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EXECUTIVE SUMMARY

This executive summary contains an overview of the key findings and conclusions. No reliance should be placed on any part of the executive summary until the whole of the report has been read. Other sections of the report may contain information that puts into context the findings that are summarised in the executive summary.

BRIEF

This report describes the findings of a site investigation carried out by Geotechnical and Environmental Associates Limited (GEA), on the instructions of Gurney Consulting Engineers, on behalf of Skyline Estates Ltd, with respect to the redevelopment of this site through the construction of a new three-storey building for a mixed end use. The purpose of the investigation has been to research the history of the site, to determine the ground conditions, to investigate the presence of contamination and to provide information to assist in the design of spread foundations.

DESK STUDY FINDINGS

The earliest historical map studied, dated 1829, shows the site to be largely undeveloped and the surrounding area to be occupied by fields. By 1896, the Kentish Town area had become well developed and the site was occupied by this time with a dwelling which by the date of the next map studied, dated 1936, had been replaced by two dwellings. Between 1936 and the date of the next map studied, dated 1952, the site had become vacant, possibly as a result of bombing during the war. The site has remained undeveloped since that time. The environmental searches have not identified anything that is considered to adversely affect the safe redevelopment of the site.

GROUND CONDITIONS

Beneath a moderate thickness of made ground, extending to depths of between 1.3 m and 1.8 m, firm brown London Clay was encountered and proved to the maximum depth investigated of 5.0 m.

Ground water was not encountered during the investigation.

A number of trial pits had been excavated by others at the time of the investigation, and these revealed the neighbouring properties to be bearing on the firm brown clay at depths of between 0.27 m and 1.04 m.

Contamination testing has revealed elevated concentrations of lead and polyaromatic hydrocarbons (PAH) to be present in the made ground.

RECOMMENDATIONS

Spread foundations bearing on the firm London Clay at a minimum depth of 1.0 m may be designed to apply a net allowable bearing pressure of 100 kN/m^2 although in view of the thickness of made ground, foundations excavations may need to extend to depths of up to 2.0 m locally.

No remediation will be required as the proposed development will cover the entire site and therefore there are no pathways for end users to come into contact with the made ground.

Part 1: INVESTIGATION REPORT

This section of the report details the objectives of the investigation, the work that has been carried out to meet these objectives and the results of the field and laboratory tests. Interpretation of the findings is presented in Part 2.

1.0 INTRODUCTION

Geotechnical and Environmental Associates (GEA) has been commissioned by Gurney Consulting Engineers, on behalf of Skyline Estates Ltd, to carry out a site investigation at 8/8a Highgate Road, London, NW5

1.1 Proposed Development

It is understood that it is proposed to redevelop the site through the construction of a three-storey building comprising a retail unit and an apartment on the ground floor with two further apartments above. The proposed development will cover the entire site and there will be no areas of soft landscaping.

This report is specific to the proposed development and the advice herein should be reviewed if the development proposals are amended.

1.2 Purpose of Work

The principal technical objectives of the work carried out were as follows:

- to check the history of the site with respect to previous contaminative uses;
- to determine the ground conditions and their engineering properties;
- to provide information on the design of spread foundations; and
- to provide a preliminary indication of the presence of contamination.

1.3 Scope of Work

In order to meet the above objectives, a desk study was carried out, followed by a ground investigation. The desk study comprised:

- a review of readily available geological maps;
- a review of historical Ordnance Survey (OS) maps and publicly available environmental data sourced from the eMapSite database;
- a review of the London Post Office street directories; and
- a walkover survey of the site by a geotechnical engineer at the time of the fieldwork.

The ground investigation comprised, in summary, the following activities:

- two window sampler boreholes advanced to a maximum depth of 5.0 m;
- the inspection of four manually excavated trial pits to expose the existing foundations to the neighbouring buildings;
- testing of disturbed soil samples for geotechnical purposes and contaminant concentrations; and
- provision of a report presenting and interpreting the above data, together with our advice and recommendations with respect to the proposed development.

1.4 Limitations

The conclusions and recommendations made in this report are limited to those that can be made on the basis of the investigation. The results of the work should be viewed in the context of the range of data sources consulted, the number of locations where the ground was sampled and the number of soil, gas or groundwater samples tested; no liability can be accepted for information in other data sources or conditions not revealed by the sampling or testing. Any comments made on the basis of information obtained from the client or other third parties are given in good faith on the assumption that the information is accurate; no independent validation of such information has been made by GEA.

2.0 THE SITE

Located approximately 300 m to the northwest of Kentish Town London Underground station the site forms an irregular shaped area which measures approximately 10 m by 8 m in maximum dimension. It is bounded by Highgate Road to the southwest and by two to three storey properties on all other sides and may be additionally located by National Grid Reference 528900 185460.

The site is a vacant plot situated behind an advertising hoarding. The site surface is generally level, although it is mostly at a level of approximately 0.5 m higher than Highgate Road, with a break in slope running parallel to the road approximately 1.0 m inside the site boundary. The site surface is mostly hard covered and is devoid of vegetation.

2.1 Site History

The history of the site has been researched by reference to historical Ordnance Survey (OS) maps sourced from the eMapSite database.

The earliest historical map studied, dated 1829, shows the site to be largely undeveloped and the surrounding area to be occupied by fields. By 1896, the Kentish Town area had become well developed and the site was occupied by this time with a dwelling which by the date of the next map studied, dated 1936, had been replaced by two dwellings. A search of the London Post Office street directories has revealed that in 1905 No 8 was occupied by a tailor and No 8a was occupied by a picture frame maker. By 1921, No 8 had changed to a bootmaker and No 8a had changed to a general draper. Between 1936 and the date of the next map studied, dated 1952, the site had become vacant, possibly as a result of bombing during the war. The site has remained undeveloped since that time.

2.2 Other Information

A search of public registers and databases has been made via the eMapSite database and relevant extracts from the search are appended. Full results of the search can be provided if required.

The searches have indicated that no landfill sites or waste disposal sites are recorded within 1 km of the site. A small recycling centre is located 340 m to the southwest although this is not considered to pose a threat to the redevelopment of the site.

Reference to records compiled by the Health Protection Agency (formerly the National Radiological Protection Board) indicates that the site falls within an area where less than 1 % of homes are affected by radon emissions; therefore, no radon protective measures will be necessary.

The Geological Survey map of the area indicates that the site is underlain by the London Clay Formation from the surface. The former National Rivers Authority (NRA) Ground Water Vulnerability map suggests that the site is underlain by a non aquifer with soils of negligible leaching potential.

2.3 Preliminary Risk Assessment

The desk study has revealed that the site has not had a potentially contaminative history having been occupied by small business before the war.

Recently published guidance on unexploded ordnance (UXO)[1] states that a site that is located in areas of potential World War II bombing and / or has a historical military usage, a preliminary risk assessment should be carried out into the likelihood of UXO being present below the site.

It is understood from internet research carried out during the desk study that Kentish Town was targeted during World War II due to the its network of railways. The historical maps show that buildings present on the site prior to the war were absent post-war and the site has not been developed since. The site level is also noted to be higher than the surrounding sites, possibly indicating the demolition of the previous building. However, if a bomb was dropped on the site and damaged the house, it is unlikely that a second bomb would have hit the same target.

However, the absence of any structures on site since the war and the elevated site level indicate that this site may have suffered bomb damage and on the basis of the CIRIA risk assessment, there is a moderate chance of encountering unexploded ordnance (UXO) on the site.

3.0 EXPLORATORY WORK

In order to meet the objectives described in Section 1.2, two boreholes were advanced to a maximum depth of 5.0 m by means of window sampling equipment. All of the work was supervised by a geotechnical engineer from GEA. Four trial pits that had previously been manually excavated by others were also inspected and logged.

The exploratory locations were chosen on site in accessible areas with due regard for the proposed development and the locations of buried services. Disturbed samples were recovered for subsequent geotechnical testing and contamination analysis.

[1] CIRIA Publication C681, *Unexploded Ordnance (UXO) – A guide for the construction industry*, London 2009

The analytical suite of testing was selected to identify a range of typical industrial contaminants for the purposes of general coverage. For this investigation the analytical suite for the soil included a range of metals, broadscan of total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAH), total cyanide and monohydric phenols. The contamination analyses were carried out at an MCERTs accredited laboratory with the majority of the testing suite accredited to MCERTS standards. A summary of the MCERTs accreditation and test methods are included with the attached results and further details are available upon request.

The borehole and trial pit records and results of the laboratory analyses are appended together with a site plan indicating the exploratory positions.

4.0 GROUND CONDITIONS

The investigation has generally confirmed the expected ground conditions in that, below a moderate thickness of made ground, London Clay was encountered and was proved to the full depth of investigation.

4.1 Made Ground

The made ground generally comprised brown sandy clay with brick, concrete, slate, charcoal, gravel and clinker and was proved to depths of between 1.3 m and 1.8 m.

No visual or olfactory evidence of contamination was noted within the made ground; however, three samples were analysed for a range of contaminants as a precautionary measure and the results are discussed in Section 4.4.

4.2 London Clay

Firm brown and blue-grey mottled London Clay was encountered beneath the made ground and proved to the maximum depth investigated of 5.0 m. Rootlets were noted to a maximum depth of 3.0 m in Borehole No 2.

The results of geotechnical testing indicate the clay to be of high volume change potential.

4.3 Ground Water

Ground water was not encountered during the investigation.

4.4 Soil Contamination

Part IIA of the Environmental Protection Act 1990, which was inserted into that Act by Section 57 of the Environment Act 1995, provides the main regulatory regime for the identification and remediation of contaminated land. The determination of contaminated sites is based on a "suitable for use" approach which involves managing the risks posed by contaminated land by making risk-based decisions. This risk assessment is carried out on the basis of a source-pathway-receptor approach.

The use of a risk-based approach, which is presented in Part 2 of this report, means that it is not appropriate to determine the significance of contamination test results by simply comparing individual contaminant concentrations to a single "trigger" or "target" concentration. The significance of the results is therefore considered in more detail in Part 2, whilst the table below

sets out the range of values measured within three samples of made ground and indicates the statistically weighted average concentrations.

Determinant	BH1, 1.0 m (mg/kg)	TP2, 0.5 m (mg/kg)	TP3, 0.4 m (mg/kg)
Arsenic	18	16	27
Cadmium	0.2	0.7	2.7
Chromium	32	58	33
Lead	**620**	300	**1600**
Mercury	1.0	1.0	2.2
Selenium	<3	<3	<3
Copper	190	78	100
Nickel	22	42	24
Zinc	250	690	1600
Total Cyanide	<1	<1	<1
Total Phenols	<0.5	<0.5	0.5
Total organic carbon%	1.0	2.3	4.4
PAH	1.7	**7.8**	**24**
Benzo(a)pyrene	0.1	0.6	**1.7**
Napthalene	<0.1	0.2	<0.1
TPH	<10	10	29
Sulphide	-	-	-

Note: The use of the normalised upper bound for 95th percentile confidence aims to remove some of the uncertainty associated with calculation of an arithmetic sample mean of a relatively small number of samples. The US95 value is the upper bound of the range within which it can be stated with 95% confidence that the true mean concentration of the data set will fall.
Figure in bold indicates concentration in excess of risk-based soil guideline values, as discussed in Part 2 of this report

The implications of these results are discussed in Part 2 of this report.

4.5 Existing Foundations

The trial pits adjacent to the neighbouring buildings were excavated by others prior to our attendance on site. They have identified brick footings to be bearing on firm brown clay at depths of between 0.27 m and 1.04 m. Trial Pit No 3 also encountered what appeared to be footings to a former internal wall.

Sketches of the trial pits are appended.

Part 2: DESIGN BASIS REPORT

This section of the report provides an interpretation of the findings detailed in Part 1, in the form of a ground model, and then provides advice and recommendations with respect to foundation options and contamination issues.

5.0 INTRODUCTION

Consideration is being given to the construction of a new three-storey mixed use structure without any areas of soft landscaping. Exact loads are not known at this stage but are expected to be low to moderate and thus typical of this type of development.

6.0 GROUND MODEL

The desk study has indicated that the site has not had a potentially contaminative history by virtue of being developed with small businesses before the Second World War and vacant since the war. On the basis of the fieldwork, the ground conditions at this site can be characterised as follows.

- Below a moderate thickness of made ground, London Clay was encountered to the full depth investigated of 5.0 m;
- the London Clay comprised firm brown clay with blue-grey mottling and occasional partings or orange-brown sand;
- ground water was not encountered during the investigation; and
- elevated concentrations of lead, PAH and benzo(a)pyrene have been measured within the made ground.

6.1 Contaminants of Concern

The use of a risk-based approach has been adopted to provide an initial screening of the test results to assess the need for subsequent site-specific risk assessments. To this end the table below indicates those contaminants of concern that have US95 values in excess of a generic human health risk based guideline value which is either that of the CLEA[2] Soil Guideline Value where available, or is a Generic Guideline Value calculated using the CLEA UK Beta Version 1.06 (2009) software assuming a residential end use. Where contaminant concentrations are measured in excess of these values it is considered that there is a potential for there to be some risk to human health and hence site specific risk assessment, soil remediation or risk management may be required. Values measured at concentrations below these values are not deemed to require further consideration with regard to human health.

The site will be developed with a mixed use building with a retail unit and an apartment on the ground floor but no areas of soft landscaping and as such will have a "residential" end use.

When compared to the relevant guideline values, the following elevated concentrations of contaminants were recorded in the made ground.

2 *Updated Technical Background to the CLEA Model (Science Report SC050021/SR3) Jan 2009* and Soil Guideline Value reports for specific contaminants; all DEFRA and Environment Agency.

Contaminant of Concern	Maximum concentration recorded (mg/kg)	Minimum concentration recorded (mg/kg)	Generic Risk-Based Screening Value
Lead	1600	300	450
PAH	24	1.7	6.7
Benzo(a)pyrene	1.7	0.1	1.0

The tables of generic screening values derived by GEA and an explanation of how each value has been derived are included in the Appendix.

Whilst there is no obvious source of contamination, the presence of lead, PAH and benzo(a)pyrene is likely to result from the demolition rubble remaining on site from the pre-war buildings.

The implications of the contaminants of concern are assessed in detail in Section 7.5.

7.0 ADVICE AND RECOMMENDATIONS

Spread foundations extending into the London Clay would be suitable to support the anticipated loads although foundations will need to be deepened to bypass the made ground. No remedial measures are considered to be required although after completing a preliminary risk assessment with regard to the risk of UXO beneath the site, it is considered that a detailed risk assessment may be necessary and this would need to be carried out by a UXO specialist.

7.1 Spread Foundations

Moderate width strip or pad foundations bearing on the firm London Clay at a minimum depth of 1.0 m may be designed to apply a net allowable bearing pressure of 100 kN/m^2. Foundations will need to bypass all made ground and may need to be deepened to up to 2.0 m in this respect. This value incorporates a suitable factor of safety against bearing capacity failure and should ensure that settlement remains within the normal tolerable limits.

7.2 Excavations

On the basis of the trial pit findings it is considered likely that it will be feasible to form relatively shallow excavations terminating within the made ground without the requirement for lateral support, although localised instability may occur.

Should deeper excavations be considered or if excavations are to remain open for prolonged periods it is recommended that provision be made for battered side slopes or lateral support and, in any case where personnel are required to enter excavations, a risk assessment should be carried out and temporary lateral support or battering of the excavation sides considered in order to comply with normal safety requirements.

Perched water may be encountered within the made ground, particularly in the vicinity of existing foundations and other buried structures, but any such occurrences should be readily dealt with by sump pumping.

7.3 Ground Floor Slab

In view of the thickness of made ground it will be necessary to suspend the floor slab.

7.4 Effect of Sulphates

Chemical analyses of selected soil samples have revealed generally moderate concentrations of soluble sulphate, corresponding to Classes DS-3 and AC-2s of Table C2 of BRE Special Digest 1: 2005. The guidelines contained in the above digest should be followed in the design of any new foundation concrete.

7.5 Contamination Risk Assessment

One of the requirements of the Environment Act (1995) is that local authorities carry out inspections of their area with a view to identifying sites that may be contaminated. When assessing whether a site is contaminated the local authority will attempt to establish the presence of a 'pollution linkage'. A pollution linkage requires there to be a source of contamination, a sensitive receptor that can be adversely affected by the contamination and a pathway via which contamination can reach the target.

The site is not considered to have had a potentially contaminative history however the results of chemical analysis of the made ground revealed concentrations of lead, PAH, and benzo(a)pyrene to be elevated above the respective guideline values. However, as the proposed development does not introduce any new pathways for end users to come into contact with the made ground by virtue of the exclusion of any areas of soft landscaping, no remedial measures will be required with regard to human health purposes.

Site workers should be made aware of the contamination and a programme of working should be identified to protect workers handling any soil. The method of site working should be in accordance with guidelines set out by HSE[3] and CIRIA[4] and the requirements of the Local Authority Environmental Health Officer.

Consideration may need to be given to the protection of buried plastic services laid within the made ground. Details of the proposed protection measures for buried plastic services will in any case need to be approved by the EHO and the relevant service authority prior to the adoption of any scheme. It is likely that barrier pipe will be required or additional testing will need to be carried out.

7.6 Waste Disposal

Any spoil arising from excavations or landscaping works may need to be disposed of to a licensed tip. Under the European Waste Directive landfills are classified as accepting Inert, Non-hazardous or Hazardous wastes in accordance with Waste Acceptance Criteria (WAC) which, for Hazardous and Inert wastes are based upon the results of CEN method bulk leaching tests or percolation tests.

Based upon the results of the analyses carried out and the technical guidance provided by the Environment Agency[5] it is considered likely that the made ground will be classified as a Non-Hazardous waste and the natural soils may be classified as an Inert waste although soils with high TPH concentrations may attract a more onerous classification. However, these classifications

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3 HSE (1992) HS(G)66 *Protection of workers and the general public during the development of contaminated land* HMSO

4 CIRIA (1996) *A guide for safe working on contaminated sites* Report 132, Construction Industry Research and Information Association

5 Environment Agency 2008. *Hazardous Waste: Interpretation of the definition and classification of hazardous waste.* Technical Guidance WM2 Version 2.2

should be confirmed by the receiving landfill once the soils to be discarded have been identified. In order to finalise this classification it will probably be necessary to carry out further analyses including WAC CEN method bulk leaching tests if a classification of Inert waste is to be considered. Such tests should be carried out upon representative samples from the waste stream once the extent of the materials to be discarded has been established.

Under the European Waste Directive all waste going to landfill requires pre-treatment. The pre-treatment process must be physical, thermal, chemical or biological, including sorting. It must change the characteristics of the waste in order to reduce its volume, hazardous nature, facilitate handling or enhance recovery. The only exceptions to this requirement are for inert waste where it is technically not feasible to do so, or for any other waste where the quantity or hazardous nature of the waste cannot be reduced. The waste producer can carry out the treatment but they will need to provide documentation to prove that this has been carried out. Alternatively, the treatment can be carried out by an approved contractor. The Environment Agency has issued a position paper[6] which states that in certain circumstances, segregation at source may be considered as pre-treatment and thus excavated material may not have to be treated prior to landfilling if the soils can be "segregated" onsite prior to excavation by sufficiently characterising the soils insitu prior to excavation.

The local waste regulation department of the Environment Agency (EA) should be contacted to obtain details of tips that are licensed to accept the soil represented by the test results. The tips will be able to provide costs for disposing of this material and may require testing to be carried out.

6 Regulatory Position Statement *'Treating non-hazardous waste for landfill - Enforcing the new requirement'* Environment Agency 23 Oct 2007

APPENDIX

Borehole Records

Trial Pit Records

Geotechnical Test Results

Chemical Analysis (soil)

Generic Guideline Values

UXO Risk Assessment Sheets

emapSite Report Summary and Extracts

Historical Maps

Site Plan