TIM O'HARE ASSOCIATES
SOIL & LANDSCAPE CONSULTANCY

Mr Andy Spetch
British Sugar plc Co-Products
Oundle Road
Peterborough
PE2 9QU

24th January 2020
Our Ref: TOHA/20/9355/1/SS
Your Ref: PO 60113175

Dear Sirs

Subsoil Analysis Report: Wissington – Free-Draining Subsoil

We have completed the analysis of the sample recently submitted, referenced *Free-Draining Subsoil*, and have pleasure reporting our findings.

The purpose of the analysis was to determine the suitability of the subsoil sample for general landscape purposes, and specifically in free-draining planting environments. In addition, the 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).*

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 waste designation purposes, especially after the subsoil has left the British Sugar factory.

SAMPLE EXAMINATION

The sample was described as a brownish yellow (Munsell Colour 10YR 6/6), slightly 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.

*This appraisal of soil structure was made from examination of a disturbed sample. Structure is a key soil characteristic that may only be accurately assessed by examination in an in-situ state.

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 and fertility of the soil, and the concentration of selected potential contaminants. The following parameters were determined:

- detailed particle size analysis (5 sands, silt, clay);
- stone content (2-20mm, 20-50mm, >50mm);
- pH and electrical conductivity values;
- exchangeable sodium percentage;
- organic matter content;
- saturated hydraulic conductivity;
- heavy metals (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 Stone Content

The sample fell into the sand texture class, and would be described as light in texture. Further detailed particle size analysis revealed the sample to have a sufficiently narrow particle size distribution and a predominance of *medium sand* (0.25-0.50mm) and *coarse sand* (0.50-1.0mm). This is acceptable for subsoil used in landscape applications as porosity levels are maintained in a compacted state and the risk of particle interpacking is minimised.

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

Saturated Hydraulic Conductivity

The sample had a saturated hydraulic conductivity value of 73mm/hr, which would be considered acceptable for a subsoil in free-draining planting environments.

pH and Electrical Conductivity Values

The sample was strongly alkaline in reaction (pH 8.4). This pH value would be considered suitable for general landscape purposes providing species with a wide pH tolerance or those known to prefer alkaline soils are selected for planting, turfing and seeding.

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

Organic Matter Content

The organic matter content was low (<2%) and acceptable.

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 that affect human health have been compared with the *residential with homegrown produce* land use in 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* (C4SLs) *for Assessment of Land Affected by Contamination – Policy Companion Document* (2014).

Of the potential contaminants determined in the sample, 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 subsoil sample for general landscape purposes, and specifically in free-draining planting environments. In addition, the 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 laboratory analysis, the sample was described as a strongly alkaline, non-saline, non-calcareous, stone-free sand with a single grain structure. The organic matter content was low and consistent with subsoil. Of the potential contaminants determined, none was found at levels that exceeded their guideline values.

Based on our findings, the sample would be considered suitable for use as subsoil for general landscape applications where a free-draining subsoil is required provided plant species with a wide pH tolerance or those known to prefer alkaline soils are selected.

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 total sand content. On this occasion, this non-compliance is considered minor and insignificant when reviewed in the context of all the other results and considering the proposed end-use of this soil as 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 sincerely

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Graduate Soil Scientist

Tim O'Hare
BSc MSc MISoilSci MBIAC CSci
Principal Consultant

For & on behalf of Tim O'Hare Associates LLP

TIM O'HARE ASSOCIATES
SOIL & LANDSCAPE CONSULTANCY

Client:	**British Sugar plc Co-Products**
Client Ref:	**Wissington**
Job:	**Subsoil Analysis**
Date:	**24/01/2020**
Job Ref No:	**TOHA/20/9355/1/SS**

Sample Reference			**Free-Draining Subsoil**
Clay (<0.002mm)	%	U	3
Silt (0.002-0.05mm)	%	U	2
Very Fine Sand (0.05-0.15mm)	%	U	9
Fine Sand (0.15-0.25mm)	%	U	17
Medium Sand (0.25-0.50mm)	%	U	43
Coarse Sand (0.50-1.0mm)	%	U	21
Very Coarse Sand (1.0-2.0mm)	%	U	5
Sand (0.05-2.0mm)	%	U	95
Texture Class (UK Classification)	--	U	S
Stones (2-20mm)	% DW	G	0
Stones (20-75mm)	% DW	G	0
Stones (>75mm)	% DW	G	0
Saturated Hydraulic Conductivity	mm/hr	A	73
pH Value (1:2.5 water extract)	units	U	8.4
Electrical Conductivity (1:2.5 water extract)	uS/cm	U	292
Moisture Content	%	U	8.1
Organic Matter (LOI)	%	U	0.9
Total Arsenic (As)	mg/kg	M	6.1
Total Barium (Ba)	mg/kg	M	9.9
Total Beryllium (Be)	mg/kg	M	0.25
Total Cadmium (Cd)	mg/kg	M	< 0.2
Total Chromium (Cr)	mg/kg	M	6.9
Hexavalent Chromium (Cr VI)	mg/kg	M	< 4.0
Total Copper (Cu)	mg/kg	M	3
Total Lead (Pb)	mg/kg	M	4.8
Total Mercury (Hg)	mg/kg	M	< 0.3
Total Nickel (Ni)	mg/kg	M	6.3
Total Selenium (Se)	mg/kg	M	< 1.0
Total Vanadium (V)	mg/kg	M	16
Total Zinc (Zn)	mg/kg	M	16
Water Soluble Boron (B)	mg/kg	M	0.8
Total Cyanide (CN)	mg/kg	M	< 1
Total (mono) Phenols	mg/kg	M	< 1.0
Naphthalene	mg/kg	M	< 0.05
Acenaphthylene	mg/kg	M	< 0.05
Acenaphthene	mg/kg	M	< 0.05
Fluorene	mg/kg	M	< 0.05
Phenanthrene	mg/kg	M	< 0.05
Anthracene	mg/kg	M	< 0.05
Fluoranthene	mg/kg	M	< 0.05
Pyrene	mg/kg	M	< 0.05
Benzo(a)anthracene	mg/kg	M	< 0.05
Chrysene	mg/kg	M	< 0.05
Benzo(b)fluoranthene	mg/kg	M	< 0.05
Benzo(k)fluoranthene	mg/kg	M	< 0.05
Benzo(a)pyrene	mg/kg	M	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	M	< 0.05
Dibenzo(a,h)anthracene	mg/kg	M	< 0.05
Benzo(g,h,i)perylene	mg/kg	M	< 0.05
Total PAHs (sum USEPA16)	mg/kg	M	< 0.80
Aliphatic TPH (C5-C6)	mg/kg	M	< 0.001
Aliphatic TPH (C6-C8)	mg/kg	M	< 0.001
Aliphatic TPH (C8-C10)	mg/kg	M	< 0.001
Aliphatic TPH (C10-C12)	mg/kg	M	< 1.0
Aliphatic TPH (C12-C16)	mg/kg	M	< 2.0
Aliphatic TPH (C16-C21)	mg/kg	M	< 8.0
Aliphatic TPH (C21-C35)	mg/kg	M	< 8.0
Aliphatic TPH (C5-C35)	mg/kg	M	< 10
Aromatic TPH (C5-C7)	mg/kg	M	< 0.001
Aromatic TPH (C7-C8)	mg/kg	M	< 0.001
Aromatic TPH (C8-C10)	mg/kg	M	< 0.001
Aromatic TPH (C10-C12)	mg/kg	M	< 1.0
Aromatic TPH (C12-C16)	mg/kg	M	< 2.0
Aromatic TPH (C16-C21)	mg/kg	M	< 10
Aromatic TPH (C21-C35)	mg/kg	M	< 10
Aromatic TPH (C5-C35)	mg/kg	M	< 10
Benzene	mg/kg	M	< 0.001
Toluene	mg/kg	M	< 0.001
Ethylbenzene	mg/kg	M	< 0.001
p & m-xylene	mg/kg	M	< 0.001
o-xylene	mg/kg	M	< 0.001
Asbestos	ND/D	I	Not-detected

Visual Examination

The sample was described as a brownish yellow (Munsell Colour 10YR 6/6), slightly 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.

S	SAND Texture Class
M	MCERTS accredited method (& UKAS accredited method)
I	ISO 17025 accredited method
U	UKAS accredited method
G	GLP accredited method
A	A2LA accredited method

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 waste designation purposes, especially after the topsoil has left the British Sugar factory.

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