

Report

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TEMPLE

LEADERS IN ENVIRONMENT,
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Report for – Fairfax (Reading) Ltd and Reading Golf Club Ltd
Reading Golf Course
Soil Survey Report
Final



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Report for: **Fairfax (Reading) Ltd and Reading Golf Club Ltd**

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1.0 Introduction

- 1.1.1 Reading Agricultural Consultants Ltd (RAC) is instructed by Fairfax (Reading) Ltd and Reading Golf Club Ltd to investigate the soil resources of land at Reading Golf Club, Emmer Green, Reading by means of a detailed survey of soil and site characteristics. A soil resource plan has also been prepared for the site setting out soil handling information in line with Defra's Construction Code of Practice for the Sustainable Use of Soils on Construction Sites¹. The soil resource plan includes best practices for stripping and storing soils as well as restoring the soil profile.

2.0 Site and climatic conditions

2.1 General features and land form

- 2.1.1 The site comprises permanent grassland with rough grassland and tree lines between the fairways, and makes up the southern 12ha of Reading Golf Course. It has an L-shape and is bounded to the east by residential properties off Brooklyn Drive and the golf course clubhouse off Kidmore End Road; to the south by Lyefield Road and Emmer Green Primary School; to the west by residential properties off Eric Avenue; and to the north by the remainder of the golf course.
- 2.1.2 Topography across the site is largely flat at approximately 82m above Ordnance Datum (AOD) with a gentle slope down to 78m AOD at the northern boundary.

2.2 Agro-climatic conditions

- 2.2.1 Agro-climatic data for the site have been interpolated from the Meteorological Office's standard 5km grid point dataset at a representative altitude of 81m AOD and are given in **Table 1**. The site has a moderate climate with moderately large crop moisture deficits. The number of Field Capacity Days (FCD) is slightly lower than the average for lowland England (150) and is favourable for providing opportunities for land work.

Table 1: Local agro-climatic conditions

Parameter	Value
Average Annual Rainfall	700mm
Accumulated Temperatures >0°C	1,429 day°
Field Capacity Days	146 days
Average Moisture Deficit, wheat	108mm
Average Moisture Deficit, potatoes	101mm

2.3 Soil parent material and soil type

- 2.3.1 The principal underlying geological units mapped by the British Geological Survey² across the site are:

¹ Defra (2009). *Construction Code of Practice for the Sustainable Use of Soils on Construction Sites*.

² British Geological Survey (2020). *Geology of Britain viewer*, <http://mapapps.bgs.ac.uk/geologyofbritain/home.html>

- the Seaford Formation and Newhaven Chalk Formation to the north, which comprise chalk with some marl seams and flint; and
- the Lambeth Group to the south and in central areas, which are variable and comprise mainly clay, some silty or sandy, with some sands and gravels.

2.3.2 Superficial deposits of the Black Park Gravel Member are mapped across most of the site and comprise sand and gravel, with local lenses of silt, clay or peat.

2.3.3 No superficial deposits are recorded across the east of the site, on the border with residential properties along Brooklyn Drive and by the clubhouse.

2.3.4 The Soil Survey of England and Wales soil association mapping³ (1:250,000 scale) shows the Hornbeam 1 soil association across the site. These soils are characterised by deep fine and coarse loamy over clayey soils with slowly permeable subsoils and slight seasonal waterlogging. Some soils are very flinty, sandy and loamy. Soils are typically assessed as Wetness Class (WC) II or III⁴.

3.0 Soil resource survey

3.1 Soil survey methods

3.1.1 Thirteen soil profiles were examined using an Edelman (Dutch) auger at an observation density of slightly more than one per hectare. Two observation pits were also excavated to examine subsoil structures. The locations of observations are shown on Figure RAC/8915/1. At each observation point the following characteristics were assessed for each soil horizon up to a maximum of 120cm or any impenetrable layer:

- soil texture;
- significant stoniness;
- colour (including localised mottling);
- consistency;
- structural condition;
- free carbonate; and
- depth.

3.1.2 A topsoil sample from Observation 3, as well as a topsoil and a subsoil sample from Observation 9, were submitted for laboratory determination of:

- soil chemical properties (pH, organic matter content and nutrient contents (P, K, Mg));
- soil physical properties (particle size distribution); and
- soil biological properties (microbial activity).

³ Soil Survey of England and Wales (1984). *Soils of South East England* (1:250,000), Sheet 6

⁴ Jarvis et al (1984). *Soils and Their Use in South East England*. Soil Survey of England and Wales Bulletin 15, Harpenden.

- 3.1.3 The chemical, physical and biological properties are combined to give a soil health index. The results are contained in Appendix 1.

3.2 Soil resources

- 3.2.1 Investigation of soil resources has been carried out across the site, with the soil profiles described according to Hodgson (1997)⁵ which is the recognised source for describing soil profiles and characteristics.
- 3.2.2 There are two main soil types present at the site. The distribution of these can be seen in Figure RAC/8915/2.

Soil Type 1

- 3.2.3 Topsoil of the first soil type is dark greyish brown to brown (10YR4/2 or 10YR4/3 in the Munsell soil colour charts⁶) sandy loam or sandy silt loam. Consistency is friable and the structure is coarse granular to fine subangular blocky. Topsoils are slightly to moderately stony, at 10-20%.
- 3.2.4 Upper subsoils commonly contained too high a proportion of stone to be augered by hand which limited observations of this horizon. Where the upper subsoil was observed it comprises brown or dark yellowish brown (10YR4/3, 10YR4/4) medium sandy loam, sandy silt loam or medium clay loam. Consistency is friable and the structure is fine subangular blocky. Upper subsoils are moderately stony, estimated at 20%.
- 3.2.5 The lower subsoil could only be observed at one location (Observation 8/Pit 2). It comprises grey (10YR6/1) stoneless clay. Consistency is firm with a medium to coarse angular blocky structure. This matches the Hornbeam series of the Hornbeam 1 soil association (described in Section 2). This observation and the description of the soil association have been used to infer the lower subsoils of profiles where augers were impeded in the field survey.
- 3.2.6 A topsoil and a subsoil sample from Observation 9, which is representative of Soil Type 1, were analysed for soil health.
- 3.2.7 The topsoil sample has a high soil health index of 4.9. The soil pH is acid at 5.8 but is not too low to restrict uptake of nutrients essential for plant growth, and is acceptable for grassland. Soil organic matter is slightly higher than average and the microbial activity is very high, which are clear indications of a healthy soil. Soil nutrient levels are low to target levels for agricultural crops but are suitable for less intensive uses such as the creation of floristically-rich grasslands.
- 3.2.8 The subsoil sample has a moderate soil health index of 3.9. The soil pH remains acid at 5.9. Organic matter is 2.5% which is within the expected range for a subsoil, and the microbial activity is high. Soils nutrients (other than magnesium) are low.

Soil Type 2

- 3.2.9 The second soil type comprises dark greyish brown to brown (10YR4/2 or 10YR4/3) sandy silt loam or medium clay loam, with one medium sandy loam (Observation 3).

⁵ Hodgson, J. M. (Ed.) (1997). *Soil survey field handbook*. Soil Survey Technical Monograph No. 5, Silsoe.

⁶ Munsell Color (2009). *Munsell Soil Color Book*. Grand Rapids, MI, USA

Consistency is friable and structure is fine subangular blocky. Topsoils are slightly to moderately stony at 10-15%.

- 3.2.10 The upper subsoil comprises brown to dark yellowish brown (10YR4/3 to 10YR4/4) medium clay loam or heavy clay loam. Consistency is friable and structure is fine to medium subangular blocky. Stone content is slight to moderate at 15-20%.
- 3.2.11 Observation of the lower subsoil was commonly impeded by stone. Where lower subsoil was observed, it comprises dark yellowish brown or yellowish brown (10YR4/4, 10YR5/4) heavy clay loam or clay. The lower subsoil is stoneless to very slightly stony, with a medium to coarse angular blocky structure.
- 3.2.12 The topsoil sample has a very high soil health index of 5.6. The soil pH is slightly acid at 6.7 but in the optimum range for healthy plant growth. Soil organic matter is slightly higher than average and the microbial activity is very high. Soil nutrients levels are generally above adequate for good plant growth.

4.0 Outline Soil Resource Plan

4.1 Purpose of the Outline Soil Resource Plan

- 4.1.1 The Outline SRP has been prepared in line with Defra's Construction Code of Practice for the Sustainable Use of Soils on Construction Sites¹. It sets out a suitable strategy and good practice procedures for stripping, storing and reinstating soils throughout the construction of the proposed development. Adherence to the SRP will ensure that the physical soil properties are maintained throughout construction so that reinstated soil profiles will be able to support healthy root growth and achieve successful plant establishment for any future use. The Outline SRP will be developed in further detail as detailed design and construction information becomes available.

4.2 Proposed works

- 4.2.1 The proposed works will involve the construction of new roads and housing across the site, as shown on the indicative site layout (Paul Hewett Drawing No: 2036/PL.04 Rev L).
- 4.2.2 All areas of grassland and tree planting will require soil resources, whether retained in situ or translocated and restored. These areas comprise gardens and green spaces, such as recreational areas, attenuation areas and tree planting.

4.3 Soil Management Strategy

- 4.3.1 The survey has identified two soil types across the site, although the distinction between the soil types is mainly in the subsoil. As topsoils are relatively consistent and will be the principal soil resource that will be disturbed by construction and used in the restoration of land, these can be stripped and stored as one soil handling unit. Where subsoils are required to be stripped, light loamy soils and heavy clays should be stored in separate stockpiles and re-used separately for different purposes.
- 4.3.2 Inevitably, soil structures will be disrupted by handling and trafficking. To minimise any potential impacts all soil material will be handled only under appropriate conditions, when in a dry and friable state, which is when they are least susceptible to damage by

compaction and smearing. To avoid damage of soils on site, weather conditions will be continuously monitored and site works will stop in line with the following criteria:

- if there is very light rain or drizzle, handling can proceed for up to four hours unless the soils are already in too moist a state (determined by field tests);
- if there is normal rain, handling will cease if the rain has not stopped in 15 minutes;
- if there is heavy rain (as from intense showers, slow-moving depressions) handling will stop immediately;
- after rainfall has ceased, field tests will be applied to determine when handling may re-start.

4.3.3 The field tests used to determine the suitability of handling should be applied to soils from at least five locations in each area to be assessed. Records of all tests will be kept.

4.3.4 The soils should be assessed as follows:

Table 2: Assessing suitability of soil for handling

If the soil sample is wet, films of water are visible on the surfaces of grains and aggregates and/or when a soil sample is squeezed in the hand and it readily deforms into a cohesive "ball".	No handling
Peds (structures) break up/crumble readily when squeezed in the hand rather than forming into a ball	Handling OK
If the sample is moist, there is a slight dampness when squeezed between the fingers but it does not significantly change colour (darken) on further wetting	No handling by dozers but may be handled by tracked excavators if consistency test in Table 3 is passed
If the sample is dry and brittle it will look dry and change colour (darken) if water is added	Handling ok if consistency test in Table 3 is passed

4.3.5 The consistency of the soil should also be assessed in line with the following methodology.

Table 3: Consistency test

Impossible to mould a soil sample into a ball by hand because the soil is too hard (dry)	Handling OK
Impossible to mould a soil sample into a ball by hand because the soil is too loose (dry)	Handling OK
Impossible to mould a soil sample into a ball by hand because the soil is too loose (wet)	No handling
Possible to mould a soil sample into a ball by hand	Go to Table 4

Table 4: Additional consistency test when sample can be moulded into a ball

Impossible to roll the ball into a thread of 3mm diameter on a flat non-adhesive surface using light pressure from	Handling OK
--	-------------

the flat of the hand; the soil crumbles or disintegrates	
Possible to roll the ball into a thread of 3mm diameter on a flat non-adhesive surface using light pressure from the flat of the hand	No handling

4.4 Soil stripping

- 4.4.1 As far as reasonably practicable, areas to be stripped must first be cleared of vegetation by cutting or spraying with herbicides. This prevents anaerobic decay of vegetation buried within the topsoil stockpile.
- 4.4.2 Plant of an appropriate size will be used when stripping soils and creating storage bunds on site, the proposed location and volumes of which are to be provided within the soil management plan.
- 4.4.3 Stripping of topsoils will initially occur along the pre-defined main haul route and the planned access routes to soil stockpiles. Where possible, these routes should use the same areas of land to be used for proposed roads. During the stripping of the haul roads the excavator will start closest to the stockpile location to minimise the trafficking on undisturbed soils.
- 4.4.4 Topsoil across the site has an average depth of 250mm. Stripping to this depth would be appropriate and would not incorporate notable volumes of upper subsoil. Every effort should be made to strip the full depth of the topsoil resource. Stripped soils will be loaded into dump trucks and transported along the haul routes to the stockpiles.
- 4.4.5 Where subsoil is to be stored, topsoil from the proposed stockpile footprint must first be stripped. Subsoil will not be stockpiled with topsoil.

4.5 Stockpile formation

- 4.5.1 During formation of the stockpiles, the dump trucks will loose-tip the soil in heaps, starting at the furthest point in the storage area and working back toward the access point. When the entire storage area has been filled with heaps, the dozer (or other tracked machine) will level them and firm the surface for a second layer of heaps to be tipped.
- 4.5.2 This sequence will be repeated until the stockpile reaches its planned height. To help shed rainwater and prevent ponding and infiltration the dozer (or other tracked machine) will compact and re-grade the sides and top of the stockpile to form a smooth gradient. Topsoil stockpiles are proposed to have a height of up to 3m and a maximum side gradient of 1 in 2. Subsoil stockpiles up to 5m in height would be appropriate.

4.6 Stockpile maintenance

- 4.6.1 Any soils that are to be stockpiled and undisturbed for more than 6 months shall be seeded with a low maintenance grass/clover mix to minimise the impact from soil erosion, dust, weed infestation and the oxidation of organic matter.
- 4.6.2 The management of grass cover and weeds will be undertaken during the summer months by spraying, mowing or strimming to prevent the weeds from shedding their seeds.

- 4.6.3 Stockpiles will be monitored for signs of ponding water. If ponding occurs, temporary drainage will be put in place or regrading of the stockpile will be required.

4.7 Subsoil preparation

- 4.7.1 Soil placement will occur once the areas to be reinstated to gardens and green space are dry, even and clear of debris. Any debris that may have been incorporated into the subsoil resource during the construction phase will be removed, and subsoils will be ripped to remove any compaction arising from construction activities.

4.8 Topsoil respreading

- 4.8.1 Topsoil should be taken out of stockpiles when in a dry and friable condition, and loose-tipped onto the prepared subsoil. As all topsoil is to be retained on site, topsoil from the footprint of roads and dwellings will be spread on appropriate areas such as gardens or green spaces, thickening the topsoil horizon. Details on spreading areas and volumes will be provided within the soil management plan.
- 4.8.2 Respreading will involve the topsoil being taken out of the stockpile using the excavator and loaded into dump trucks to be transported to the prepared subsoil platform, where it will be loose-tipped in strips. The loose tip will be levelled by a tracked machine to the specified depth for the intended use.
- 4.8.3 Tree and grass establishment will be monitored subsequent to planting. At the first signs of failure, the soil profiles will be examined in order to identify any drainage or compaction issues, and a strategy to ameliorate these issues will be developed.

5.0 Summary

- 5.1.1 The site at Reading Golf Club extends to 12ha of predominantly permanent grassland. There are two soil types present at the site, distinguished primarily by their subsoil characteristics. The topsoils are medium or light textured, slightly acid, with high levels of microbial activity. They have high to very high indices of soil health.
- 5.1.2 The proposed construction works would mostly involve stripping topsoils only. These can be treated as one soil handling unit. Any stripping and storing of subsoils should differentiate between light loamy and heavy textured soils.
- 5.1.3 The outline soil resource plan within this document advises on soil handling, storage and reinstatement to reduce the effects of construction activities on soils at the site. All soils should be handled in line with the soil management strategy and only in appropriate conditions, when in a dry and friable state. This will minimise adverse effects and allow for good tree and grass establishment following construction. Further details of soil volumes to be stripped and restored will be provided in a detailed soil resource plan.

A.1 Laboratory Data

Determinand	A3 Topsoil	A9 Topsoil	A9 Subsoil	Units
Soil pH	6.7	5.8	5.9	
Phosphorus (P)	33.8	7	8.4	Mg/l (av)
Potassium (K)	273	82.2	53.6	Mg/l (av)
Magnesium (Mg)	92.4	86.2	73.7	Mg/l (av)

Determinand	A3 Topsoil	A9 Topsoil	A9 Subsoil	Units
Phosphorus (P)	3	0	0	ADAS Index
Potassium (K)	3	1	0	ADAS Index
Magnesium (Mg)	2	2	2	ADAS Index

Determinand	A3 Topsoil	A9 Topsoil	A9 Subsoil	Units
Sand 2.00-0.063 mm	55	45	38	% w/w
Silt 0.063-0.002 mm	32	39	42	% w/w
Clay <0.002 mm	13	16	20	% w/w
Organic Matter	4.8	4.7	2.5	% w/w
Texture	Sandy Loam	Sandy Silt Loam	Medium Clay Loam	

A.2 Soil Profile Summary

Wetness calculations are made according to the methodology given in Appendix 3 of the ALC guidelines, MAFF 1988. Droughtiness calculations are made according to the methodology given in Appendix 4 of the ALC guidelines, MAFF 1988. Grades are shown for drought, wetness and any other soil or site factors which are relevant. The overall Grade is set by the most limiting factor and shown on the right.

Stone types			Climate Data		Wetness Class Guidelines				
%	TAv	Eav	MDwheat	108	SPL within 80cm, gleying within 40cm	II >67cm	III 39-67cm	IV <39cm	V
hard	1	0.5	MDpotat o	101	SPL within 80cm, gleying at 40-70cm	>50cm	<50cm		
			FCD	146	No SPL but gleying within 40cm	coarse subsoil	I	other cases	II

3	T	0	28	mSL	10YR4/2			10	-	43	43	n	n	/	N/A	N/A	Other Land
		28	100	mCL	10YR4/4	Femn	com	15		73	57	n	n				
		100	120	hCL	10YR4/4	Fe	com	5		19	0	n	n				
									Total	135	100			Some fine sand through profile			
									MD	27	-1						
									Droughtiness grade (DR)	2	2						
4	T	0	25	SZL	10YR4/3			10	-	43	43	n	n	II-III	N/A	N/A	Other Land
		25	50	SZL	10YR4/4			20		34	34	n	n				
		50	120	C	10YR6/1			0	poor	56	32	n	y				
									Total	133	109						
									MD	25	8						
									Droughtiness grade (DR)	2	2						
5	T	0	30	mCL	10YR4/2			15	-	46	46	n	n	II	N/A	N/A	Other Land
		30	80	hCL	10YR4/4			20		62	64	n	n				
		80	120	C	10YR5/4			0	poor	32	0	n	y				
									Total	140	110						
									MD	32	9						
									Droughtiness grade (DR)	1	2						
6	T	0	26	mCL	10YR4/2			15	-	40	40	n	n	/	N/A	N/A	Other Land
		26	82	hCL	10YR4/4			15		60	60	n	n				
		82	120	C	10YR5/4	Fe	com	0	poor	30	0	n	y				
									Total	130	100						
P1									MD	22	-1						
									Droughtiness grade (DR)	2	2						

7	T	0	28	mCL	10YR4/3	Fe	com	10	-	45	45	n	n	//	N/A	N/A	Other Land
		28	80	mCL	10YR4/4	Fe	com	20		53	54	n	n				
		80	120	C	10YR5/4	Fe	com	0	poor	32	0	n	y				
									Total	130	99						
									MD	22	-2						
Droughtiness grade (DR)										2	2						
8	T	0	20	mSL	10YR4/3			10	-	31	31	n	n	///	N/A	N/A	Other Land
		20	40	mSL	10YR4/4			20		24	24	n	n				
		40	120	C	10YR6/1	Fe	many	0	poor	62	39	y	y				
									Total	117	94						
									MD	9	-7						
Droughtiness grade (DR)										2	2						
9	T	0	23	SZL	10YR4/2			10	-	39	39	n	n	//	N/A	N/A	Other Land
		23	60	mCL	10YR4/4			20		43	47	n	n				
		60	70	mCL	10YR4/4			20		8	13	n	n				
		70	120	C	10YR6/1			0	poor	33	0	n	y				
									Total	123	99						Gouge auger/ spade
									MD	15	-2						
Droughtiness grade (DR)										2	2						
10	T	0	24	mSL	10YR4/2			15	-	35	35	n	n	//	N/A	N/A	Other Land
		24	50	mSL	10YR4/4			20		31	31	n	n				
		50	60	mSL	10YR4/4			20		9	12	n	n				
		60	120	C	10YR6/1			0	poor	40	13	n	y				
									Total	114	91						USS-some fine sand
									MD	6	-10						
Droughtiness grade (DR)										2	3a						

11	T	0	28	mSL	10YR4/2	15	-	40	40	n	n	II-III	N/A	N/A	Other Land
		28	35	mSL	10YR4/4	20		8	8	n	n				
		35	50	mSL	10YR4/4	20		18	18	n	n				
		50	120	C	10YR6/1	0	poor	56	32	n	y				
							Total	123	99						
							MD	15	-2						
							Droughtiness grade (DR)	2	2						
12	T	0	20	SZL	10YR4/2	15	-	32	32	n	n	II-III	N/A	N/A	Other Land
		20	40	SZL	10YR4/4	20		27	27	n	n				
		40	50	SZL	10YR4/4	20		14	14	n	n				
		50	120	C	10YR6/1	0	poor	56	32	n	y				
							Total	129	105						
							MD	21	4						
							Droughtiness grade (DR)	2	2						
13	T	0	20	mSL	10YR4/2	20	-	27	27	n	n	II-III	N/A	N/A	Other Land
		20	50	mSL	10YR4/4	20		36	36	n	n				
		50	120	C	10YR6/1	0	poor	56	32	n	y				
							Total	119	95						
							MD	11	-6						
							Droughtiness grade (DR)	2	2						

A.3 Soil Photograph



Observation 13: Example of
topsoil stone content



Pit 1: Topsoil
stone example



Pit 1: Topsoil depth



Pit 1: Upper subsoil
extracted by auger



Pit 1: Lower subsoil
extracted by auger



Pit 1: Overview