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MINISTRY OF AGRICULTURE, FISHERIES AND FOOD

REPORT ON THE AGRICULTURAL LAND CLASSIFICATION AND SOIL SUITABILITY OF LAND AT GRAFTON LODGE FARM, GRAFTON REGIS, NORTHAMPTONSHIRE

1.0 SUMMARY

1.1 This semi-detailed survey was undertaken during April 1991 for Mr H C Sargeant of Grafton Lodge Farm. The farm is shown on the provisional one inch to one mile Agricultural Land Classification Map as predominantly grade 2 (MAFF, 1968). Recent site investigations indicate that the majority of the land is in fact subgrade 3b, with smaller areas of subgrade 3a and 4. Six soil variants are identified on the farm, grouped into four main soil types which relate closely to the underlying geology. Despite these soil variations the majority of the land remains principally suited to grass and cereals and other combinable crops.

1.2 Although small areas of slightly more flexible soils do occur on the farm (which largely coincide with land graded 3a) the distribution of these areas makes them difficult to farm separately.

1.3 Details of the MAFF Agricultural Land Classification (ALC) System are included in Appendix 1.

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2.0 INTRODUCTION

2.1 This report provides information on agricultural land quality and soil suitability of 208 hectares of agricultural land at Grafton Lodge Farm. The accompanying map supercedes information contained on the provisional one inch to one mile ALC map but should be used with caution when assessing small areas where localised variations may occur.

2.2 The farm, which is tenanted by Mr H C Sargeant, extends south westwards from the village of Grafton Regis tapering gently to meet the A5(T) road in the southwest.

On the one inch to one mile Agricultural Land Classification (ALC) map, sheet number 146 (MAFF, 1968) the farm is predominantly shown as grade 2, with small areas of grade 3 located immediately south of Grafton Regis, and adjoining the A5(T) road. Since this map is of a reconnaissance nature, designed primarily for strategic planning purposes, the current survey was undertaken to provide more detailed information on land quality within the farm boundary.

2.3 The farm was inspected during early April 1991, when a total of 102 soil inspections were made using a hand held Dutch soil auger, giving an overall density of one inspection per two hectares. This information was supplemented by further data from 6 representative soil profile pits. The results of this survey and the location of individual sampling points are shown on maps 1 and 2.

2.4 At the time of survey the land was under grass and arable crops (mainly cereals and oilseed rape).

3.0 PHYSICAL FACTORS AFFECTING LAND QUALITY

Climate

3.1 Site-specific climate data was obtained by interpolating information contained in the 5 kilometre grid agro-climatic dataset, compiled by the Meteorological Office (Met Office, 1989). This shows that for an average altitude of 100 metres A.O.D. average annual rainfall is approximately 686 mm (27.4 inches) which is moderately low by national standards.

3.2 The accumulated temperature for the Grafton Regis area is 1376°C. This parameter measures the cumulative build up of warmth available for crop growth, and in conjunction with rainfall, influences the development of soil moisture deficits (SMD*) and susceptibility to drought. Soil moisture deficits of 102 mm and 93 mm are recorded for wheat and potatoes respectively.

3.3 The Field Capacity Days are recorded at 154 per annum. This represents the period when the soil moisture deficit is at zero, and excess rainfall has to be disposed of through the soil profile. When assessed together with soil drainage and the topsoil texture, it indicates the wetness/ workability characteristics of the land.

Climatic factors do not constitute a limitation to agricultural land quality in the area.

* SMD: represents the balance between rainfall and potential evapo-transpiration. For ALC purposes the soil moisture deficits developing under a winter wheat and maincrop potato crop are considered. These reference crops have been selected because they are widely grown and in terms of their susceptibility to drought are representative of a wide range of crops.

Altitude & Relief

3.4 The farm occupies a watershed location within a meander loop of the River Tove. From an approximate altitude of 106 metres above ordnance datum (AOD) at Grafton Lodge buildings the land rises in a southwesterly direction over very gentle gradients to a maximum altitude of 120 metres AOD in the vicinity of Plum Park. To the northeast, east, and south of the farm buildings the land falls over moderate gradients into dry, open valley features. A minimum altitude of 80 metres AOD occurs in the northeastern and eastern corners of the site adjoining the A508 road. Altitude and relief do not constitute limiting factors to agricultural land quality.

Geology

3.5 The geology of this area is shown on the 1:63,360 scale solid and drift edition geology map, sheet number 202 (Geol. Surv. 1969). This shows the solid geology of the site to comprise Great Oolite limestone. This is underlain by the thinly bedded limestones and clays of the Estuarine Series, which in turn rests on Upper Lias Clay.

3.6 Over the very gently sloping central and western parts of the farm this solid geology is completely masked by more recent spreads of glacial boulder clay drift, which forms the main soil making material in these areas.

3.7 The underlying solid geology is consequently mainly exposed in areas of more sloping ground. On the gentle slopes in the central-southern part of the site and in a smaller ribbon north and east of Grafton Lodge buildings, Great Oolite limestone is mapped as being exposed. On the moderately sloping northeastern and eastern corners of the site this is underlain by the Upper Estuarine Series clays and limestones which give way on the lowest ground to small areas of stiff Upper Lias clay.

3.8 Field survey observations largely confirm these findings and indicate that a close degree of correlation exists between the soils occurring on the farm and the underlying geological deposits.

Soils

3.9 No detailed soil map exists for this area. However the very generalised 1:250,000 scale soil map (Soil Survey, 1983) indicates that the majority of the site comprises soils of the Hanslope Soil Association (derived from glacial boulder clay) with smaller areas of Aberford soils (derived from limestone) located along the eastern and southern boundaries. Very small areas of heavy Wickham 2 soils are mapped as occurring on the lowest ground in the north eastern and eastern corners of the site. Brief descriptions of these soil associations are provided in Appendix 2. Field survey observations indicate that the soils occurring on site are rather more complex than indicated on this generalised map. Six soil variants are identified on the farm, based on differences in texture, depth, drainage characteristics and stone content. The location of these individual soil variants (labelled A-F) is shown on Map 2. For descriptive purposes they conveniently group into 4 main types, which relate to their geological origins.

3.10 Firstly, and occurring over extensive areas on the farm are moderately well drained soils derived from glacial boulder clay drift (Soil Type A). These profiles are typically stoneless or very slightly stony and comprise clay topsoils to 25-30 cm overlying clay upper subsoils which in turn overlie chalky boulder clay drift below 50-60 cm. Although usually decalcified in upper horizons these soils are moderately well structured to depths of approximately 70 cm and are assessed predominantly as wetness class II. (Brief definitions of wetness classes are included in Appendix 3.)

3.11 A small area of more poorly structured boulder clay soils is located on the gentle ridge which extends eastwards from Plum Park to Grafton Park Wood (Soil Type B). Soils in these areas are distinctly gleyed beneath the topsoil and are assessed as wetness class III.

3.12 Secondly are soils derived from Great Oolite Limestone.

Along the central-southern boundary of the farm (in the vicinity of Grafton Fields), and in the vicinity of the small valley due south of Grafton Lodge buildings the soils are mainly shallow (Soil Type C).

Typical profiles in these areas are strongly calcareous, moderately stony and comprise clayey textures overlying limestone between 30-45 cm depth. Soil pit observations within this area indicate that the limestone is shattered and fissured to moderate depth, allowing root penetration to at least 65 cm. The ability of plant roots to penetrate and extract water from the underlying limestone helps offset the moderately severe droughtiness limitation associated with this land. A small area of particularly shallow and stony soils occurs in the vicinity of SP 748458 where the droughtiness constraint is more severe.

3.13 Around the northern fringes of the area described above, and in small areas north and east of Grafton Lodge buildings, generally deeper soils over limestone occur (Soil Type D). Profiles in this area are typically calcareous, slightly stony and comprise heavy clay loam or silty clay loam topsoils to 25-30 cm depth overlying clay loam or clay upper subsoils which in turn overlie limestone rock below depths of 60-65 cm. Occasionally the subsoil contains horizons of highly weathered limestone rock, which when rubbed, is of a sandy clay loam or medium clay loam texture. Soils of this type are well structured, free draining and hold moderate to moderately large reserves of plant available water.

3.14 Thirdly are the complex of soils derived from the Estuarine Series clays and Limestones and from the Upper Lias Clays (Soil Type E). These occur on the moderately sloping ground in the northeast and eastern corners of the site, and in a small part of the lower valley south west of Grafton Lodge buildings. Although small areas of limestone soils continue to occur in these areas (derived from narrow bands of Upper Estuarine Limestone), the soils are principally derived from Clay.

3.15 Profiles in these areas are typically stoneless or very slightly stony (although brashy limestone patches may occur locally) and comprise heavy clay topsoils to 20-30 cm depth over strongly gleyed clay subsoils which often become increasingly plastic and moist with depth. These soils are variably calcareous, poorly structured and are assessed predominantly as wetness class III and IV.

3.16 Fourthly, and lastly, are soils which occur at the junction of glacial boulder drift with Oolite Limestone (Soil Type F). These form a discontinuous, narrow ribbon around the farm. Profiles in these areas typically comprise clay or clay loam topsoils overlying similar subsoils which usually overlie limestone rock below 90-100 cm depth. These soils are usually non calcareous in upper horizons but become increasingly calcareous with depth. They are well structured, permeable and mainly assessed as wetness class I.

3.17 It should be noted that soils described above do not always occur in mutually exclusive areas, and may occur in complexes together, particularly at or close to a geological boundary.

4.0 AGRICULTURAL LAND CLASSIFICATION

4.1 Using the Revised guidelines and criteria for assessing the quality of agricultural land (MAFF, 1988), the site is principally graded 3b, with smaller areas of 3a and 4. A precise breakdown of the individual ALC grades, in hectares and % terms is provided below.

ALC	Ha	%
3a	40.5	19.5
3b	159.6	76.8
4	1.8	0.8
Non Agricultural	3.4	1.6
Agricultural bldg	2.6	1.3
Total	207.9	100.0

Grade 3a

This occurs in relatively small areas of the site in two main situations:-

4.2 Firstly are areas to the southwest, north and east of Grafton Lodge buildings which broadly coincide with the junction of glacial boulder clay drift with Great Oolite Limestone. These soils comprise clay and occasionally clay loam textures to in excess of 90/100 cms depth overlying limestone (see paragraph 3.16). Although well structured and freely drained this land is excluded from grade 2 by its workability limitations which derive from its clayey topsoil texture.

4.3 Secondly are smaller areas of deeper soils over limestone which are more fully described in paragraph 3.13. This land is limited by droughtiness and stoniness constraints. Although patches of brashier soils do occur within this area, which are/approach grade 3b, it has not been possible to delineate them at the scale of mapping undertaken.

4.4 Although this land is potentially capable of producing above average yields, it is questionable to what extent these yields could be achieved practically due to the rather linear distribution of the individual soil types.

Subgrade 3b

This occurs extensively over the site in three main situations:

4.5 Firstly are large areas in the central and western parts of the site where soils are principally derived from glacial boulder clay drift. These soils are moderately well drained (mainly wetness class II with smaller areas of wetness class III) and comprise clayey textures overlying chalky boulder clay drift below 50/60 cm (see paragraphs 3.10-3.11).

4.6 Secondly are smaller areas in the eastern and north eastern corner of the site where soils are principally derived from Estuarine Series deposits. Soils in these areas are poorly structured and poorly to very poorly drained (see paragraph 3.14). Land of the above types is limited by more severe wetness and workability imperfections, and requires careful timing of cultivations to avoid soil structural damage.

4.7 Thirdly and lastly are areas of shallow, moderately stony soils over limestone. These soils mainly occur along the southern boundary of the farm in the vicinity of Grafton Fields, and are more fully described in paragraph 3.12. This land is limited by droughtiness and stoniness constraints.

Grade 4

4.8 This is mapped in a small area of particularly stony and shallow soils, northwest of Grafton Fields. Due to a very high stone content in close proximity to the surface, the land is reported to be virtually unploughable and is in long term grass. It is limited by severe droughtiness and stoniness constraints.

Non Agricultural

4.9 This category includes woodland, pheasant keep, scrub/woodland in a worked out quarry, and the site of a scheduled ancient monument.

Urban

4.10 This category includes houses, farm buildings and associated land.

5.0 SOIL SUITABILITY

5.1 For land to be judged suitable to grow a crop there must be reasonable confidence that it can be grown regularly and make a profitable contribution to the farm economy. There are a number of limitations to cropping range at Grafton Lodge Farm, the main ones being heavy texture, difficulty in cultivation, wetness and droughtiness. In small areas, steep gradient and stoniness provide further limitation. The suitability of the individual soil types occurring at Grafton Lodge Farm are discussed below:

Soil Type A

5.2 This soil type covers the largest area of land. It is heavy textured and has a moderate wetness limitation. The full potential of this soil type is only achieved where underdrainage is installed.

5.3 Since the moisture-retentive topsoil remains wet and sticky after rain it is not generally suitable for cultivation in spring nor for harvesting root crops in autumn. It is in the most suitable condition for cultivation when it has been wetted by late summer/early autumn rain. Thus it is best suited to establishing and harvesting winter cereals, winter oilseed rape and winter beans.

5.4 It has a moderately high available water capacity which would support good grass growth. However, care would need to be taken to avoid soil and grass sward damage by grazing cattle in early spring and late autumn. In wet winters there would be a risk of damage by slurry tankers/manure spreaders travelling across the land but damage could be minimised by using extra wide wheels and by travelling "on the frost".

5.5 Crop roots are able to penetrate to more than 100 cms in this soil to extract moisture from depth. In an average year yield will be slightly restricted by drought but with a high standard of husbandry winter wheat yields in the range 7.5 to 8.5 t/ha should be achieved.

Soil Type B

5.6 This area occurs in the extreme west of the farm (specifically between Plum Park and Grafton Park Wood). It is similar to soil A but is less well structured and consequently less well drained. Greater care has to be exercised in cultivating this soil. It is suitable only for grass and combinable crops established in autumn.

Soil Type C

5.7 Cropping range on this soil is restricted to some extent by stoniness and heavy texture but more particularly by the moderately severe drought limitation. The high stone content prevents precision drilling of fine-seeded vegetable crops and the drought restriction rules out high cash value root crops.

5.8 Drought will restrict the yield of all crops including grass in all but the wettest years. In some areas where the surface stone content is high and/or where the land undulates because of past limestone quarrying the soil is more suited to permanent grass. Otherwise cereals and other combinable crops can be grown. Spring drilling of cereals, peas, beans, linseed and oilseed rape is possible despite the heavy texture since the soil quickly dries out after rain but spring crops are more at risk to drought since root exploration to depth is unavoidably lower than for autumn established crops.

Soil Type D

5.9 This soil is more productive than Soil C since there is a greater depth of soil over limestone. Nevertheless, heavy texture in the more shallow areas, stoniness and droughtiness remain limitations so higher cash value root and vegetable crops cannot be grown. Irrigation would improve productivity but this is not considered practical since the areas which would benefit are too small to be economic, even if the necessary water could be obtained.

5.10 Despite the heavy texture, spring drilling could be successfully achieved on this soil type in most years but since it often occurs adjacent to and in the same field as less well drained soil, cropping will often be restricted to grass and autumn sown combinable crops.

Soil Type E

5.11 This soil type is mainly formed from clay and is poorly drained over most of its extent. The lowest areas are difficult to drain adequately since they receive water from a wide area. Over most of the area there is a narrow moisture range over which the soil is in a suitable condition for cultivation. Thus great care must be taken in cultivation and spring cropping should not be contemplated except where autumn crops have unavoidably not been established or have failed.

Soil Type F

5.12 This is a well-drained, well-structured, deep, moisture retentive soil. In yield terms this is likely to be the most productive soil on the farm. Its main limitation is heavy texture which restricts the cropping range.

5.13 The soil has a moderately high clay content in the topsoil which is moisture retentive and hence somewhat slow to dry out in spring. In a drier than average spring potatoes, sugar beet and a range of vegetable crops, particularly transplanted brassicas and possibly root vegetables too could be grown. In a very wet autumn it might prove impossible to harvest potatoes and root vegetables.

5.14 The land would be suitable for spring drilling of cereals, peas, beans, oilseed rape and linseed particularly if the seedbed was largely prepared in the previous autumn or on a frost in winter.

5.15 Thus this soil type is potentially the most flexible on the farm but since it mainly occurs in a narrow band, practical considerations dictate that it is cropped in a similar manner to adjacent soils. Thus cropping will largely be restricted to grass and autumn-established combinable crops.

6.0 SOIL DRAINAGE

6.1 Soil type affects the rate at which water passes through the soil profile and determines its permeability. At Grafton Lodge, subsoil structure and nearness of limestone to the surface are the dominant factors. Soils C, D and F are naturally well drained and do not need artificial drainage.

6.2 It may be that the land is already adequately underdrained where required. The observed rust and brown mottling and black manganese concretions in soils A, B and E may be relict and do not necessarily reflect the current drainage status. The previous winter before the site visit had been unusually dry so a confident assessment of present field drainage status could not be made. If the fields are not underdrained, the current economic state of farming probably does not justify the capital expenditure involved.

6.3 Soils A and B are similar and both require drainage to give of their best although the need is greater in soil B. The design of a drainage scheme is influenced by many considerations - rainfall, cropping system, soil type and slope. In practice these interact with each other. Mole channels will remain stable for 7 to 9 years or possibly longer on these two soils. Thus an appropriate system would be tile or plastic land drains at 40 metre spacing with gravel backfill and mole channels pulled at 2 to 2.5 metres apart.

6.4 A similar system incorporating land drains, permeable fill and moling would be suitable on soil E. On the low lying, flat wetter ground drain spacing would need to be 20 to 30 metres apart. On the higher ground drain spacing would depend on gradient.

7.0 CULTIVATIONS AND STRAW INCORPORATION

7.1 The topsoils are quite uniformly heavy textured across the farm. They are mainly moisture retentive and slow to dry out after rain in spring. Whereas the surface soil may be dry, the soil at 10 cm depth remains moist or wet. Thus they are better suited to autumn cultivations.

7.2 Straw incorporation on soils C and D is best achieved by ploughing. On B and E every opportunity should be taken to incorporate straw by shallow cultivations since ploughing is much slower, particularly in dry autumns when several secondary cultivations are required to form a tilth and seedbed moisture is more easily lost. On soils A and F a flexible approach should be adopted with shallow incorporation in some areas to achieve timely drilling and ploughing in others to assist grass weed control and to remove shallow compaction.

7.3 Where ploughing is done in wet autumns and the tractor wheel travels in the furrow there is a risk of causing compaction in the upper subsoil. Use of a subsoiler is then needed in dry autumns to maintain continuity of vertical fissuring from the topsoil into the deeper subsoil.

8.0 SOIL NUTRIENTS

8.1 Soil analysis should be used to determine soil nurient status. In general soil types A, B, E and F are normally well supplied with potash but can be low in phosphorus. Soils C and D are normally moderately well supplied with both nutrients.

8.2 Trace element deficiencies are not normally encountered on any of the six soil types.

8.3 Although soils A and B are derived from chalky boulder clay they are decalcified now and may be acid at the surface. Regular checks with soil indicator during the site visit did identify slight acidity across soil B and also on soil A to the west and north west of Grafton Cottage Farm. Soil E was also found to be acid with the most severe acidity identified on a lighter textured east facing bank to the west of the drain marked on the lowest ground in the extreme east.

MAY 1991

ADAS
CAMBRIDGE REGIONAL OFFICE

SOURCES OF REFERENCE

GEOLOGICAL SURVEY OF ENGLAND AND WALES (1980). 1:63,360 scale solid and drift edition geology map, sheet number 202 (Towcester)

MAFF (1968). 1:63,360 scale provisional ALC map, sheet number 146.

MAFF (1988). Revised guidelines and criteria for grading the quality of agricultural land.

METEOROLOGICAL OFFICE (1989). Climate data extracted from the published agro-climatic dataset

SOIL SURVEY OF ENGLAND AND WALES (1983). 1:250,000 scale map sheet number 4. Soils of Eastern England

1. Agricultural Land Classification (ALC) assesses land quality based on its long term physical potential. The ALC system grades land according to the degree to which its inherent physical characteristics impose long term limitations on agricultural use.

2. The main physical factors which are taken into account in assessing ALC grade are climate site and soil. These may act singly, or in combination to result in varying degrees of constraint on agricultural use. The ALC grade is determined by the most limiting factor present.

3. Five main grades of land are recognised ranging from grade 1 land of excellent quality to grade 5 land of very poor quality. Other issues, such as the location of farms, the standard of fixed equipment and the accessibility of land do not affect grading although they may influence land use decisions.

DESCRIPTION OF GRADES

Grade 1 - excellent quality agricultural land

4. 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

5. 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

6. Land with moderate limitations which affect the choice of crops, timing and type of cultivation, harvesting or the level of yield. When 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

7. 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

8. 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

9. 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 (eg cereals and forage crops) the yields of which are variable. In most 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

10. Land with very severe limitations which restrict use to permanent pasture or rough grazing, except for occasional pioneer forage crops.

SOIL SURVEY DEFINITIONS

Hanslope Soil Association

Slowly permeable calcareous clayey soils. Some slowly permeable non calcareous soils. Slight risk of water erosion.

Aberford Soil Association

Shallow, locally brashy, well drained calcareous fine loamy soils over limestone. Some deeper calcareous soils in colluvium.

Wickham 2

Slowly permeable, seasonally waterlogged fine loamy over clayey, fine silty over clayey and clayey soils. Small areas of slowly permeable calcareous soils on steeper slopes.

APPENDIX 3

SOIL WETNESS CLASSIFICATION

1. Soil wetness is classified according to the depth and duration of waterlogging in the soil profile. Six soil wetness classes are recognised and are defined below.

Definition of Soil Wetness Classes

Wetness Class	Duration of Waterlogging[1]
I	The soil profile is not wet within 70 cm depth for more than 30 days in most years.[2]
II	The soil profile is wet within 70 cm depth for 31-90 days in most years.
III	The soil profile is wet within 70 cm depth for 91-180 days in most years.
IV	The soil profile is wet within 70 cm depth for more than 180 days but not within 40 cm depth for more than 210 days in most years.
V	The soil profile is wet within 40 cm depth for 211-335 days in most years.
VI	The soil profile is wet within 40 cm depth for more than 335 days in most years.

[1] The number of days specified is not necessarily a continuous period.

[2] 'In most years' is defined as more than 10 out of 20 years.