December 2018

A C Goatham & Sons

Agricultural Land Classification and Soil Resources

at

Pump Farm, Lower Rainham

Beechwood Court,
Long Toll, Woodcote,
RG8 0RR

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1 Introduction

1.1 Reading Agricultural Consultants Ltd (RAC) is instructed by A C Goatham & Sons to investigate the Agricultural Land Classification (ALC) and soil resources of land at Pump Farm, Lower Rainham, by means of a detailed survey of soil and site characteristics.

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)[1] , and summarised in Natural England's Technical Information Note 049[2].

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 Grade 1. 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 after 1976. They have not been updated and are out of print. A 1:250 000 scale map series based*

[1] **MAFF (1988).** *Agricultural Land Classification of England and Wales. Revised guidelines and criteria for grading the quality of agricultural land*. MAFF Publications.

[2] **Natural England (2012).** *Technical Information Note 049 - Agricultural Land Classification: protecting the best and most versatile agricultural land*, Second Edition.

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 approximately 52ha, predominantly comprising apple orchard with a small area of grass in the east. The site is bounded to the north by Lower Rainham Road, to the east by Lower Bloors Lane, to the south by a railway line and to the west by agricultural land and residential properties off Lower Twydall Lane.

2.2 There is a general downward slope across the site from west to east, with localised undulations. The altitude falls from around 30m above Ordnance Datum (AOD) to 10m AOD. Slopes are shallow and not limiting to agricultural land quality.

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 20m AOD, and are given in Table 1. The site is warm and moderately dry with large crop moisture deficits. The Field Capacity Day (FCD) regime is shorter than is typical for lowland England, providing adequate opportunities for agricultural field work.

Table 1: Local agro-climatic conditions

Parameter	Value
Average Annual Rainfall	619mm
Accumulated Temperatures >0°C	1,478 day°
Field Capacity Days	124 days
Average Moisture Deficit, wheat	121mm
Average Moisture Deficit, potatoes	118mm

Soil parent material and soil type

2.4 The underlying geology mapped by the British Geological Survey[3] in the east and west of the site is the Thanet Formation, which mostly includes fine-grained sand that can be clayey. A narrow

[3] **British Geological Survey (2018).** *Geology of Britain viewer*, http://mapapps.bgs.ac.uk/geologyofbritain/home.html

band of the Seaford Chalk Formation runs through the site, aligned roughly north east to south west and comprises firm white chalk. Superficial deposits of glacial Head overlie the chalk and may include gravel, sand and clay.

2.5 The Soil Survey of England and Wales soil association mapping[4] (1:250,000 scale) shows the Hamble 1 association across the site. Hamble 1 soils are mainly characterised by deep, often stoneless, fine silty soils. Component series within the association may be affected by groundwater, have impeded drainage at depth or be shallow over chalk. However profiles are typically well drained, of WC I[5].

3 Agricultural land quality

Soil survey methods

3.1 A total of 69 soil profiles were examined using an Edelman (Dutch) or gouge auger at an observation density of more than one per hectare. One observation pit was also excavated to examine subsoil structures. The locations of observations are indicated on Figure RAC8231-1. 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.

3.2 Four topsoil samples were submitted for laboratory determination of particle size distribution, pH, organic matter content and nutrient contents (P, K, Mg). Two of the samples were

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

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

additionally subject to sand fractionation to determine the proportions of fine, medium and coarse sand. 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 FCDs 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 agricultural land quality has been carried out according to the MAFF revised ALC guidelines (1988)[1]. Soil profiles have been described according to Hodgson (1997)[6] which is the recognised source for describing soil profiles and characteristics according to the revised ALC guidelines. Where profiles could not be observed to depth due to stones, data from surrounding observations have been used to infer likely subsoil conditions.

3.6 Agricultural land quality at this site is affected mostly by soil droughtiness, with some profiles also limited by soil wetness. Most of the site is limited to Grade 2, with smaller areas of Grade 1.

3.7 There is considerable variability in the soil characteristics across the site. Five main soil types are identified, as set out below and shown in Figure RAC8231-2.

C1 Deep Light Silts

Topsoil 0-25cm: dark brown silt loam to medium silty clay loam, not more than 5% stone flint. Very friable structure with many roots.

Upper Subsoil 25-50cm: brown becoming yellow-brown silt loam or medium silty clay loam. Some organic matter inclusion. Very friable.

Lower Subsoil 50-120cm: yellow-brown or strong brown silty clay loam or silt loam with moderate structure, usually unmottled, varying from stoneless to slightly stony.

Variants: **x** contains moderately or very stony layers within 90cm.

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

k Chalk or Chalky Drift occur within 90cm

Profiles are well drained, of WC I. Crop available water is high, except where subsoil contains stony layers.

C2 Deep Medium Silts

Topsoil 0-25 cm: dark brown medium silty clay loam or clay loam. Friable; 2-10% stones, locally more.

Upper Subsoil 25-50cm: brown becoming yellow-brown medium (silty) clay loam. Moderate structure.

Lower Subsoil 50-120 cm: yellow-brown or strong brown silty clay loam, commonly heavier textured and mottled below 80cm.

Variants: **x** moderately or very stony layers within 90cm.

k Chalk, Chalky Clay or Chalky Drift within 90cm.

c clayey layers in lower subsoil (permeable).

Profiles are well drained, of WC I. Crop available water is good. C2 soils tend to be stonier than C1 soils.

C2g Medium soils with some drainage impedance

Topsoil 0-25cm: dark brown medium silty clay loam or clay loam. Friable; 2-10% stones

Upper Subsoil 25-50cm: greyish brown heavy clay loam with common ferruginous (iron) mottles.

Lower Subsoil 50-120cm: greyish brown, mottled and variable texture - locally fine sandy; stoneless to very slightly stony (Thanet Beds).

Profiles are imperfectly drained, of WC II. Crop available water is good.

G2 Medium soils over clay

Topsoil 0-25cm: dark brown medium silty clay loam or clay loam. Friable; 2-10% stones.

Upper Subsoil 25-50cm: greyish-brown heavier subsoil with common ferruginous mottles. Clay starts at depths varying from 25 to 55cm.

Lower Subsoil 50-120cm: greyish-brown mottled clay (slowly permeable). Stoneless to very slightly stony. (Thanet Beds Clay).

Profiles are imperfectly to moderately well drained, of WC II or locally III. Crop available water is good.

C3 and G3

Variants of above with heavy (silty) clay loam topsoil. This poses a workability limitation even if the profile is well drained below.

3.8 It should be noted that many of the topsoils were hand textured in the field as medium silty clay loam. The particle size analysis undertaken by the laboratory shows that some of the samples assessed as medium silty clay loam are medium clay loams. Sand fractionation shows that there is a relatively high proportion of fine and very fine sand (0.212-0.106mm and 0.106-0.063mm respectively) in the samples analysed. Although the proportions of clay, silt and sand place the samples within the ranges for medium clay loam, the workability and the 'feel' of the topsoils is often, but not always, considered as medium silty clay loam. The soils have been noted accordingly.

3.9 A majority of the soils at the site are most affected by droughtiness, due to large moisture deficits, slight stoniness and medium or heavy textured subsoils. The limitation is predominantly slight, to Grade 2. In a few places the upper subsoil is moderately stony or chalky, which results in a droughtiness limitation to Subgrade 3a. Some low-stone light silty profiles have adequate available water and have no limitation to agricultural land quality, classified as Grade 1.

3.10 Profiles of WC I with heavy topsoil textures and profiles of WC II with medium topsoil textures are limited slightly by wetness and workability to Grade 2. There are rare instances of profiles of WC III, in which there exists a wetness limitation to Subgrade 3a.

3.11 There are also rare instances of profiles limited equally by droughtiness and topsoil stone content, where stones larger than 2cm exceed 5% by volume. Large stones can cause additional wear and tear to agricultural machinery as well as potentially affecting crop establishment and nutrient holding capacity of the soil. These profiles are limited to Grades 2 and 3a.

3.12 Most of the land at the site is of very good quality Grade 2. Levels of organic matter are ample at between 3.1 and 5.6%, and are reflected in the generally very good structure of the topsoil.

3.13 The areas of each ALC grade of land on the site are given in Table 2 and are shown in Figure RAC8231-3. Photographs taken at the site are given in Appendix 3.

Table 2: Agricultural land classification

Grade	Description	Area (ha)	% of agri land
1	Excellent quality	8.6	17
2	Very good quality	40.6	79
3a	Good quality	2.3	4
Total Agricultural		51.5	100
	Non-agricultural	0.5	-

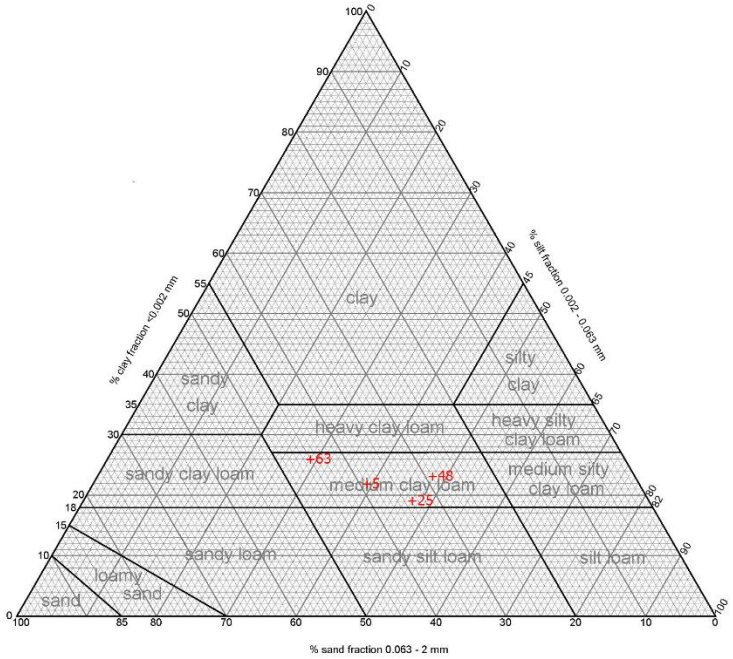
Appendix 1: Laboratory Data

Determinand	Site 5	Site 25	Site 48	Site 63	Units
Sand 2.00-0.063 mm	-	-	29	45	% w/w
Coarse (2.00-0.60mm)	1	2	-	-	% w/w
Medium (0.60-0.212mm)	3	7	-	-	% w/w
Fine (0.212-0.106mm)	8	7	-	-	% w/w
Very fine (0.106-0.063mm)	27	18	-	-	% w/w
Silt 0.063-0.002 mm	39	47	48	29	% w/w
Clay <0.002 mm	22	19	23	26	% w/w
Organic Matter	4.1	5.0	5.6	3.1	% w/w
Texture	Medium Clay Loam	Medium Clay Loam	Medium Clay Loam	Medium Clay Loam	

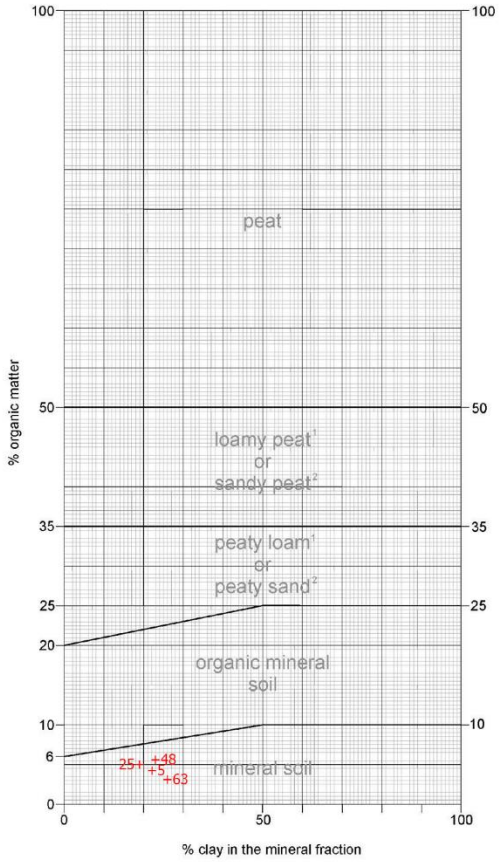
Determinand	Site 5	Site 25	Site 48	Site 63	Units
Soil pH	5.8	6.5	7.1	5.6	
Phosphorus (P)	33	94	62	43	Mg/l (av)
Potassium (K)	88	385	291	322	Mg/l (av)
Magnesium (Mg)	157	93	192	149	Mg/l (av)

Determinand	Site 5	Site 25	Site 48	Site 63	Units
Phosphorus (P)	3	5	4	3	ADAS Index
Potassium (K)	1	3	3	3	ADAS Index
Magnesium (Mg)	3	2	4	3	ADAS Index

Soil Texture by Particle Size Analysis



Organic Matter Class



[1] Less than 50% sand in the mineral fraction

[2] 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.

Stone types		
%	TAv	Eav
hard	1	0.5
chalk	10	7

Climate Data	
MDwheat	121
MDpotato	118
FCD	124
AAR	619

Wetness Class Guidelines	*II*	*III*	*IV*	*V*
SPL within 80cm, gleying within 40cm	>61cm	>61cm		
SPL within 80cm, gleying at 40-70cm	>41cm	<41cm		
No SPL but gleying within 40cm	coarse subsoil	*I*	other cases	*II*

hard flint

Maximum depth of auger penetration is underlined

20m

ATO 1478

Site No.		Depth cm		Texture	$CaCO_3$	Colour	Mottle colour	abund-ance	stone% hard	stone% chalk	Struct-ure	APwheat mm	AP potato mm	Gley	SPL	WC	Wetness grade WE	Final Grade	Limiting Factor(s)
1	T	0	30	mZCL	n	10YR4/2			10			52	52			*II*	2	**2**	WE DR
		30	55	mZCL	n	10YR4/3			10			35	39						
		55	70	C	n	10YR5/3	Fe	com	5			11	23	y					
		70	120	C	n	10YR5/2	Fe	com	1		poor	35	0	y	y				
											Total	**134**	**113**						
											MD	13	-5						
									Droughtiness grade (DR)			2	2						
2	T	0	20	mZCL	n	10YR4/2			5		-	36	36			*II*	2	**2**	WE DR
		20	80	C	n	10YR5/3	Fe	com	5			69	76	y					
		80	120	mZCL	n	2.5Y5/3	Fe	com	2			39	0	y					
											Total	**144**	**112**						
											MD	23	-6						
									Droughtiness grade (DR)			2	2						
3	T	0	38	mZCL	y	10YR4/2			15		-	62	62			*II*	2	**3a**	DR
		38	45	C	y	10YR5/3			5	20		10	10	y					
		45	80	C	y	2.5Y5/3			5	60		27	29	y					
		80	120	Chalk								28	0						
											Total	**127**	**101**						
											MD	6	-17						
									Droughtiness grade (DR)			2	3a						

4	T	0	30	mZCL	n	10YR4/2			10		-	52	52			*II*	2	**2**	WE DR
		30	45	mZCL	n	10YR4/3			5			24	24						
		45	70	C	n	10YR5/3			1			24	40						
		70	120	C	n	10YR5/2	Fe	com	1		poor	35	0	y	y				
											Total	**134**	**116**						
											MD	13	-2						
											Droughtiness grade (DR)	2	2						
5	T	0	38	mCL	n	10YR4/2			2		-	71	71			*I*	1	**2**	DR
		38	70	mZCL	n	10YR4/3			2			40	53						
		70	120	mZCL	n	10YR4/3			5	20		45	0						
											Total	**155**	**124**						
											MD	34	6						
											Droughtiness grade (DR)	1	2						
6	T	0	24	mZCL	y	10YR4/2			2	8	-	43	43			*III*	3a	**3a**	WE
		24	28	hZCL	y	10YR4/3	Fe	com	2	10		6	6	y					
		28	45	hZCL	y	10YR4/3	Fe	com	10	10		25	25	y					
		45	120	C	y	10YR5/3			2	10	poor	62	38	y	y				
											Total	**136**	**112**						
											MD	15	-6						
											Droughtiness grade (DR)	2	2						
7	T	0	25	mCL	n	10YR3/2			5		-	43	43			*II*	2	**2**	WE DR
		25	40	hCL	n	10YR4/2	Fe	com	5			23	23	y					
		40	70	mCL	n	2.5Y5/3	Fe	com	2			35	47	y					
		70	80	mCL	n	2.5Y5/3	Fe	many	2			10	0	y					
		80	120	mCL	n	2.5Y5/3	Fe	com	2			39	0	y					
											Total	**150**	**113**						
											MD	29	-5						
											Droughtiness grade (DR)	2	2						
8	T	0	25	hCL	n	10YR4/2			2		-	44	44			*I*	2	**2**	WK DR
		25	40	hCL	y	10YR4/3			2	15		22	22						
		40	75	C	n	10YR5/3	Fe	com	2	2		35	47	y					
		75	120	ZC	n	2.5Y5/3	Fe	com	2			35	0	y					
											Total	**137**	**113**						
											MD	16	-5						
											Droughtiness grade (DR)	2	2						

9	T	0	26	mZCL	n	10YR4/2			5		-	47	47			*II*	2	**2**	WE DR
		26	55	hCL	n	10YR5/3	Fe	com	1			43	46	y					
		55	75	mZCL	n	2.5Y5/3	Fe	com	0			20	26	y					
		75	120	mZCL	n	2.5Y6/1	Fe	com	0			45	0	y					
											Total	**155**	**119**						
											MD	34	1						
											Droughtiness grade (DR)	1	2						
10	T	0	40	mZCL	n	10YR4/2			5		-	72	72			*I*	1	**2**	DR
		40	75	mZCL	n	10YR5/3	Fe	com	0			42	51	y					
		75	120	hZCL	n	2.5Y5/3	Fe	com	0			45	0	y					
											Total	**159**	**123**						
											MD	38	5						
											Droughtiness grade (DR)	1	2						
11	T	0	30	mZCL	n	10YR4/2			2		-	56	56			*II*	2	**2**	WE DR
		30	70	hCL	n	10YR5/3	Fe	com	0			52	64	y					
		70	120	mCL	n	2.5Y5/3	Fe	com	0			50	0	y					
											Total	**158**	**120**						
											MD	37	2						
											Droughtiness grade (DR)	1	2						
12	T	0	38	mZCL	n	10YR3/2			10		-	65	65			*I*	1	**2**	DR
		38	45	mZCL	n	10YR4/2			0			12	12						
		45	60	hCL	n	10YR5/3	Fe	com	0	12		17	23	y					
		60	80	fSZL	n	10YR5/4	Fe	many	2			29	21						
		80	120	fS	n	2.5Y6/1	Fe	com	5			46	0	y					
											Total	**170**	**121**						
											MD	49	3						
											Droughtiness grade (DR)	1	2						
13	T	0	28	mZCL	n	10YR4/2			10		-	48	48			*I*	1	**2**	DR
		28	40	mZCL	n	10YR3/2			0	15		19	19						
		40	80	C	n	7.5YR4/4	Fe	com	0			40	48	y					
		80	120	SCL	n	10YR5/4	Fe	com	2			39	0						
											Total	**147**	**115**						
											MD	26	-3						
											Droughtiness grade (DR)	2	2						

14	T	0	34	mZCL	n	10YR4/2			2	-	63	63		*II-III*	2	**2**	WE DR
		34	100	hZCL	n	10YR5/3	Fe	com	0	m/poor	63	52	y				
		100	120	ZC	n	10YR5/3	Fe	com	0	m/poor	15	0	y				
										Total	**142**	**116**					
										MD	21	-2					
									Droughtiness grade (DR)		2	2					
15	T	0	25	mZCL	n	10YR4/2			4	-	46	46		*I*	1	**2**	DR
		25	40	hZCL	slight	10YR4/4			10	good	29	29					
		40	55	ZCL		10YR6/6			20	good	22	26					
		55	120	ZCL					30		46	18					
						or organic				Total	**143**	**118**					
										MD	22	0					
									Droughtiness grade (DR)		2	2					
16	T	0	26	mZCL	n	10YR4/3			4	-	48	48		*I*	1	**2**	DR
		26	42	mZCL		10YR5/4			5		26	26					
		42	50	SZL		10YR6/6			10	good	14	14					
		50	70	hZCL		7.5YR6/8			10		18	31					
		70	90	mCL	very	10YR7/4			15	10	17	0					
		90	120	mCL		7.5YR6/8			30	10	21	0					
					compact					Total	**142**	**118**					
					topsoil					MD	21	0					
									Droughtiness grade (DR)		2	2					
17	T	0	32	fSZL	n	10YR4/2			4	-	68	68		*I*	1	**1**	none
		32	50	ZL		10YR6/8			5		38	38					
		50	86	mZCL		10YR6/8			10		33	31					
		86	120	Chalk					5		23	0					
										Total	**161**	**136**					
										MD	40	18					
									Droughtiness grade (DR)		1	1					
18	T	0	25	mZCL	n	10YR4/3			4	-	46	46		*I*	1	**2**	DR
		25	75	mZCL		10YR6/4			5		64	73					

		75	100	mZCL		10YR6/6			15			21	0						
		100	120	ZCL					30			14	0						
					compact						Total	**146**	**119**						
					topsoil						MD	25	1						
										Droughtiness grade (DR)		2	2						
19	T	0	20	mZCL	n	10YR4/3			6	-		36	36			*I*	1	**2**	DR
		20	45	mZCL		10YR4/4			15	good		45	45						
		45	80	hZCL		10YR6/4			10			35	39						
		80	120	ZCL					30			29	0						
											Total	**144**	**119**						
											MD	23	1						
										Droughtiness grade (DR)		2	2						
20	T	0	20	mZCL	n	10YR4/2			4	-		37	37			*I*	1	**2**	DR
		20	32	mZCL		10YR5/2			20	good		20	20						
		32	75	mZCL		10YR6/4			10			50	59						
		75	120	ZCL					30			32	0	y					
											Total	**139**	**115**						
											MD	18	-3						
										Droughtiness grade (DR)		2	2						
21	T	0	25	mCL	n	10YR2/2			4	-		43	43			*I*	1	**2**	DR
		25	50	mCL		10YR6/4			10	good		48	48						
		50	70	mZCL		10YR5/4			10			18	31						
		70	90	hZCL		7.5YR6/8	grey	com	0	poor		12	0	y					
		90	120	hZCL					20	poor		15	0						
											Total	**136**	**122**		ST.stone	a few large			
											MD	15	4						
										Droughtiness grade (DR)		2	2						
22	T	0	23	mCL	n	10YR5/3			6	-		39	39			*I*	1	**2**	DR
		23	30	mCL		10YR5/2			20	good		12	12						
		30	50	mZCL		10YR5/4			5			32	32						

		50	75	mZCL		10YR6/6		10		23	31					
		75	120	hZCL		7.5YR6/8		10	m/poor	33	0					
									Total	**139**	**114**					
									MD	18	-4					
									Droughtiness grade (DR)	2	2					
23	T	0	25	fSZL	n	10YR4/3		6	-	52	52		/	1	**1**	none
		25	40	ZL		10YR5/2		10	good	31	31					
		40	70	mZCL		10YR6/6		10		34	46					
		70	90	mCL		7.5YR6/6		10		18	0					
		90	120	CL				20		24	0					
									Total	**159**	**129**					
									MD	38	11					
									Droughtiness grade (DR)	1	1					
24	T	0	24	mCL	n	10YR4/3		8	-	40	40		/	1	**2**	DR
		24	35	ZCL		10YR5/2		5	good	22	22					
		35	50	hZCL		10YR6/6		15		22	22					
		50	70	C		7.5YR6/6		5	m/poor	14	28					
		70	120	C				30		29	0					
									Total	**127**	**111**					
									MD	6	-7					
									Droughtiness grade (DR)	2	2					
25	T	0	25	fSZL	n	10YR3/3		4	-	53	53		/	1	**1**	none
		25	55	ZL	n	10YR6/6		10		56	60					
		55	120	mZCL				30		46	18					
									Total	**155**	**131**					
						Organic?			MD	34	13					
									Droughtiness grade (DR)	1	1					
26	T	0	20	mZCL	n	10YR4/2		8	-	35	35		/	1	**3a**	DR
		20	35	ZCL		10YR5/4	OM	20	good	26	26					
		35	52	hZCL		10YR6/6		10		25	26					

		52	120	ZC		10YR6/8		30			39	19							
										Total	**125**	**106**							
										MD	4	-12							
									Droughtiness grade (DR)		3a	3a							
27	T	0	20	oCL	n	10YR3/2		6		-	53	53		*I*	1	**1**	none		
		20	32	mCL		10YR5/2	OM	15		good	22	22							
		32	50	hZCL		10YR5/4	OM	10			28	28							
		50	85	ZC		10YR6/8		5			27	29							
		85	120	mCL	very	10YR7/4		10	10		31	0							
										Total	**159**	**131**							
					Chalky Drift					MD	38	13							
									Droughtiness grade (DR)		1	1							
28	T	0	25	mZCL	n	10YR4/3		6		-	45	45		*I*	1	**2**	DR		
		25	40	mZCL	mod	10YR4/6	OM	20		good	26	26							
		40	50	mZCL	very	2.5Y7/4		10	10		15	15							
		50	75	mCL	extr.	2.5Y7/3		5	20		22	28							
		75	120	Chalk				5			30	0							
					Chalky Drift	on Chalk				Total	**137**	**113**							
										MD	16	-5							
									Droughtiness grade (DR)		2	2							
29	T	0	24	mZCL	n	10YR4/2		20		-	37	37		*I*	1	**3a**	DR ST		
		24	42	hZCL		10YR5/2	OM	15		good	32	32							
		42	80	ZC		10YR6/4	OM	10			33	38							
		80	100	hZCL				5		poor	11	0							
		100	120	hZCL				5		poor	11	0							
										Total	**125**	**107**	ST.stone>2cm			large flint	3a		
										MD	4	-11							
									Droughtiness grade (DR)		3a	3a							
30	T	0	30	mCL	n	10YR4/3		10		-	49	49		*I*	1	**2**	DR ST		
		30	50	mCL		10YR6/4	OM	15		good	36	36							

		50	80	mZCL		10YR6/6		10		27	31						
		80	100	mZCL				20		16	0						
		100	120	mZCL				30		14	0						
									Total	**143**	**116**	ST.stone>2cm		>5% ?	2		
									MD	22	-2						
								Droughtiness grade (DR)		2	2						
31	T	0	25	mZCL	n	10YR4/3		4	-	46	46		/	1	**1**	none	
		25	40	ZL		10YR4/6	OM	5	good	33	33						
		40	90	ZL		10YR5/8		10		71	60						
		90	120	mZCL				40	poor	11	0						
					lower OM				Total	**160**	**138**						
									MD	39	20						
								Droughtiness grade (DR)		1	1						
32	T	0	25	mZCL	n	10YR3/3		6	-	45	45		/	1	**1**	none	
		25	40	ZL		10YR6/4		6		31	31						
		40	55	ZL		10YR6/4		15		25	28						
		55	80	ZL/ZCL		10YR6/6		5		29	27						
		80	120	mZCL				30		29	0						
									Total	**158**	**131**						
									MD	37	13						
								Droughtiness grade (DR)		1	1						
33	T	0	25	mZCL		10YR3/2		4	-	46	46		/	1	**1**	none	
		25	40	ZL		10YR4/4		5		31	31						
		40	65	ZL		10YR6/4		5		41	52						
		65	80	mZCL		7.5YR6/6		5		14	8						
		80	120	mZCL				5	poor	23	0						
					oZL ?				Total	**155**	**138**						
									MD	34	20						
								Droughtiness grade (DR)		1	1						
34	T	0	26	mZCL	n	10YR4/3		4	-	48	48		/	1	**1**	none	

		26	42	mZCL		10YR5/4			10		good	30	30					borderline	
		42	65	ZL		10YR6/8			10			35	46						
		65	120	ZCL					30			39	6						
											Total	**152**	**130**						
											MD	31	12						
											Droughtiness grade (DR)	1	1						
35	T	0	26	mCL	n	10YR4/3			4		-	45	45			*I*	1	**2**	DR
		26	60	mZCL		10YR5/4			8			47	53						
		60	80	hZCL		7.5YR6/8	grey	com	10			18	15	y					
		80	98	C	mod	7.5YR7/4			10	10		13	0						
		98	120	mCL	very	7.5YR7/2			30	10		15	0						
											Total	**138**	**114**						
											MD	17	-4						
											Droughtiness grade (DR)	2	2						
36	T	0	24	hCL	n	10YR5/3			4		-	42	42			*I*	2	**2**	WK DR
		24	55	ZCL		10YR5/4			8			45	49						
		55	120	ZCL					30			46	18	y					
					Twice						Total	**134**	**109**						
					vst 55						MD	13	-9						
											Droughtiness grade (DR)	2	2						
37	T	0	25	fSZL		10YR4/3			6		-	52	52			*I*	1	**1**	none
		25	50	ZL		10YR5/4	Mn	few	15		comp	47	47						
		50	98	ZL		10YR6/6			10			61	40	y					
		98	120	ZCL					30			16	0	y					
											Total	**175**	**139**						
											MD	54	21						
											Droughtiness grade (DR)	1	1						
38	T	0	28	hZCL	slight	10YR4/3			6	2	-	50	50			*II*	2	**2**	WE DR
		28	35	hZCL	slight	10YR5/4			10	2		11	11						
		35	42	hZCL	mod				10	5		11	11						

		42	70	hZCL	n	7.5YR6/4	Fe	com	10			30	43	y					
		70	90	hZCL	mod	7.5YR6/4	greyFe	many	10	10	poor	11	0	y	y				
		90	120	Chalk					5			20	0						
											Total	**132**	**114**						
											MD	11	-4						
											Droughtiness grade (DR)	2	2						
39	T	0	22	hCL		10YR4/3			6		-	37	37			*II*	3a	**3a**	WE
		22	45	hCL		10YR5/4			5			35	35						
		45	80	mZCL	slight	10YR5/4	Fe	com	10	10	good	40	45	y					
		80	100	hZCL		7.5YR6/4	Fe	com	5		poor	11	0	y	y				
		100	120	hZCL					0		poor	12	0						
											Total	**136**	**117**						
											MD	15	-1						
											Droughtiness grade (DR)	2	2						
40	T	0	25	mZCL		10YR4/3			4		-	46	46			*I*	1	**2**	DR
		25	40	mZCL		10YR6/6			10			23	23						
		40	85	mZCL		10YR6/6			5			50	49						
		85	120	ZC		7.5YR6/4	Fe	many	0		poor	25	0	y	y				
											Total	**143**	**117**						
											MD	22	-1						
											Droughtiness grade (DR)	2	2						
41	T	0	22	mZCL		10YR4/3			4		-	40	40			*I*	1	**2**	DR
		22	40	mZCL		10YR6/4			5			29	29						
		40	50	mZCL		10YR6/6			20		good	17	17						
		50	120	mZCL					30			50	24						
											Total	**136**	**111**						
											MD	15	-7						
											Droughtiness grade (DR)	2	2						
42	T	0	22	fSZL		10YR4/2			2		-	47	47			*I*	1	**1**	none
		22	35	ZL			Fe	com	5		comp	27	27	y					

		35	80	ZL		10YR6/8			5			71	73							
		80	120	ZL					0		poor	36	0							
											Total	**182**	**148**							
											MD	61	30							
											Droughtiness grade (DR)	1	1							
43	T	0	22	mZCL	n	10YR4/2			4		-	40	40		*II*	2	**2**	DR WE		
		22	32	ZCL		10YR5/2	Fe	few	10			15	15							
		32	50	hZCL		10YR5/4	Fe	few	10			28	28							
		50	120	C		7.5YR6/6	greyMn	com	5		poor	47	25	y	y					
											Total	**130**	**108**							
											MD	9	-10							
											Droughtiness grade (DR)	2	2							
44	T	0	28	hZCL	slight	10YR4/2			8		-	49	49		*I*	2	**3a**	DR		
		28	55	hZCL	very	10YR4/4			20	20	good	37	40							
		55	120	Chalk					5			43	14							
											Total	**129**	**103**		DP.depth		<60cm	2		
											MD	8	-15							
											Droughtiness grade (DR)	2	3a							
45	T	0	24	mZCL		10YR4/2			2		-	45	45		*I*	1	**1**	none		
		24	50	mZCL		10YR5/6			5			42	42							
		50	80	ZL		10YR6/6			0			42	44							
		80	120	ZL/ZCL		10YR7/2	Fe	com	0		poor	30	0	y						
											Total	**159**	**131**							
											MD	38	13							
											Droughtiness grade (DR)	1	1							
46	T	0	30	fSZL		10YR4/3			2		-	65	65		*I*	1	**1**	none		
		30	80	ZL		10YR5/4			5			82	84							
		80	105	ZL		10YR6/6			10			32	0							
		105	120	mZCL					30			11	0	y						
											Total	**189**	**149**							

											MD	68	31						
								Droughtiness grade (DR)				1	1						
47	T	0	28	mZCL		10YR4/3			2		-	52	52			*I*	1	**1**	none	
		28	40	mZCL		10YR5/4			2			20	20							
		40	50	mZCL	mod	10YR6/6			2	10	good	20	20							
		50	80	ZL					10			38	40	y						
		80	120	ZCL/ZL	slight				0	5	poor	30	0							
											Total	**160**	**132**							
											MD	39	14							
								Droughtiness grade (DR)				1	1							
48	T	0	28	mZCL		10YR4/3			4		-	51	51			*II*	2	**2**	WE DR	
		28	50	hZCL		7.5YR6/6			2			37	37							
		50	80	mZCL					5			29	32							
		80	120	hZCL		10YR6/8			0		poor	24	0	y						
											Total	**140**	**120**							
											MD	19	2							
								Droughtiness grade (DR)				2	2							
49	T	0	22	mCL		10YR4/3			4		-	38	38			*I*	1	**2**	DR	
		22	75	ZCL		10YR5/4			2			71	80							
		75	90	hZCL		10YR6/6	Fe	com	10			14	0	y						
		90	120	ZC		7.5YR6/2	Fe	many	5		poor	20	0	y	y					
											Total	**143**	**118**							
											MD	22	0							
								Droughtiness grade (DR)				2	2							
50	T	0	22	mZCL		10YR4/3			4		-	40	40			*I*	1	**1**	none	
		22	90	ZCL/ZL		10YR5/4			2			101	89							
		90	120	hZCL		7.5YR6/2	Fe	many	5		poor	17	0	y	y					
											Total	**158**	**130**							
											MD	37	12							
								Droughtiness grade (DR)				1	1							

51	T	0	22	hZCL		10YR4/3			2		-	41	41				*I*	2	**2**	DR WK
		22	32	hZCL		10YR5/4			2		good	21	21							
		32	50	hZCL		10YR6/8			2			30	30							
		50	75	mZCL		10YR6/8			2			24	33							
		75	100	hZCL		10YR6/8			0			25	0							
		100	120	hZCL					5		poor	11	0							
											Total	**152**	**125**							
											MD	31	7							
											Droughtiness grade (DR)	1	2							
52	T	0	25	ZCL		10YR4/3			6		-	45	45				*I*	1	**2**	DR
		25	38	mZCL		10YR6/6			10			20	20							
		38	50	mZCL	slight	10YR6/6			2	5		20	20							
		50	80	ZL	slight	10YR6/8			0			42	44							
		80	105	hZCL		7.5YR6/6			5		poor	14	0							
		105	120	hZCL					5		poor	9	0							
											Total	**149**	**128**							
											MD	28	10							
											Droughtiness grade (DR)	2	1							
53	T	0	25	mZCL		10YR4/3			4		-	46	46				*I*	1	**2**	DR
		25	75	mZCL		10YR6/6			10			61	69							
		75	100	hZCL	slight	7.5YR6/6	grey	com	5		poor	14	0	y						
		100	120	ZL		7.5YR6/6					poor	18	0	y						
											Total	**139**	**115**							
											MD	18	-3							
											Droughtiness grade (DR)	2	2							
54	T	0	20	mZCL		10YR4/2			5		-	36	36				*I*	1	**1**	none
		20	50	ZL		10YR4/3			5	5		61	61							
		50	70	ZL		10YR4/3			25			21	34							
		70	120	ZCL		7.5YR6/6			25			38	0							
											Total	**157**	**131**							
											MD	36	13							

							Droughtiness grade (DR)		1	1					
55	T	0	24	mZCL	10YR4/2		10	-	41	41		*I*	1	**2**	DR
		24	26	ZL	10YR4/3		25		3	3					
		26	40	ZL	10YR4/3		25		23	23					
		40	120	ZL	7.5YR6/6		10		108	60					
								Total	**177**	**128**					
								MD	56	10					
							Droughtiness grade (DR)		1	2					
56	T	0	22	mCL	10YR4/1		2	-	39	39		*I*	1	**2**	DR
		22	60	mZCL	10YR4/2		8		53	60					
		60	70	fSL	10YR5/1		10		12	16					
		70	120	fSL	10YR5/1		10		59	0					
								Total	**163**	**115**					
								MD	42	-3					
							Droughtiness grade (DR)		1	2					
57	T	0	30	fSZL	10YR4/2		20	-	53	53		*I*	1	**3a**	DR
		30	60	mZCL	10YR4/3		30		32	37					
		60	70	mZCL	10YR4/3		10		9	15					
		70	120	mZCL	7.5YR6/6		10		45	0					
								Total	**139**	**105**	ST.stone>2cm			>5%	2
								MD	18	-13					
							Droughtiness grade (DR)		2	3a					
58	T	0	22	mZCL	10YR4/2		2	-	41	41		*I*	1	**2**	DR
		22	60	mZCL	10YR4/3		15		49	55					
		60	120	mZCL	10YR4/3		20		49	14					
								Total	**139**	**110**					
								MD	18	-8					
							Droughtiness grade (DR)		2	2					
59	T	0	32	mZCL	10YR4/2		2	-	60	60		*I*	1	**2**	DR
		32	90	mZCL	10YR5/3		0		71	65					
		90	120	mZCL	2.5Y5/3	Fe com	0		30	0					
								Total	**160**	**124**					
								MD	39	6					
							Droughtiness grade (DR)		1	2					

60	T	0	40	hZCL	10YR4/2			5	-	72	72			*I*	1	**2**	DR
		40	48	mZCL	10YR4/3			15		12	12						
		48	120	mZCL	10YR5/3			10		66	34						
									Total	**151**	**118**						
									MD	30	0						
									Droughtiness grade (DR)	1	2						
61	T	0	32	hZCL	10YR4/2			5	-	58	58			*I-II*	2	**2**	WE DR
		32	80	SC	10YR5/3	Fe	few	1	m/poor	52	53	y					
		80	120	SC	10YR5/3	Fe	few	1	m/poor	36	0	y					
									Total	**145**	**111**						
									MD	24	-7						
									Droughtiness grade (DR)	2	2						
62	T	0	27	mZCL	10YR4/2			8	-	47	47			*II*	2	**2**	WE DR
		27	75	C	10YR5/3	Fe	com	1		56	68	y					
		75	120	C	10YR6/1	Fe	com	2	poor	31	0	y	y				
									Total	**135**	**116**						
									MD	14	-2						
									Droughtiness grade (DR)	2	2						
63	T	0	30	mCL	10YR4/2			5	-	51	51			*II*	2	**2**	DR WE
		30	80	fSCL	10YR5/3	Fe	com	5		59	61	y					
		80	120	LfS	10YR6/3	Fe	com			52	0	y					
									Total	**163**	**112**						
									MD	42	-6						
									Droughtiness grade (DR)	1	2						
64	T	0	20	ZL	10YR4/2			2	-	45	45			*I*	1	**2**	DR
		20	60	mZCL	10YR4/3			2		60	67						
		60	120	hCL	10YR4/2	Fe	few	10		54	15						
									Total	**159**	**126**						
									MD	38	8						
									Droughtiness grade (DR)	1	2						
65	T	0	38	mZCL	10YR4/2			2	-	71	71			*I*	1	**2**	DR
		38	70	mZCL	10YR4/3			2		40	53						
		70	120	hZCL	10YR5/3			0		50	0						
									Total	**160**	**124**						

									MD	39	6						
								Droughtiness grade (DR)		1	2						
66	T	0	30	mZCL	10YR4/2			5	-	54	54		*I*	1	**2**	DR	
		30	70	mZCL	10YR4/3			5		51	65						
		70	120	hCL	2.5Y5/3			0		50	0						
									Total	**156**	**119**						
									MD	35	1						
								Droughtiness grade (DR)		1	2						
67	T	0	28	mZCL	10YR4/2			5	-	51	51		*I*	1	**2**	DR	
		28	80	hCL	10YR5/3	Fe	few	10		59	61						
		80	120	hCL	10YR5/3	Fe	few	10		36	0						
									Total	**146**	**112**						
									MD	25	-6						
								Droughtiness grade (DR)		2	2						
68	T	0	28	mZCL	10YR4/2			10	-	48	48		*I*	1	**2**	DR	
		28	40	hZCL	10YR5/3	Fe	few	25		16	16						
		40	120	hZCL	10YR5/3	Fe	few	10		79	46						
									Total	**143**	**110**						
									MD	22	-8						
								Droughtiness grade (DR)		2	2						
69	T	0	25	mZCL	10YR4/2			10	-	43	43		*I*	1	**2**	DR	
		25	40	hZCL	10YR5/3	Fe	few	25		20	20						
		40	120	hZCL	10YR5/3	Fe	few	10		79	46						
									Total	**141**	**109**						
									MD	20	-9						
								Droughtiness grade (DR)		2	2						

Appendix 3: Site Photographs

Site 29, topsoil with few large flint

Site 20, friable topsoil with earthworms

Site 35, subangular topsoil structure

Site 37, slight compaction in the topsoil

Pit 1

Pit 1 topsoil

Pit 1 subsoil

Site 62, heavier soil variant

Site 62, mottled subsoil

Survey Area

+1 Auger Observation

.P1 Pit Observation

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Figure RAC8231-1: Observations

Site: Pump Farm, Lower Rainham

Client: A C Goatham and Sons

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C1	C2x
C2	C3
C2c	C3g
C2g	C3k
C2k	G2
	G3

N

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Figure RAC8231-2: Soil Types

Site: Pump Farm, Lower Rainham

Client: A C Goatham and Sons

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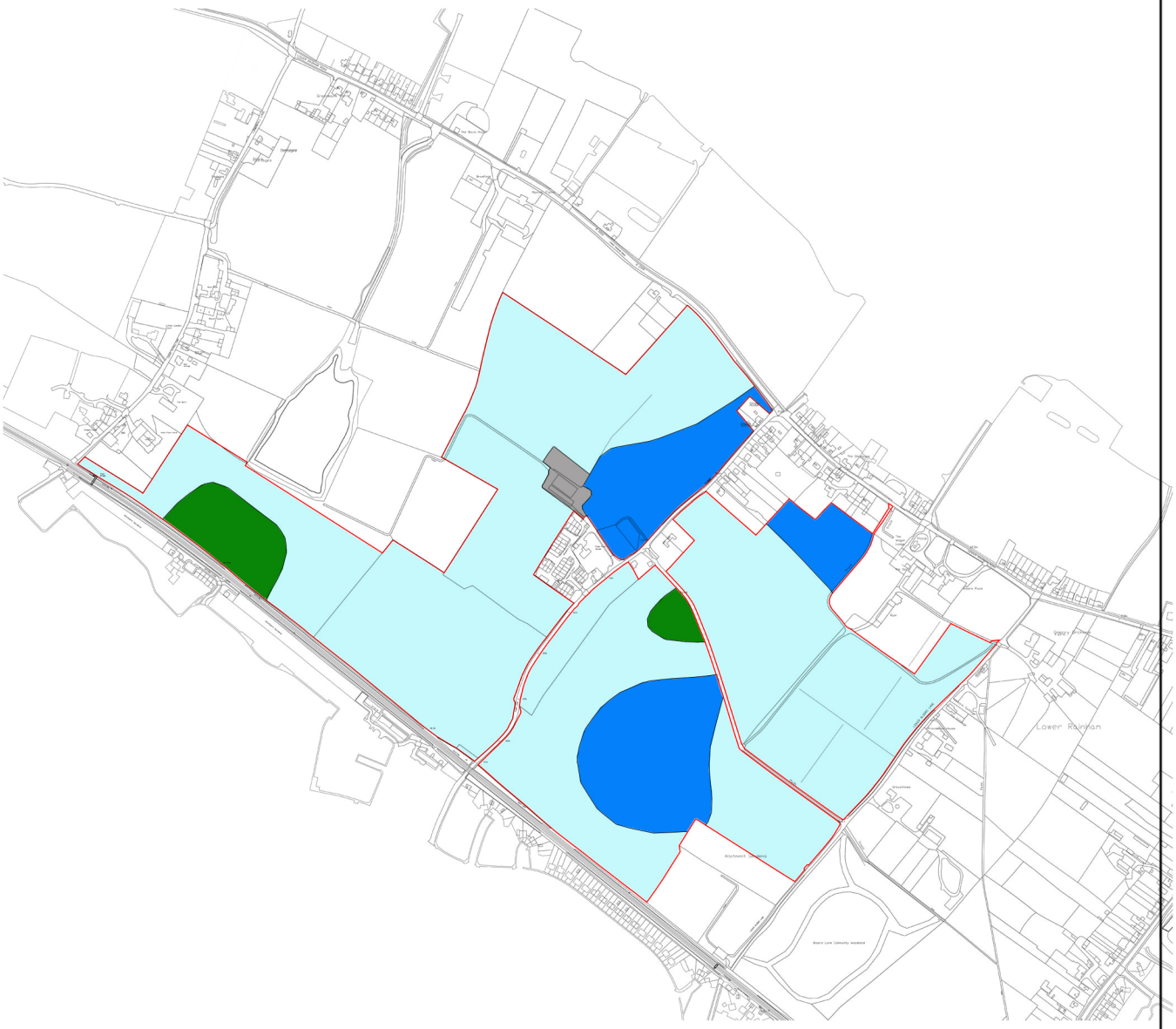

Grade 1 - excellent quality
Grade 2 - very good quality
Subgrade 3a - good quality
} Best and most versatile land

Subgrade 3b - moderate quality
Grade 4 - poor quality
Grade 5 - very poor quality

* Not Present

N

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Figure RAC8231-3: Agricultural Land Classification

Site: Pump Farm, Lower Rainham

Client: A C Goatham and Sons

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