TIM O'HARE ASSOCIATES
SOIL & LANDSCAPE CONSULTANCY

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18th January 2024
Our Ref: TOHA/24/1206/5/SS
Your Ref: see below

Dear Sirs

Subsoil Analysis Report: Bury Hill Horsham Yard – Bury Hill Kent Medium / Coarse Subsoil

We have completed the analysis of the soil sample recently submitted, referenced *Bury Hill Kent Medium / Coarse Subsoil* and have pleasure reporting our findings.

The purpose of the analysis was to determine the suitability of the sample for use as a subsoil in general landscape applications (trees, shrubs, amenity grass). In addition, this sample has been assessed to determine its compliance with the requirements of the British Standard for Subsoil *(BS8601:2013 – Specification for subsoil and requirements for use – Table 1, Multipurpose Subsoil),* including analysis of potential contaminants.

This report presents the results of analysis for the sample submitted to our office, and it should be considered 'indicative' of the subsoil source. The report and results should therefore not be used by third parties as a means of verification or validation testing, or for any project-specific applications, especially after the subsoil has left the Bury Hill Landscape Supplies Ltd site.

SAMPLE EXAMINATION

The sample can be described as a yellow (Munsell Colour, 10YR 7/8), moist, friable, non-calcareous SAND with a single grain structure. The sample was stone free and no unusual odours, deleterious materials, roots or rhizomes of pernicious weeds were observed.

Plate 1: Bury Hill Kent Medium / Coarse Subsoil Sample

ANALYTICAL SCHEDULE

The sample was submitted to a UKAS and MCERTS accredited laboratory for a range of physical and chemical tests to confirm the composition of the soil. The following parameters were determined:

- detailed particle size analysis (5 sands, silt, clay);
- stone content (2-20mm, 20-75mm, >75mm);
- saturated hydraulic conductivity;
- pH and electrical conductivity (1:2.5 water extract);
- exchangeable sodium percentage
- calcium carbonate.
- organic matter content;
- california bearing ratio (CBR);
- visible contaminants;
- heavy metals (Sb, As, B, Ba, Be, Cd, Cr, Cu, Pb, Hg, Ni, Se, V, Zn);
- total cyanide and total (mono) phenols;
- speciated PAHs (US EPA16 suite);
- aromatic and aliphatic TPH (C5-C35 banding);
- benzene, toluene, ethylbenzene, xylene (BTEX);
- asbestos screen.

The results are presented on the attached Certificate of Analysis and an interpretation of the results is given below.

RESULTS OF ANALYSIS

Particle Size Analysis and Saturated Hydraulic Conductivity

The sample fell into the *sand* texture class. Further detailed particle size analysis revealed the sample to have a narrow particle size distribution with a predominance of *medium sand* (0.25-0.50mm) and a lower proportion of *coarse sand* (0.50-1.0mm). This is acceptable for subsoil in general landscape applications as porosity levels are maintained in a compacted state and the risk of particle interpacking is minimised. However, such soils can possess poor water retention capacities and as a consequence they often have a greater risk of drought, particularly during prolonged dry periods.

The subsoil represented by this sample would be described as 'very free-draining', which is confirmed by the high saturated hydraulic conductivity result (460 mm/hr).

The particle size distribution falls outside of the range indicated in *BS8601:2013 – Figure 1,* on account of the high sand content.

Stone Content

The sample was stone-free and, as such, stones should not restrict the use of the soil for use as subsoil in general landscape purposes.

pH and Electrical Conductivity Values

The sample was alkaline in reaction (pH 8.5) with a low calcium carbonate (lime) content. Therefore, the high pH recorded is likely to be due to the very low buffering capacity of the material as a result of its very high sand and very low organic matter contents. As such, this pH value should not restrict the use of the subsoil for any landscape purposes.

The electrical conductivity (salinity) value (water extract) was low, which indicates that soluble salts were not present at levels that would be harmful to plants.

The electrical conductivity value by $CaSO_4$ extract (*BS8601* requirement) fell below the maximum specified value (2800 µS/cm) given in *BS8601:2013 – Table 1*.

Organic Matter Content

The organic matter content was low (<0.5%) and compliant with *BS8601:2013 – Table 1*.

California Bearing Ratio

A re-compacted California Bearing Ratio (CBR) was completed as part of the engineering testing undertaken on the sample. The sample was re-compacted using the 2.5kg rammer at the as received moisture content and the sample returned a minimum CBR of 12%. Assuming that the in-situ compaction method selected during installation provides similar levels of compaction to that of the laboratory test, the in-situ performance of the material should be able to achieve a similar result, provided it is compacted at the same moisture content (9%).

As the performance of the soil will be linked to the moisture content at time of compaction, further work may be required in order to correlate the change in engineering performance of the material over the range of moisture contents at which the soil is likely to be placed and compacted.

We recommend a more conservative approach with the performance of the material, and, as opposed to a CBR of 12%, we would quote "should achieve a CBR in excess of 5%..." The 5% CBR is important as this is the lower limit for the sub-grade for the minimum construction thickness.

Potential Contaminants

With reference to *BS8601:2013 – Section 4.2: Note 2*, there is a requirement to confirm levels of potential contaminants in relation to the subsoil's proposed end use. This includes human health, environmental protection and metals considered toxic to plants. In the absence of site-specific assessment criteria, the concentrations of selected potential contaminants that affect human health have been assessed for the concentrations that affect human health have been assessed for *residential* end-use against the Suitable For Use Levels (S4ULs) presented in the LQM/CIEH S4ULs for Human Health Risk Assessment (2015) and the DEFRA SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document (2014).

Of the potential contaminants determined, none exceeded their respective guideline values.

Phytotoxic Contaminants

Of the phytotoxic (toxic to plants) contaminants determined (copper, nickel, zinc), none was found at levels that exceeded the maximum permissible levels specified in *BS8601:2013 – Table 1*.

CONCLUSION

The purpose of the analysis was to determine the suitability of the sample for use as subsoil in general landscape applications (trees, shrubs, amenity grass). In addition, this sample has been assessed to determine its compliance with the requirements of the British Standard for Subsoil *(BS8601:2013 – Specification for subsoil and requirements for use – Table 1, Multipurpose Subsoil).*

From the soil examination and subsequent laboratory analysis, the soil represented by this sample was described as a strongly alkaline, non-saline, non-calcareous, sand with a single grain structure. The sample was stone free and the organic matter content was low and consistent with subsoil. Of the potential contaminants determined, none exceeded their respective guideline values.

The high pH level recorded would not be considered a significant limitation due to the very high sand content of the subsoil. In this instance, due to the very low buffering capacity, the pH will be predominantly influenced by external factors (e.g. overlying topsoil, water input) and therefore should not constitute a limitation for plant selection.

To conclude, based on our findings, the subsoil represented by this sample would be considered suitable for landscape applications where a free-draining subsoil is required or where there will be a low drought risk.

The sample was largely compliant with the requirements of the British Standard for Subsoil *(BS8601:2013 – Specification for subsoil and requirements for use – Table 1, Multipurpose Subsoil)* with the exception of the high sand content. On this occasion, this non-compliance is considered minor provided the landscape application proposed for this subsoil requires a free-draining subsoil.

Soil Handling Recommendations

Reference should be made to Section 6.0 of *BS8601:2013* with regard to the handling and management of the subsoil:

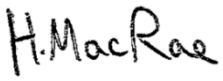
"Soils generally lose strength and become less resistant to damage as they become wetter; therefore, it is essential that they are stripped, handled and trafficked only in the appropriate conditions of weather and soil moisture, and with suitable machinery. If sustained heavy rainfall (e.g. >10 mm in 24 h) occurs during soil stripping operations, work should be suspended and not restarted until the ground has had at least one dry day or until a suitable moisture content has been reached. A soil can be considered to have a suitable moisture content for stripping and handling if the whole thickness of the subsoil layer being stripped and/or handled is at a moisture content below the plastic limit as determined in accordance with BS 1377-2:1990 (incorporating Amendment No. 1).

Machinery should be selected and routed to minimise soil compaction."

Further guidance is provided in Clauses 6.1–6.5.

We hope this report meets with your approval and provides the necessary information. Please do not hesitate to contact the undersigned if we can be of further assistance.

Yours faithfully



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For & on behalf of Tim O'Hare Associates LLP

TIM O'HARE ASSOCIATES
SOIL & LANDSCAPE CONSULTANCY

Client:	**Bury Hill Landscape Supplies Ltd**
Project	**Bury Hil Horsham Yard**
Job:	**Subsoil Analysis - BS8601:2013**
Date:	**18/01/2024**
Job Ref No:	**TOHA/24/1206/5/SS**

Sample Reference	**Bury Hill Kent Medium / Coarse Subsoil**

		Accreditation	
Clay (<0.002mm)	%	UKAS	1
Silt (0.002-0.05mm)	%	UKAS	2
Very Fine Sand (0.05-0.15mm)	%	UKAS	3
Fine Sand (0.15-0.25mm)	%	UKAS	11
Medium Sand (0.25-0.50mm)	%	UKAS	49
Coarse Sand (0.50-1.0mm)	%	UKAS	30
Very Coarse Sand (1.0-2.0mm)	%	UKAS	5
Total Sand (0.05-2mm)	%	UKAS	97
Texture Class (UK Classification)	--	UKAS	S
Stones (2-20mm)	% DW	GLP	0
Stones (20-75mm)	% DW	GLP	0
Stones (>75mm)	% DW	GLP	0
Saturated Hydraulic Conductivity	mm/hr	A2LA	460
pH Value (1:2.5 water extract)	units	UKAS	8.5
Calcium Carbonate	%	UKAS	<1.0
Electrical Conductivity (1:2.5 water extract)	uS/cm	UKAS	105
Electrical Conductivity (1:2 $CaSO_4$ extract)	uS/cm	UKAS	2239
Organic Matter (LOI)	%	UKAS	<0.5
Exchangeable Sodium Percentage	%	UKAS	0.4
Moisture Content (Initial)	%	UKAS	9
Moisture Content (Top)	%	UKAS	9
Moisture Content (Base)	%	UKAS	9
Moisture Content (Mean)	%	UKAS	9
Initial Bulk Density	Mg/m3	UKAS	1.91
Initial Dry Density	Mg/m3	UKAS	1.75
CBR Top	%	UKAS	12
CBR Base	%	UKAS	22
Visible Contaminants: Plastics >2.00mm	%	UKAS	0
Visible Contaminants: Sharps >2.00mm	%	UKAS	0
Total Antimony (Sb)	mg/kg	MCERTS	< 1.0
Total Arsenic (As)	mg/kg	MCERTS	1.2
Total Barium (Ba)	mg/kg	MCERTS	4.1
Total Beryllium (Be)	mg/kg	MCERTS	< 0.06
Total Cadmium (Cd)	mg/kg	MCERTS	< 0.2
Total Chromium (Cr)	mg/kg	MCERTS	5.7
Hexavalent Chromium (Cr VI)	mg/kg	MCERTS	< 1.8
Total Copper (Cu)	mg/kg	MCERTS	4.2
Total Lead (Pb)	mg/kg	MCERTS	< 1.0
Total Mercury (Hg)	mg/kg	MCERTS	< 0.3
Total Nickel (Ni)	mg/kg	MCERTS	2
Total Selenium (Se)	mg/kg	MCERTS	< 1.0
Total Vanadium (V)	mg/kg	MCERTS	4.7
Total Zinc (Zn)	mg/kg	MCERTS	2.4
Water Soluble Boron (B)	mg/kg	MCERTS	< 0.2
Total Cyanide (CN)	mg/kg	MCERTS	< 1.0
Total (mono) Phenols	mg/kg	MCERTS	< 1.0
Naphthalene	mg/kg	MCERTS	< 0.05
Acenaphthylene	mg/kg	MCERTS	< 0.05
Acenaphthene	mg/kg	MCERTS	< 0.05
Fluorene	mg/kg	MCERTS	< 0.05
Phenanthrene	mg/kg	MCERTS	< 0.05
Anthracene	mg/kg	MCERTS	< 0.05
Fluoranthene	mg/kg	MCERTS	< 0.05
Pyrene	mg/kg	MCERTS	< 0.05
Benz(a)anthracene	mg/kg	MCERTS	< 0.05
Chrysene	mg/kg	MCERTS	< 0.05
Benzo(b)fluoranthene	mg/kg	MCERTS	< 0.05
Benzo(k)fluoranthene	mg/kg	MCERTS	< 0.05
Benzo(a)pyrene	mg/kg	MCERTS	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	MCERTS	< 0.05
Dibenzo(a,h)anthracene	mg/kg	MCERTS	< 0.05
Benzo(g,h,i)perylene	mg/kg	MCERTS	< 0.05
Total PAHs (sum USEPA16)	mg/kg	MCERTS	< 0.80
Aliphatic TPH >C5 - C6	mg/kg	MCERTS	< 0.020
Aliphatic TPH >C6 - C8	mg/kg	MCERTS	< 0.020
Aliphatic TPH >C8 - C10	mg/kg	MCERTS	< 0.050
Aliphatic TPH >C10 - C12	mg/kg	MCERTS	< 1.0
Aliphatic TPH >C12 - C16	mg/kg	MCERTS	< 2.0
Aliphatic TPH >C16 - C21	mg/kg	MCERTS	< 8.0
Aliphatic TPH >C21 - C35	mg/kg	MCERTS	< 8.0
Aliphatic TPH (C5 - C35)	mg/kg	MCERTS	< 10
Aromatic TPH >C5 - C7	mg/kg	MCERTS	< 0.010
Aromatic TPH >C7 - C8	mg/kg	MCERTS	< 0.010
Aromatic TPH >C8 - C10	mg/kg	MCERTS	< 0.050
Aromatic TPH >C10 - C12	mg/kg	MCERTS	< 1.0
Aromatic TPH >C12 - C16	mg/kg	MCERTS	< 2.0
Aromatic TPH >C16 - C21	mg/kg	MCERTS	< 10
Aromatic TPH >C21 - C35	mg/kg	MCERTS	< 10
Aromatic TPH (C5 - C35)	mg/kg	MCERTS	< 10
Benzene	mg/kg	MCERTS	< 0.005
Toluene	mg/kg	MCERTS	< 0.005
Ethylbenzene	mg/kg	MCERTS	< 0.005
p & m-xylene	mg/kg	MCERTS	< 0.005
o-xylene	mg/kg	MCERTS	< 0.005
MTBE (Methyl Tertiary Butyl Ether)	mg/kg	MCERTS	< 0.005
Asbestos	D/ND	ISO 17025	Not-detected

S = SAND

Visual Examination

The sample can be described as a yellow (Munsell Colour, 10YR 7/8), moist, friable, non-calcareous SAND with a single grain structure. The sample was virtually stone free and no unusual odours, deleterious materials, roots or rhizomes of pernicious weeds were observed.

H.MacRae

Harriet MacRae
BSc MSc
Graduate Soil Scientist

Results of analysis should be read in conjunction with the report they were issued with.