SOIL RESOURCES
AND AGRICULTURAL QUALITY
OF LAND AT KELHAM
NEWARK

Report 1909/2

19th September 2023

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SOIL RESOURCES AND AGRICULTURAL QUALITY

OF LAND AT KELHAM, NEWARK

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Report 1909/2
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19th September 2023

SUMMARY

A soil resource and agricultural land quality survey has been undertaken of 65.7 ha of land at Kelham, Newark in November 2021.

The land has three main soil types: coarse loamy soils; medium loamy soils and heavy slowly permeable soils. The site is a combination of grade 2, subgrade 3a and 3b agricultural quality, variably limited by wetness and droughtiness restrictions.

1.0 Introduction

1.1 This report provides information on the agricultural quality of 65.7 ha of land at Kelham, Newark. The land forms part of a wider survey of 94.9 ha undertaken in November 2021.

SITE ENVIRONMENT

1.2 The survey area comprises five fields, bordered to the south-east by the A617, to the north-east by woodland, and on other sides by adjoining agricultural land.

1.3 The land was in arable use at the time of survey.

1.4 The land is mainly level, with gentle slopes in the north. Average elevation is approximately 10 m AOD.

PUBLISHED INFORMATION

1.5 British Geological Survey 1:50,000 scale BGS information records the basal geology of the land as Mercia Mudstone Group. Superficial deposits of Holme Pierrepont Sand and Gravel are recorded to overlie the bedrock, with bands of recorded alluvium along ditched waterways.

1.6 The National Soil Map (published at 1:250,000 scale) records the land as mainly with the Arrow Association: typically deep permeable coarse loamy soils affected by groundwater. Land in the north is recorded as within the Compton Association, typically comprising stoneless mostly reddish clayey soils affected by groundwater[1].

[1]Ragg, J.M., *et al.,* (1984). *Soils and their Use in Midland and Western England,* Soil Survey of England and Wales Bulletin No. 12, Harpenden.

2.0 Soils

2.1 A detailed soils and agricultural quality survey was carried out in November 2021 in strict accordance with MAFF (1988) guidelines[2]. It was based on observations at intersects of a 100 m grid, giving a density of one observation per hectare. During the survey, soils were examined by a combination of pits and augerings to a maximum depth of 1.1 m. A log of the sampling points and a map (Map 1) showing their location is in an appendix to this report.

2.2 The soils were found to vary in texture and drainage, as described below.

COARSE LOAMY SOILS

2.3 These soils occur across the centre of the site and comprise sandy loam topsoils and subsoils, that often become sandier with depth. The subsoils often have bands of gravel that vary between 15-40% stone content.

2.4 An example is described below from a pit at observation 58 (Map 1).

0-27 cm	Dark reddish brown (5YR 3/3) medium sandy loam; slightly stony with small subrounded hard stones and angular flints; well developed fine crumb structure; very friable; few fine fibrous roots; 2% bio-pores; smooth clear boundary to:
27-46 cm	Reddish brown (5YR 4/4) medium sandy loam with 5% diffuse fine reddish yellow (7.5YR 7/8) mottles; very slightly stony with small sub-rounded hard stones; moderately developed fine crumb structure; very friable; medium to low packing density; 2% bio-pores; very few fine fibrous roots; smooth gradual boundary to:
46-80 cm	Reddish brown (5YR 5/4) coarse sandy loam with 4% reddish yellow (7.5YR 7/8) mottles; moderately stony (15% small angular gravel stones); weakly developed fine granular structure; very friable low packing density; smooth clear boundary to:
80-100 cm+	Yellowish red (5YR 5/8) medium sand with large diffuse yellowish red (7.5YR 7/8) and red (2.5YR 5/6) mottles; stoneless; structureless (single grain); loose; low packing density.

HEAVY SOILS WITH IMPEDED DRAINAGE

2.5 These soils occur in the north of the site and in a small area in the south-east. They comprise fine loamy topsoils that often directly overlie dense clay. The subsoils are gleyed (greyish and pale colours with ochreous mottles), indicating waterlogging to shallow depth.

[2]MAFF, (1988).*Agricultural Land Classification for England and Wales: Guidelines and Criteria for Grading the Quality of Agricultural Land*.

2.6 An example profile is described below from a pit at observation 7 (Map 1).

0-28 cm	Dark greyish brown (10YR 4/2) heavy clay loam; slightly stony (5% small and medium subrounded hard stones); common fine fibrous roots; weakly developed coarse subangular blocky structure; friable; 1% bio-pores; smooth clear boundary to:
28-100 cm+	Brown (7.5YR 5/2) clay with 20% reddish yellow (7.5YR 6/8) and grey (7.5YR 5/1) mottles; weakly developed very coarse prismatic structure; very firm; no roots; <0.5% biopores; high packing density. .

MEDIUM LOAMY SOILS

2.7 These soils occur most of the site and comprise sandy clay loam topsoils and subsoils. The subsoils are usually gleyed (greyish and pale colours with ochreous mottles), indicating seasonal waterlogging.

2.8 An example is described below from a pit at observation 35 (Map 1).

0-30 cm	Dark brown (7.5YR 3/2) sandy clay loam; slightly stony with 5-10% medium rounded hard stones; well developed medium subangular blocky structure; friable; few fine fibrous roots; 2% bio-pores; smooth clear boundary to:
30-100 cm+	Brown (7.5YR 5/6) sandy clay loam with 10% reddish yellow (7.5YR 7/8) mottles with pinkish grey (7.5YR 7/2) ped faces; slightly stony (5-10% small and medium subrounded hard stones); well developed medium subangular blocky structure; friable; 2% bio-pores; medium packing density.

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3.0 Agricultural land quality

3.1 To assist in assessing land quality, the Ministry of Agriculture, Fisheries and Food (MAFF) developed a method for classifying agricultural land by grade according to the extent to which physical or chemical characteristics impose long-term limitations on agricultural use for food production. The MAFF ALC system classifies land into five grades numbered 1 to 5, with grade 3 divided into two subgrades (3a and 3b). The system was devised and introduced in the 1960s and revised in 1988.

3.2 The agricultural climate is an important factor in assessing the agricultural quality of land and has been calculated using the Climatological Data for Agricultural Land Classification[3]. The relevant site data for an average elevation of 10 m and a central grid reference at SK 764,555 is given below.

- Average annual rainfall: 569 mm
- January-June accumulated temperature >0°C 1431 day°
- Field capacity period (when the soils are fully replete with water) 111 days early Dec-early Apr
- Summer moisture deficits for: wheat: 118 mm potatoes: 113 mm

3.3 The survey described in the previous section was used in conjunction with the agro-climatic data above to classify the site using the revised guidelines for ALC issued in 1988 by MAFF[4]. There are no overriding climatic limitations at this locality.

SURVEY RESULTS

3.4 The agricultural quality of the land is primarily limited by droughtiness and wetness. Other factors were assessd but do not affect the land grade. Land of grade 2 and 3 has been identified.

Grade 2

3.5 This land grade comprises medium loamy soils that have slight wetness limitations. The combination of moderately high topsoil clay content and slight

[3]Meteorological Office, (1989).*Climatological Data for Agricultural Land Classification*.
[4]MAFF, (1988).*Agricultural Land Classification for England and Wales: Guidelines and Criteria for Grading the Quality of Agricultural Land*.

drainage impedance means access restrictions in wet years may affect cultivation/harvest timings.

3.6 Also included in this grade are the deep coarse loamy soils. This land has slight droughtiness limitations due to the subsoils storing slightly sub-optimal moisture reserves for crop uptake in dry summers.

Subgrade 3a

3.7 This land grade comprises coarse, and medium loamy soils with gravel at moderately shallow depth (typically 40 cm depth). The land is limited by droughtiness restrictions, as the subsoils will store below optimum moisture for crop uptake, reducing average yields of arable crops.

3.8 Also included in this subgrade are loamy soils with heavy topsoils and slight drainage restrictions. This combination means that land access will be restricted in winter and early spring in most years, although late spring and autumn sowings are usually possible.

Subgrade 3b

3.9 This land includes the heavy slowly permeable soils in the north and south-east of the site. The high topsoil clay content combined with imperfect drainage (Soil Wetness Class III) means access with machinery is restricted in winter and spring. Arable cropping of the land is therefore mainly limited to autumn-sown crops in years.

3.10 Also included are minor areas of sandy soils limited by droughtiness where sand occurs directly below the topsoil. The sandy subsoils will store little moisture for summer crop uptake, meaning this land is likely give low average yields of arable crops.

Non agricultural

3.11 This includes a soil bund, a pond area and farm tracks.

Grade areas

3.12 The land grades are shown on Map 2 and the areas occupied shown below.

Table 1: Areas occupied by the different land grades

Grade/subgrade	*Area (ha)*	*% of the land*
Grade 2	36.0	55
Subgrade 3a	24.3	37
Subgrade 3b	3.5	5
Non agricultural	31.9	3
Total	65.7	100

APPENDIX
DETAILS OF OBSERVATIONS
MAPS

Land at Kelham: Soils and ALC survey – Details of observations at each sampling point

Obs	Topsoil			Upper subsoil			Lower subsoil			Slope	Wetness	Agricultural quality	
No	Depth (cm)	Texture	Stones >20 mm (%)	Depth (cm)	Texture	Mottling	Depth (cm)	Texture	Mottling	(°)	Class	Grade	Main limitation
1	0-28	HCL	<5	28-61	HCLr	xxx	61-100+	HCLr	xxx	1	II	3a	W
2	0-30	HCL	<5	30-50+	SCL/HCLr	xxx	50+	Stopped on stone		2	II	3a	W
3	0-30	HCL	5-10	30-65+	C	xxx				0	III	3b	W
4	Pond												
5	0-33	HCL	<5	33-70	HCLr	xxx	70+	Stopped on stone		0	II	3a	W
6	0-31	C	<5	31-85+	C	xxx				1	III	3b	W
7	0-28	HCL/C	<5	28-100+	C	xxx				0	III	3b	W
8	Pond												
9	0-30	SCL	5-10	30-40	SCL	xxx	40+	Stopped on stone		0	II	2	W
10	0-32	SCL	5-10	32-66	SCL	xxx	66-100+	MSL	xx	0	II	2	W
11	0-25	HCL	<5	25-42	Cr	xxx	42-100+	C grey	xxx	0	III	3b	W
12	0-20	HCL	5-10	20-68+	C	xxx				0	III	3b	W
13	0-32	HCL	<5	32-60	SCL	xxx	60+	Stopped on stone		0	II	3a	W
14	0-28	SCL	<5	28+	Stopped					1	-	-	-
15	0-20	SCL	5-10	20-60	MSL sl st	xxx	60-100+	MSr	o	1	I	3a	D
16	Hedge/ditch												
17	0-38	SC	5-10	38-70	SCL sl st	xxx	70+	Stopped on stone		0	II	2	W
18	0-30	SCL	5-10	30-80+	SCL	x				1	I	2	D
19	0-28	HCL	5-10	28-90+	C	xxx				0	III	3b	W
20	0-10	MCL	<5	10-90+	MCL	x				0	I	2	D
21	0-30	SCL	<5	30-40	SCL	xxx	40-90+	MS	xxx	0	I	3a	D
22	0-24	SCL	<5	24-40	SCL	xxx	40-100+	MS	xxx	1	I/II	3a	D
23	0-30	SCL	5-10	30-71	SCLr	xxx	71+	Stopped on stone		0	II	2	W
24	0-27	HCL	<5	27-85+	C	xxx				0	III	3b	W
25	0-30	MSL	5-10	30-59+	MSLr	xxx	45+	gravel		1	I	3a	D
26	0-31	SCL	5-10	31-80+	SCL	xxx				0	II	2	W
27	0-31	SCL	5-10	31-46	SCL	x	46+	Stopped on stone		0	I	2	D
28	0-28	HCL	<5	28-90+	C	xxx				0	III	3b	W
29	0-30	SCL	5-10	30-45	MSL grav.	xxx	45+	gravel		0	I	3a	D
30	0-30	SCL	5-10	30-80+	SCL	xxx				0	II	2	W
31	0-29	SCL	5-10	29-75	MCL	xxx	75-100+	MSL	xx	0	II	2	W
32	0-33	SCL	5-10	33-63	SCL	xxx	63-75+	SCL grav.	xxx	0	II	2	W
33	0-30	SCL	5-10	30-90+	SCLr	xx				0	I	2	D
34	0-30	M/SCL	5-10	30-78	MSL	xxx	78-100+	C	xxx	0	II	2	W
35	0-30	SCL	5-10	30-70+	SCL	xxx	70+	Stopped on stone		0	II	2	W

Obs	Topsoil			Upper subsoil			Lower subsoil			Slope	Wetness	Agricultural quality	
No	Depth (cm)	Texture	Stones >20 mm (%)	Depth (cm)	Texture	Mottling	Depth (cm)	Texture	Mottling	(°)	Class	Grade	Main limitation
36	Ditch												
37	0-33	HCL	<5	33-60	HCL	xxx	60-100+	SCL	xxx	0	II	3a	W
38	0-30	SCL	5-10	30+	Stopped on stone					0	-	-	-
39	0-28	SCL	5-10	28-60+	SCL	xxx				0	II	2	W
40	0-20	SCL	5-10	28-80+	SCL	xxx				0	II	2	W
41	0-34	SCL	<5	34-55	SCL	xxx	55-71 71+	MSL Gravel.	xxx	0	II	2	W
42	0-28	SCL/HCL	5-10	28-42	SCL dist.	xxx				0	II	2/3a	W
43	0-27	HCL	5-10	27-51	HCL	xxx	51-100+	MS	xxx	0	II/III	3a	W
44	0-30	SCL	5-10	30-100+	MCL/HCL	xxx				0	II	2	W
45	0-30	SCL	5-10	30-100+	SCL	xxx				0	II	2	W
46	0-30	SCL	5-10	30-46	SCL	x	46-100+	SCL	xxx	0	I	2	D
47	0-28	HCL	<5	28-90+	C	xxx				0	III	3b	W
48	Ditch												
49	0-32	MSL	<5	32-78	MSLr	x	78-100+	MSL	xxx	0	I	2	D
50	0-26	SCL/MSL	<5	26-100+	MSLr	x				0	I	2	D
51	0-31	SCL	5-10	31-50+	Cr	xxx	50+	Drain?		0	III	3a	W
52	0-34	MSL	5-10	34-60+	MSL gravel	x	60+	Gravel.		0	I	3a	D
53	0-30	MSL (bund)	<5	30+	Gravel.					0	-	-	-
54	Woodland												
55	0-32	HCL	<5	30-90+	H/SCL	xxx				0	II	3a	W
56	0-31	MSL	5-10	31-60+	MSL grav.	x	60+	Gravel		0	I	3a	D
57	0-39	MSL	5-10	39-66+	MSLr	x	60+	Stopped on stone		0	I	3a	D
58	0-27	MSL	<5	27-46	MSLr	x	46-80 80-100+	CSLr MS	x xxx	0	I	3a	D
59	0-32	SCL	5-10	32-50_	SCL (dist?)	xx				0	-	-	-
60	0-32	MSL	10-15	32-50+	MSL grav.	xx	50+	gravelly		0	I	3a	D
61	Pond bank												
62	0-29	HCL	<5	29-43	C	xxx	43-50+	SCL grav.	xxx	0	II	3a	W/D
63	0-31	MSL	10-15	31-54	MSL	xx	54-60+	MSL	xxx	0	I	2/3a	D
64	0-30	MSL	5-10	30-60+	MSL	xxx				0	I	2	D
65	0-30	MSL	5-10	30-85+	MSLr	x				0	I	2	D
66	0-40	SCL	<5	40-60+	SCL	xxx				0	II	2	W
67	0-34	MSL	10-15	34-68	CSL grav.	xxx	68-100+	CSL grav.	xx	0	I	2	D
68	0-32	SCL	10-15	32-49+	CSL grav.	xxx	49+	Gravel		0	I	3a	D
69	0-30	HCL/C	<5	30-50+	SCL grav.	xxx				0	II	3a	W
70	0-30	C	<5	30-70+	C	xxx				0	III	3b	W
71	0-32	MSL	10-15	32-61+	MSL	xxx	61+	Gravel		1	I	3a	D

Obs	Topsoil			Upper subsoil			Lower subsoil			Slope	Wetness	Agricultural quality	
No	Depth (cm)	Texture	Stones >20 mm (%)	Depth (cm)	Texture	Mottling	Depth (cm)	Texture	Mottling	(°)	Class	Grade	Main limitation
72	0-30	MSL	5-10	30-85+	MSL/gravel.	x				0	I	2	D
73	0-30	SCL	5-10	30-60+	MSL	xxx				0	I	2	D
74	0-30	MSL	5-10	30-62	MSLr	x	62+	Gravel		0	I	2	D
75	0-31	MSL	5-10	31-40+	MSL/gravel.	x	40+	Gravel.		1	I	3a	D
76	0-31	MSL	<5	31-62+	MSLr	x	62+	Stopped		1	I	2	D
77	0-32	MSL	5-10	32-100+	MSr	xx				0	I	3b	D
78	0-30	MSL/SCL	5-10	30-60+	MSL/gravel..	xxx				0	I	2	D
79	0-33	MSL	5-10	33-64	MSL	x	64-100+	LMSr	x	0	I	2	D
80	0-31	SCL	5-10	31-60	SCL	xxx	61-80+	MS	xxx	0	II	2	W
81	0-29	MSL	5-10	29-80+	MSL/gravel.	xx				0	I	2	D
82	0-26	SCL	<5	26-60+	MSLr	xxx				0	I	2	D
83	0-31	MSL	10-15	31-65+	CSL	xxx	65+	Gravel		0	I	2	D
84	Ditch												
85	0-40	SCL	5-10	40+	CSL/gravel.	x				0	I	3a	D
86	0-29	MSL	5-10	29-100+	MSLr	o				0	I	2	D
87	0-30	MSL	10-15	30-70+	CLS	xxx	70+	Gravel.		0	I	2	D
88	0-30	HCL	5-10	30-100+	C	xxx				0	III	3b	W
89	0-30	HCL	<5	30-59	C	xxx	59-100+	SCL	xxx	0	III	3b	W
90	0-30	MSL	10-15	30-66	MSL/gravel.	xx				0	I	2	D
91	0-33	MSL	<5	33-68	MSL	xxx	68-100+	LMS	xxx	0	I	2	D
92	0-31	MSL	10-15	31-40+	MS/gravel.	xx				1	I	3b	D
93	0-30	MSL	5-10	30-70	MSL/gravel.	x	70-90+	MS	xxx	0	I	3a	D
94	0-33	MSL	10-15	30-50	MSLr	x	50+	Gravel		0	I	3a	D

Soil survey log key

Gley indicators[1]

o	unmottled
x	1-2% ochreous mottles and brownish matrix (or a few to common root mottles (topsoils))[3]
xx	>2% ochreous mottles and brownish matrix and/or dull structure faces (slightly gleyed horizon)
xxx	>2% ochreous mottles and greyish or pale matrix (gleyed horizon) or reddish matrix and >2% greyish, brownish or ochreous mottles and pale ped faces
xxxx	mottles or f-m concentrations (gleyed horizon) dominantly blueish matrix, often with some ochreous mottles (gleyed horizon)

Texture[2]

C – clay
ZC - silty clay
SC - sandy clay
CL - clay loam (H-heavy, M-medium)
ZCL - silty clay loam (H-heavy, M-medium)
SZL - sandy silt loam (F-fine, M-medium,C-coarse)
LS - loamy sand (F-fine, M-medium, C-coarse)
SL - sandy loam (F-fine, M-medium, C-coarse)
S - sand (F-fine, M-medium, C-coarse)
SCL - sandy clay loam
P - peat (H-humified, SF-semi-fibrous, F-fibrous)
LP - loamy peat; PL - peaty loam

Limitations:

W - wetness/workability
D - droughtiness
De - depth
F - flooding
St – stoniness
G – gradient
T – topography/microrelief
C - Climate

Suffixes & prefixes:

o - organic

(vsl, sl, m, v, x)**st** – (very slightly, slightly, moderately, very, extremely) **stony**[6]

(vsl, sl, m, v, x)**ca**
(very slightly, slightly, moderately, very, extremely) **calcareous**[7]

Slowly permeable layers[4]

a depth underlined (e.g. 50) indicates the top of a slowly permeable layer

A wavy underline (e.g. 50 indicates the top of a layer borderline to slowly permeable

Wetness Class[5]

I (freely drained) to VI (very poorly drained)

Other abbreviations

fmn - ferri-manganiferous concentrations
dist - disturbed soil layer; chky - chalky
R – bedrock (CH – chalk, SST – sandstone LST – limestone, MST – Mudstone)
r-reddish, gn – greenish

[1]Gley indicators in accordance with Hodgson, J.M., 1997. Soil Survey Field Handbook (third edition). Soil survey technical monograph No. 5

[2]Texture in accordance with particle size classes in Hodgson (1997)

[3] Occasionally recorded in the texture box

[4]Permeability is estimated for auger borings and must be confirmed by full pit observations in accordance with the definitions in: Revised Guidelines for grading the quality of Agricultural Land (Maff 1988)

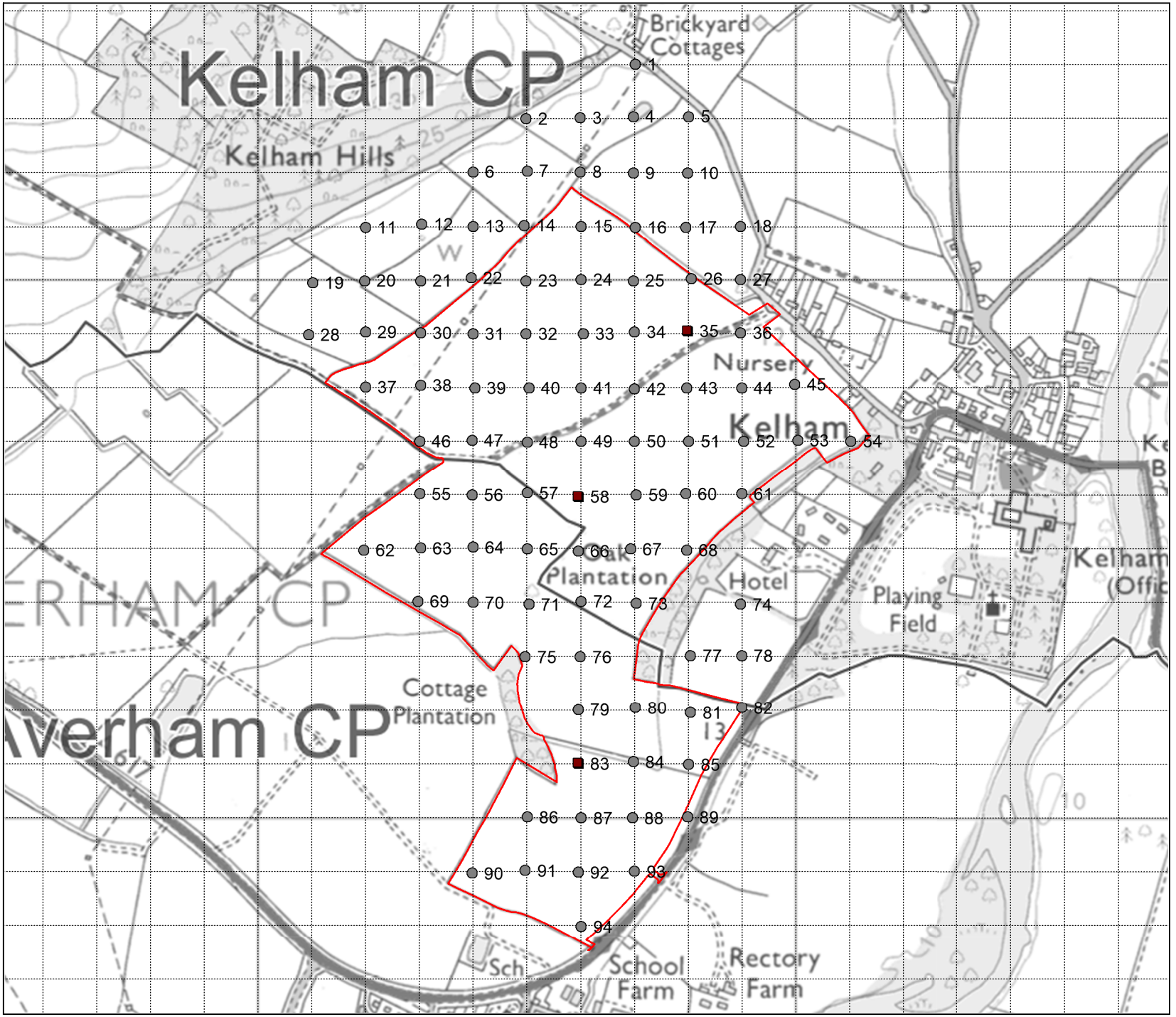
[5]Soil Wetness Classes are defined in Hodgson (1997)

[6]stoniness classes as defined in Hodgson (1997)

[7]calcareous classes as defined in Hodgson (1997)

Grades in brackets eg. (3a) raised by one grade due to calcareous topsoil

Observations close to or on grade boundaries are sometimes recorded as borderline e.g. 3a/3b. In these cases the former grade shows the estimated grading according to the criteria



KEY

- Auger observations
- Pits
- Site boundary

Site:

Kelham

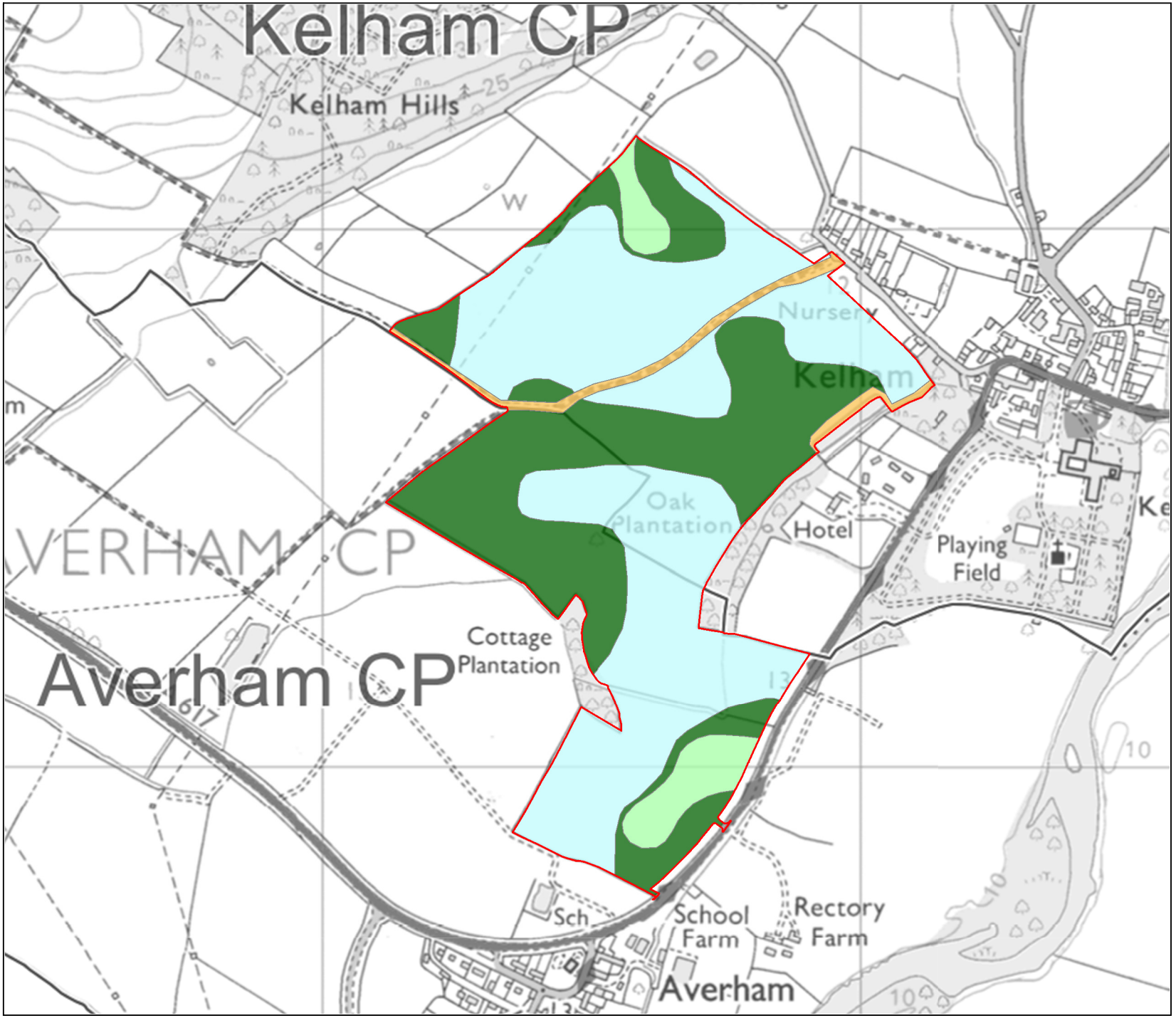
Map title:

MAP 1
Observations

Land Research ASSOCIATES
Lockington Hall
Lockington
Derby
DE74 2RH
www.lra.co.uk

Date: 19/09/2023

Scale: 1:10,00



KEY

- Grade 2
- Subgrade 3a
- Subgrade 3b
- Other land
- Site boundary

Site:

Kelham

Map title:

MAP 2
Agricultural Land Classification

Land Research ASSOCIATES
Lockington Hall
Lockington
Derby
DE74 2RH
www.lra.co.uk

Date: 19/09/2023

Scale: 1:10,00