Review of Soils and Agricultural Land Classification Cottam Solar Project

Lincs County Council

September 2023

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Review of Soils and ALC Cottam Solar Project

1. Instructions to Landscope

1.1 Landscope is instructed by Lincolnshire County Council to review and report on the agricultural aspects of this application for a Development Consent Order for an extensive ground mounted solar array and associated infrastructure. The proposed development occupies a total area of 1,180ha plus connectors and the cable route. The Scheme will include substations and an Energy Storage Systems (sometimes referred to as 'BESS'), buried cabling within the sites, and other equipment and security fencing; and the buried Cable Route Corridor. The combined area of the substations and BESS will be approximately 29ha.

1.2 A review of the grading of soils for agricultural land classification compares differences between expected grades and those found in the soils baseline. It is noted that an ALC survey has been undertaken by AMET and a small area by Land Research Associates (LRA) and the soils and agriculture report is prepared by Danield Baird Consultancy (DBC). This report seeks to clarify the findings and set them in context.

1.3 The proposed development is likely to have a cumulative or defined negative impact that will result in the loss of agricultural production in the development area generally and/or the permanent loss of production from mostly moderate quality agricultural land.

2. The Site and Proposal

2.1 The Proposed Development comprises the installation of solar photovoltaic (PV) generating modules, cabling, and grid connection infrastructure with significant.

2.2 The Site is located within the administrative boundary of West Lindsey District, in the county of Lincolnshire. The Site measures approximately 1,200 hectares (ha) and extends across 4 sites Cottam 1, Cottam 2 and Cottam 3a & 3b. The Site boundaries are represented in **Appendix 1,** which also shows the findings of the ALC report. The total area including cable route is 1,451.23 hectares.

3. Geology and Soils

Geology

3.1 The geology of the area is shown on a British Geological Map reproduced in part (**Appendix 2**) for reference. The land is primarily shown as the Scunthorpe Mudstone Formation, a heavy clay-based mudstone and various smaller areas of drift, glaciofluvial deposits and diamicton. In all three parts of the site the bedrock geology is shown to be Scunthorpe Mudstone Formation. Each part has some variations, but primarily the land is of heavy clay character,

Soils

3.2 According to available published data, local knowledge and the national soil map indicates that the area predominates with three main soil types (**Appendix 3**). Three clay soil types predominate; Fladbury 2, Beccles and Salop Associations. The only exception is a small area of Cottam 3 that is of the Cranymoor Association, a well-drained sandy soil, which is droughty in character, but does not constitute a large area of the site.

3.3 These three soils are described as slowly permeable seasonally waterlogged fine loam over clayey soils, or fine silty over clayey soils. **Appendix 4** sets out a description of each of these main soil associations from Cranfield University.

3.4 The ALC survey undertaken has revealed similar clay based soil types across the site; except the sandy soils, in Cottam 3. A soil map is included within the ALC report and this broadly confirms the national soils map picture.

4. Agricultural Land Classification

4.1 The ALC should identify where BMV land is located and the scheme should seek to protect and minimise damage to higher grade land wherever possible in line with national planning policy. There is undoubtedly BMV land in this general vicinity and the ALC has sought to identify where it is and what the Grade and quality is. Laboratory analysis of representative samples have been used to determine textures.

4.2 AMET have undertaken most of the work and Land Research Associates (LRA) have undertaken an ALC over a smaller area. Some small areas were not surveyed, but these are not in themselves likely to change the overall scale of BMV. The survey was at a detailed scale with 1 borehole per hectare as recommended in TIN049 and the report surveyed most of the land.

4.3 In general the work seems to have been undertaken in line with guidance issued by British Society of Soil Scientists, with most aspects of the work being completed according to the guidance in the 1988 MAFF Guidelines. At present the cable route has not been surveyed.

4.4 The majority of the site is shown as Grade 3 on the provisional ALC maps of the area. **Appendix 5** shows the approximate location of the 4 main land areas, in relation to land grades. **Appendix 5** includes the map of predicted Best and Most Versatile (BMV) land indicated the area is expected to have only a medium (20-60%) chance of the presence of BMV.

4.5 It is normally expected that the ALC survey be undertaken in line with the MAFF 1988 guidelines and TIN049. These documents set out the precise methodology by which the ALC survey should be undertaken, with auger bore sampling at 1 hectare intervals and a suitable number of soil pits dug to determine the precise nature of the soil(s).

4.6 In this case it appears that Natural England have accepted the ALC report on the basis that the expected level of BMV is only moderate. The findings of the ALC report essentially identify over 90% of the site as Grade 3b. The majority of any BMV land is shown to be Grade 3a, with only around 30 ha of Grade 2.

ALC Summaries

Cottam 1

4.7 This site amounts to 923.9 hectares and is divided into 3 areas, 1a, 1b and 1c. The majority of the site has been found to be ALC grade 3b. There are relatively small quantities of Grade 2 and 3a, but the clear majority of the land is shown as of 3b. The soils are described as Stoneless clayey soils variably affected by groundwater, or slowly permeable seasonally waterlogged reddish fine loamy over clayey, fine loamy and clayey soils.

Cottam 2

4.8 131.2 hectares of arable land Mainly Grade 3b with around 8% Grade 3a. Soils are described as slowly permeable, seasonally waterlogged fine loamy over clayey soils.

Cottam 3a and 3b

4.9 180.5 hectares of arable land to the east of Blyton. The site is mainly Grade 3b with very small quantities of Grade 2 and 3b. The soils are described as heavy clay over slowly permeable clay subsoils resulting in seasonal wetness and limiting the cultivation of the soils in late autumn and spring.

4.10 The breakdown of land by classification is:

COTTAM 1
Grade 2: 25.2Ha 2.7%
Grade 3a: 55.7Ha 6.0%
Grade 3b: 843Ha 91.3%
Total: 923.9Ha

COTTAM 2
Grade 3a: 15.4Ha 11.7%
Grade 3b: 115.8Ha 88.3%
Total: 131.2Ha

COTTAM 3a and 3b
Grade 2: 1.4Ha 0.8%
Grade 3a: 7.7Ha 4.3%
Grade 3b: 171.4Ha 94.9%
Total: 180.5Ha

Climate Assessment Table	
Grid Reference	**SU 164 895**
Altitude	130
Average annual rainfall	693.1
Accumulated temp >0^{o}C (Jan-June)	1380.86
Moisture deficit, wheat	100.34
Moisture deficit, potatoes	89.94
Field capacity period	155.22
Overall Climatic Grade	1

5. Cable Route; Soil and ALC Assessment

5.1 The report does not estimate the land grades of the cable route in the ALC report or ES chapter. We conclude that the cable route is likely to comprise a combination of BMV and poorer agricultural quality land. Land formed on sand and gravel will likely give land of best and most versatile quality, (grade 2 and subgrade 3a). Land formed in alluvial deposits and in the mudstone geology will typically give heavy slowly permeable soils of poorer subgrade 3b agricultural quality.

5.2 The report states 'The Cable Route Corridor has not yet been subject to soil survey or farming circumstances assessment. This is as the narrow cable trench will need a specific survey along its actual path to inform soil management planning of the trenching works. Detailed ALC survey of fields places sample points at 100m intervals, too widely spaced to monitor soil variation within the soil to be excavated for the trench.

Agricultural occupancy and land use information for the Cable Route Corridor will need to be collected ahead of trenching work to avoid, where possible, an active construction site at sensitive periods of time for land management, for instance anticipated harvest dates. Any such information collected preplanning will lose validity and need to be replaced once an approximate work start date was established post consent.'

5.3 From viewing the maps included in the report it seems likely that 50+% of the cable route will be BMV. However, irrespective of the land quality there will be issues of concern to farmers and landowners including:-

- Land drainage
- Weed burden
- Biosecurity for plant diseases
- Timeliness of soil stripping and storage

5.4 These matters will need to be addressed if the scheme is to proceed.

6. Soil Damage During Construction

6.1 Soil structure can be significantly damaged during the construction phase of the process, particularly on heavy clay soils. There is inevitably a lot of trafficking of vehicles on the land to erect the panels and if this work is undertaken when soils are wet, there can be significant damage. Much of this damage can be remedied post construction, but not all and it is possible that long term drainage issues occur on the site due to the construction.

6.2 During the construction phase many of the areas will affect soil and water issues. **Appendix 6** sets out a basic Soil Management Plan that should be established as part of the Construction Phase, to minimise the impact on soil resources. The following headings should be included in the Soil Management Plan, both for the site and the cable route.

- Site preparation;
- Import of construction materials, plant and equipment to Site;
- Establishment of Site construction compounds and welfare facilities;
- Cable installation;
- Temporary construction compounds;
- Trenching in sections
- Upgrading existing tracks and construction of new access roads within the Site;
- The upgrade or construction of crossing points (bridges /culverts) at drainage ditches within the Site;
- Appropriate storage and capping of soil;
- Appropriate construction drainage;
- Sectionalised approach of duct installation;
- Excavation and installation of jointing pits;
- Cable pulling;
- Testing and commissioning; and
- Site reinstatement (i.e. returning any land used during construction, for temporary purposes, back to its previous condition).
- Use of borrow pits

6.3 **Appendix 7** shows photographs of before during and after construction of a large solar farm in Hampshire where soil structural issues were a major problem post construction. Once the panels are in place usual agricultural practices such as ploughing and subsoiling become difficult. It is therefore important that a soil management plan is in place and forms part of the conditions attached to any consent, so that it can be enforced.

7. Cumulative Impacts including County Wide ALC

7.1 There are a number of small(er) and several largescale Solar PV schemes in Lincolnshire, with others planned or proposed. There are five known solar project NSIP schemes; specifically in relation to impacts on agricultural land. The situation is a moving picture as new proposals come forward from time to time. Most of these sites are proposed on farmland. Lincolnshire is very much an agricultural area with substantial areas of land within the Best and Most Versatile category. Much of the non BMV land will be Grades 3b, still considered to be 'moderate' quality and still productive land.

7.2 A county-level alternative assessment area should be applied which as a minimum should consider scope for connection into the National Grid at the locations proposed by the registered NSIP solar projects locally, and with specific consideration of agricultural land impacts.

7.3 For a project of this scale where the proposal will tie up the land for up to 40 years, there will be some significant impact. The area is large locally and although the quantities of BMV are relatively low the impact will still be moderately significant.

7.4 Environmental Impact Assessments give guidance on the size and quality of Land Grade that is or can be affected by development proposals. The loss of such a large area of land would normally be considered as significant at District or County level, even though the use is 'temporary'. Any permanent loss of land due either to construction or through biodiversity designation may affect this assessment further.

8. Limitations of the ALC

a) Predictive versus Actual ALC

8.1 As set out above the ALC report is in line with the MAFF 1988 guidance, which recommends auger borings at 1 hectare intervals, and soil pits dug in representative soils types. The report is broadly in line with recommendations, but we have not been able to check any soil samples.

8.2 The results are not out of keeping with the expected finding given that the provisional map is showing Grade 3 land and the Predictive BMV map suggest only moderate amounts of BMV. The actual BMV findings are less than the expected findings, but this still falls within the normal range.

b) Farming Circumstance and Impact on Land Holdings

8.3 There is explanation of the impact on farm holdings or land structures affected by the proposal. From local knowledge there are 4 farming operators outlined in the report which outlines the impact on each holding.

'Four farm businesses occupy the Sites. Information on the size and nature of these farm businesses has been obtained from the landowners' land agents. Additional farm businesses occupy land crossed by the Cable Route Corridor where the interruption to current land management is considerably shorter compared to land within the Sites.'

‘Of the four farm businesses, Farm Business D is currently in the process of winding up an agricultural enterprise. Its dairy unit has been reduced in size in preparation for its planned cessation. The future baseline for Farm Business D will therefore not include the dairy enterprise, with land likely to be increasingly managed by third parties as the farm owners retire.’

Farming Circumstances

‘Four farm businesses occupy land within the Sites as shown on Figure 19.4. Baseline information for each of these has been gathered through interviews with the farmers and landowner’s land agents. Farming Circumstances information has not yet been collected for the Cable Route Corridor.’

8.4 Overall the impact on each of the four holdings has been detailed in the report. The impact will be significant for each unit in different ways, with some leading to dramatic changes in the farming systems and overall operations.

8.5 In considering the impact on the overall farming enterprises both locally and across the District or County, it may be necessary to seek additional information on the impact on the individual farms along the cable route.

Cable Route

The cable route has not yet been surveyed for ACL or soils and this work will need to be undertaken to ensure there is no damage to soils going forward.

Cottam ALC Report Summary Information

The 1:250,000 series Agricultural Land Classification maps show the land to be all Grade 3. The Predictive map for best and most versatile land shows the area to be low to moderate chance of BMV, i.e. 20-60%.

The survey work has been undertaken using recognised competent operators and surveyed in line with the 1988 Guidelines and TAN 049. The work has been undertaken at 1 borehole per hectare and occasional soil pits dug, with laboratory reports of soil samples to verify soil texture.

I have checked calculations and background date and as far as can be established the information is correct.

Without taking soil samples I cannot verify the findings any further than the report provides. However the information appears to be in line with the expected findings and likely to meet the criteria of MAFF 1988 Guidelines and other professional standards.

ALC Summary from ALC Report

Table 1 : ALC Grade Distribution

ALC Grade	Area (ha)*	%
2	6.1	0.5
3a	42.0	3.6
3b	1118.3	94.8
Not Surveyed	13.3	1.1
Total	**1179.7**	**100.0**

According to the ALC survey 95% of the land is not Best and Most Versatile. The main determinant for this is due to the Wetness Class of the soil and issues such as workability of the land.

Geology and Soils

In all three parts of the site the bedrock geology is shown to be Scunthorpe Mudstone Formation. Each part has some variations, but primarily the land is of heavy clay character, such as Fladbury 2, Beccles and Salop Associations. The only exception is a small area of Cottam 3 that is of the Cranymoor Association, a well-drained sandy soil, which is droughty in character, but does not constitute a large area of the site.

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Cottam 2

131.2 hectares of arable land Mainly Grade 3b with around 8% Grade 3a. Soils are described as slowly permeable, seasonally waterlogged fine loamy over clayey soils.

Cottam 3a and 3b

180.5 hectares of arable land to the east of Blyton. The site is mainly Grade 3b with very small quantities of Grade 2 and 3b. The soils are described as heavy clay over slowly permeable clay subsoils resulting in seasonal wetness and limiting the cultivation of the soils in late autumn and spring.

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COTTAM 3

Grade 2: 1.4Ha 0.8%

Grade 3a: 7.7Ha 4.3%

Grade 3b: 171.4Ha 94.9%

Total: 180.5Ha

Farming and Food Production

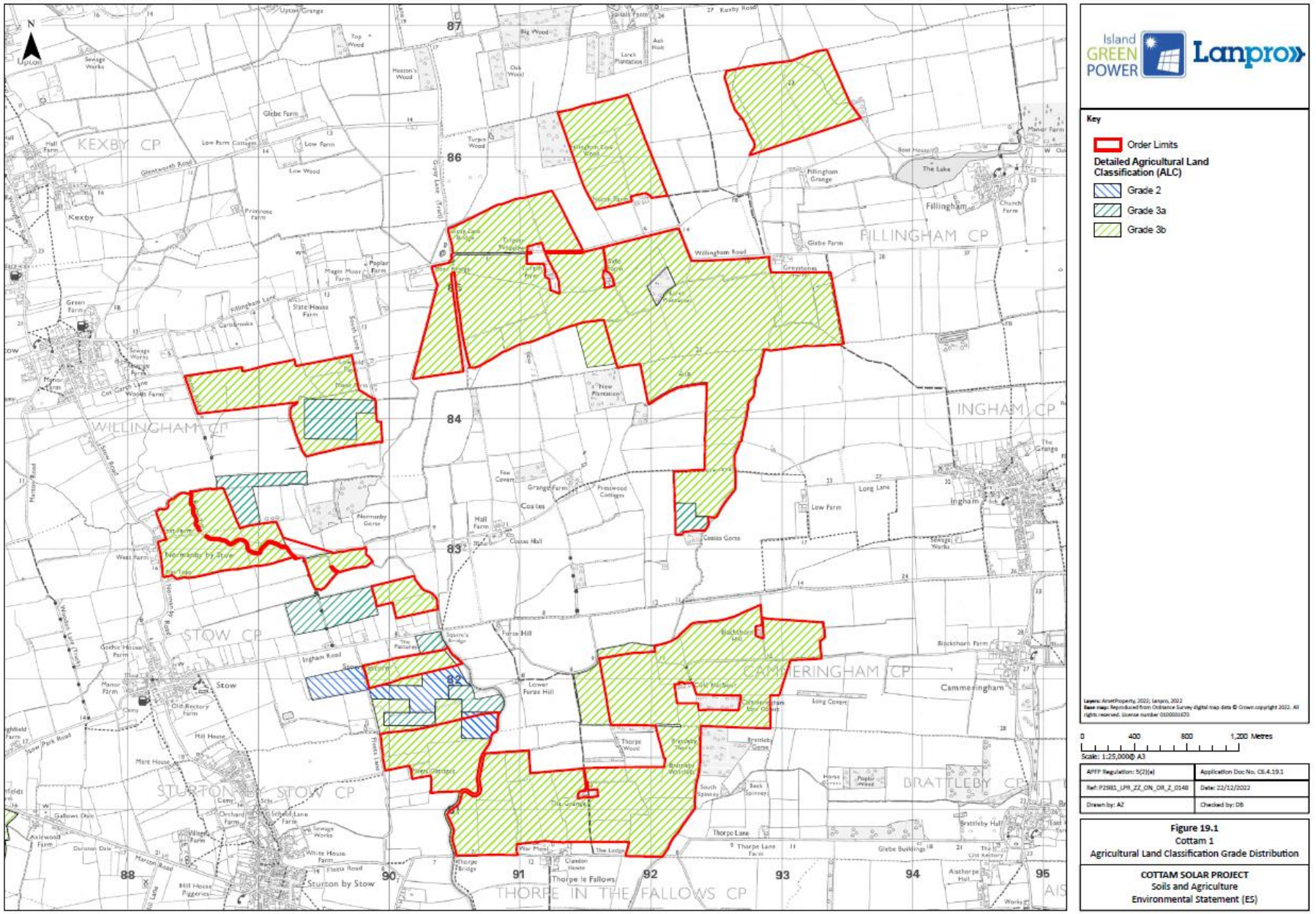
Four farm businesses are identified to manage the land within the site. All are owners of the land occupied and all own and occupy additional land outside of the site area. Each unit is described in summary with the stated impact, but that income from the solar farm would more than compensate for the loss of mainly arable farm land.

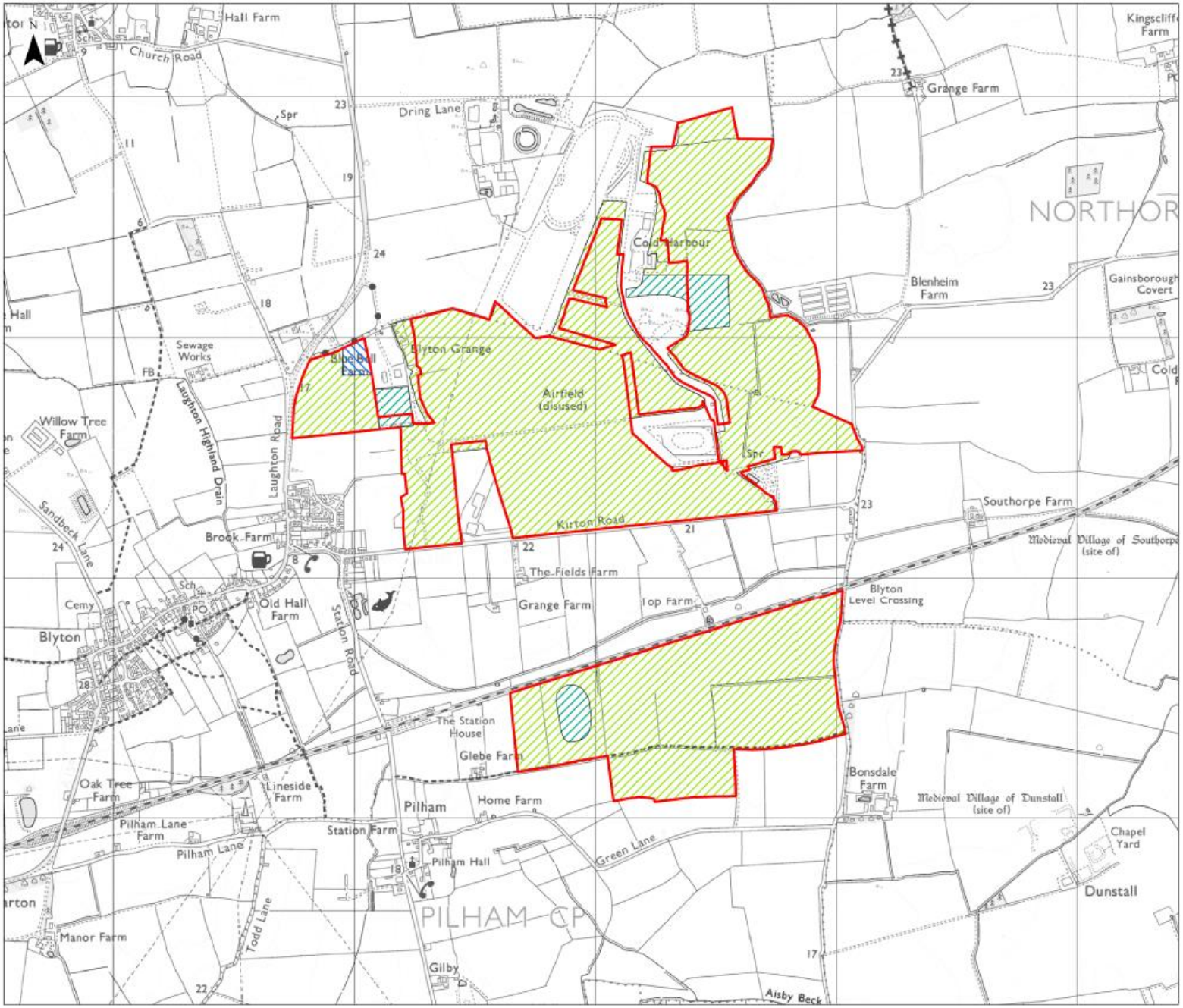
The loss of otherwise productive farmland is not particularly covered in the report on the basis that the majority is not BMV. However is does represent a significant area of land particularly when considering the wider cumulative impact on farmland across Lincolnshire and the larger Gate Burton scheme locally.

Biographical

Sam Franklin BSc (Hons) MSc MISoilSci PIEMA FBIAC
A Panel Member of the Agricultural and Land Drainage Tribunal

- Sam is a Member of the Institute of Professional Soil Scientists and a Life Member of the British Society of Soil Science. He undertakes soil survey and land management work for private clients, developers, local authorities and government agencies and has worked on soil restoration, flood risk, drainage and land improvement projects, as well as Agricultural Land Classification for roads, development sites, renewable energy projects and EIA. He has been a Professional Associate of the Institute of Environmental Assessment, since 2001.
- He has an MSc from Cranfield University, attending Cranfield advanced training in Soil Matters, Land Evaluation, Soil & Water: Principles and Management in Production Systems and soil science courses of IPSS and Lancaster University. He has given talks, demonstrations and on-farm advice on ALC, soil and water management, land drainage, rainwater harvesting and soil husbandry. Sam has worked overseas in dryland climates and is familiar with land drainage, irrigation scheduling and reservoir design.
- He is from a family farm and has a BSc (Hons) in Agriculture from Newcastle University and considerable practical, farm-based agricultural, horticultural and soils management experience gained on mixed, livestock, horticultural and arable units and international work. Sam is a Fellow of the British Institute of Agricultural Consultants (FBIAC) and holds the Royal Horticultural Society Certificate in Horticulture.
- As a qualified chartered surveyor (MRICS, FAAV) and agricultural consultant he has over 35 years of experience across a wide range of property matters including both commercial and housing planning projects, compulsory purchase, new roads, pipelines and rail projects, development land, farming, property management, renewable energy, minerals, land restoration, archaeological surveys, and EIA.
- Sam has been managing director of a surveying and rural planning business since 2001 (www.landscope.co.uk). Previous employment includes five years at the RSPB, work for other environmental and conservation organisations, regarding landscape restoration & management, habitat creation, minerals restoration and woodland management; all requiring detailed soils, water and environmental knowledge.
- He has undertaken soil and water management, soil husbandry and Catchment Sensitive Farming work for Natural England and since 2003 has given regular rural planning consultancy advice to Local Planning Authorities, mainly across southern, eastern and midland England; acting as agricultural, equestrian and rural resource expert, regularly attending planning committees, public inquiries, hearings, NSIP and examinations in public.


Island GREEN POWER
Lanpro
Key
Order Limits
Detailed Agricultural Land Classification (ALC)
Grade 2
Grade 3a
Grade 3b
KEXBY CP
WILLINGHAM CP
PILLINGHAM CP
INGHAM CP
STOW CP
CAMMERINGHAM CP
BRATTLEBY CP
STURTON BY STOW CP
THORPE IN THE FALLOWS CP
0 400 800 1,200 Metres
Scale: 1:25,000@ A3
APFP Regulation: 5(2)(a)
Application Doc No. CS.4.19.1
Ref: P2981_LPR_ZZ_ON_DR_Z_0148
Date: 22/12/2022
Drawn by: AZ
Checked by: DB
Figure 19.1
Cottam 1
Agricultural Land Classification Grade Distribution
COTTAM SOLAR PROJECT
Soils and Agriculture
Environmental Statement (ES)



Island GREEN POWER

Lanpro

Key

- Order Limits

Detailed Agricultural Land Classification (ALC)

- Grade 2
- Grade 3a
- Grade 3b

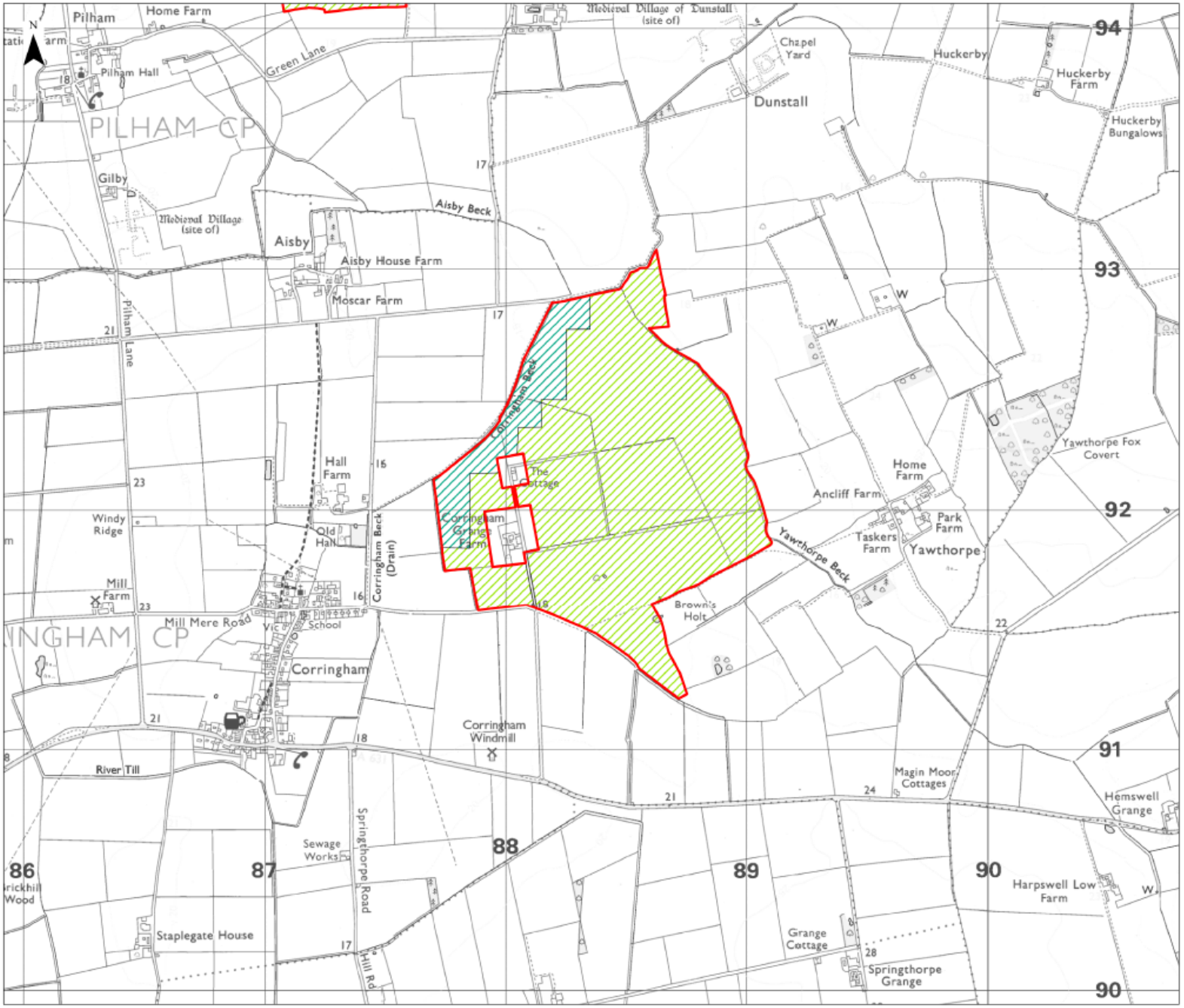
0 400 800 Metres

Scale: 1:15,000@ A3

APFP Regulation: 5(2)(a)	Application Doc No. C6.4.19.3
Ref: b2981_LPR_22_ON_DR_Z_0148	Date: 11/01/2023
Drawn by: AZ	Checked by: DB

Figure 19.3
Cottam 3a and 3b
Agricultural Land Classification Grade Distribution

COTTAM SOLAR PROJECT
Soils and Agriculture
Environmental Statement (ES)



Island GREEN POWER

Lanpro

Key

Order Limits

Detailed Agricultural Land Classification (ALC)

Grade 3a

Grade 3b

0 400 800 Metres

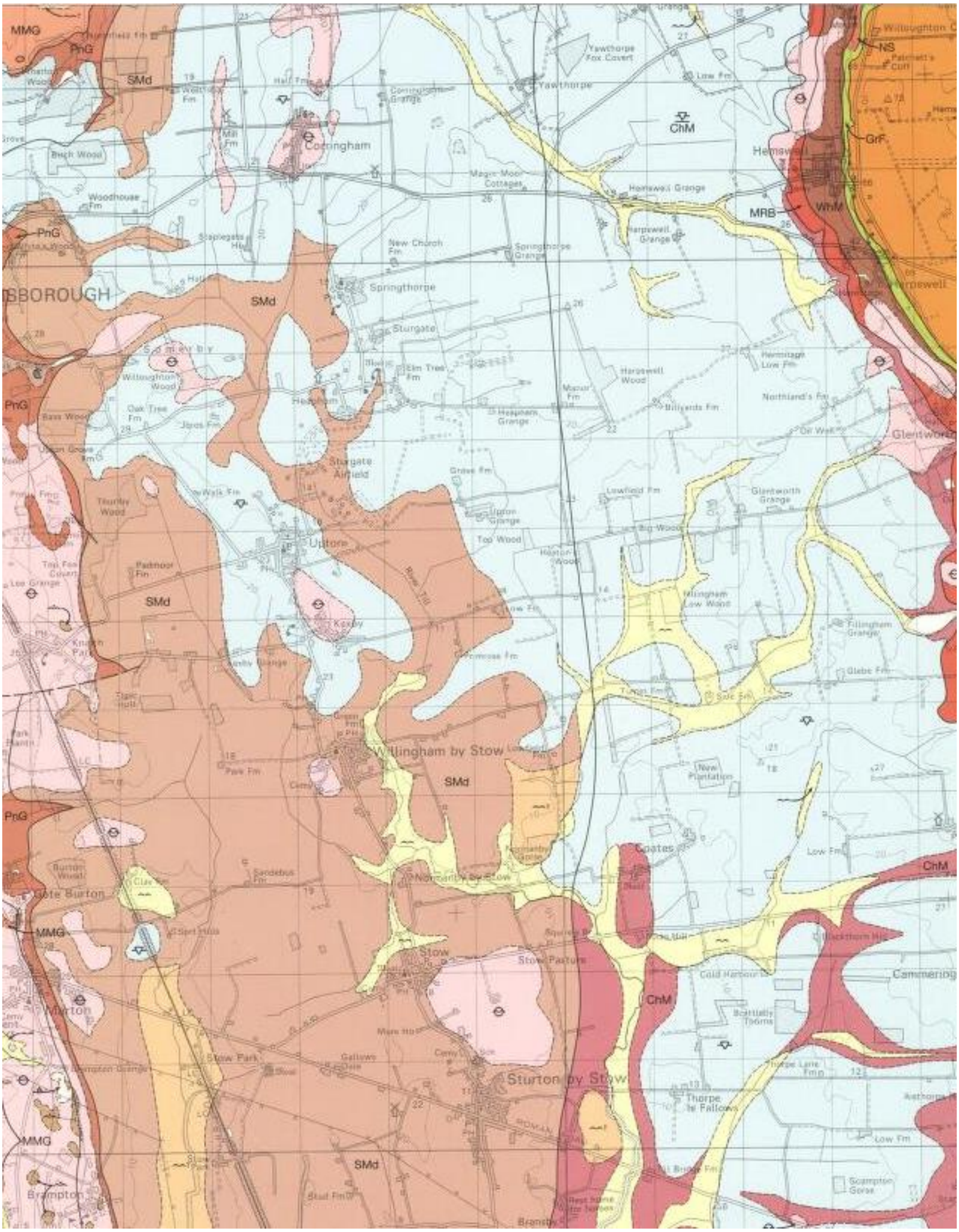
Scale: 1:15,000@ A3

APFP Regulation: 5(2)(a)	Application Doc No. C6.4.19.2
Ref: P2981_LPR_ZZ_ON_DR_Z_0148	Date: 13/01/2023
Drawn by: AZ	Checked by: DB

Figure 19.2
Cottam 2
Agricultural Land Classification Grade Distribution

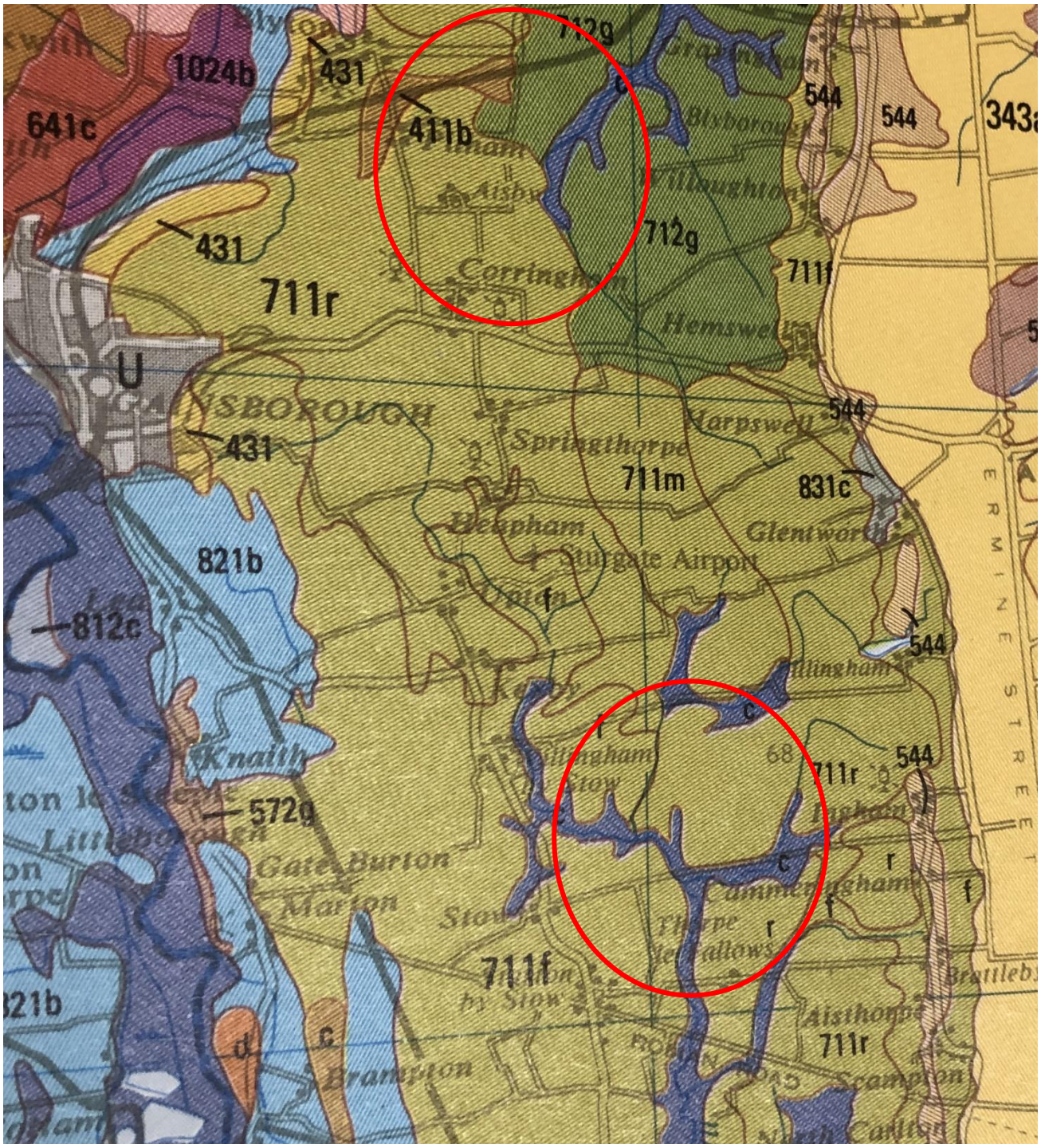
COTTAM SOLAR PROJECT
Soils and Agriculture
Environmental Statement (ES)

Appendix 2



MMG
PnG
SMd
Corringham
Yawthorpe
Yawthorpe Fox Covert
Low Fm
ChM
Hemswell Grange
MRB
WhM
GrF
NS
Birch Wood
Woodhouse Fm
New Church Fm
Springthorpe Grange
Springthorpe
Sturgate
Elm Tree Fm
Harpswell Wood
Hermitage Low Fm
Northland's Fm
Billyards Fm
Heapham
Heapham Grange
Oak Tree Fm
Sturgate Airfield
Grove Fm
Lowfield Fm
Glentworth Grange
Upton Grange
Top Wood
Big Wood
Upton
Padmoor Fm
Kexby
Primrose Fm
Willingham by Stow
Park Fm
Normanby by Stow
Coates
New Plantation
Low Fm
Stow
Stow Pasture
Cold Harbour
Stow Park
Sturton by Stow
Thorpe le Fallows
Scampton Gorse
Brampton
Stud Fm
Cammeringham

Appendix 3


1024b
431
641c
411b
712g
544
544
343a
431
712g
711r
711f
U
544
431
Springthorpe
711m
831c
821b
812c
544
Knaith
572g
711r
544
711f
711r
Brampton

0813c FLADBURY 2

Detailed Description

This association, developed in greyish and brownish alluvium, consists of mottled clayey soils, Fladbury and Stixwould series, and subsidiary loamy soils, Trent series. It occurs on the flat floodplains of the River Trent and its tributaries and along several smaller rivers and streams in Lincolnshire. Fladbury series belongs to the pelo-alluvial gley soils and has a mottled, slowly permeable, clayey subsoil. Stixwould soils are similar but pass into coarse loamy or sandy glaciofluvial material within 80 cm depth. Trent series (gleyic brown alluvial soils) is fine loamy, relatively permeable and has no grey mottling in the upper 40 cm. It is found on slightly raised parts of the Trent floodplain.

These soils are mapped along the Trent from Gainsborough upstream as far as Rugeley, along the Dove to Uttoxeter, the Tame to Tamworth and the Soar to Leicester. In total they cover 178 km². From Newark upstream as far as Alrewas and along the Dove and Tame there are few Stixwould but many Trent soils and occasional Alun or Wharfe soils on levees. Between Burton upon Trent and Tamworth on low terraces within the floodplain, soils similar to Trent series, but over gravel, are common. Downstream from Newark there are few Trent soils but occasionally on low terraces some Arrow soils are included. Stockwith soils (Reeve and Thomasson 1981) occur near Gainsborough where the clayey alluvium has a thin superficial silty layer of marine alluvium. Trent soils are also rare on the Soar floodplain and along the Trent north-west of Alrewas. In the latter area, Stixwould soils and similar soils over gravel are dominant locally. In the Idle valley north of East Retford most soils are Stixwould series, many having coarse material within 40 cm of the surface. Small fans of reddish Compton soils occur locally where streams draining adjacent Triassic lowlands join the main floodplain.

In Lincolnshire the association consists almost entirely of Fladbury and Stixwould series and covers 117 km². Fladbury soils dominate the Trent floodplain between Dunham Bridge and Gainsborough and the Witham alluvium from Grantham to Lincoln. Near Claypole, many Fladbury soils contain buried topsoils and there are local inclusions of Midelney and Thames series. Along the small streams draining into the River Witham, east of Lincoln, Stixwould series is dominant. The association is found in the Till valley north-west of Lincoln, the Bain valley and along the middle and upper reaches of the Great Eau and Steeping River. Where the Bain valley narrows upstream, Conway and Kettlebottom soils are common.

Soil Water Regime

Most soils of the Fladbury series have slowly permeable subsoils and Stixwould soils have slowly permeable upper horizons, but in both cases the primary source of waterlogging is groundwater. Both soils are waterlogged for long periods of the winter (Wetness Class IV) and waterlogging can occur during the growing season (Wetness Class V) in low-lying sites. Because of the permeable substratum, however, groundwater levels in Stixwould series

respond more rapidly to changes in river level than those in Fladbury soils. Stixwould soils also respond better to drainage, but in both soils underdrainage is only effective where satisfactory outfalls can be achieved above river level. Trent soils are only waterlogged for short periods in winter (Wetness Class II or III) because they are on slightly higher ground. Along the Trent and its tributaries winter flooding is common, though usually of short duration. Locally the floodplain is protected from minor flooding by low banks. Other parts of the floodplain, such as Beckingham Marshes, are allowed to flood when the river is unusually high, thus easing the flood risk elsewhere. Flooding on Beckingham Marshes is infrequent but can last several weeks. Stixwould soils also respond better to drainage, but in both soils underdrainage is only effective where satisfactory outfalls can be achieved above river level or where pumping, as into the embanked River Witham, is provided. Flooding is infrequent but parts of the Trent floodplain are designated as flood storage areas, as at Lea Marshes near Gainsborough.

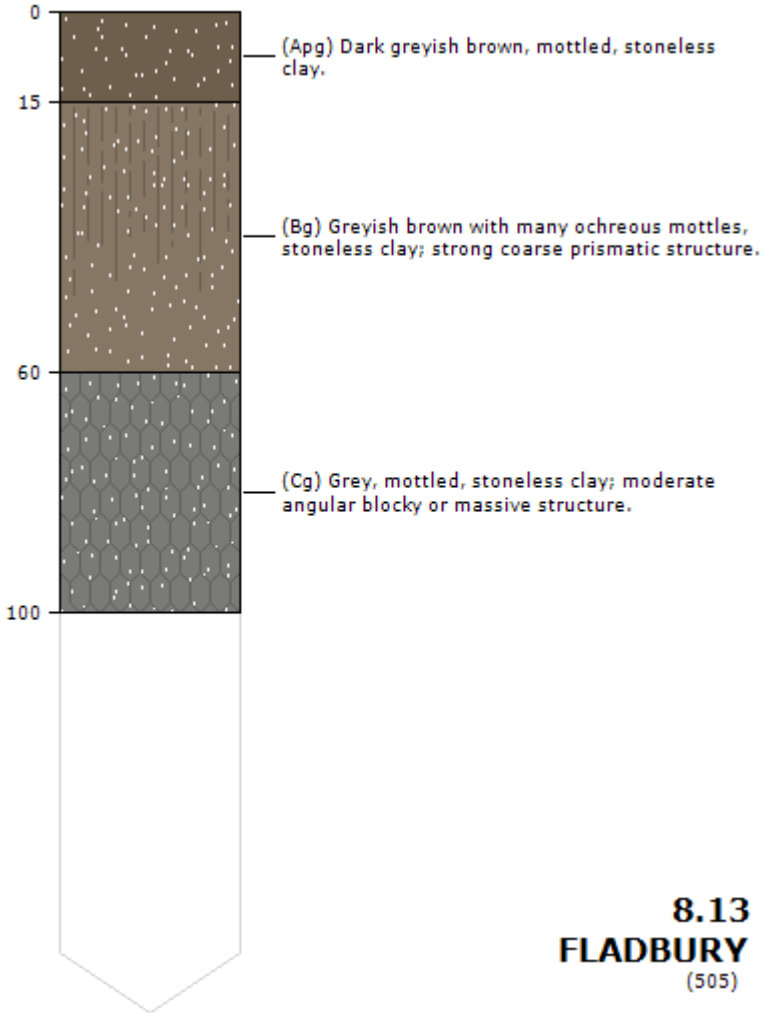
Cropping and Land Use

Land use is a mixture of permanent grassland, long leys and cereals. The distribution of cereal growing depends on the local flood risk, climate and presence of Trent soils. There is a gradual change from mainly arable farming east of Nottingham to almost exclusively grassland on the Trent floodplain above Alrewas and in the Dove and Tame valleys. Fladbury and Stixwould soils have a large retained water capacity and a low bearing strength when wet, so under grass there is a serious risk of poaching in winter and grazing is restricted to summer. Nevertheless, they provide useful mowing grass and good summer fattening pastures. Growth is maintained during all but the very driest periods by the reserves of available soil water. Cereal crops are sown in spring into autumn-cultivated ground where there is an appreciable risk of winter flooding but are autumn-sown where there is little flood risk. Cultivations on these soils need careful timing because of soil wetness. Trent soils are relatively easy to work and are less frequently flooded, so where they are extensive within the association they offer greater flexibility in cropping and root crops are occasionally grown. Fladbury, Stixwould and Trent soils are naturally acid and require occasional dressings of lime. They have good reserves of potassium but phosphorus levels depend on recent fertilizer use. Manganese deficiencies in herbage are common on Fladbury and Stixwould soils.

8.13c Fladbury 2 Definition

Major soil group:	08 ground-water gley soils	Seasonally waterlogged soils affected by a shallow fluctuating groundwater-table. They are developed mainly within or over permeable material and have prominently mottled or greyish coloured horizons within 40 cm depth Most occupy low-lying or depressional sites.
Soil Group:	1 alluvial gley soils	With distinct topsoil, in loamy or clayey recent alluvium more than 30 cm thick.
Soil Subgroup:	3 pelo-alluvial gley soils	(clayey with non-calcareous subsoil)
Soil Series:		clayey river alluvium

Brief Profile Description



Detailed Description

This Beccles association is very extensive (1761 km²) in north and central Lincolnshire, and on the central watershed of Norfolk and Suffolk. It occurs also in small patches in Leicestershire. It is generally found on level or sloping land at 10 to 150 m O.D. on wide spreads of chalky till, or on the isolated dissected remnants of a once extensive till cover, as on the Jurassic dipslope north and south of Lincoln. The association is composed mainly of Beccles series, typical stagnogley soils, and Ragdale series, pelo-stagnogley soils. The lowest horizons of both soils are grey weakly-structured clays containing chalk stones. In Beccles series the fine loamy upper horizons vary greatly in thickness and contain quartz or flint stones. Ragdale soils are clayey to the surface. Aldeby, Hanslope and Ashley series also occur.

There is some variation in the occurrence and proportions of subsidiary soils. Aldeby series is relatively extensive in Lincolnshire and Norfolk but is absent elsewhere. In Norfolk it occurs mostly on the flat crests of interfluves with Ragdale and Hanslope soils on the sloping spurs. These latter two soils are locally dominant but Aldeby, Beccles, Ragdale and Hanslope series often occur in intricate patterns. The kind of pattern and the dominant soils change gradually from crest to slope. In north Lincolnshire there are small inclusions of Salop and Crewe series where the till is partly derived from Triassic rocks. In south and central Lincolnshire, Beccles and Ragdale soils are co-dominant and there are small areas of Hanslope series on steeper slopes.

Soil Water Regime

The clayey subsoils of Beccles and Ragdale series are relatively impermeable, restricting downward water movement and causing lateral flow at shallow depth in winter. In land with adequate underdrainage the soils are seasonally waterlogged (Wetness Class III) but on undrained land they are waterlogged for longer periods in winter (Wetness Classes III and IV). Most arable crops on Beccles and Ragdale soils suffer only slight droughtiness with the exception of potatoes for which these soils are moderately droughty. Both soils are very droughty for grass.

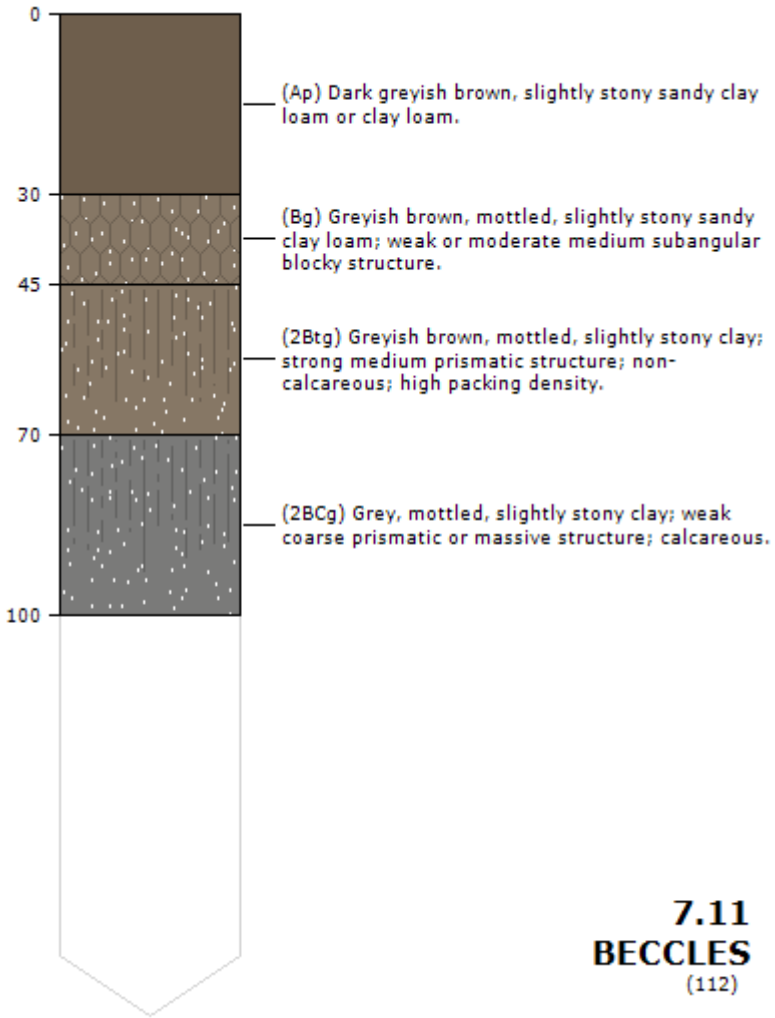
Cropping and Land Use

Both Beccles and Ragdale soils have only a few good working days in spring and none at all in wet years, so that farmers aim to sow in autumn. In Lincolnshire and Suffolk the main crops are winter cereals with oilseed rape as a break crop, and some ley grassland. An early return to field capacity in wet years makes sugar beet and potato crops difficult to harvest. In spite of this these crops are grown locally on Beccles series. In Norfolk, besides winter cereals, some peas, beans and maize are grown but potatoes are confined to the small areas of Aldeby soils. Direct drilling of spring-sown crops is risky, but yields from direct-drilled autumn-sown crops are similar to those from conventional techniques provided topsoils are loosened every two to three years. Droughtiness restricts grass yields and limits summer grazing. The soils are also unsuitable for out-wintering stock because of the severe risk of poaching.

Definition

Major soil group:	07 surface-water gley soils	Seasonally waterlogged slowly permeable soils, formed above 3 m 0.D. and prominently mottled above 40 cm depth. They have no relatively permeable material starting within and extending below 1 m of the surface.
Soil Group:	1 stagnogley soils	With a distinct topsoil. They are found mainly in lowland Britain.
Soil Subgroup:	1 typical stagnogley soils	(with ordinary clay enriched subsoil)
Soil Series:		medium loamy over clayey chalky drift

Brief Profile Description



7.11
BECCLES
(112)

Detailed Description

This association consists mainly of stagnogley soils with slowly permeable subsoils in reddish drift mostly derived from Permo-Triassic rocks. There is a small proportion of stagnogleyic argillic brown earths. As there is little run-off on the level or gently sloping land these slowly permeable soils are seasonally waterlogged. The association occupies large areas in the Midlands and Northern England and occurs on the narrow coastal lowland of north Wales. The Salop series, fine loamy over clayey typical stagnogley soils, occupies one-third to two-thirds of the area. Clifton series, similar but fine loamy throughout, is generally a minor associate but in Cheshire covers about a quarter of the ground. Small patches of the clayey Crewe series, pelostagnogley soils, usually on level land, are included. Coarse loamy over clayey Rufford soils occur locally where there are glaciofluvial deposits nearby. Stagnogleyic brown earths belonging to Flint series mainly cover the steeper slopes.

The association is found mainly in the lowlands of Lancashire, Cheshire and north Shropshire where it is developed in Devensian drift. It is also extensive on the older Wolstonian tills in east Staffordshire, Derbyshire, Leicestershire and Warwickshire. A narrow belt occurs between Newport and Stafford and there is a south-westerly outlier in Worcestershire around Sherriff's Lench near Evesham. Crewe series is the most common subsidiary soil in Cheshire and Shropshire especially near the boundary with the Crewe association in nearby glaciolacustrine basins. In contrast, Crewe soils are rare in north-west Leicestershire. Clifton series is also commonly included in Cheshire while Oak profiles occur on the older tills particularly in Needwood Forest and around Coventry. Where the drift thins over Triassic mudstone along the Ridgeway in Worcestershire and in parts of Cheshire small patches of Brockhurst and Whimple soils are found. Rufford, Flint and Salwick series are minor inclusions throughout, Rufford soils being especially common bordering areas of sandy and coarse loamy soils in Lancashire, Cheshire and Shropshire. Similar soils derived mainly from greyish Carboniferous rocks, in particular the Dunkeswick series, are included in Derbyshire and Staffordshire. Along the north coast of Wales these soils are found where reddish Devensian drift is sufficiently thick to impede drainage. There is a small area at Beaumaris on Anglesey but the largest extent is in the Vale of Clwyd and along the border with Cheshire and Shropshire where rigg and furrow and water-filled marl pits are common features of the landscape. The proportion of Clifton and Salop soils is determined by the depth of fine loamy drift over the reddish clay. East of Wrexham there are fewer profiles of the Clifton series but Crewe replaces Salop series in the lowest and most level parts, probably in glaciolacustrine deposits. In the Vale of Clwyd and on Anglesey in particular, the proportion of Flint profiles is greater and Crewe soils are rare. Clifton profiles are most common at Hawarden where these soils adjoin the Clifton association to the north.

In Lincolnshire the association covers 131 km². There are small patches south and east of Gainsborough where the soils are in till derived from the Triassic beds which outcrop on the sides of the Trent valley. The main spread is along the eastern and southern margins of the Wolds with local extensions into the Fenland south of Spilsby. The till here contains chalk stones, and Elkington series occupies up to a third of the land. Small areas of Holderness soils are included near the eastern boundary. Where the till thins over chalk, Burlingham and Tathwell profiles are included.

At Moreton-in-Marsh the parent material is of glaciolacustrine origin, and is related to ice of eastern (Chalky Boulder Clay) provenance. The soils are usually stoneless at depth and Ashley soils, stagnogleyic argillic brown earths, are present where chalky drift is within moderate depth.

The association is extensive over the outcrop of Permo-Triassic rocks east of the Pennines from Harrogate northwards to Middlesborough, and skirting the North York Moors to the coast at Whitby. Other occurrences are in Furness and on the Solway plain, Cumbria, and near the Northumberland coast, where the drift is derived from Carboniferous rather than Permo-Triassic rocks. Clifton, Flint and Rufford soils are present throughout but Crewe series is only found in the east, usually on more level ground. Isolated patches of Salwick series are included. Reddish and non-reddish soils are frequently intermixed and the association also contains Dunkeswick profiles.

Soil Water Regime

Most of the soils when undrained are waterlogged for long periods in winter (Wetness Class IV). Surface waterlogging results from the combination of slowly permeable subsoil and slow surface run-off from relatively flat land. The soils can be improved to Wetness Class III with underdrainage especially in the drier eastern districts. Where the field capacity period exceeds 200 days, Salop, Clifton and Crewe soils remain severely waterlogged even with underdrainage (Wetness Class IV). Flint soils suffer some waterlogging in winter (Wetness Class III) but duration depends on climate and the efficiency of drainage measures. The soils are slightly droughty for most crops but moderately droughty for grass and non-droughty for spring barley.

Cropping and Land Use

These soils are traditionally used for grass production and form the basis of the dairy industry in Cheshire and Shropshire. The wet climate of Lancashire prevents regular cultivation but elsewhere cropping is mixed with a variety of cereals and fodder crops between leys. The land is generally difficult to work and timing of cultivations is critical especially on the wetter, heavier soils. With suitable underdrainage and regular subsoiling there are adequate machinery work days in the autumn on all except clayey Crewe soils but opportunities for spring cultivation are very limited and thus autumn sowing is preferable. Yields of autumn cereals achieved by direct drilling are comparable to those of conventionally sown crops provided the technique is used carefully, but there is some risk of surface ponding causing seed to rot especially on compacted soil. Grassland suitability varies with locality. In the west potential grass yields are large because drought seldom restricts growth, and there is a valuable autumn flush. However, grazing and silage production on wet soil lead to poaching and compaction with subsequent deterioration of grass growth and soil drainage. In the east, moisture stress restricts growth in mid and late season, and in most years there is no autumn flush although the longer grazing period compensates for this to some extent. Overall, winter wetness restricts grazing to summer as the soils are easily damaged by untimely stocking. Slurry is stored in winter because spreading is impracticable while the land is wet. Surface horizons tend to become acid despite calcium-rich subsoils and occasional liming is required.

Although Common oak and holly are the main woodland and hedgerow trees on these soils, most native trees thrive. The many marl pits support valuable base-rich wetland communities (Day et al. 1982) and older pastures, particularly if undrained, can develop a

distinctive base-rich vegetation. In places the soils are abnormally corrosive and buried ironwork should be protected (Argent and Furness 1979).

Definition

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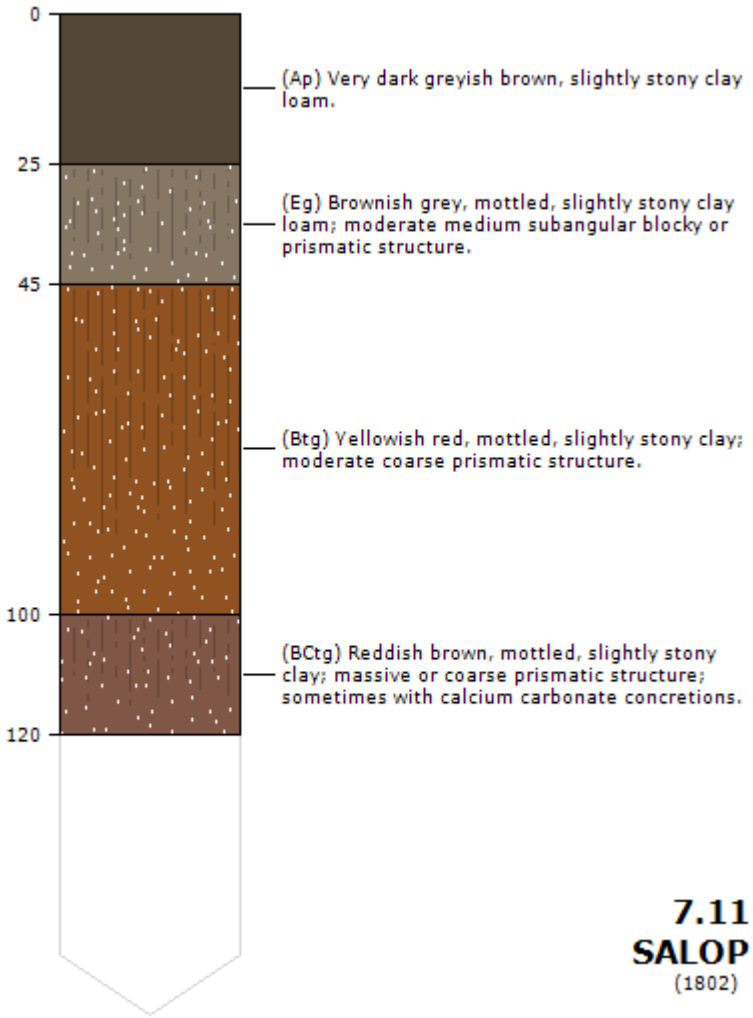
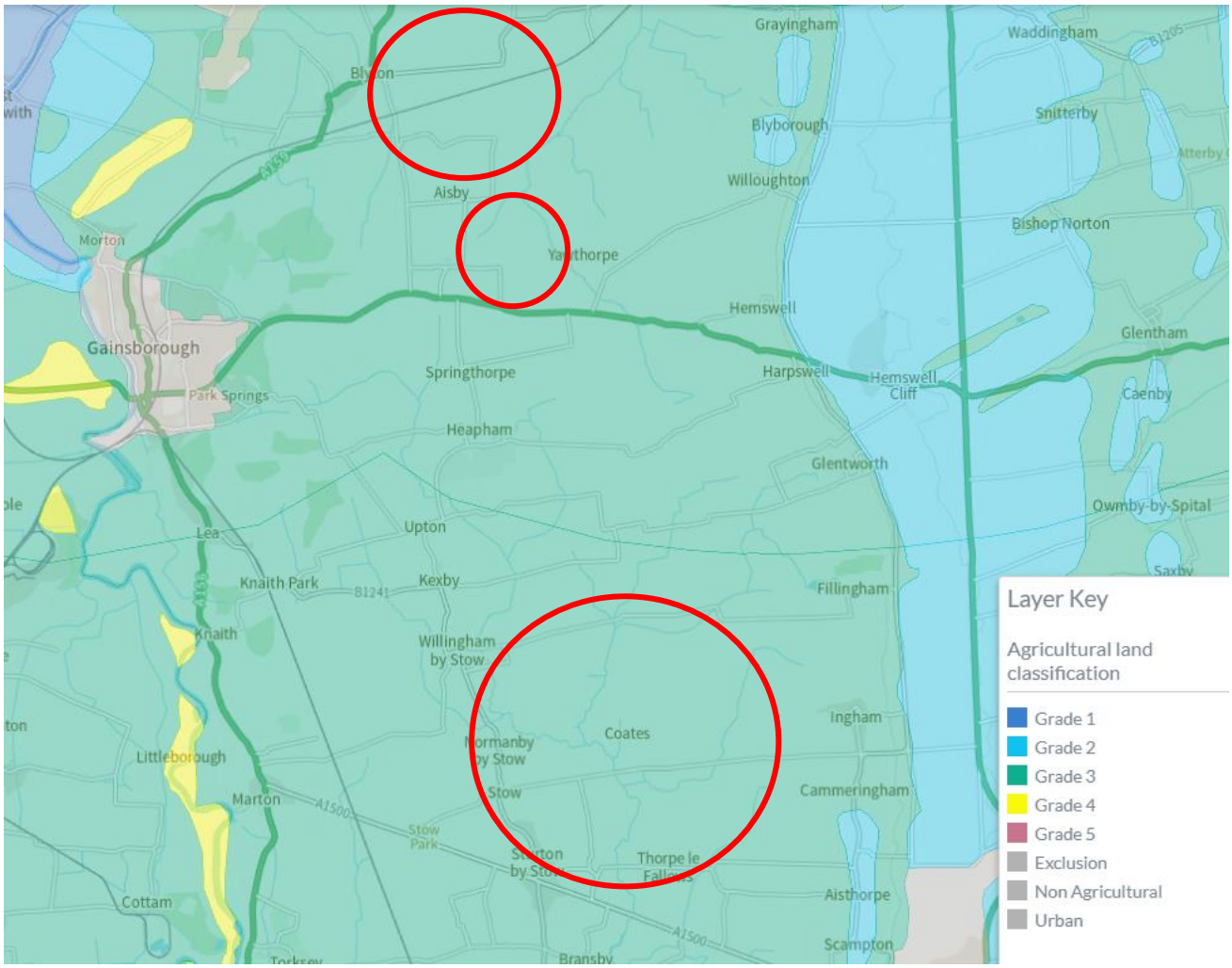
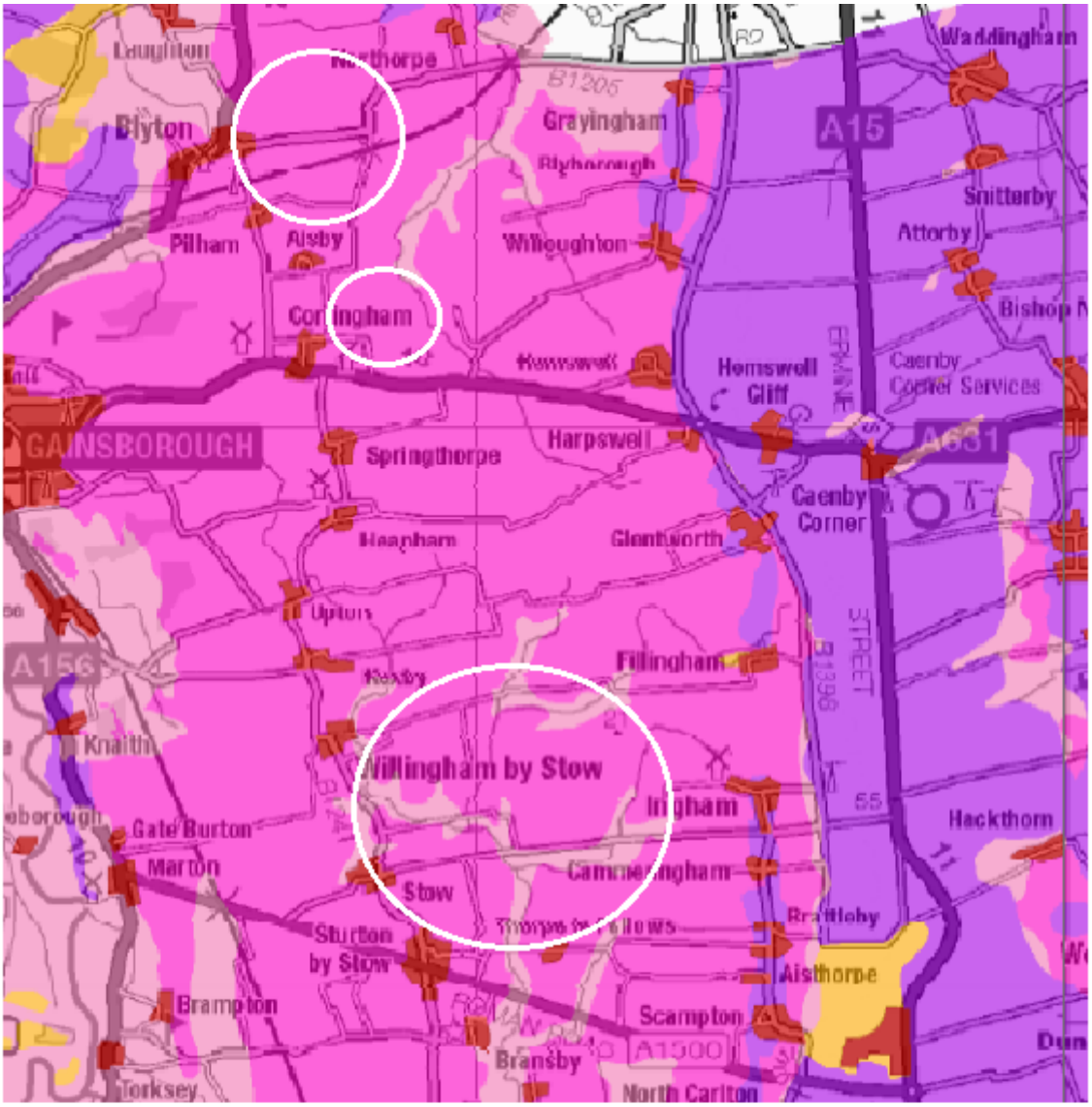
Soil Subgroup:	1 typical stagnogley soils	(with ordinary clay enriched subsoil)
Soil Series:		reddish medium loamy over clayey drift with siliceous stones

Brief Profile Description



Appendix 5


Grayingham
Waddingham
Blyborough
Snitterby
Willoughton
Aisby
Bishop Norton
Morton
Hemswell
Glentham
Gainsborough
Springthorpe
Harpswell
Hemswell Cliff
Caenby
Park Springs
Heapham
Glentworth
Qwmby-by-Spital
Upton
Lea
Knaith Park
Kexby
Fillingham
Knaith
Willingham by Stow
Coates
Ingham
Littleborough
Marton
Stow
Cammeringham
Stow Park
Thorpe le Fallows
Aisthorpe
Cottam
Scampton
Bransby
Layer Key
Agricultural land classification
Grade 1
Grade 2
Grade 3
Grade 4
Grade 5
Exclusion
Non Agricultural
Urban



Predictive BMV Land Assesment © Defra

- High likelihood of BMV land (>60% area bmv)
- Moderate likelihood of BMV land (20 - 60% area bmv)
- Low likelihood of BMV land (<= 20% area bmv)
- Non-agricultural use
- Urban / Industrial

Soil Management Plan (Outline)

1. The soil stripping, handling, storage and replacement operations should be undertaken in a manner that is consistent with suitable specification and methodology set out in a Soil Management Plan.
2. All topsoil and subsoil material shall be stripped from areas affected by top soil storage bunds, subsoil storage bunds, general fill bunds, hard-standings and other constructions including temporary access roads and vehicle trafficking routes, and shall be stored separately in bunds from any imported material and shall be used for the restoration of the temporary soil storage site unless otherwise agreed in writing by the Local Planning Authority.
3. Soils should be stripped, stored and replaced in line with the MAFF Good Practice Guide for Handling Soils Sheets 1, 2, 3 and 4 - http://webarchive.nationalarchives.gov.uk/20090306103114/http:/www.defra.gov.uk/farm/environment/land-use/soilguid/index.htm .
4. Topsoil and subsoil storage bunds should be placed in approved locations and constructed to ensure secure storage without damage, loss or contamination.
5. Topsoil and subsoil should be stored in bunds not exceeding 3m in height above adjacent existing ground level and shall be constructed and shaped by excavator only (dump trucks should not traffic across the bunds at any time).
6. Imported general fill material should be stored in bunds not exceeding 4m in height above adjacent existing ground level.
7. Bunds should be seeded to grass at the earliest opportunity and shall not be allowed to over-winter without grass cover.
8. No topsoil or subsoil should be sold or otherwise removed from the site.
9. Within 3 months of their construction, the Developer should provide a detailed plan of soil storage bunds showing details of position, volume and soil type. The Developer shall be responsible for maintaining an up-to-date record of all soil storage and general fill bunds throughout the life of the site.
10. The stripping, movement and re-spreading of topsoil and subsoil material should only be undertaken when the topsoil and subsoil material is in a dry and friable condition and the ground is sufficiently dry to allow the passage of heavy machinery and vehicles over it without damage to the soils.
11. All injurious weeds, as defined by the Weeds Act 1959, growing within the working site should be eradicated or adequately controlled by approved method.
12. All vegetation growing on soil storage bunds and peripheral areas within the site should be kept in tidy condition by cutting at least once during the growing season.
13. The boundary of the development should be made stock proof for the duration of the temporary development.
14. All temporary plant, machinery, buildings, fixed equipment, roads and areas of hard standing including site compounds should be removed.
15. The natural subsoil base material should be comprehensively ripped to a minimum depth of 500mm to break up surface compaction before any soil material is spread. The developer should give the Planning Authority notice of an intention to carry out this operation. All large stones and boulders, wire rope and other foreign material arising should be removed. Special attention should be given to areas of excessive compaction such as haul roads where deeper ripping may be necessary.
16. The Developer should be responsible for providing all necessary training of operatives and site supervision by suitably qualified personnel to ensure that the soil replacement operation is carried out in the approved manner.
17. Prior to the commencement of spreading soil, all stones, boulders or foreign objects likely to impede normal agricultural cultivations should be removed from that area.
18. The soil material set aside for use in any agricultural restoration should be spread uniformly in the correct sequence (subsoil followed by topsoil) over the ripped base material, and should be rooted and

scarified to full depth without causing mixing between different soil layers. The reinstated agricultural soil profile should be total 450mm thickness overlying prepared and free draining natural stony base material, and should consist of 250mm topsoil and 200mm subsoil derived from the soil stripping operation. This soil profile should meet the technical requirements of the identified Agricultural Land Classification Grade on restoration.

19. All base material ripping, soil spreading and cultivation operations should be carried out in such a manner as to minimise compaction and achieve unimpeded drainage down through the soil profile.
20. Any part of the site restored for agricultural purposes which is affected by localised settlement that adversely affects the agricultural after use should be re-graded including the re-construction of the soil profile to approved specification.
21. Following restoration of the soil materials, the land will be cultivated, seeded and managed appropriately for a minimum of a year and until agreed with the Local Planning Authority that the land meets satisfactory requirements.

Conditions during construction

1

2

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Conditions as construction proceeds

Commencement

Mid construction

Near completion

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