Remarks																			
Bore Hole No.	Type	Sample Ref.	Top Depth	Water Content (BS5434) Liquid Plastic Limits Wet Sieve Preparation Substrate Content/pH Value Particle Size Distribution (BS3377)														Sample Remarks	
WS01	D	1	0.75	1	1	1	1												
WS01	D	2	1.50	1															
WS01	D	3	2.00			1	1												
WS02	D	1	0.50	1															
WS02	D	2	1.50	1															
WS03	D	1	0.50	1															
WS03	D	2	1.20	1	1	1													
WS04	D	1	0.80	1															
WS04	D	2	1.20	1		1													
Totals				8	2	2	3	1											End of Schedule



TEST REPORT

ISSUED BY SOIL PROPERTY TESTING LTD
DATE ISSUED: 27/08/2020



0998

Contract		Garrick House, Havering												
Serial No.		37366_1												
SUMMARY OF WATER CONTENT, LIQUID LIMIT, PLASTIC LIMIT, PLASTICITY INDEX AND LIQUIDITY INDEX														
Borehole / Pit No.	Depth (m)	Type	Ref.	Water Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Liquidity Index	SAMPLE PREPARATION				Description	CLASS
									Method	Ret'd >0.425mm (%)	Cor'd <0.425mm W/C	Curing Time (hrs)		
WS01	0.75	D	1	13.9	42	15	27	-0.04	Wet Sieved	11 (M)	15.6%	25	Very stiff slightly gravelly slightly sandy silty CLAY with occasional reddish yellow mottling. Gravel is white, brown and grey fine to medium angular to subrounded quartzite and chert.	CI
WS01	1.50	D	2	13.6									Very stiff orangish brown slightly gravelly slightly sandy silty CLAY with rare dark grey mottling. Gravel is white and grey fine to medium angular to subangular chert.	
WS02	0.50	D	1	7.1									Very stiff friable yellowish brown slightly gravelly slightly sandy silty CLAY with occasional sandy pockets, and rare decayed roots. Gravel is black, grey, brown and white fine to medium subangular to rounded quartzite.	
WS02	1.50	D	2	10.6									Very stiff reddish yellow friable slightly gravelly slightly sandy silty CLAY with occasional decayed roots. Gravel is white, grey and brown fine to medium subangular to subrounded quartzite and chert.	
WS03	0.50	D	1	14.1									Very stiff orangish brown sandy silty CLAY with rare gravel. Sand is fine to medium.	
WS03	1.20	D	2	15.0	33	13	20	0.10	Wet Sieved	15 (M)	17.7%	25	Stiff orangish brown slightly gravelly slightly sandy silty CLAY with occasional sandy pockets. Gravel is white, grey and brown fine to medium angular to subrounded quartzite and chert.	CL
WS04	0.80	D	1	12.5									Very stiff orangish brown slightly gravelly slightly sandy silty CLAY. Gravel is white, brown and grey fine to medium subangular to subrounded quartzite and chert.	
WS04	1.20	D	2	13.8									Stiff orangish brown slightly gravelly slightly sandy silty CLAY with occasional reddish yellow mottling. Gravel is white, brown and grey fine to medium angular to subrounded chert.	
Method Of Preparation: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2:1990:4.2														
Method of Test: BS EN ISO: 17892-1: 2014 & BS1377:Part 2:1990:3.2, 4.4														
Type of Sample Key: U = Undisturbed, L = Liner, B = Bulk, D = Disturbed, J = Jar, W = Water, SP = Split Spoon Sample, C = Core Cutter														
Comments: *Corrected water content assume material greater than 0.425mm is non porous. See BS1377: Part 2: 1990 Clause 3 Note 1.														
Table Notation: Ret'd 0.425mm: (A) = Assumed, (M) = Measured														



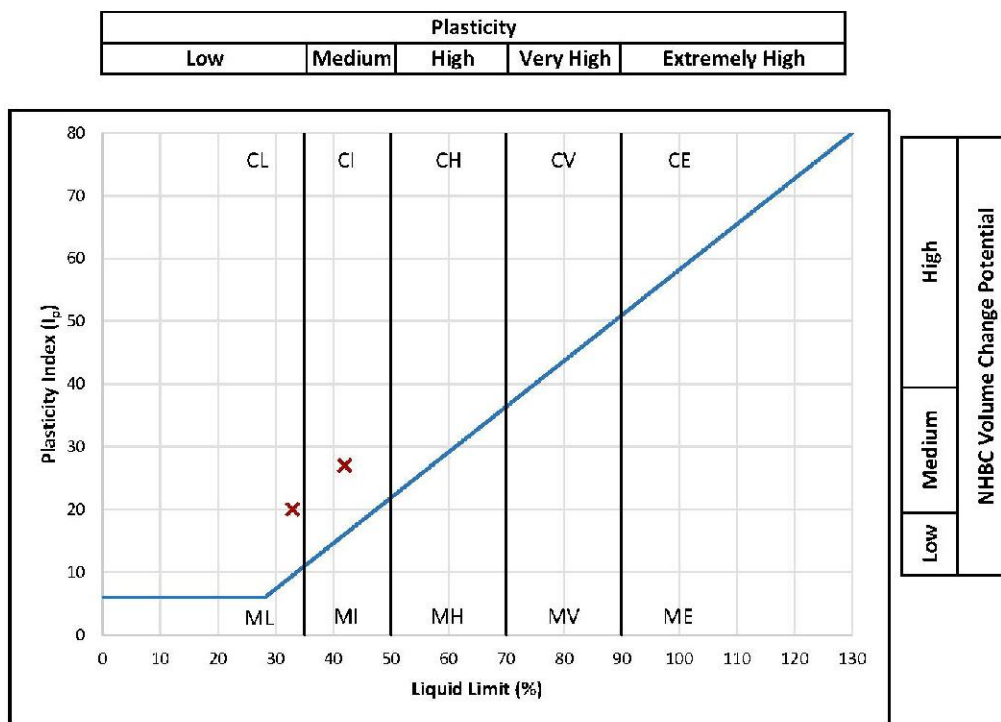
TEST REPORT

ISSUED BY SOIL PROPERTY TESTING LTD
DATE ISSUED: 27/08/2020



Contract	Garrick House, Havering
Serial No.	37366_1

PLOT OF PLASTICITY INDEX AGAINST LIQUID LIMIT USING CASAGRANDE CLASSIFICATION CHART



Method of Preparation:	BS 1377: Part 2: 1990: 4.2
Method of Test:	BS1377: Part 2: 3.2, 4.4, 5.3, 5.4
Type of Sample Key:	U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter
Comments:	Volume Change Potential: NHBC Standards Chapter 4.2 Unmodified Plasticity Index



TEST REPORT

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DATE ISSUED: 27/08/2020



Contract		Garrick House, Havering						
Serial No.		37366_1						
DETERMINATION OF WATER CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX								
Borehole / Pit No.	Depth m	Sample		Water Content (W) %	Description	Remarks		
		Type	Reference					
WS01	0.75	D	1	13.9	Very stiff slightly gravelly slightly sandy silty CLAY with occasional reddish yellow mottling. Gravel is white, brown and grey fine to medium angular to subrounded quartzite and chert.			
PREPARATION					Liquid Limit	42 %		
Method of preparation					Wet sieved over 0.425mm sieve	Plastic Limit	15 %	
Sample retained 0.425mm sieve (Measured)					11 %	Plasticity Index	27 %	
Corrected water content for material passing 0.425mm					15.6 %	Liquidity Index	-0.04	
Sample retained 2mm sieve (Measured)					7 %	NHBC Modified (I'p)	24 %	
Curing time				25 hrs	Clay Content	Not analysed	Derived Activity	Not analysed

C-CLAY

Plasticity Index % (Ip)

M-SILT

Plasticity Chart BS5930: 2015: Figure 8

High

Medium

Low

NHBC Volume Change Potential

Liquid Limit %

Method of Preparation:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2
Method of Test:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 3.2, 4.4, 5.3, 5.4
Type of Sample Key:	U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
Comments:	Corrected water content assume material greater than 0.425mm non-porous. See BS1377: Part2: 1990 Clause 3 Note 1 Volume Change Potential: NHBC Standards Chapter 4.2 Unmodified Plasticity Index Note: Modified Plasticity Index I'p = Ip x (% less than 425microns/100)



TEST REPORT

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Contract		Garrick House, Havering						
Serial No.		37366_1						
DETERMINATION OF WATER CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX								
Borehole / Pit No.	Depth m	Sample		Water Content (W) %	Description	Remarks		
		Type	Reference					
WS03	1.20	D	2	15.0	Stiff orangish brown slightly gravelly slightly sandy silty CLAY with occasional sandy pockets. Gravel is white, grey and brown fine to medium angular to subrounded quartzite and chert.			
PREPARATION					Liquid Limit	33 %		
Method of preparation					Wet sieved over 0.425mm sieve	Plastic Limit	13 %	
Sample retained 0.425mm sieve (Measured)					15 %	Plasticity Index	20 %	
Corrected water content for material passing 0.425mm					17.7 %	Liquidity Index	0.10	
Sample retained 2mm sieve (Measured)					6 %	NHBC Modified (I'p)	17 %	
Curing time				25 hrs	Clay Content	Not analysed	Derived Activity	Not analysed

C-CLAY

Plasticity Index % (I_p)

M-SILT

Plasticity Chart B55930: 2015: Figure 8

High

Medium

Low

NHBC Volume Change Potential

Liquid Limit %

Method of Preparation:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2
Method of Test:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 3.2, 4.4, 5.3, 5.4
Type of Sample Key:	U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
Comments:	Corrected water content assume material greater than 0.425mm non-porous. See BS1377: Part2: 1990 Clause 3 Note 1 Volume Change Potential: NHBC Standards Chapter 4.2 Unmodified Plasticity Index Note: Modified Plasticity Index I'p = I _p x (% less than 425microns/100)



TEST REPORT

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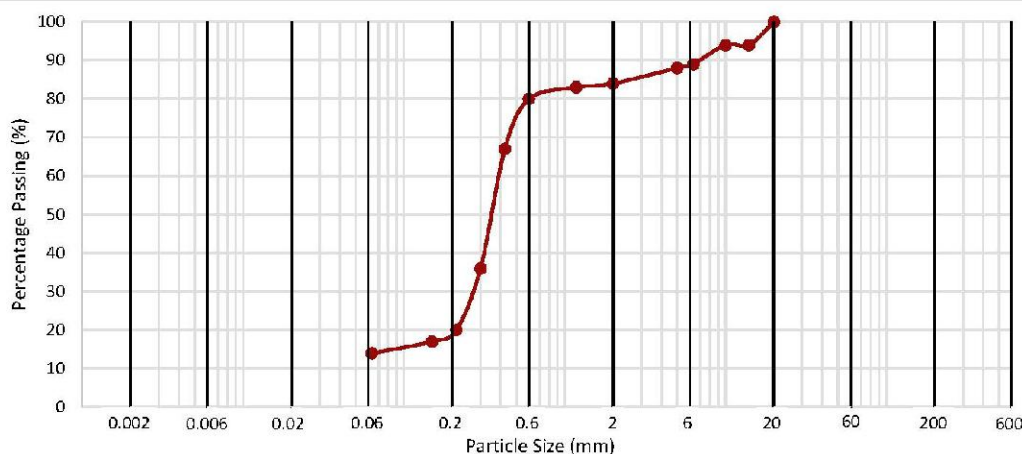


Contract	Garrick House, Havering
Serial No.	37366_1

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Pit No.	Depth (m)	Sample		Description	Remarks
		Type	Reference		
WS01	2.00	D	3	Dark yellowish brown gravelly silty slightly clayey SAND with rare soft dark yellowish brown clay lumps. Gravel is black, brown and white subangular to subrounded chert.	

Method of Test: **Wet Sieve** Method of Pretreatment: **Not required**



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES	BOULDERS
	SILT			SAND			GRAVEL				

H y d r o m e t e r	Particle Size (mm)	Passing (%)	Silt by Dry Mass (%)
	0.075		
	0.15		
	0.3		
	0.6		
	2.0		
	Particle Size (mm)	Passing (%)	Clay by Dry Mass (%)
	0.075		
	0.15		
	0.3		
	0.6		
	2.0		

Sieve Size (mm)	Passing (%)	Sand By Dry Mass (%)
2.00	84	
1.18	83	
0.600	80	
0.425	67	
0.300	36	
0.212	20	
0.150	17	
0.063	14	

Fines By Dry Mass (%)	
<0.063mm	14

Sieve Size (mm)	Passing (%)	2mm+ By Dry Mass (%)
300		
125		
90		
63		
50		
37.5		
28		
20	100	
14	94	
10	94	
6.3	89	
5	88	

Method of Preparation: BS1377: Part 1: 2016: 8.3 & 8.4.5
 Method of test: BS1377: Part 2: 1990: 9.2
 Type of Sample Key: U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
 Comments:



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Contract:	Garrick House, Havering
Serial No:	37366_1

DETERMINATION OF THE SULPHATE CONTENT AND pH OF SOIL AND GROUNDWATER										
Borehole / Pit No.	Depth (m)	Sample		Conc. of Soluble SO ₃		Calc'd Conc. of SO ₄ (g/L)	pH Value	% Sample Passing 2mm Sieve	Description	Remarks
		Type	Ref.	Water Soluble 2:1 (g/L)	Ground Water (g/L)					
WS01	0.75	D	1	0.08		0.10	5.8	93	Very stiff slightly gravelly slightly sandy silty CLAY with occasional reddish yellow mottling. Gravel is white, brown and grey fine to medium angular to subrounded quartzite and chert.	
WS01	2.00	D	3	0.04		0.05	5.9	84	Dark yellowish brown gravelly silty slightly clayey SAND with rare soft dark yellowish brown clay lumps. Gravel is black, brown and white subangular to subrounded chert.	
WS04	1.20	D	2	0.02		0.03	5.9	97	Stiff orangish brown slightly gravelly slightly sandy silty CLAY with occasional reddish yellow mottling. Gravel is white, brown and grey fine to medium angular to subrounded chert.	
Method of Preparation: BS1377: Part 1: 2016: 8.5, BS1377: Part 3: 1990: 5.3 Soil/Water Extract, 5.4 Groundwater Method of Test: BS1377: Part 3: 1990: 5.5 Type of Sample Key: U= Undisturbed, B= Bulk, D= Disturbed, J= Jar, W= Water, SPT= Split Spoon Sample, C= Core Cutter Comments: Test not UKAS accredited Remarks to Include: Sample disturbance, loss of moisture, variation from test procedure, location, and origin of test specimen within original sample. Oven drying temperature if not 105-110C.										

Appendix 8 – Photographs

Photograph 1



Photograph 3



Photograph 2



Photograph 4



DESCRIPTION

Photograph 1

From surface of TP01

Photograph 2

Foundation profile within TP01

Photograph 3

From surface of TP02

Photograph 4

Foundation profile within TP01

PROJECT

Garrick House, Adelphi Crescent,
Hilmchurch

PROJECT NUMBER

4822, GL_GAR

TITLE

**Photographs of Foundation
Exposures**

DATE

01/09/2020

PAGE NO.

1 of 1



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GEOSPHERE ENVIRONMENTAL LTD

Brightwell Barns, Ipswich Road, Brightwell, Suffolk, IP10 0BJ

T: 01603 298076 | **01473 353519** | **E:** info@geosphere-environmental.co.uk | **W:** geosphere-environmental.co.uk