



Geo-Environmental

GROUND APPRAISAL REPORT

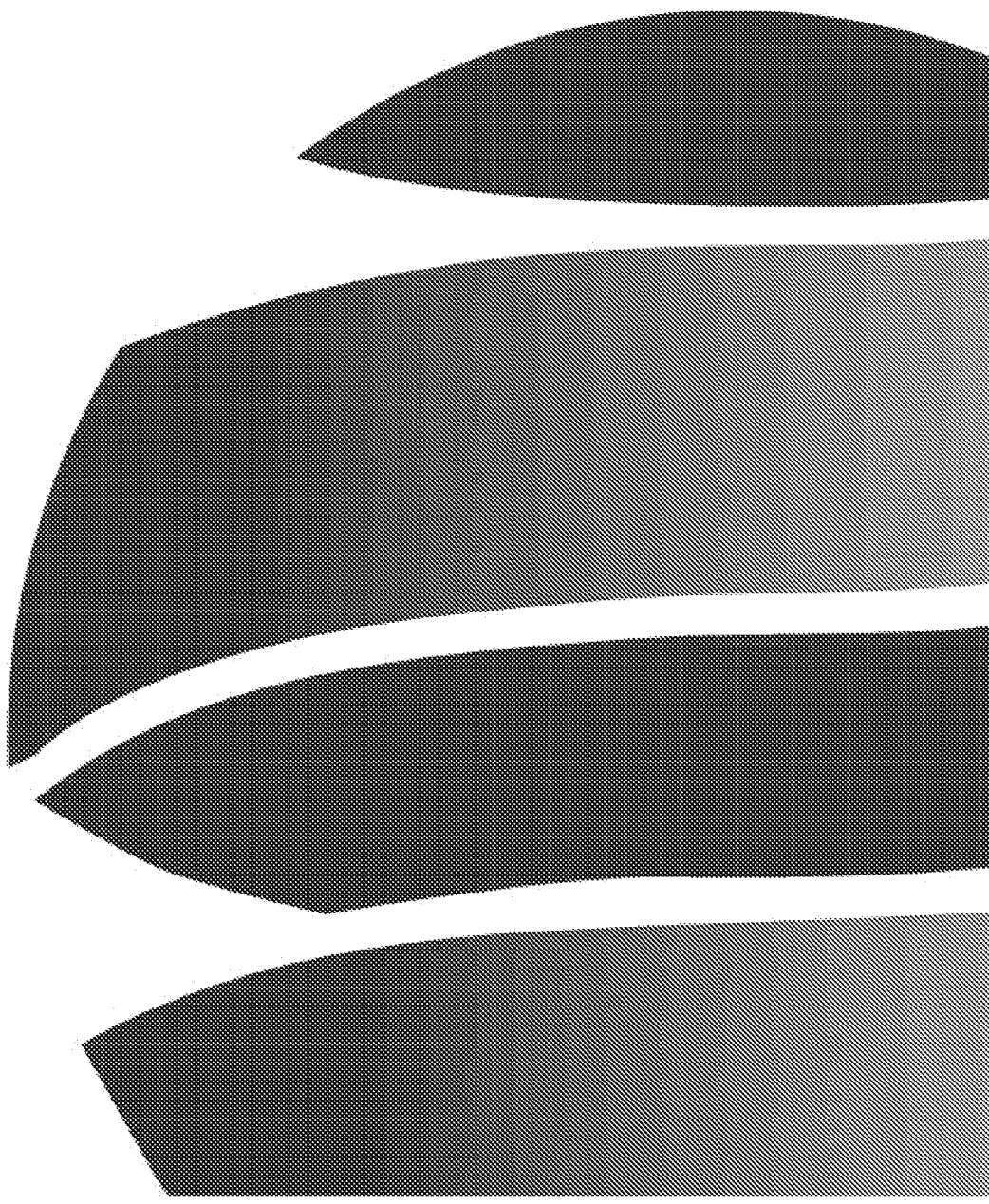
for the site at

LAND OFF LIDSEY ROAD, WOODGATE

WEST SUSSEX, PO20 3SU

on behalf of

THAKEHAM CLIENT LIMITED



Report:	GROUND APPRAISAL REPORT
Site:	LAND OFF LIDSEY ROAD, WOODGATE, WEST SUSSEX, PO20 3SU
Client:	THAKEHAM CLIENT LIMITED
Date:	10/10/2019
Reference:	GE18390-GAR-OCT-19
Version:	2.0
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EXECUTIVE SUMMARY		
	Site Address	Land At Lidsey Road, Woodgate, West Sussex, PO20 3SU
	Form of Development	Construction of residential properties with gardens, car parking, access road and associated infrastructure.
Encountered Conditions	Scope of works	An intrusive investigation to confirm the ground and groundwater conditions and support the development of geotechnical and geo-environmental assessments of the site in relation to the proposed development.
	Ground Conditions	The ground conditions comprised a limited thickness of Topsoil and Made Ground overlying River Terrace Deposits and the London Clay Formation.
	Groundwater	Groundwater was encountered at depths of between 1.85m and 3.00m bgl, during the fieldworks, with water standing at depths of between 1.20m and 2.50m bgl after twenty minutes. Groundwater monitoring wells were installed within WS1, WS2, WS3 and WS6 to depths of between 2.50m and 3.70m bgl. Two return monitoring visits have been made to date, with further visits to be undertaken throughout the winter period. To date, groundwater has been recorded at depths of between 0.91m and 1.75m bgl.
Geotechnical Considerations	Foundations	Based on the ground and groundwater conditions encountered in the boreholes conventional foundations are considered suitable for the proposed low rise development. Foundations should be taken below any Made Ground, soft, desiccated or disturbed ground and bear onto the firm to very stiff sandy silty gravelly clays or silty sands of the River Terrace Deposits. Based on the laboratory results, the more clayey parts of the River Terrace Deposits <i>en masse</i> should be considered Medium Volume Change Potential in accordance with the NHBC Standards, Chapter 4.2. A minimum founding depth within the River Terrace Deposits of 0.90m is therefore applicable remote from trees. Foundations should not be less than 450mm in width. Within the zone of moisture demand of any existing, proposed or recently felled trees it is recommended that foundation depths be calculated in accordance with the NHBC Standards, Chapter 4.2. Foundations should also be taken through any major root zone and desiccated clay soils should this be found at greater depth. Design measures will be required to prevent heave forces from developing on the faces of the foundations where footing depths are in excess of 1.5m on account of trees. It should be noted that the NHBC stipulate that foundations cast at depths greater than 2.5m should be "engineer designed". Based on the typical settlement parameters for the types of soil encountered, a maximum net allowable bearing capacity of 125kPa is applicable for trench, strip or isolated pad foundations taken through any Made Ground, soft or loose zones, desiccated or disturbed soils and placed wholly into or onto the firm to very stiff sandy silty gravelly clays of the River Terrace Deposits. Under the above loading the settlements should remain within tolerable limits for the proposed scheme. It would be prudent to further consider the depth to the groundwater during the winter months as this could cause construction difficulties



		where intercepted within foundation or service trenches. The risk of intercepting the groundwater would be higher where foundations are required to be deepened on account of the presence of trees and careful design is required in this respect.
	Floor Slabs	Based on the laboratory testing results and the presence of trees and shrinkable soils, it is recommended that suspended ground floor slabs be adopted.
	Excavations	Shallow excavations within the Made Ground should remain relatively stable in the short term. Long deep excavations within the Made Ground are likely to be prone to instability, particularly where left open for prolonged periods, and should be battered back to a safe angle, or suitable shoring techniques should be adopted to provide stability. Shallow excavations within the River Terrace Deposits should remain relatively stable in the short term. Long, deep excavations within the River Terrace Deposits are likely to be prone to instability, particularly where left open for prolonged periods, or open to wet weather conditions and should be battered back to a safe angle, or suitable shoring techniques should be adopted to provide stability. Any excavations taken below the groundwater table is likely to be prone to collapse and running sand.
	Pavements	Where encountered, the Made Ground was noted to be of mixed composition and of limited thickness. The engineering characteristics of such soils are variable and unpredictable and the CBR value of Made Ground does not predict the overall settlements that may occur in such materials. Due to the heterogeneity of the variable amounts of Made Ground it would be prudent to assume the material to be deemed non-frost susceptible throughout. As part of the investigation, three bulk samples of the underlying River Terrace Deposits were taken from hand pits referenced TP DCP1, TP DCP4 and TP DCP6, with samples taken from depths of 0.50m bgl. The results of the laboratory remoulded (2.5kg rammer method) soaked CBR tests from gave results in the range of 1% and 9.5%. In addition, six dynamic cone penetrometer tests were undertaken across the site. The results between the depth of 300mm and 600mm bgl ranged between 5% and 22%. The Transport and Road Research Laboratory Report (LR1132) entitled '<i>The Structural Design of Bituminous Roads</i>' (1984) cites an estimated equilibrium suction index of 5% for the sandy silty gravelly clays such as those of the near surface River Terrace Deposits, under average construction conditions and a high groundwater level. An overall CBR value of 5% is recommended. Furthermore, based on the geotechnical results, the near surface River Terrace Deposits should be considered as being frost susceptible for pavement design purposes with abundant gravel noted within the sandy silty clays within the upper metre.



		It is recommended that the sub-grade be proof rolled and any soft spots removed and replaced with a suitable compacted granular fill.
	Drainage	The results indicate a relatively poor infiltration rate within the River Terrace Deposits, whilst groundwater was also noted to be shallow. Based on these findings, the design and construction of conventional soakaways may be viable, though the storage capacity will be severely restricted by the presence of the groundwater table.
	Buried Concrete	Seven pH and Sulphate tests were undertaken on the River Terrace Deposits. The results for the River Terrace Deposits corresponded to design class DS-1 as defined within the BRE Special Digest 1 (2005). The pH analyses indicate the ACEC class to be AC-1. It is recommended that a design class of DS-1 and an ACEC class of AC-1 be applied to all sub-surface concrete within this stratum.
Considerations	Human Health	All of the results indicated concentrations less than the Atkins ATRISK/C4SI screening values with the exception of Benzo(a)pyrene (TP1 0.10m 120mg/kg, TP2 0.10m 64mg/kg), Barium (TP2 0.10m 290mg/kg, WS7 0.20m 130mg/kg) and Beryllium (TP2 0.10m 2.40mg/kg). The Atkins ATRISK values for Benzo(a)pyrene are 4.95mg/kg, Barium 110mg/kg and 1.71mg/kg for Beryllium. The locations of TP1 and TP2 were within the area of the glasshouse, formerly used as a nursery. The location of WS7 was within the grounds of the residential property. Based on these initial findings, a cover system will be required within these areas. However, based on the limited sampling within these locations, it is recommended that further investigation in and around the garden nursery and residential property be undertaken. Those findings, along with these findings should be used to finalise a cover system for affected plots within those areas. As a preliminary guide it is likely that recommendations will be to strip the existing Made Ground from the proposed gardens and soft landscaping areas for the units located within the grounds of the house and glasshouse.
	Ground gas	Two ground gas monitoring visits have been undertaken to date to provide an initial assessment. No significant ground gas concentrations were noted and therefore no remedial works are required in this respect. A final assessment will be made upon completion of all monitoring visits.
	Built Environment	The current guidance on selection of materials for water supply pipes to be laid in contaminated land is contained in UK Water Industry Research's (UKWIR) report reference 10/WM/03/21 (re-issued 2010). However, the guidance is not mandatory and there have been concerns raised by various industry technical associations regarding the document and the methodologies proposed. Although there are concerns regarding the document, in lieu of any further guidance in the first instance the results of this investigation have been compared with the proposed thresholds published in UKWIR Table 3.1. The results of the relevant chemical analyses indicated elevated concentrations of SVOCs and TPH, barrier pipe is likely to be required on the area of the site currently occupied by the house and glasshouse, unless they are wholly placed in natural soils. It is recommended that the results of this investigation be presented to the water utility company as soon as reasonably practicable in order to



Confined Spaces Regulations.

4.3 Floor Slabs

Based on the laboratory testing results and the presence of trees and shrinkable soils, it is recommended that suspended ground floor slabs be adopted.

4.4 Pavements

Where encountered, the Made Ground was noted to be of mixed composition and of limited thickness. The engineering characteristics of such soils are variable and unpredictable and the CBR value of Made Ground does not predict the overall settlements that may occur in such materials. Due to the heterogeneity of the variable amounts of Made Ground it would be prudent to assume the material to be deemed non-frost susceptible throughout.

As part of the investigation, three bulk samples of the underlying River Terrace Deposits were taken from hand pits referenced TP DCP1, TP DCP4 and TP DCP6, with samples taken from depths of 0.50m bgl. The results of the laboratory remoulded (2.5kg rammer method) soaked CBR tests from gave results in the range of 1% and 9.5%.

In addition, six dynamic cone penetrometer tests were undertaken across the site. The results between the depth of 300mm and 600mm bgl ranged between 5% and 22%.

The Transport and Road Research Laboratory Report (LR1132) entitled '*The Structural Design of Bituminous Roads*' (1984) cites an estimated equilibrium suction index of 5% for the sandy silty gravelly clays such as those of the near surface River Terrace Deposits, under average construction conditions and a high groundwater level.

Based on the laboratory results, in-situ testing and TRRL report, a CBR value of 5% is recommended.

Furthermore, based on the geotechnical results, the near surface River Terrace Deposits should be considered as being frost susceptible for pavement design purposes with abundant gravel noted within the sandy silty clays within the upper metre.

It is recommended that the sub-grade be proof rolled and any soft spots removed and replaced with a suitable compacted granular fill.

4.5 Sulphates

Seven pH and Sulphate tests were undertaken on the River Terrace Deposits. The results for the River Terrace Deposits corresponded to design class DS-1 as defined within the BRE Special Digest 1 (2005). The pH analyses indicate the ACEC class to be AC-1. It is recommended that a design class of DS-1 and an ACEC class of AC-1 be applied to all sub-surface concrete within this stratum.

4.6 Soakaways

As part of the investigation, full scale soakage testing to BRE Digest 365 was undertaken within TP2, TP3, TP5 and TP6. Infiltration rates were calculated as follows:

Location	Test No	Infiltration Rate (m/s)
TP2	Run1	4.9×10^{-6}
	Run2	5.9×10^{-6}
	Run3	5.4×10^{-6}
TP3	Run1	3.4×10^{-6}



	Run2	5.8×10^{-6}
	Run3	5.1×10^{-6}
TP5	Run1	5.7×10^{-6}
	Run2	9.4×10^{-6}
	Run3	7.2×10^{-6}
TP6	Run1	5.4×10^{-6}
	Run2	1.2×10^{-5}
	Run3	5.7×10^{-6}

Table 4.1: Infiltration Rates (River Terrace Deposits)

The results indicate a relatively poor infiltration rate within the River Terrace Deposits, whilst groundwater was also noted to be shallow. Based on these findings, the design and construction of conventional soakaways may be viable, though the storage capacity will be severely restricted by the presence of the groundwater table.