Agricultural Land Classification (ALC) for Statera Energy

Culham site
access through Culham no.1 site
follow signs to Lockwood Farm
Oxford
OX14 3DA

Area for first visit: 7.8ha, area for second visit: 12.2ha,
Area for third visit 1.7ha. Total area surveyed: 21.7ha

Soil survey and report for first visit carried out in Nov 2022, second visit Feb 2023 and third visit Jan 2024.

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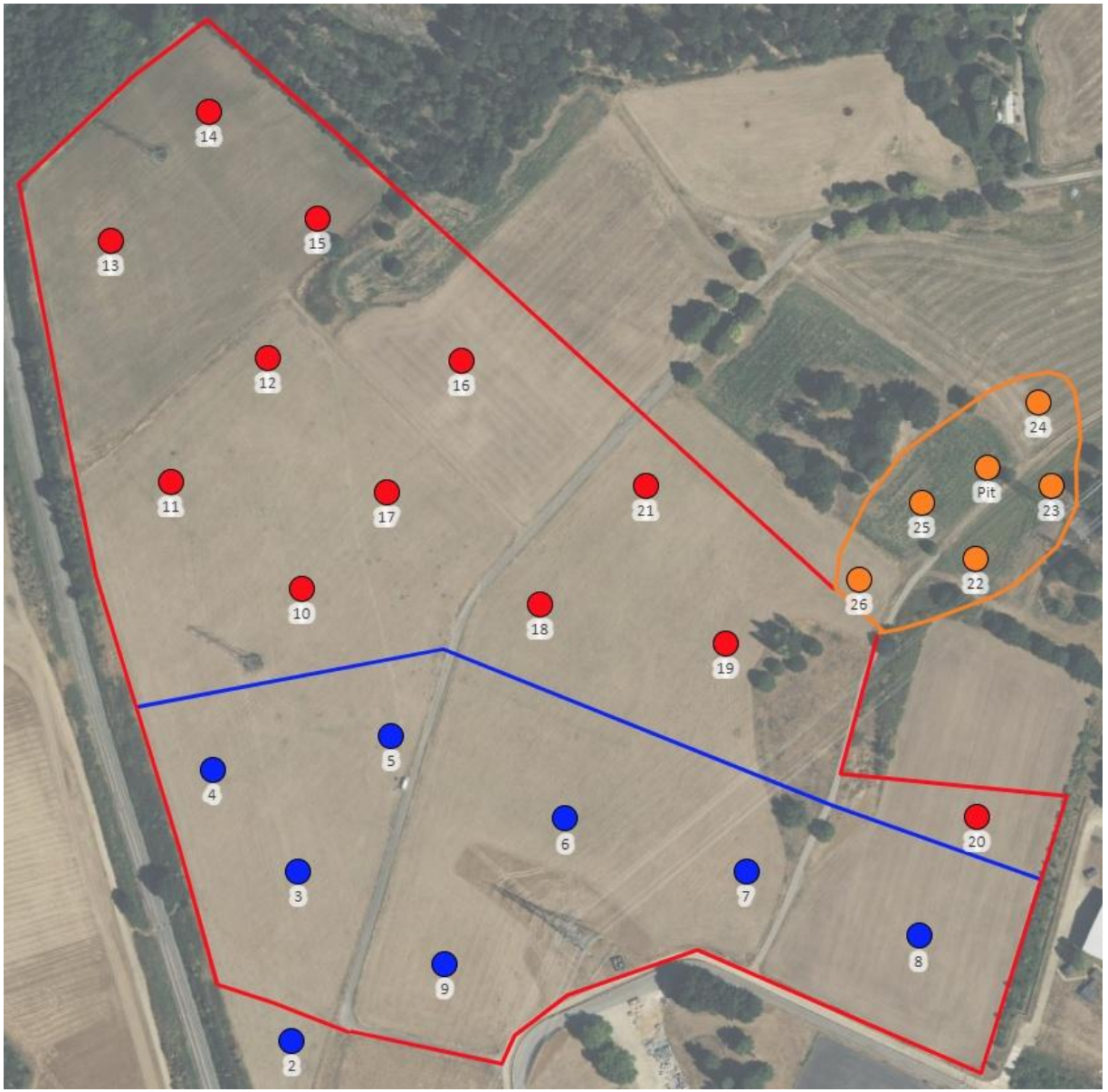
9 samples were taken in 7.8ha (first visit, blue points),12 samples were taken in 12.2ha on the second visit (red points) and 6 samples were taken in 1.7ha on the third visit (orange points).
The site is situated on the north eastern edge of Culham Science Centre and east of the railway.
All land was in grass that is grazed periodically by sheep except points 1, 22, 23, 25 & pit which have been left wild for sometime.

Map 1: Area of land surveyed in Nov 2022 (blue points) and Feb 2023 (red points) at Culham and location of survey points



Introduction and explanation of climatic and site limitations for Culham

The criteria for assessing agricultural land classification (ALC) are taken from guidelines issued by DEFRA or formerly the Ministry of Agriculture, Fisheries & Food, MAFF in 1988. They are based on assessing grading according to four categories, 1) climatic, 2) site, 3) soil & 4) interactive. The grading is then made according to the most limiting factor. Where these factors vary in the field then assessments are made approximately every hectare & a land classification map of the field is drawn up according to the most limiting factor.

1) The climate in this area is good for agriculture and there are no limitations from the climate itself. The criteria are given below:

- Average annual rainfall: 616mm
- Jan to June accumulated temperature >0°C 1443 day°
- Field capacity period 127 days
  (when the field drains flow in winter)
- Summer moisture deficits for: wheat: 112mm
  potatoes: 105mm

Field capacity and summer moisture deficits will be used later in the report together with some of the soil properties to establish the land grade.

2) Site limitations are based on a) gradient, b) microrelief & c) flooding risk.

a) The gradient on the field is less than 7° in all directions which means that there is no limitation according to gradient.

b) The microrelief has no irregularities such as pits or boulders which would limit the grading.

c) Details of flooding risk are not given here since local knowledge is required over at least a 15 year period. However since the land is gently sloping and generally well drained, this is likely to considerably reduce any flooding risk and it would be very unlikely to be limiting.

Explanation of soil limitations

3) Soil limitations are based on a) soil depth to consolidated or fragmented rock, b) stoniness & c) chemical status.

a) Soil depth to stone (limestone gravel) is greater than 60cm at all points except for point 1 which varied from 30 to 50cm and point 20 from 40 to 60cm. Therefore there is no limitation from depth except for point 1 and point 20 which are both limited to grade 3a by depth.

b) Measured topsoil stone content over the site is less than 5% which gives no limitation.

Both points 1 and 2 were measured for stone content in the top 25cm depth of soil. In an 8 litre bucket the volumetric stone content of stones greater than 2cm diameter was measured at 3% in point 1 and 2% in point 2.
There were no stones greater than 6cm diameter.

c) Chemical status that may show up toxicity in the soil is unlikely since in the recent past the field has been used for grazing sheep with no record of any potentially toxic inputs.

Explanation of soil droughtiness limitation

4)Interactive limitations are based on a) droughtiness & b) soil wetness.

a) **droughtiness** is calculated according to available water capacity (AP). This is calculated from the soil texture, stone content & soil structure at each survey point down to a depth of 120cm for wheat & 70cm for potatoes (see figures 1 & 2 below). Each profile was assessed on a 1cm core taken down to a depth of 100cm.

The grading is calculated from the moisture balance for both wheat & potatoes. The moisture balance is the available water capacity minus the climatic moisture deficit for that area. The moisture deficit for this area for wheat is 112mm & for potatoes is 105mm, see page 4.

Table 1 to assess droughtiness

Summary of calculated values taken from figs 1 & 2 below on page 7 & 8

Soil type	Available water (mm)		Limiting grade
	Wheat	Pots	
A	105	80	3a
B	145	106	2
C/B	136	102	2
$C_{shallow}$	109	86	3a
C_{ss}	136	102	2
C_{ds}	129	103	2
D	133	109	2
E	120	96	2

Range of available water for grade 2 for wheat is 117 to 141mm
for grade 2 for potatoes is 95 to 114mm
for grade 3a for wheat is 92 to 116mm
for grade 3a for potatoes is 75 to 94mm

Either one or both crops will limit the grade.

Figure 1a – **Observations on soil types A to C** and available water (AP) for wheat and potatoes

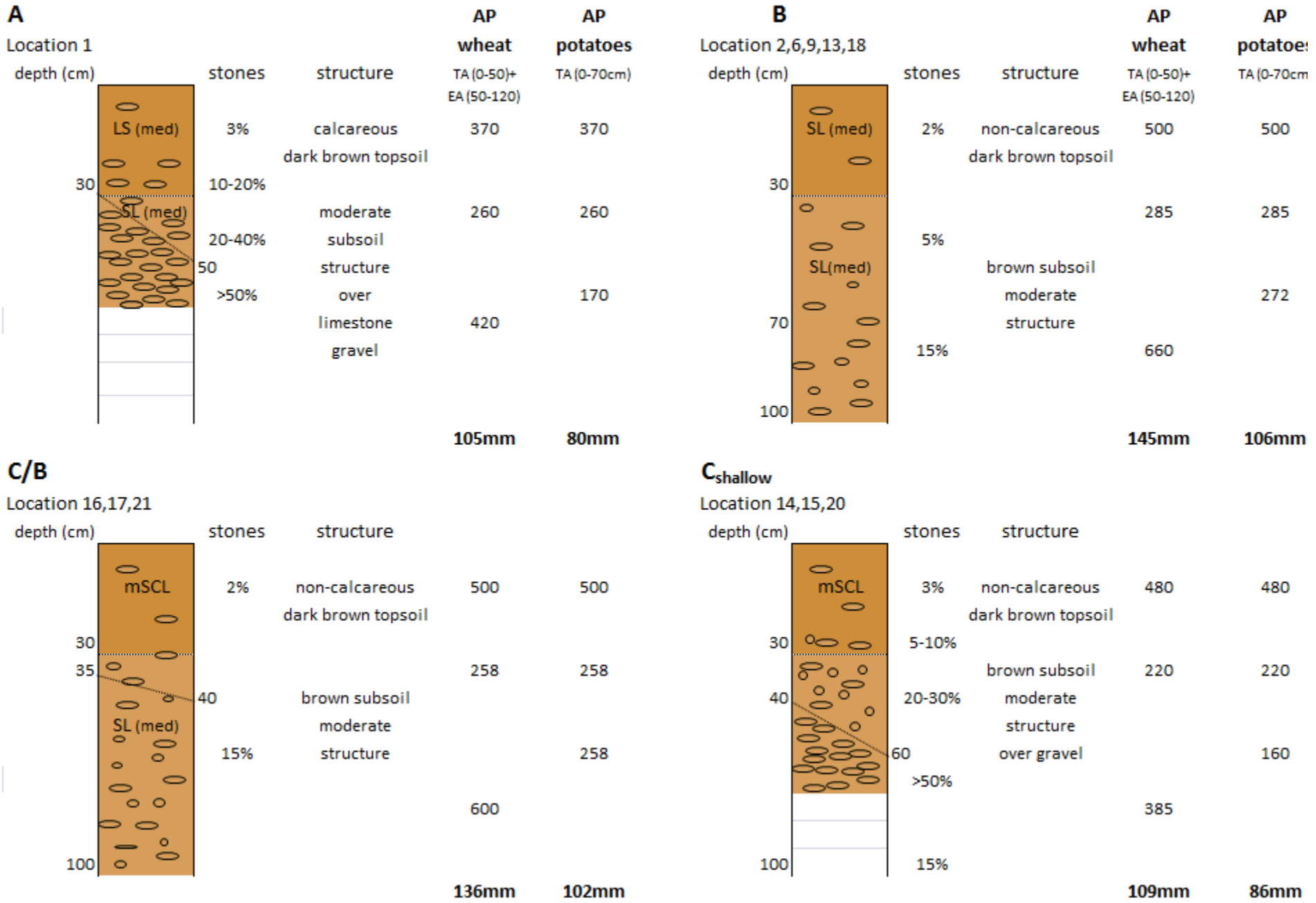
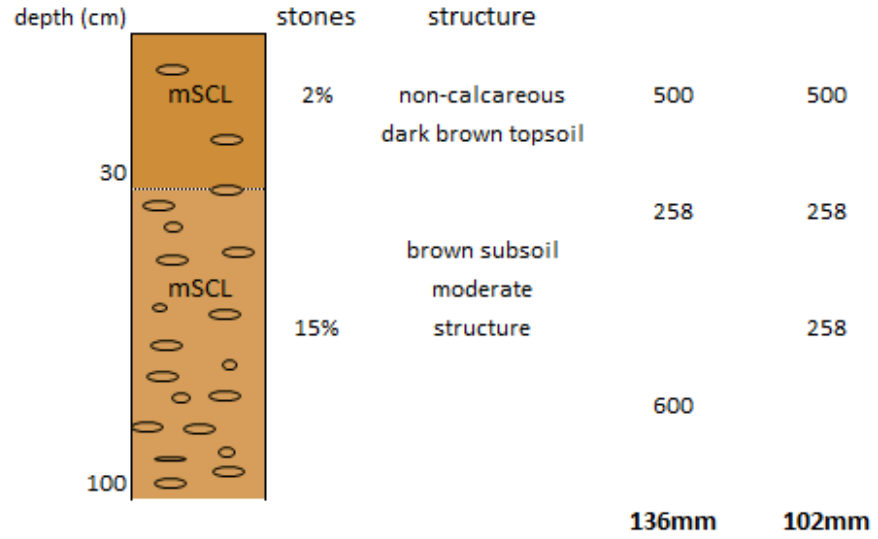


Figure 1b – **Observations on soil types C to E** and available water (AP) for wheat and potatoes

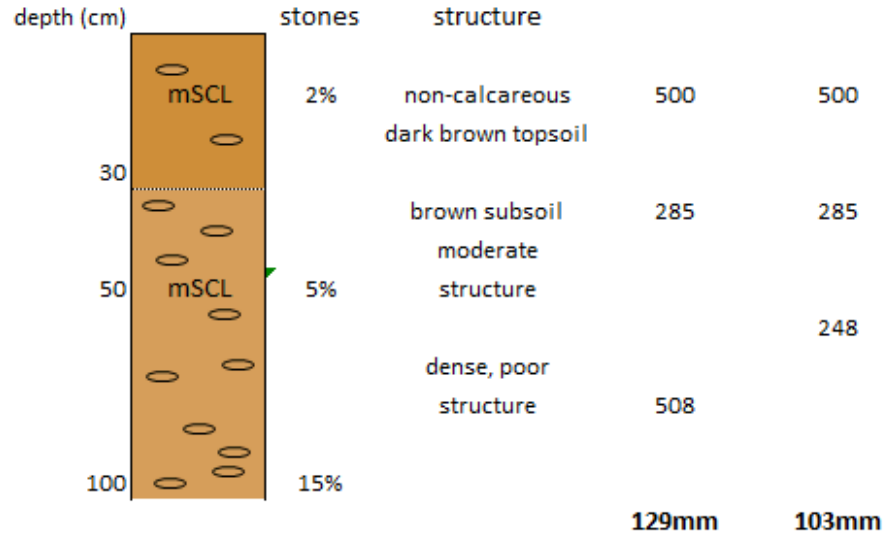
C$_{\text{stony subsoil}}$

Location 3,4,5,10,11,12,19,26



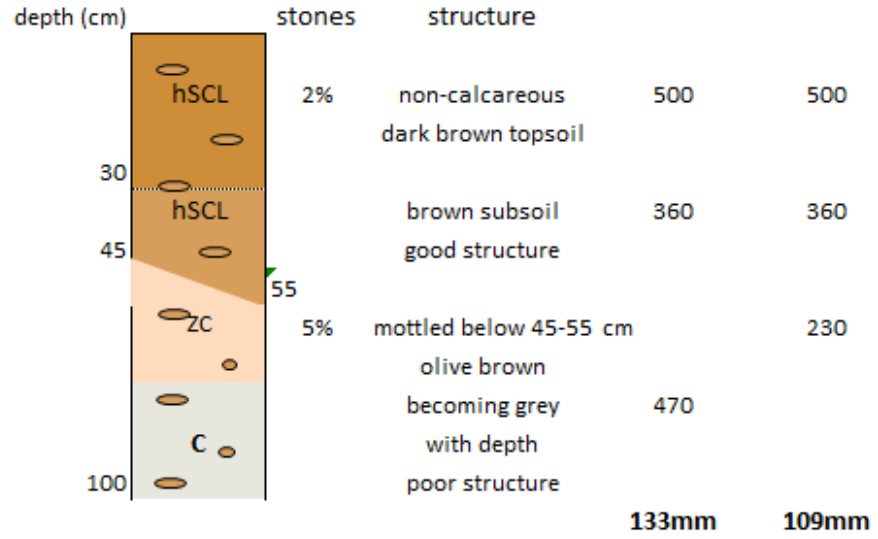
C$_{\text{dense subsoil}}$

Location 7,8



D

Location 22,23,24



E

Location 25

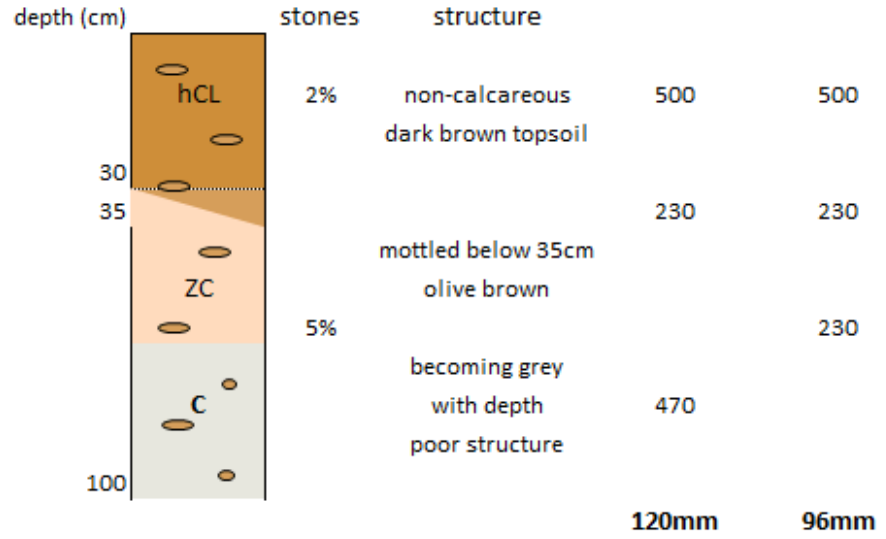


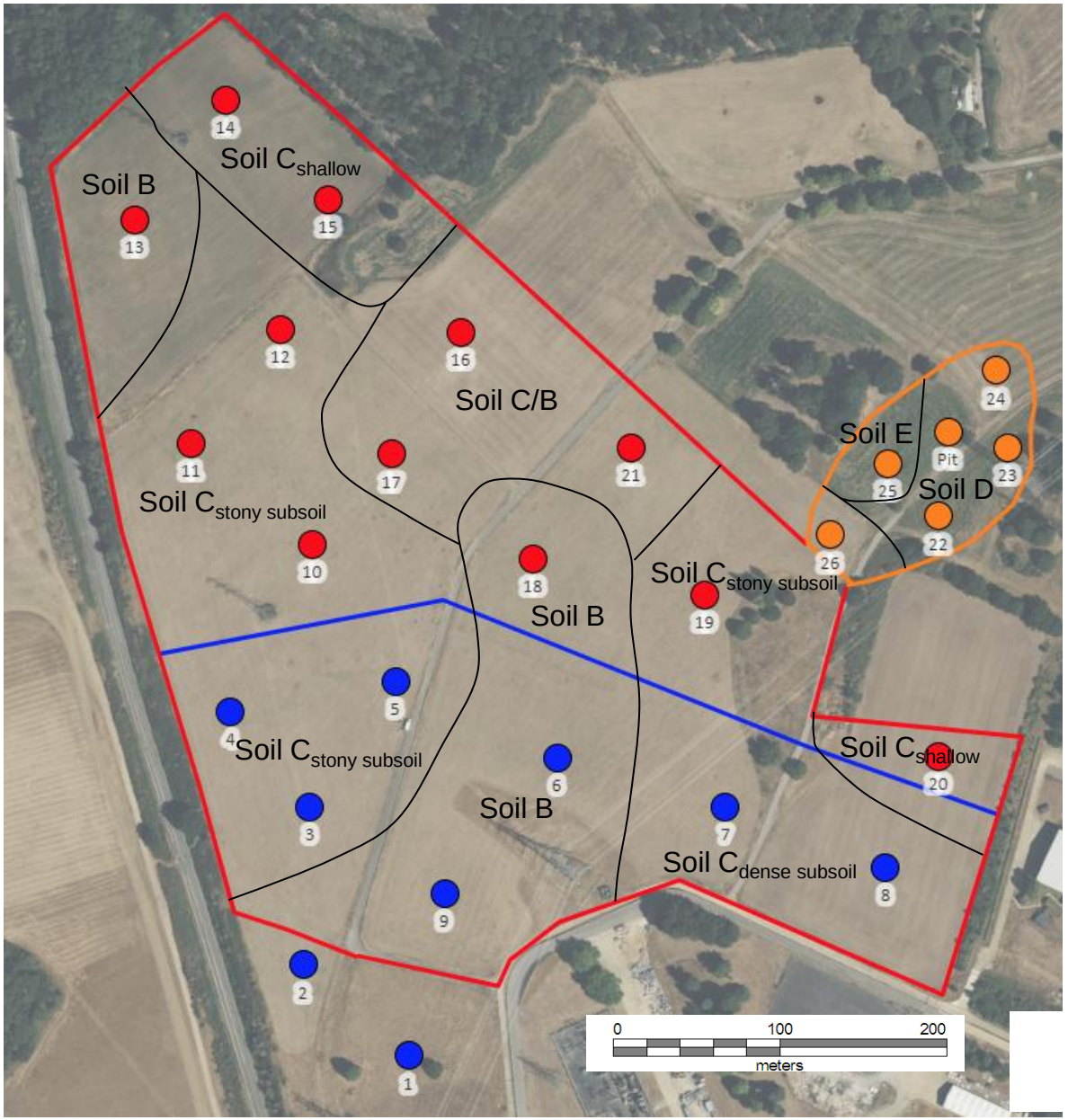
 Table 2: legend for figure 1

Legend

LS (med)	Loamy sand (medium size particles)
SL (med)	Sandy loam (medium size particles)
mSCL	medium sandy clay loam
hSCL	heavy sandy clay loam
hCL	heavy clay loam
ZC	Silty clay
C	heavy clay
AP	Available water
TA	Total available water
EA	Easily available water

Soil types are described more fully in the profile descriptions on pages 7 and 8

Map 2: Soil type map of the surveyed land at Culham



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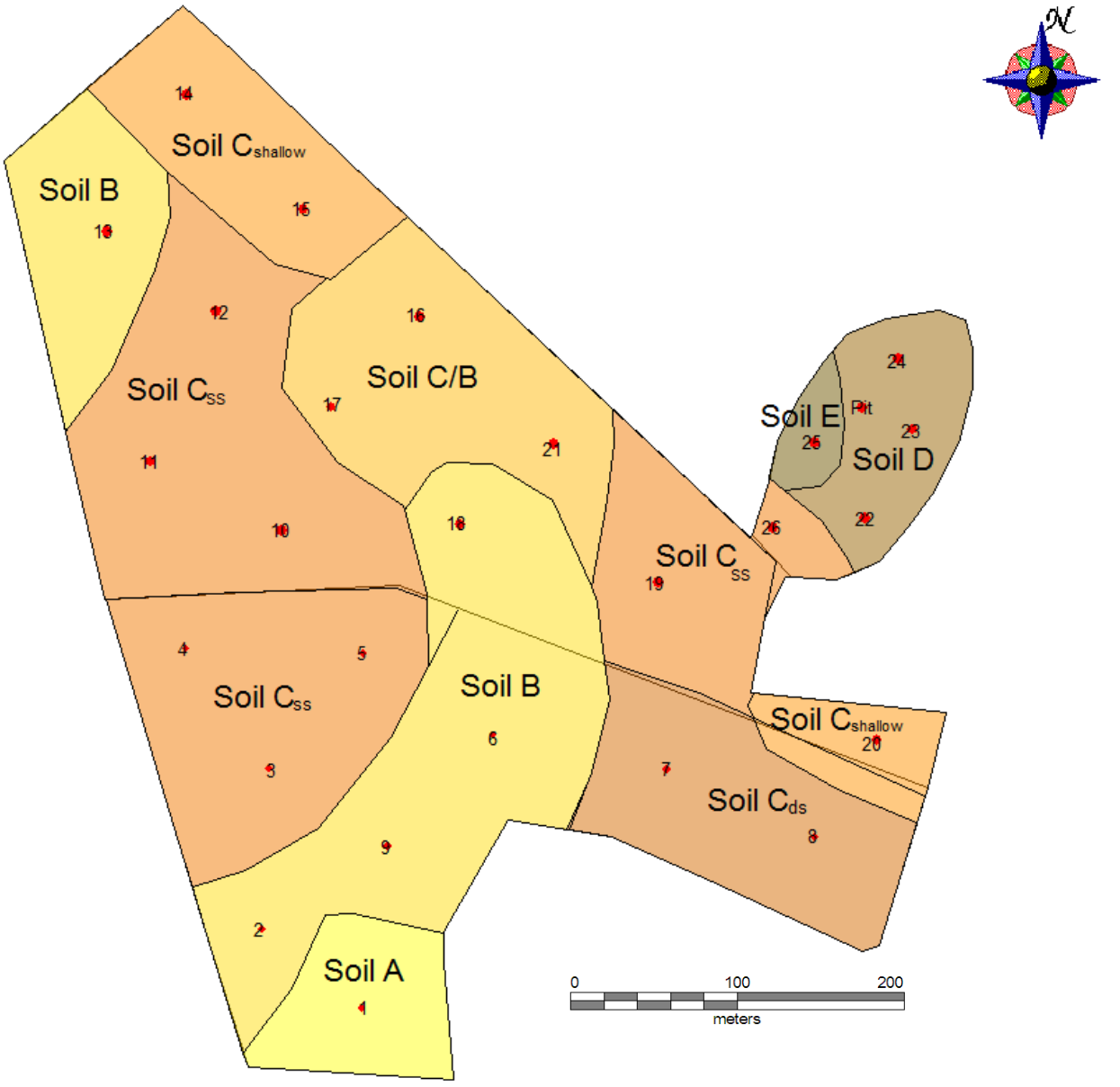
Soil descriptions

- A
- B
- C/B
- $C_{shallow}$
- C_{ss}
- C_{ds}
- D
- E

A: light soil over limestone gravel.
B: light soil (deep).
C/B: medium/light soil (deep).
$C_{shallow}$: medium over gravel.
C_{ss}: medium soil, moderately gravelly subsoil.
C_{ds}: medium soil, dense subsoil below 50cm.
D : medium/heavy soil over clay below 50cm.
E : heavy soil over clay subsoil.

Soil types are described more fully in the profile descriptions on pages 7 & 8

Map 3: Soil type map for the Culham site



Interactive limitations continued

4b) soil wetness class is assessed from
1) the depth to a gleyed/mottled horizon
2) the depth to a slowly permeable layer
3) the duration of field capacity (127 days at this site).

Table 3 to assess wetness class

	Depth to gleyed/mottled horizon	Depth to slowly permeable layer	Wetness class
Soil types A-C	not within 70cm	not within 80cm	I
Soil type D	within 70cm, not 40cm	starts between 45-55cm	II
Soil type E	within 40cm	starts below 35cm	III

Soil types A-C with wetness class I are well drained and therefore grade 1 according to wetness.
Soil type D with wetness class II and sandy clay loam topsoil is grade 2 according to wetness.
Soil type E with wetness class III and heavy clay loam topsoil is grade 3b according to wetness.

See table 4 below for a summary of grade according to wetness.

Maps 4 & 5 shows the final grade which uses the most limiting factor at each point. This is due to droughtiness on most soil types, depth to gravel on some grade 3a soil and soil wetness for the grade 3b soil.

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Taken from the MAFF agricultural land classification guidelines of 1988 (page 23).

Table 4 – Criteria for calculating soil wetness according to the ALC

Agricultural Land Classification of England and Wales

Table 6 Grade according to soil wetness - mineral soils

Wetness Class	Texture[1] of the top 25 cm	Field Capacity Days <126	126-150	151-175	176-225	>225
I	S[2] LS[3] SL SZL	1	1	1	1	2
	ZL MZCL MCL SCL	1	1	1	2	3a
	HZCL HCL	2	2	2	3a	3b
	SC ZC C	3a(2)	3a(2)	3a	3b	3b
II	S[2] LS[3] SL SZL	1	1	1	2	3a
	ZL MZCL MCL SCL	2	2	2	3a	3b
	HZCL HCL	3a(2)	3a(2)	3a	3a	3b
	SC ZC C	3a(2)	3b(3a)	3b	3b	3b
III	S[2] LS SL SZL	2	2	2	3a	3b
	ZL MZCL MCL SCL	3a(2)	3a(2)	3a	3a	3b
	HZCL HCL	3b(3a)	3b(3a)	3b	3b	4
	SC ZC C	3b(3a)	3b(3a)	3b	4	4
IV	S[2] LS SL SZL	3a	3a	3a	3b	3b
	ZL MZCL MCL SCL	3b	3b	3b	3b	3b
	HZCL HCL	3b	3b	3b	4	4
	SC ZC C	3b	3b	3b	4	5
V	S LS SL SZL	4	4	4	4	4
	ZL MZCL MCL SCL	4	4	4	4	4
	HZCL HCL	4	4	4	4	4
	SC ZC C	4	4	4	5	5
Soils in Wetness Class VI - Grade 5						

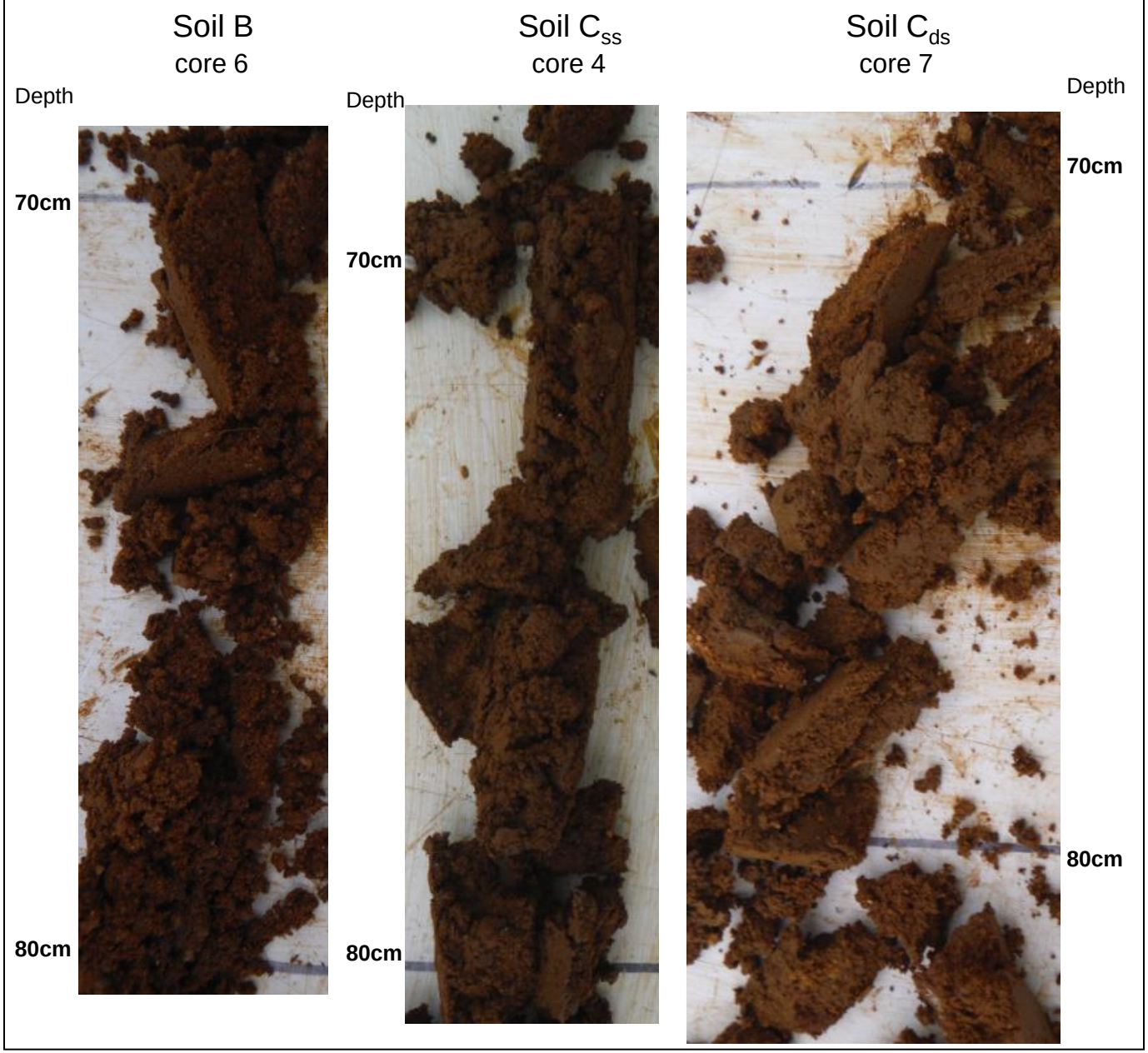
[1]For naturally calcareous soils with more than 1% $CaCO_3$ and between 18% and 50% clay in the top 25 cm, the grade, where different from that of other soils, is shown *in brackets* (see page 16).

Soil B, grade 2
This soil is fairly light textured (sandy loam) all the way down to 100cm. There is no evidence of mottling or a slowly permeable layer and therefore the wetness class is I and the soil is well drained.

Soil C_{ss}, grade 2
This soil is similar to soil B but there is slightly more clay making it a sandy clay loam down to 100cm. The subsoil is moderately stony although this was evidenced more by the resistance to the corer rather than what the corer actually sampled as in the photo.

Soil C_{ds}, grade 2
This core is the same textured soil as above but denser in the subsoil due to compaction. Again this is evidenced by resistance to the corer and not by the photo.

Fig 2a: Photos of subsoil cores representative of soil types B and C at a depth of between 70 and 80cm. The profiles are also described more generally on page 7.

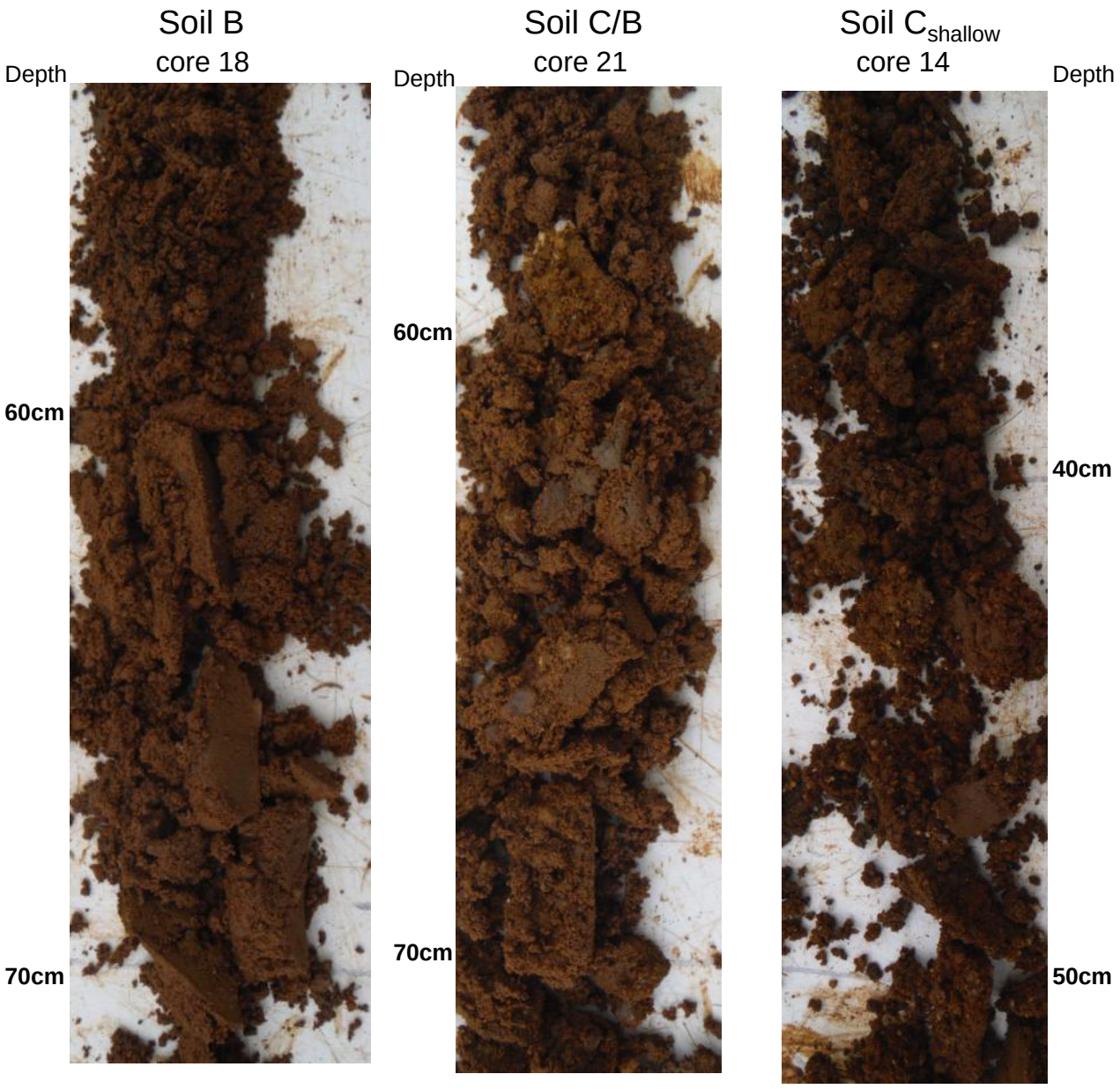


Soil B, grade 2
This core 18 is fairly light textured (sandy loam) down to 70cm. Below this depth the core is more medium textured (sandy clay loam).

Soil C/B, grade 2
This soil is similar to soil B but there is slightly more clay in the topsoil making it a sandy clay loam down to 35 or 40cm. The subsoil is moderately stony as shown in this photo.

Soil $C_{shallow}$, grade 3a
This core is very gravelly (unaugerable) below 55 to 60cm and is moderately stony above this depth with particularly small stones (0.2 to 0.6cm) as shown in the photo.

Fig 2b: Photos of subsoil cores representative of soil types B and C at varying depths between 40 and 70cm. The profiles are also described more generally on page 7.

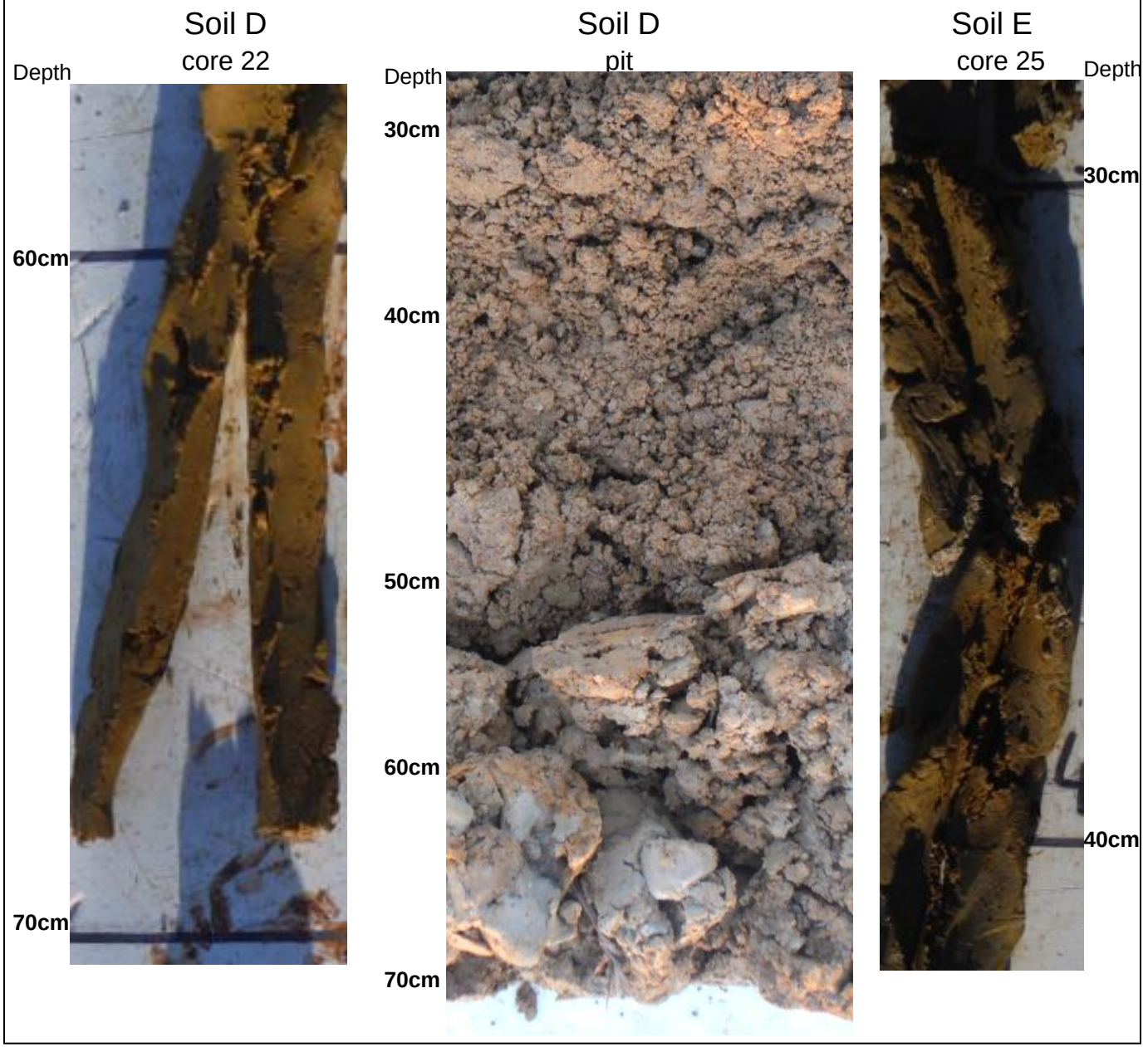


Soil D, grade 2
This core 22 is medium to heavy down to 50cm. Clay is below this depth and the photo shows mottling below 60cm.

Soil D, grade 2
A pit was dug down to 70cm and the soil laid on a board. The subsoil structure above 50cm is good as evidenced by the friable, fine, granular shape of the aggregates shown in the photo. Below this depth the structure changes to very coarse, angular blocky which is indicative of a poor structure. Mottling is clearly shown below 45cm.

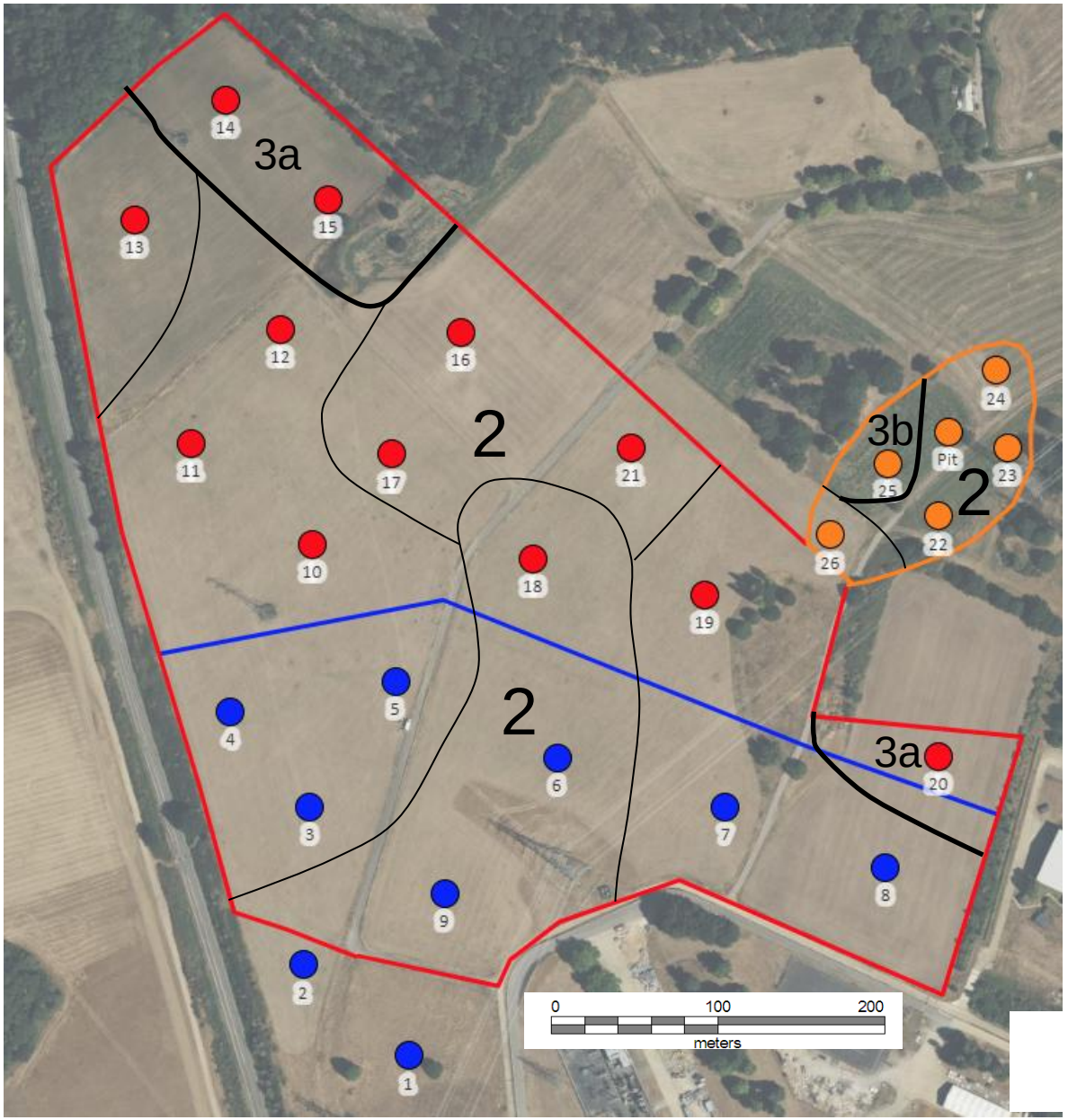
Soil E, grade 3b
This core is heavy topsoil over mottled clay below 30-35cm depth. This is the least well drained profile on the site at wetness class III which coupled with it's heavy topsoil makes it the worst quality land on the site at grade 3b.

Fig 2c: Photos of subsoil cores representative of soil types D and E at varying depths between 30 and 70cm. The profiles are also described more generally on page 7 & 8.



See map 5 below for area of each grade

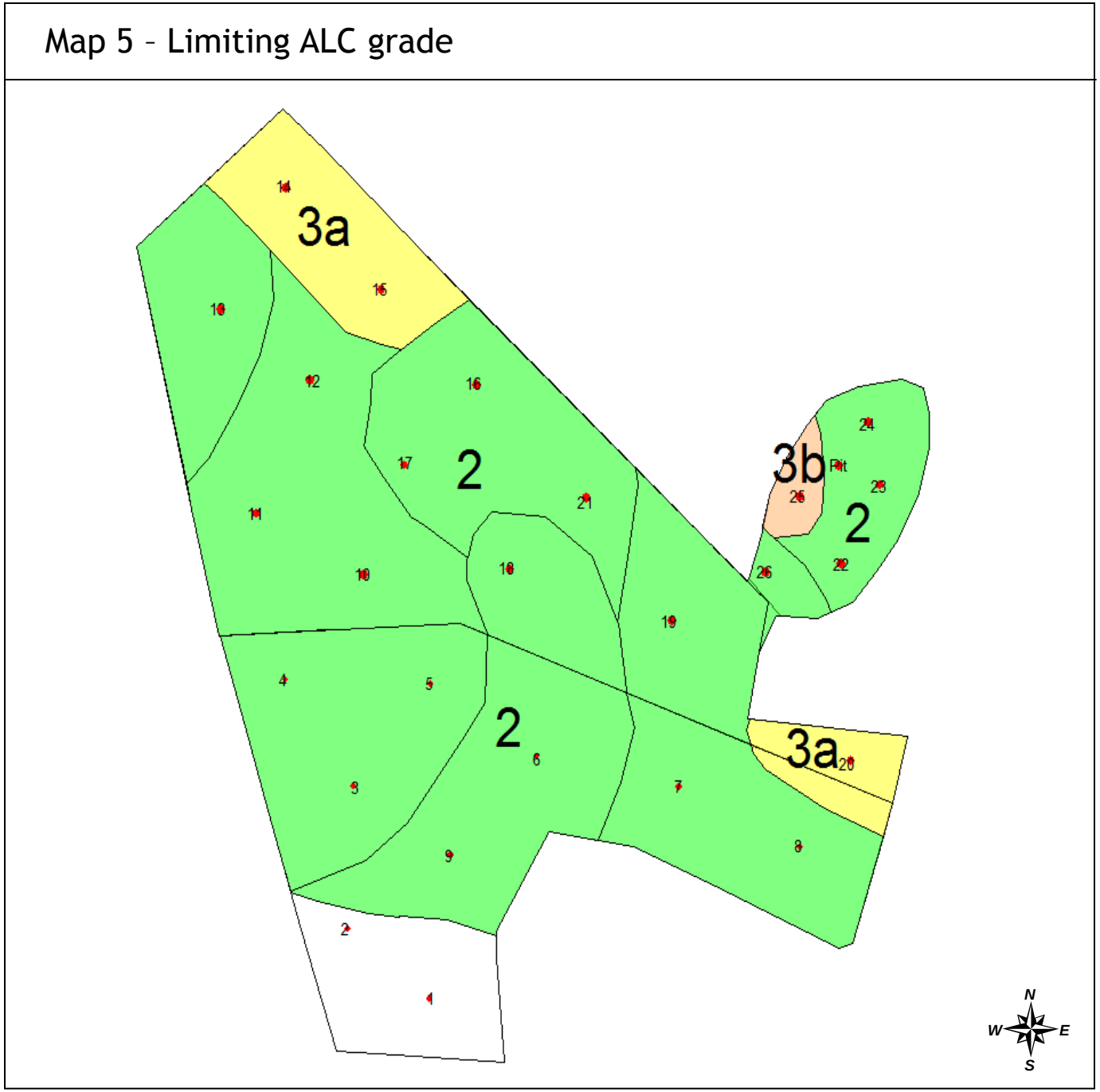
Map 4: Limiting agricultural land classification ALC map of the surveyed land at Culham



Area: 21.7 ha

2	19.1ha	**88%**
3a	2.3ha	**11%**
3b	0.3ha	**1%**

Map 5 – Limiting ALC grade



Executive summary

The soils on this site are a mixture of loamy sand, sandy loam, sandy clay loam and clay with a range of gravel content in the subsoil. They are all well drained except for soils D & E over clay.
The land is mainly grade 2 with bits of grade 3a where the land is more gravelly at depth as shown on maps 3, 4 & 5. There is also a little bit of grade 3b next to a wood where the subsoil is slowly permeable clay.
The more gravelly grade 3a soil is limited by droughtiness and depth of soil while the rest of the land is grade 2 again limited by droughtiness except for a small area of grade 3b which is limited by soil wetness.

88% of the site is grade 2, 11% is grade 3a and 1% is grade 3b.

Description of the yielding qualities and cropping suitability of the different ALC grades is given in appendix 1 on the next page.

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Appendix 1

Taken form the MAFF ALC guidelines 1988, pages 9 and 10

SECTION 2

DESCRIPTION OF THE GRADES AND SUBGRADES

The ALC grades and subgrades are described below in terms of the types of limitation which can occur, typical cropping range and the expected level and consistency of yield. In practice, the grades are defined by reference to physical characteristics and the grading guidance and cut-offs for limitation factors in Section 3 enable land to be ranked in accordance with these general descriptions. The most productive and flexible land falls into Grades 1 and 2 and Subgrade 3a and collectively comprises about one-third of the agricultural land in England and Wales. About half the land is of moderate quality in Subgrade 3b or poor quality in Grade 4. Although less significant on a national scale such land can be locally valuable to agriculture and the rural economy where poorer farmland predominates. The remainder is very poor quality land in Grade 5, which mostly occurs in the uplands.

Descriptions are also given of other land categories which may be used on ALC maps.

Grade 1 - excellent quality agricultural land
Land with no or very minor limitations to agricultural use. A very wide range of agricultural and horticultural crops can be grown and commonly includes top fruit, soft fruit, salad crops and winter harvested vegetables. Yields are high and less variable than on land of lower quality.

Grade 2 - very good quality agricultural land
Land with minor limitations which affect crop yield, cultivations or harvesting. A wide range of agricultural and horticultural crops can usually be grown but on some land in the grade there may be reduced flexibility due to difficulties with the production of the more demanding crops such as winter harvested vegetables and arable root crops. The level of yield is generally high but may be lower or more variable than Grade 1.

Grade 3 - good to moderate quality agricultural land
Land with moderate limitations which affect the choice of crops, timing and type of cultivation, harvesting or the level of yield. Where more demanding crops are grown yields are generally lower or more variable than on land in Grades 1 and 2.

Subgrade 3a - good quality agricultural land
Land capable of consistently producing moderate to high yields of a narrow range of arable crops, especially cereals, or moderate yields of a wide range of crops including cereals, grass, oilseed rape, potatoes, sugar beet and the less demanding horticultural crops.

Subgrade 3b - moderate quality agricultural land
Land capable of producing moderate yields of a narrow range of crops, principally cereals and grass or lower yields of a wider range of crops or high yields of grass which can be grazed or harvested over most of the year.

Grade 4 - poor quality agricultural land
Land with severe limitations which significantly restrict the range of crops and/or level of yields. It is mainly suited to grass with occasional arable crops (e.g. cereals and forage crops) the yields of which are variable. In moist climates, yields of grass may be moderate to high but there may be difficulties in utilisation. The grade also includes very droughty arable land.

Grade 5 - very poor quality agricultural land
Land with very severe limitations which restrict use to permanent pasture or rough grazing, except for occasional pioneer forage crops.