Light-Weight Soil Analysis: Soil-based Growing Media

We have now completed the analysis of your light-weight soil and have the pleasure of reporting our findings.

The purpose of the work was to determine the horticultural and engineering properties of the sample and to consider the significance of these to the proposed end use of the soil. It is understood that this soil is intended to be placed at a maximum depth of 400 mm in situations where the weight of the soil is important, eg. roof gardens.

SOIL EXAMINATION

The soil was described as a friable, dark brown, sandy loam with a well developed coarse granular structure. The soil contained a low proportion of stones and no deleterious materials (eg. building waste materials, glass, etc.), or unusual odours (eg. hydrocarbons) were present.

Phone: 01797 254020 Fax: 01797 252724 Email: enquiries@soil-land.com

Soil & Land Consultants Ltd. Registered in England: Coppards Land, Northiam, East Sussex TN31 6QP
Company Registration No: 4293320

LABORATORY ANALYSIS

The soil sample was submitted to the laboratory for physical and chemical parameters to confirm the composition and fertility status. The following parameters were determined for the soil:

- pH value (1:2.5 soil/water extract & soil/KCl extract);
- electrical conductivity;
- major plant nutrients - N, P, K, Mg;
- organic matter content;
- particle size distribution and stone content;
- bulk density under compacted and water-saturated conditions;
- water storage capacity;
- permeability;
- porosity (total, capillary & air-filled.)
- heavy metals & potentially toxic elements (As, Cd, Cr, Cu, Pb, Hg, Ni, Se, Zn, B);
- sulphate, sulphur, sulphide;
- total cyanide and total (mono) phenols;
- speciated PAHs (US EPA16)
- total petroleum hydrocarbons (C_{10}-C_{40}).

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

pH values

The pH value of the sample was slightly alkaline (7.7.) This pH range is well within the permitted range of BS3882 2007: multipurpose grade and the pH of this soil will be suitable for planting the vast majority of species used in commercial landscaping.

Particle Size Distribution

From the laboratory analysis, the sample was shown to contain 67% sand and 13% clay. As such, it fell into the *sandy loam* texture class. Provided they are properly handled and placed, soils of this texture are typically free-draining and less prone to problems with water-logging and compaction than heavier soils; therefore, they are considered suitable for landscaping purposes.

The sample was free from stones greater than 50 mm in diameter, and only contained a small proportion of smaller stones. Of these, the majority (2.6 %) were 2-20 mm in diameter. As such, stones will not restrict the use of the soil in the proposed landscaping environment.

Organic Matter and Nutrient Status

The soil contained an adequate level of organic matter (4.6%) and was well-supplied with the essential plant nutrients nitrogen, phosphorus, potassium, and magnesium. This level of organic matter should provide a reserve of nutrients and be beneficial to the structure and water-holding capacity of the soil.

Potential Contaminants

We are not aware of any specified contaminant levels set for the proposed end-use of this topsoil so the following comments are based on the Soil Guideline Values (SGVs) for residential end-use presented in the Contaminated Land Exposure Assessment (CLEA) Model (EA/DEFRA:2002). The SGVs currently only consider a limited range of parameters so where a potential contaminant is not covered by the CLEA Model other relevant schedules for contamination assessment, such as the Dutch Guidelines, and professional judgement have been used.

Of all the potential contaminants determined, none was found at levels that would indicate significant contamination.

Engineering and Physical Properties of Soil

The results described so far have all been determined on an isolated sample of the soil in a laboratory. In order to obtain a better understanding of how the soil will perform over time when placed, a dynamic falling-head permeability test was carried out on the sample. This is a dynamic experiment which attempts to replicate the physical properties of an in-situ soil. The tests also provide supporting information to designers and engineers to calculate the potential loadings required for this soil. The method of compaction used for this sample was a light tamp. This replicates the degree of compaction and settling that would be expected from a soil placed at the specified depth for this product (maximum 400 mm.)

The compacted and water-saturated bulk density of the roof garden soil was low (1.42 tonnes/m^3) compared to those of standard soil and rootzone mixes, demonstrating the light weight nature of this product.

The permeability and porosity information was determined to confirm that the soil will provide sufficient drainage and aeration once placed and firmed. The results indicate that the soil will provide satisfactory levels of drainage and aeration for the specified planting environment. The permeability rate (5.74×10^{-5} m/s) indicates a fairly fast-draining soil that will retain sufficient water for plant uptake, whilst removing surplus water to prevent water ponding and water-logging. This drainage rate reduces the risk of drought stress and the reliance on excessive amounts of irrigation water whilst minimising the risk of anaerobic conditions bought about by water-logging.

This is, of course, dependent on the drainage properties of the material underlying the soil. It is important to give equal consideration to any subsoil or base layer used beneath the soil; if this is likely to only be slow draining, a positive drainage system should be installed before the soil is placed.

CONCLUSIONS

The results of the tests confirm that the light-weight soil has the necessary physical and chemical properties to support plant growth in the proposed landscape environment. The soil has been shown to be free from significant levels of contamination and possesses favourable particle size distribution and drainage characteristics. The soil was shown to have a relatively low density when lightly compacted and water-saturated.

This soil would comply with all aspects of BS3882 2007: multipurpose grade. No additions of fertiliser or organic matter are required, or indeed recommended for at least the first growing season.

In conclusion, provide it is correctly handled and not placed at depths greater than 400 mm, this soil would be well-suited to use in roof gardens.

Soil Handling Recommendations

It is important to maintain the physical condition of the soil and avoid structural degradation during all phases of soil handling (eg. respreading, cultivating, planting). As a consequence, soil handling operations should be carried out when soil is reasonably dry and non-plastic (friable) in consistency.

In particular, it is important to ensure that the soils (topsoil and subsoil) are not unnecessarily compacted by trampling or trafficking by site machinery. In addition, topsoil handling should be stopped during and after heavy rainfall, and not continued until the soil is again non-plastic in consistency. If, at any stage during the course of the soiling works, the soil is structurally damaged and compacted, it will be important to ensure that it is suitably cultivated to relieve the compaction and restore the structure prior to any planting, turfing or seeding.

We hope this report meets with your approval and provides the necessary information. Please do not hesitate to contact the undersigned if you have any queries or comments.

Yours sincerely

Dr Eric Crouch

Client	Boughton Loam Limited
Project	Light-weight soil analysis
Job Ref	SLC/08/EC/174/SA

Sample Reference	A: Light-Weight soil-based growing media

pH Value & Salinity

pH value	units	7.7
Electrical Conductivity (1:2.5 soil/water extract)	uS/cm	414
Electrical Conductivity (1:2.5 soil/KCl extract)	uS/cm	2255

Organic Matter & Nutrient Status

Organic Matter (LOI)	%	4.6
Total Nitrogen	%	0.30
Extractable Phosphorus	mg/l	39
Extractable Potassium	mg/l	429
Extractable Magnesium	mg/l	67

Particle Size Analysis & Stones

Clay (<0.002mm)	%	13
Silt (0.063-0.002mm)	%	20
Sand (2.0-0.063mm)	%	67
Texture Class	UK Class	Sandy Loam
Stones 2-20 mm	%	2.6
Stones 20-50 mm	%	0.1
Stones >50 mm	%	0.0

Potential Contaminants

Total Arsenic (As)	mg/kg	16.6
Total Cadmium (Cd)	mg/kg	0.24
Total Chromium (Cr)	mg/kg	44.9
Total Copper (Cu)	mg/kg	20
Total Lead (Pb)	mg/kg	23.4
Total Mercury (Hg)	mg/kg	0.04
Total Nickel (Ni)	mg/kg	27.5
Total Selenium (Se)	mg/kg	0.29
Total Zinc (Zn)	mg/kg	51.7
Water Soluble Boron (B)	mg/kg	2
Total Cyanide (CN)	mg/kg	< 1
Total (mono) Phenols	mg/kg	< 1
Elemental Sulphur (S)	mg/kg	< 20
Total Sulphide (S^{2-})	mg/kg	< 1
Water Soluble Sulphate (SO_4^{2-})	g/l	0.06
Total Petroleum Hydrocarbons (C_{10}-C_{40})	mg/kg	< 50

Soil Land Consultants Ltd,

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East Sussex,
TN316QP

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Sample Reference		A: Light-Weight soil-based growing media
Polyaromatic Hydrocarbons		
Naphthalene	mg/kg	< 0.2
Acenaphthylene	mg/kg	< 0.1
Acenaphthene	mg/kg	< 0.1
Fluorene	mg/kg	< 0.1
Phenanthrene	mg/kg	< 0.2
Anthracene	mg/kg	< 0.1
Fluoranthene	mg/kg	< 0.2
Pyrene	mg/kg	< 0.2
Benzo(a)anthracene	mg/kg	< 0.1
Chrysene	mg/kg	< 0.1
Benzo(b)fluoranthene	mg/kg	< 0.1
Benzo(k)fluoranthene	mg/kg	< 0.1
Benzo(a)pyrene	mg/kg	< 0.1
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1
Dibenzo(a,h)anthracene	mg/kg	< 0.1
Benzo(g,h,i)perylene	mg/kg	< 0.1
Total PAHs sum US EPA 16	mg/kg	< 2
Engineering Properties: Falling Head Permeability		
Sample Compacted With	-	Light Tamp
Bulk Density: water-saturated soil	tonne/m^3	1.42
Total Porosity (final)	%	51.3
Air Filled Porosity (final)	%	10.5
Capillary Porosity (final)	%	40.8
Water Storage Capacity	%	40.3
Permeability	m/s	$5.74x10^{-5}$
Permeability	mm/hour	207

Authorised by:

Dr Eric Crouch

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