

September 2019

# **Robert Hitchins Ltd**

# **Agricultural Land Classification and Soil Resources**

at Oakley Farm, Battledown, Cheltenham

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## 1 Introduction

- 1.1 Reading Agricultural Consultants Ltd (RAC) is instructed by Robert Hitchins Ltd to investigate the Agricultural Land Classification (ALC) and soil resources of land at Oakley Farm, Battledown, Cheltenham, by means of a detailed survey of soil and site characteristics. This report has been prepared on behalf of Robert Hitchins Ltd and successors in title to the land.
- 1.2 Guidance for assessing the quality of agricultural land in England and Wales is set out in the Ministry of Agriculture, Fisheries and Food (MAFF) revised guidelines and criteria for grading the quality of agricultural land (1988)<sup>1</sup>, and summarised in Natural England's Technical Information Note 049<sup>2</sup>.
- 1.3 Agricultural land in England and Wales is graded between 1 and 5, depending on the extent to which physical or chemical characteristics impose long-term limitations on agricultural use. The principal physical factors influencing grading are climate, site and soil which, together with interactions between them, form the basis for classifying land into one of the five grades.
- 1.4 Grade 1 land is excellent quality agricultural land with very minor or no limitations to agricultural use, and Grade 5 is very poor quality land, with severe limitations due to adverse soil, relief, climate or a combination of these. Grade 3 land is subdivided into Subgrade 3a (good quality land) and Subgrade 3b (moderate quality land). Land which is classified as Grades 1, 2 and 3a in the ALC system is defined as best and most versatile agricultural land.
- 1.5 As explained in Natural England's TIN049, the whole of England and Wales was mapped from reconnaissance field surveys in the late 1960s and early 1970s, to provide general strategic guidance on agricultural land quality for planners. This Provisional Series of maps was published on an Ordnance Survey base at a scale of One Inch to One Mile (1:63,360). The Provisional ALC map shows the site as undifferentiated Grade 3. However, TIN049 explains that:

"These maps are not sufficiently accurate for use in assessment of individual fields or development sites, and should not be used other than as general guidance. They show only five grades: their preparation preceded the subdivision of Grade 3 and the refinement of criteria, which occurred

<sup>&</sup>lt;sup>1</sup> **MAFF (1988).** Agricultural Land Classification of England and Wales. Revised guidelines and criteria for grading the quality of agricultural land. MAFF Publications.

<sup>&</sup>lt;sup>2</sup> **Natural England (2012).** *Technical Information Note 049 - Agricultural Land Classification: protecting the best and most versatile agricultural land,* Second Edition.

after 1976. They have not been updated and are out of print. A 1:250 000 scale map series based on the same information is available. These are more appropriate for the strategic use originally intended ..."

1.6 TIN049 goes on to explain that a definitive ALC grading should be obtained by undertaking a detailed survey according to the published guidelines, at an observation density of one boring per hectare. This survey follows the detailed methodology set out in the MAFF guidelines.

## 2 Site and climatic conditions

#### General features, land form and drainage

- 2.1 The site extends to 14.8ha of mostly agricultural grassland. Non-agricultural land comprises the farm buildings, access track and mature trees and hedgerows which surround a shallow valley. The site is bounded to the north, north-east, west and south by residential areas of Oakley and Battledown. Hewletts Reservoir is to the south-east.
- 2.2 Topography is moderately to steeply sloping from the highest altitude of 125m above Ordnance Datum (AOD) in the south-east of the site, falling to the north-west to an altitude of 78m AOD. The shallow valley is roughly central to the site and is aligned south-east to north-west.

#### Agro-climatic conditions

2.3 Agro-climatic data for the site have been interpolated from the Meteorological Office's standard 5km grid point data set at a representative altitude of 100m AOD, and are given in Table 1. The climate is temperate, with moderate rainfall and mild temperatures. Moisture deficits are moderate to moderately large. The Field Capacity Day regime (which estimates the duration of the period from the autumn or early winter to spring when the soil moisture deficit is zero) is slightly longer than is typical for lowland England, which is considered to be slightly unfavourable for agricultural work.

Parameter	Value
Average Annual Rainfall	707mm
Accumulated Temperatures >0°C	1,404 day°
Field Capacity Days	159 days
Average Moisture Deficit, wheat	100mm
Average Moisture Deficit, potatoes	89mm

### Soil parent material and soil type

- 2.4 The principal underlying geology mapped by the British Geological Survey<sup>3</sup> across the site is the Charmouth Mudstone Formation which includes dark grey laminated shales and dark, pale and bluish grey mudstones. There are no superficial deposits mapped.
- 2.5 The Soil Survey of England and Wales soil association mapping<sup>4</sup> (1:250,000 scale) shows the Martock association to be present across the site. Martock soils are characterised by silty over clayey and clayey soils over siltstone or shale. Subsoils are slowly permeable resulting in seasonal waterlogging. Profiles are commonly assessed as Wetness Class (WC) IV<sup>5</sup>.

## 3 Agricultural land quality

### Soil survey methods

- 3.1 Sixteen soil profiles were examined across the site using an Edelman (Dutch) auger at an observation density of one per hectare in accordance with the established recommendations for ALC surveys<sup>2</sup>. One observation pit was also excavated to examine subsoil structures. The locations of observations are indicated on Figure RAC8498-1. 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.

<sup>&</sup>lt;sup>3</sup> British Geological Survey (2019). Geology of Britain viewer, http://mapapps.bgs.ac.uk/geologyofbritain/home.html

<sup>&</sup>lt;sup>4</sup> Soil Survey of England and Wales (1984). Soils of South West England (1:250,000), Sheet 5

<sup>&</sup>lt;sup>5</sup> **Findlay et al (1984).** *Soils and Their Use in South West England*. Soil Survey of England and Wales Bulletin 14, Harpenden.

- 3.2 Two topsoil samples were submitted for laboratory determination of particle size distribution,
   pH, organic matter content and nutrient contents (P, K, Mg). Results are presented in Appendix
   1.
- 3.3 Soil Wetness Class (WC) was inferred from the matrix colour, presence or absence of, and depth to, greyish and ochreous gley mottling, and slowly permeable subsoil layers at least 15cm thick, in relation to the number of Field Capacity Days at the location.
- 3.4 Soil droughtiness was investigated by the calculation of moisture balance equations (given in Appendix 2). Crop-adjusted Available Profile Water (AP) is estimated from texture, stoniness and depth, and then compared to a calculated moisture deficit (MD) for the standard crops wheat and potatoes. The MD is a function of potential evapotranspiration and rainfall. Grading of the land can be affected if the AP is insufficient to balance the MD and droughtiness occurs.

#### Agricultural land classification and site limitations

- 3.5 Assessment of land quality has been carried out according to the MAFF revised ALC guidelines (1988)<sup>1</sup>. Soil profiles have been described according to Hodgson (1997)<sup>6</sup> which is the recognised source for describing soil profiles and characteristics according to the revised ALC guidelines.
- 3.6 Agricultural land quality at this site is affected by soil wetness and gradient which mostly limit to Subgrade 3b, with isolated profiles of better drained land in Subgrade 3a.
- 3.7 Two soil types have been identified. The main soils mostly include silty clay topsoil of 28cm average thickness. The topsoil is brown or dark greyish brown (10YR4/2 or 4/3 in the Munsell soil colour charts<sup>7</sup>) and is stoneless to very slightly stony, with up to 5% stone by volume. The topsoil has a moderately well-developed medium or fine subangular blocky structure and is relatively workable.
- 3.8 Upper subsoil is predominantly of light olive brown (2.5Y5/3) clay, with instances of heavy clay loam. Ochreous mottles are common and are indicative of restricted drainage. Stone content continues to be up to 5% by volume and mostly comprises small stones. Where the upper subsoil has a weakly developed and/or coarse angular or prismatic structure, the soil is slowly permeable. In some instances, the structure is moderately well developed, and the upper subsoil is gleyed but permeable. In the north-west of the site, the upper subsoil is slightly calcareous.

<sup>&</sup>lt;sup>6</sup> Hodgson, J. M. (Ed.) (1997). Soil survey field handbook. Soil Survey Technical Monograph No. 5, Silsoe.

<sup>&</sup>lt;sup>7</sup> Munsell Color (2009). Munsell Soil Color Book. Grand Rapids, MI, USA

- 3.9 Lower subsoil comprises thick grey (10Y6/1) clay which is prominently mottled. The structure is poor and coarse prismatic to massive. The horizon is gleyed and slowly permeable. Although the lower subsoils are generally stoneless, there is localised stoniness in the south of the site. The pit excavated in this location revealed large pebbles within the clay.
- 3.10 Profiles which include a permeable upper subsoil over the clay are of WC III. Profiles in which the soil becomes slowly permeable within 43cm depth are of WC IV. With heavy topsoil textures, profiles of WC III and IV are limited by wetness to Subgrade 3b.
- 3.11 The second soil type identified has very similar characteristics to the main type but is either permeable throughout or becomes slowly permeable at depths of 75 to 90cm. These profiles are of WC II. Profiles of WC II with heavy clay loam topsoil are limited by wetness to Subgrade 3a and with silty clay topsoil are of Subgrade 3b. One profile of Subgrade 3a, located in the south-east of the site, is also affected equally by microrelief, where the ground is more hummocky and uneven. Another of the better drained profiles is limited more severely by gradient.
- 3.12 Gradient is limiting to agricultural land quality in the centre, north and south-west of the site, where slopes of more than 7° occur. Land with gradients of more than 7° is precluded from being best and most versatile land due to safety and efficiency limitations for some farming machinery and greater risk of soil erosion from cultivations. This land is therefore limited to Subgrade 3b.
- 3.13 Two profiles are of Subgrade 3a, however they are isolated observations in the west and southeast of the site and do not form a coherent map unit. Therefore all of the agricultural land at the site is classified as Subgrade 3b as shown in Table 2 and Figure RAC8498-2. Photographs taken at the site are given in Appendix 3.

 Table 2: Agricultural land classification

Grade	Description	Area (ha)	% of agri land
3b	Moderate quality	13.0	100
Total Agricultural		13.0	100
Non-Agricultural		1.8	-

## Appendix 1: Laboratory Data

Determinand	Site 5	Site 11	Units
Sand 2.00-0.063 mm	7	10	% w/w
Silt 0.063-0.002 mm	47	50	% w/w
Clay <0.002 mm	46	40	% w/w
Organic Matter	6.0	4.8	% w/w
Texture	Silty Clay	Silty Clay	

Determinand	Site 5	Site 11	Units
Soil pH	6.5	6.0	
Phosphorus (P)	6.6	11.0	Mg/l (av)
Potassium (K)	76.6	86.6	Mg/l (av)
Magnesium (Mg)	336	174	Mg/l (av)

Determinand	Site 5	Site 11	Units			
Phosphorus (P)	0	1	ADAS Index			
Potassium (K)	1	1	ADAS Index			
Magnesium (Mg)	5	3	ADAS Index			

## Soil Texture by Particle Size Analysis



<sup>1</sup>Less than 50% sand in the mineral fraction <sup>2</sup> 50% sand or more in the mineral fraction

## Appendix 2: Soil Profile Summaries and Droughtiness Calculations

Wetness / workability limitations are determined 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.

	Stor	ne type	es			Climate Data			Wetness Class Guidelines					<i>III</i>		IV		V	
	%		TAv	Eav		MDwheat	100		SPL withi	n 80cm, gle	ying within 4	40cm	>71cm	43-710	m	<43cm			
	hard	ł	1	0.5		MDpotato	89		SPL withi	n 80cm, gle	ying at 40-7	'0cm	>56cm	<56cm	1				
	chall	k	10	7		FCD	159		No SPL b	ut gleying w	vithin 40cm		coarse su	ıbsoil	1	other c	ases	II	
	hard	1	flint &	pebble	J			1	Maximum depth of auger penetration is underlined		ned						I		
Site		Dej	oth	Texture	CaCO₃	Colour	Mottle	abund-	stone%	stone%	Struct-	APwheat	AP	Gley	SPL	wc	Wetness	Final	Limiting
No.		CI	n				colour	ance	hard	chalk	ure	mm	mm				grade WE	Grade	Factor(s)
1	т	0	25	ZC	n	10YR4/3			0	0		43	43			IV	3b	3b	WE
		25	65	С	n	10YR5/3	Fe	com.	0	0	poor	43	52	У	у				
		65	85	С	slight	10YR5/2	Fe	com.	0	0	poor	14	7	у	у				
		85	120	С	slight	10Y5/1	Fe	com.	0	0	poor	25	0	У	у	r			
											Total	124	101			Slope -	6°		
											MD	24	12						
									Droughti	ness grade	(DR)	2	1						
2	т	0	30	hCL	n	10YR4/3			0			51	51			11	3a	3a	WE
		30	55	hCL	n	10YR5/3	FeMn	com.	0			37	40	У					
		55	95	С	n	2.5Y5/3	FeMn	com.	0			32	24	У					
		95	120	С	n	2.5Y5/3	Fe	com.	0		poor	18	0	У	У	r			
											Total	138	115			Slope -	6°		
											MD	38	26						
									Droughti	ness grade	(DR)	1	1						
3	Т	0	32	hCL	n	10YR4/3	FeMn	few	5		-	55	55			IV	Зb	3b	WE GR
		32	70	С	n	2.5Y5/3	Fe	com.	5		poor	36	47	у	У				
		70	90	С	n	10Y6/1+2.5Y5/4	Fe	com.	0		poor	14	0	у	у				

		90	120	С	n	10Y6/1	Fe	many	0	poor	21	0	у	у	<b>r</b>			
										Total	126	102			Slope - 8	3°		
										MD	26	13						
									Droughtine	ss grade(DR)	2	1						
4	Т	0	40	ZC	n	10YR5/3	Fe	few	0	-	68	68			11	3b	3b	WE GR
		40	50	hCL	n	10YR5/3	Fe	com.	0		16	16	У					
		50	75	hCL	n	2.5Y5/3+5/4	Fe	com.	0		25	32	У					
		75	120	С	n	10Y6/1	Fe	many	0	poor	32	0	у	У				
										Total	140	116			Slope - 7	7-8°		
										MD	40	27						
									Droughtine	ss grade(DR)	1	1						
5	Т	0	22	ZC	n	10YR4/2			2	_	39	39			IV	3b	3b	WE
P1		22	65	С	n	10Y6/1	Fe	com.	15	poor	40	48	у	У				
		<u>65</u>	120	С	n	10Y6/1	Fe	com.	20	poor	31	5	у	У				
										Total	111	92						
										MD	11	3						
									Droughtine	ss grade(DR)	2	2						
6	Т	0	35	ZC	n	10YR4/3	Fe	com.	2	-	58	58			IV	3b	3b	WE
		35	70	С	n	2.5Y5/3	FeMn	com.	0	poor	34	46	У	У				
		70	95	С	n	10Y5/1	Fe	com.	0	poor	18	0	у	У				
		95	120	С	n	10Y5/1	Fe	com.	0		20	0	У		ſ			
										Total	129	104			Slope - 6	5°		
										MD	29	15						
									Droughtine	ss grade(DR)	2	1						
7	Т	0	30	ZC	n	10YR4/3			0	-	51	51			IV	3b	3b	WE
		30	40	hCL	n	2.5Y5/3	Fe	com.	1		16	16	У					
		40	60	С	n	10Y6/1+2.5Y5/3	Fe	com.	0	poor	20	26	У	У				
		60	120	С	n	10Y6/1	Fe	com.	0	poor	42	13	У	У	<b>-</b>			
										Total	129	106			Slope - 8	5-6°		

										MD	20	47						
									<b>D</b>		29	17			L			
									Droughtine	ss grade(DR)	2	1						
8	Т	0	30	hCL	n	10YR5/3			0	-	54	51			11	3a	3a	WE MR
		30	80	С	n	10YR5/3	Fe	com.	5		53	61	У					
		80	120	С	n	2.5Y5/3	Fe	com.	0		32	0	У		<b></b>			
										Total	139	112			Level			
										MD	39	23						
									Droughtine	ss grade(DR)	1	1						
9	Т	0	28	hCL	n	10YR5/3			0	-	50	50			<i>III</i>	3b	3b	WE
		28	55	С	n	2.5Y5/3	Fe	com.	5		37	41	у					
		55	120	С	n	10Y6/1	Fe	com.	0	poor	46	20	у	У				
										Total	133	111			Level			
										MD	33	22						
									Droughtine	ss grade(DR)	1	1						
10	Т	0	30	ZC	n	10YR4/3			2	_	50	50			IV	3b	3b	WE
		30	65	С	n	2.5Y5/3	Fe	com.	0	poor	37	46	у	у				
		65	120	С	n	10Y6/1	Fe	com.	0	poor	39	7	у	у				
										Total	125	102			Slope - 2	-4°		
										MD	25	13						
									Droughtine	ss grade(DR)	2	1						
11	Т	0	30	ZC	n	10YR4/2			2	-	53	53			<i>III</i>	3b	3b	WE
		30	45	hCL	n	2.5Y5/3	Fe	com.	0		24	24	у					
		45	120	С	n	10Y6/1	Fe	com.	0	poor	56	33	у	у				
										Total	132	109			Slope - 6	0		
										MD	32	20						
									Droughtine	ss grade(DR)	1	1						
12	Т	0	35	ZC	n	10YR4/3			1		59	59			IV	3b	3b	WE
		35	80	С	n	2.5Y5/3	Fe	com.	0	poor	41	46	у	у				
		80	120	С	n	10Y6/1	Fe	com.	0	poor	28	0	у	У				

										Total	127	104			Slope - 6	6-7°		
										MD	27	15						
									Droughtines	s grade(DR)	2	1						
13	Т	0	20	ZC	n	10YR4/2			1	-	34	34			<i>III</i>	3b	3b	WE GR
		20	60	С	n	10YR5/3	Fe	com.	0		56	64	У					
		60	120	С	n	2.5Y5/3	FeMn	com.	0	poor	42	13	. у	у				
										Total	132	111			Slope - 7	7-8°		
										MD	32	22						
									Droughtines	s grade(DR)	1	1						
14	Т	0	20	ZC	n	10YR4/2			0	-	34	34			IV	3b	3b	WE GR
		20	60	С	n	2.5Y5/3	Fe	com.	0	poor	46	52	У	У				
		60	120	С	n	10Y6/1	Fe	com.	0	poor	42	13	. у	у	<b>-</b>			
										Total	122	99			Slope - 7	7-8°		
										MD	22	10						
									Droughtines	s grade(DR)	2	1						
15	т	0	30	ZC	n	10YR4/2			0	-	51	51			<i>III</i>	3b	3b	WE GR
		30	60	С	n	2.5Y5/3	Fe	com.	0		40	48	У					
		60	80	С	n	2.5Y5/3-5/4	Fe	com.	0	poor	14	13	У	У				
		80	120	С	n	2.5Y5/1	FeMn	com.	0	poor	28	0	. у	У				
										Total	133	112			Slope - 7	7-8°		
										MD	33	23						
									Droughtines	s grade(DR)	1	1						
16	т	0	30	ZC	n	10YR4/2			1	-	51	51			IV	3b	3b	WE GR
		30	70	С	slight	2.5Y5/3	Fe	com.	5	m/poor	42	55	У	у				
		<u>70</u>	120	С	slight	2.5Y5/3	Fe	com.	10	poor	32	0	у	У	<b>r</b>			
										Total	124	106			Foot of 7	7-8° slope		
										MD	24	17						
									Droughtines	s grade(DR)	2	1						

# Appendix 3: Site Photographs



Pit 1

Topsoil

Subsoil

Pebbles in Pit 1 Subsoil



Permeable upper subsoil (Ob 7)

Permeable upper subsoil (Ob 8)



