TIM O'HARE ASSOCIATES

SOIL & LANDSCAPE CONSULTANCY

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2nd October 2018
Our Ref: TOHA/18/7722/SS/R1
Your Ref: C2304/M 2902

Dear Sirs

Topsoil Analysis Report: Cranbrook, Exeter

We have completed the analysis of the soil samples recently submitted, referenced *Sample 1 LH Side of Pitch* and *Sample 2 RH Side of Pitch*, and have pleasure reporting our findings.

The purpose of the analysis was to determine the suitability of the samples for sports pitch use (football / cricket outfield). With reference to email correspondence received from Kay Fleming (FCPR) Environment and Design Ltd), it is understood that extensive drainage works have recently been undertaken to the sports field (football / cricket outfield), comprising a network of piped lateral drains. The surface of the topsoil (top 50-75mm) is to be ameliorated with sand to allow a 50% mixing rate. Cultivation work has been specified to achieve a satisfactory tilth for seeding.

This report presents the results of analysis for the samples submitted to our office, and it should be considered 'indicative' of the topsoil source. The report and results should therefore not be used by third parties as a means of verification or validation testing.

SAMPLE EXAMINATION

The samples were consistent in appearance and can be described as strong brown (Munsell Colour 7.5YR 4/6), slightly moist, friable, slightly calcareous HEAVY CLAY LOAMS TO CLAYS with moderately developed, fine to medium granular to sub-angular blocky structures*. The stone content of the samples was low, 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(s). Structure is a key soil characteristic that may only be accurately assessed by examination in an in-situ state.

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ANALYTICAL SCHEDULE

The samples were 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:

- particle size analysis (sand, silt, clay);
- stone content (>2mm, >20mm, >50mm);
- permeability;
- pH value;
- electrical conductivity values (water and $CaSO_4$ extracts);
- exchangeable sodium percentage;
- organic matter content;
- C:N ratio;
- heavy metals (As, B, Cd, Cr, Cu, Pb, Hg, Ni, Se, Zn);
- total cyanide and total (mono) phenols;
- speciated PAHs (US EPA16 suite);
- aromatic and aliphatic TPH (C5-C35 banding);
- benzene, toluene, ethylbenzene, xylene (BTEX).

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 samples fell into the *clay* and *heavy clay loam* texture classes. The heavy texture of the topsoil is not ideally suited to winter sports pitches without amendment, and particularly at high usage levels. Although the samples currently have a moderately developed structure, this could soon be lost when the soils are used for winter sports. Its plastic consistency at relatively low moisture contents makes it prone to smearing and compaction during play in wet weather conditions. This smearing can effectively seal the surface of the soil and reduces infiltration, percolation drainage and aeration capabilities through the soil profile. Such conditions are unfavourable for root growth and would subject the grass to significant stress. Continual or intensive use when wet is likely to damage/destroy grass cover, further compounding the problem of poor aeration and impeded infiltration.

In this instance, the installed drainage and proposed surface sand amelioration should mitigate these effects, provided the sports field is maintained to an appropriate standard, including regular topdressing and aeration/decompaction work.

The overall stone content was low, however the sample contained occasional stones greater than 20mm in size. It may be prudent to remove any larger stones by raking, picking and/or burying.

Permeability

The samples were found to be slowly permeable (4 – 9 mm/hr), which is usually acceptable for topsoil used for sports pitches, provided the pitch surface is maintained appropriately.

pH and Electrical Conductivity Values

The samples were slightly acid in reaction (pH 6.4 & 6.7), with pH values that would be considered ideal for grass species typically used for sports pitches.

The electrical conductivity (salinity) values were low, which indicates that soluble salts were not present at levels that would be harmful to grass.

Organic Matter and Fertility Status

The table below summarises the organic matter contents and fertility status for each sample in relation to sports pitch grass establishment:

	Sample 1	***Sample 2***
Organic Matter	✓	✓
Total Nitrogen	x	✓
Extractable Phosphorus	x	x
Extractable Potassium	x	x
Extractable Magnesium	✓	✓

✓✓ - well supplied; ✓ - adequately supplied; o - slightly deficient; x - deficient; xx - very deficient

These deficiencies may be remedied by application of an appropriate pre-seeding fertiliser and an ongoing maintenance fertiliser programme as required.

The C:N ratios of the samples were low and acceptable.

Potential Contaminants

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, none was found at levels that exceeded their 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 *BS3882:2015 – Table 1*.

CONCLUSION

The purpose of the analysis was to determine the suitability of the samples for sports pitch use (football / cricket outfield).

From the soil examination and laboratory analysis, the samples were described as slightly acid, very slightly calcareous, non-saline, heavy clay loam to clays with moderate structures and low stone content. The overall fertility status of the samples was moderate to low, with a number of deficiencies in *Sample* 1 and low mineral nutrient reserve in *Sample* 2. Of the potential contaminants determined, none was found at levels that exceeded their guideline values.

Based on our findings, the topsoil represented by these samples would be considered suitable for sports pitch use, provided:

- the physical properties of the topsoil surface are improved by the proposed sand amelioration;
- the installed drainage system functions as required and is adequately maintained;
- the nutrient deficiencies are addressed with an appropriate fertiliser application;
- the required cultivation works are undertaken prior to seeding and the physical condition of the soil is satisfactory;
- any larger stones (>20mm) are removed as necessary.

An application of a pre-seeding fertiliser during pitch construction will be required, together with a suitable fertiliser programme as part of ongoing maintenance operations.

It is suggested that the sand amelioration treatment requirements are amended to allow for a 25mm layer of sand to be lightly incorporated into the upper 25mm of topsoil (e.g. using a power harrow) to provide a 50mm depth of sandier soil at the surface. Regular sand topdressing application (min. annually) is recommended to maintain this surface layer.

RECOMMENDATIONS

Fertiliser for Amenity Grass Establishment

To address the nutrient deficiencies and to help promote effective grass establishment, we recommend applying and incorporating the pre-seeding grass fertiliser *ICL Sportsmaster Pre-seeder* (8%N:12%P_2O_5:8%K_2O+3%MgO) prior to seeding or turfing at a rate of 35 g/m^2 and to a depth of 100mm.

Stone Removal

It may be prudent to remove a portion of the larger stones (>20mm) by picking, raking and/or burying prior to seeding.

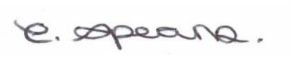
Soil Handling Recommendations

The heavy texture of this topsoil will make it particularly vulnerable to physical degradation (compaction) during all subsequent cultivation works. It is important to ensure that the soil is not unnecessarily compacted by trampling or trafficking, and soil handling should be stopped during and after heavy rainfall, and not continued until the soil has returned to a friable state.

If the soil is structurally damaged and compacted at any stage during the works, it should be cultivated appropriately to relieve the compaction and to restore the soil's structure prior to seeding.

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:	**Parsons Landscapes Limited**
Project	**Cranbrook, Exeter**
Job:	**Topsoil Analysis**
Date:	**03/09/2018**
Job Ref No:	**TOHA/18/7722/SS/R1**

Sample Reference			**Sample 1 - LH Side of pitch**	**Sample 2 - RH Side of pitch**
		Accreditation		
Clay (<0.002mm)	%	UKAS	27	39
Silt (0.002-0.063mm)	%	UKAS	35	40
Sand (0.063-2.0mm)	%	UKAS	38	21
Texture Class (UK Classification)	--	UKAS	CL	C
Stones (2-20mm)	% DW	GLP	2	2
Stones (20-50mm)	% DW	GLP	1	1
Stones (>50mm)	% DW	GLP	0	0
Falling Head Permeability (light tamp)	mm/hr	UKAS	9	4
pH Value (1:2.5 water extract)	units	UKAS	6.4	6.7
Electrical Conductivity (1:2.5 water extract)	uS/cm	UKAS	165	120
Electrical Conductivity (1:2 $CaSO_4$ extract)	uS/cm	UKAS	2088	2017
Exchangeable Sodium Percentage	%	UKAS	1.3	1.1
Organic Matter (LOI)	%	UKAS	3.4	6.5
Total Nitrogen (Dumas)	%	UKAS	0.14	0.31
C : N Ratio	ratio	UKAS	14	12
Extractable Phosphorus	mg/l	UKAS	13	15
Extractable Potassium	mg/l	UKAS	72	58
Extractable Magnesium	mg/l	UKAS	131	112
Total Arsenic (As)	mg/kg	MCERTS	9	10
Total Cadmium (Cd)	mg/kg	MCERTS	< 0.2	< 0.2
Total Chromium (Cr)	mg/kg	MCERTS	20	22
Hexavalent Chromium (Cr VI)	mg/kg	MCERTS	< 4.0	< 4.0
Total Copper (Cu)	mg/kg	MCERTS	14	17
Total Lead (Pb)	mg/kg	MCERTS	27	32
Total Mercury (Hg)	mg/kg	MCERTS	< 0.3	< 0.3
Total Nickel (Ni)	mg/kg	MCERTS	14	15
Total Selenium (Se)	mg/kg	MCERTS	< 1.0	< 1.0
Total Zinc (Zn)	mg/kg	MCERTS	35	47
Water Soluble Boron (B)	mg/kg	MCERTS	0.9	1.6
Total Cyanide (CN)	mg/kg	MCERTS	< 1	< 1
Total (mono) Phenols	mg/kg	MCERTS	< 1	< 1
Naphthalene	mg/kg	MCERTS	< 0.05	< 0.05
Acenaphthylene	mg/kg	MCERTS	< 0.05	< 0.05
Acenaphthene	mg/kg	MCERTS	< 0.05	< 0.05
Fluorene	mg/kg	MCERTS	< 0.05	< 0.05
Phenanthrene	mg/kg	MCERTS	< 0.05	< 0.05
Anthracene	mg/kg	MCERTS	< 0.05	< 0.05
Fluoranthene	mg/kg	MCERTS	< 0.05	< 0.05
Pyrene	mg/kg	MCERTS	< 0.05	< 0.05
Benzo(a)anthracene	mg/kg	MCERTS	< 0.05	< 0.05
Chrysene	mg/kg	MCERTS	< 0.05	< 0.05
Benzo(b)fluoranthene	mg/kg	MCERTS	< 0.05	< 0.05
Benzo(k)fluoranthene	mg/kg	MCERTS	< 0.05	< 0.05
Benzo(a)pyrene	mg/kg	MCERTS	< 0.05	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	MCERTS	< 0.05	< 0.05
Dibenzo(a,h)anthracene	mg/kg	MCERTS	< 0.05	< 0.05
Benzo(g,h,i)perylene	mg/kg	MCERTS	< 0.05	< 0.05
Total PAHs (sum USEPA16)	mg/kg	MCERTS	< 0.8	< 0.8
Aliphatic TPH >C5 - C6	mg/kg	MCERTS	< 0.001	< 0.001
Aliphatic TPH >C6 - C8	mg/kg	MCERTS	< 0.001	< 0.001
Aliphatic TPH >C8 - C10	mg/kg	MCERTS	< 0.001	< 0.001
Aliphatic TPH >C10 - C12	mg/kg	MCERTS	< 1.0	< 1.0
Aliphatic TPH >C12 - C16	mg/kg	MCERTS	< 2.0	< 2.0
Aliphatic TPH >C16 - C21	mg/kg	MCERTS	< 8.0	< 8.0
Aliphatic TPH >C21 - C35	mg/kg	MCERTS	< 8.0	8.3
Aliphatic TPH (C5 - C35)	mg/kg	MCERTS	< 10	< 10
Aromatic TPH >C5 - C7	mg/kg	MCERTS	< 0.001	< 0.001
Aromatic TPH >C7 - C8	mg/kg	MCERTS	< 0.001	< 0.001
Aromatic TPH >C8 - C10	mg/kg	MCERTS	< 0.001	< 0.001
Aromatic TPH >C10 - C12	mg/kg	MCERTS	< 1.0	< 1.0
Aromatic TPH >C12 - C16	mg/kg	MCERTS	< 2.0	< 2.0
Aromatic TPH >C16 - C21	mg/kg	MCERTS	< 10	< 10
Aromatic TPH >C21 - C35	mg/kg	MCERTS	< 10	14
Aromatic TPH (C5 - C35)	mg/kg	MCERTS	15	14
Benzene	mg/kg	MCERTS	< 0.001	< 0.001
Toluene	mg/kg	MCERTS	< 0.001	< 0.001
Ethylbenzene	mg/kg	MCERTS	< 0.001	< 0.001
p & m-xylene	mg/kg	MCERTS	< 0.001	< 0.001
o-xylene	mg/kg	MCERTS	< 0.001	< 0.001
MTBE (Methyl Tertiary Butyl Ether)	mg/kg	MCERTS	< 0.001	< 0.001

CL = CLAY LOAM
C = CLAY

Visual Examination

The samples were consistent in appearance and can be described as strong brown (Munsell Colour 7.5YR 4/6), slightly moist, friable, slightly calcareous HEAVY CLAY LOAMS TO CLAYS with moderately developed, fine to medium granular to sub-angular blocky structures. The stone content of the samples was low, and no unusual odours, deleterious materials, roots or rhizomes of pernicious weeds were observed.

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