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GA Site Investigation Limited

GA1420.22 4th May 2022

Optima Foundations Ltd
Unit 30
Broomhouse Lane Industrial Estate
Edlington
DN12 1WQ

For the attention: Andrew Fairclough

Dear Sirs,

SITE INVESTIGATION: ORCHARD FARM, DOWSDALE BANK, SHEPAU STOW, PE12 0UA

Further to your instructions we have attended the above site and undertaken a single dynamic sampling borehole with associated in-situ soil testing in the area of the proposed dwelling to be constructed on site.

Limitations of Investigation:
All comments, opinions and recommendations contained in this report are solely based on the information obtained from the intrusive investigation, in-situ and laboratory testing of soils undertaken as part of this investigation. There may however be areas of site where differing substrata conditions are present which have not been identified in this investigation and which may have a bearing on the causes of movement, damage or remediation required to correct them. Should such items be brought to light during any subsequent investigatory or construction operations, we reserve the right to review our report to include the as yet unidentified site conditions accordingly.

This investigation was undertaken to provide information for foundation design use and an initial limited contaminated land assessment for the site by direct sampling and chemical analysis of near surface deposits.

Full limitations contained in Appendix D.

Site Work:
The borehole was excavated using a track mounted dynamic drilling rig with in-situ standard penetration tests being taken through the length of the excavation.

The location of the borehole was in the corner of the garden area where the new building is to be located.

The standard penetration test (SPT) comprises recording the number of blows required from a falling drive mass of 63.5-kilogram weight, falling through a constant drop of 0.76m, to drive an "open spoon sampler" 0.30m into the deposits under test, after an initial penetration of 0.15m has been achieved. The recorded resistance to penetration, number of blows for 0.30m penetration, known as the N_{300} value, allows determination of the compactness of the deposits to be undertaken.

The super heavy dynamic probe test [SHDP] comprises recording the number of blows required from a falling drive mass of 63.5-kilogram weight, falling through a constant drop of 0.76m, to drive a solid 60mm diameter steel probe tip, of 90-degree angle, 0.10m into the deposits under test. The recorded resistance to penetration, number of blows, allows determination of the compactness of the deposits to be undertaken.

Borehole Findings:
The borehole encountered 1.10m of Made ground comprising sandy gravelly clay fill with lose fine angular gravel content of brick and rare coal fragments. Below 1.10m depth lies loose silty Sand which is water bearing below 2.10m below ground level and extends to in excess of 5.00m depth. The borehole was drilled to 6.00m bgl with no sample recovery below 5.00m due to groundwater, struck at 2.40m bgl, rising rapidly to stand inside the borehole casing at

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2.3 throughout the drilling, with hydrostatic pressure build up in side both the sampling device and casing causing issue with sample recovery and borehole progress.

In-situ Testing:
Standard penetration tests were undertaken in the borehole with SPT N-values ranging from 3 to 5 being recorded.

Dynamic Probe Test:
The dynamic probe test commenced through the base of the sampling borehole and indicates the strata between 6.00m to 7.00m bgl to have an assessed equivalent SPT N-value of 30 with this increasing to in excess of 60 below 7.00m depth. The test terminated at 8.60m bgl with 63no blows being required for the final 0.30m penetration.
The results of the probe test are contained in appendix B.

Groundwater:
Groundwater was struck at 2.40m rising to 2.30m in 10 minutes at which depth it remained throughout the drilling operations. A standing water level of 2.80m was recorded before removing the borehole casing with this rising to 2.10m after removal.

Borehole Records:
Details of the strata encountered, their thickness, depth and description, together with the depth and results of sampling and testing, are contained in Appendix A.

LABORATORY ANALYSIS:
Chemical Analysis:
Water Soluble Sulfate and pH Analysis:
2no samples of substrata were forwarded to i2 Analytical which is accredited under UKAS and MCerts, where the samples were subjected to chemical analysis. The full test results are presented in Appendix C.

The results of the sulphate analysis recorded water soluble sulphates, as SO_4 of 0.038mg/kg to 0.071mg/kg and total sulphates, again as SO_4 of 29mg/kg to 150mg/kg.

The above results place the deposits, as tested, in Class DS-1 of Building Research Special Digest 1, “Concrete in aggressive ground” 2005, with insufficient water-soluble sulphates present to cause potential sulphate attack on concrete containing Ordinary Portland Cement.

HUMAN HEALTH QUANTITATIVE RISK ASSESSMENT

Qualitative assessment of risks may be sufficient in many cases to eliminate the possibility of significant pollutant linkages. However, quantitative risk assessment is formally required to determine whether there is a 'significant possibility of significant harm being caused'. Part IIA of the Environmental Protection Act 1990 recommends that ‘authoritative and scientifically based guideline values for concentrations of the potential pollutants in or under the land’ be used to quantify the risk posed by contamination.

Under the Planning Regime a quantitative risk assessment can be used to decide whether the site is suitable for the proposed use. In addition, the National Planning Policy Framework (March 2012) also indicates that after remediation as a minimum land should not be capable of being determined as contaminated land under Part IIA.

Current UK Screening Values

The UK technical guidance for assessing risks to human health is issued from various UK bodies including the Environment Agency (EA), the DEFRA, Contaminated Land: Applications in Real Environment (CL:AIRE), Chartered Institute of Environmental Health (CIEH) and Land Quality Management (LQM) Ltd (part of the University of Nottingham).

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New and updated screening values in the form of provisional Category four Screening Levels (C4SL) (published in 2014) and Suitable for Use Levels (S4UL) (published 2015) have been produced by defra and CIEH / LQM respectively using modified versions of the EA's Contaminated Land Exposure Assessment (CLEA) software.

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C4SL

Provisional C4SL have been derived by CL:AIRE following guidance and as a tool to assist in applying the Part IIA Category 1- 4 classifications to a site. The purpose of the C4SL is to provide a simple test for deciding that land is suitable for use and 'definitely not' contaminated land under Part IIA. They describe a level of risk that is above minimal but is still low.

Six contaminants have been assigned provisional C4SL: arsenic; benzene; benzo[a]pyrene; cadmium; chromium VI and lead for the standard land uses (residential with and without plant uptake, allotments, commercial and public open space (parks and residential).

The C4SL are also considered suitable to be used under the planning regime.

S4UL

The LQM / CIEH S4UL represent generic assessment criteria based on minimal or tolerable risk that are intended to be protective of human health. They represent values above which further assessment of the risks or remedial actions may be needed.

S4UL have been derived for a comprehensive list of organic and inorganic determinants.

Results

The results of chemical testing of a sample of the Made Ground deposits near surface soils are compared with the C4SL and the LQM S4UL for a residential with plant uptake end use.

Table 9 Comparison of Chemical Test Results with Guideline Values (Metals and PAH)

Determinant	Maximum Measured Concentration (mg/kg)	LQM/CIEH S4UL Residential With Plant Uptake (TOC of 1%) (mg/kg)	No. of tests carried out	No. of exceedances
Metals				
Arsenic	2.7	37	1	0
Boron	0.3	290	1	0
Cadmium	0.4	11	1	0
Chromium total	6.7	910	1	0
Copper	43	2400	1	0
Lead	85	210**	1	0
Mercury	<0.3	1.2	1	0

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Determinant	Maximum Measured Concentration (mg/kg)	LQM/CIEH S4UL Residential With Plant Uptake (TOC of 1%) (mg/kg)	No. of tests carried out	No. of exceedances
Metals				
Nickel	7.5	180	1	0
Selenium	<1.0	250	1	0
Zinc	65	3700	1	0
BTEX				
Benzene	<1.0	0.087	1	0
Toluene	<1.0	130	1	0
Ethylbenzene	<1.0	47	1	0
Xylene	<1.0	56	1	0
Aliphatic TPH				
TPH Aliphatic $C_5 – C_6$	<0.001	3200	1	0
TPH Aliphatic $C_6 – C_8$	<0.001	7800	1	0
TPH Aliphatic $C_8 – C_{10}$	<0.001	2000	1	0
TPH Aliphatic $C_{10} – C_{12}$	<1.0	97000	1	0
TPH Aliphatic $C_{12} – C_{16}$	<2.0	59000	1	0
TPH Aliphatic $C_{16} – C_{21}$	<8	160000	1	0
TPH Aliphatic $C_{21} – C_{35}$	<8	160000	1	0
Aromatic TPH				
TPH Aromatic $C_5 – C_7$	<0.001	26000	1	0
TPH Aromatic $C_7 – C_8$	<0.001	56000	1	0
TPH Aromatic $C_8 – C_{10}$	<0.001	3500	1	0
TPH Aromatic $C_{10} – C_{12}$	<1.0	16000	1	0
TPH Aromatic $C_{12} – C_{16}$	<2.0	36000	1	0
TPH Aromatic $C_{16} – C_{21}$	<8	28000	1	0
TPH Aromatic $C_{21} – C_{35}$	<8	28000	1	0
PAHs Speciated				
Phenol	<0.05	280	1	0
Naphthalene	<0.05	2.3	1	0
Acenaphthylene	<0.05	170	1	0
Acenaphthene	<0.05	210	1	0
Fluorene	<0.05	170	1	0
Phenanthrene	<0.05	95	1	0
Anthracene	<0.05	2400	1	0
Fluoranthene	<0.05	280	1	0
Pyrene	<0.05	620	1	0
Benzo(a)anthracene	<0.05	7.2	1	0
Chrysene	<0.05	15	1	0
Benzo(b)fluoranthene	<0.05	2.6	1	0
Benzo(k)fluoranthene	<0.05	77	1	0
Benzo(a)pyrene	<0.05	2.2	1	0
Indeno(1,2,3-c,d)pyrene	<0.05	27	1	0
Dibenzo(a,h)anthracene	<0.05	0.24	1	0
Benzo(g,h,i)perylene	<0.05	320	1	0
General				
Asbestos	Not-detected	Presence	1	0

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The above results indicate the sample, as tested, to be free from elevated Metals, Metalloids, PAH, Hydrocarbon and asbestos contamination.

Yours faithfully,

G M Anderson
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APPENDIX A
BOREHOLE RECORD

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APPENDIX B
DYNAMIC PROBE TEST DATA

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APPENDIX C
LIMITATIONS OF INVESTIGATION