OXFORDSHIRE COUNTY COUNCIL

REFUSED

DATE: 03/09/2024
APPLICATION No: P21/S3961/CM, (MW.0115/21)

Soil Handling & Soil Movement Scheme for Proposed Quarry Development at Land at White Cross Farm, Wallingford to comply with Best Practice

AUGUST 2021

SOIL HANDLING METHOD STATEMENT

PROPOSED QUARRY DEVELOPMENT:
Land at White Cross Farm, Wallingford, Oxfordshire

1. Introduction

1.1 This method statement details the basic soil handling techniques to be used at the proposed mineral site. Specific details for each phase of soil movement are to be produced.

1.2 The objectives of this statement are:

1. To assist in the implementation of soil management.
2. To aid in achieving a high quality restoration of the site.
3. To ensure all planning conditions are met.

2. Soil stripping, storage and replacement

2.1 All top soils and sub soils will be stripped using a tracked 360º bucket excavator without teeth to minimise mixing of soil horizons and will be transported by dumpers.

2.2 Before any part of the site is excavated or traversed by heavy vehicles or machinery (except for the purpose of stripping that part or stacking topsoil on that part), all available top soil shall be stripped from that part.

2.3 The dump trucks will only run on a mineral surface and shall be confined to clearly defined haul routes as specified by the Quarry Manager for the works. Haul routes will not cross topsoil or subsoil areas except for the express purpose of soil stripping or replacement.

2.4 Soils shall only be moved when they are in a dry and friable condition, based on field assessment of the soils' wetness in relation to its lower plastic limit, as set-out below:-

This will be assessed by attempting to roll a ball of soil into a thread on the surface of a clean plain glazed tile (or plate glass square) using light pressure from the flat of the hand. If a long thread of less than 3mm diameter can be formed, the soil is wetter than the lower plastic limit and soil moving should not take place until the soils have sufficiently dried out. If the soil crumbles before a long thread of 3mm diameter can be formed, then the soil is dry enough to move. This assessment shall be carried out on representative samples of each major soil type.

2.5 Top soils and sub soils, shall be stripped to their full depth, as required in the planning permission for the site.

2.6 Temporary and separate soil storage mounds will be constructed (if immediate re-spreading is not practicable) to heights of no taller than 3m for topsoil and 5m for subsoil, if these soils are to be used in the agricultural restoration. Soils for designated landscaping bunds can be stored in higher bunds. Any deviation from this will be agreed with Mineral planning Authority as set-out in the planning conditions for the site.

2.7 All top soil and sub soil will be spread in sequential layers to depths and profiles as detailed in the restoration scheme for the site.

2.8 No access is allowed onto top soil or sub soil by any earthmoving machinery. Topsoil and subsoil is to be spread in trips whilst standing on the exposed sand only. During restoration, all sub soils will be spread to the relevant depths with tracked low ground pressure machinery or using a tracked excavator with a tooth-less bucket. Topsoil will then be placed in strips on the sub soil and spread with tracked low ground pressure machinery or a tracked excavator with a tooth-less bucket.

2.9 This process will be repeated so that the tracked excavator and dump trucks will be confined to the sand surface within restricted haul routes.

2.10 Care should be taken to keep all relevant soil types separate and ensure each strip keys into the next. When linking phases a strip of subsoil will be left so as to enable continuation of the scheme without contamination of soils.

2.11 All storage mounds that are to be kept in situ for more than 6 months or over the winter period must be grassed over and weed control and necessary maintenance be carried out to the satisfaction of the Mineral Planning Authority. The seed mixture and application rates shall be agreed with the MPA in writing no later than one month before it is expected to complete the formation of the storage mounds.

2.12 The MAFF guidance notes for each type of soil operations include images that show typical soil stripping, storage and placement operations and these are attached for assistance.

2.13 All soils will be stored on comparable soil units such that top soils will be stored on top soils and sub-soils will be stored on sub soils. All sub-soil storage areas shall therefore be stripped of top soils prior to any sub-soil placement.

2.14 All soil and earthworks operations will be supervised by a suitably competent project manager to ensure that the works are carried out as specified in this Method Statement.

MAFF GUIDANCE & BEST PRACTICE
FOR SOIL STRIPPING & RESTORATION

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Greenfield Environmental Ltd Registered in England & Wales. Company No. 4120443

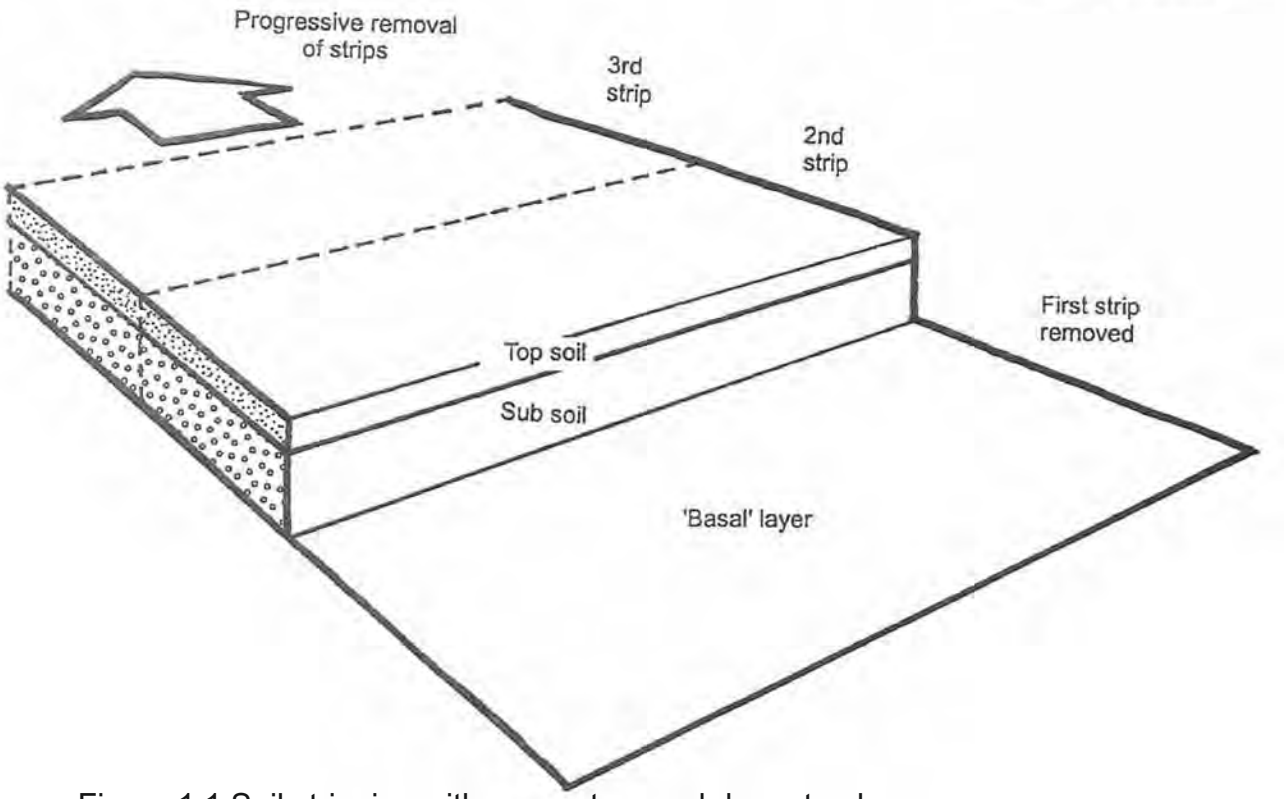


Figure 1.1 Soil stripping with excavators and dump trucks: The bed system

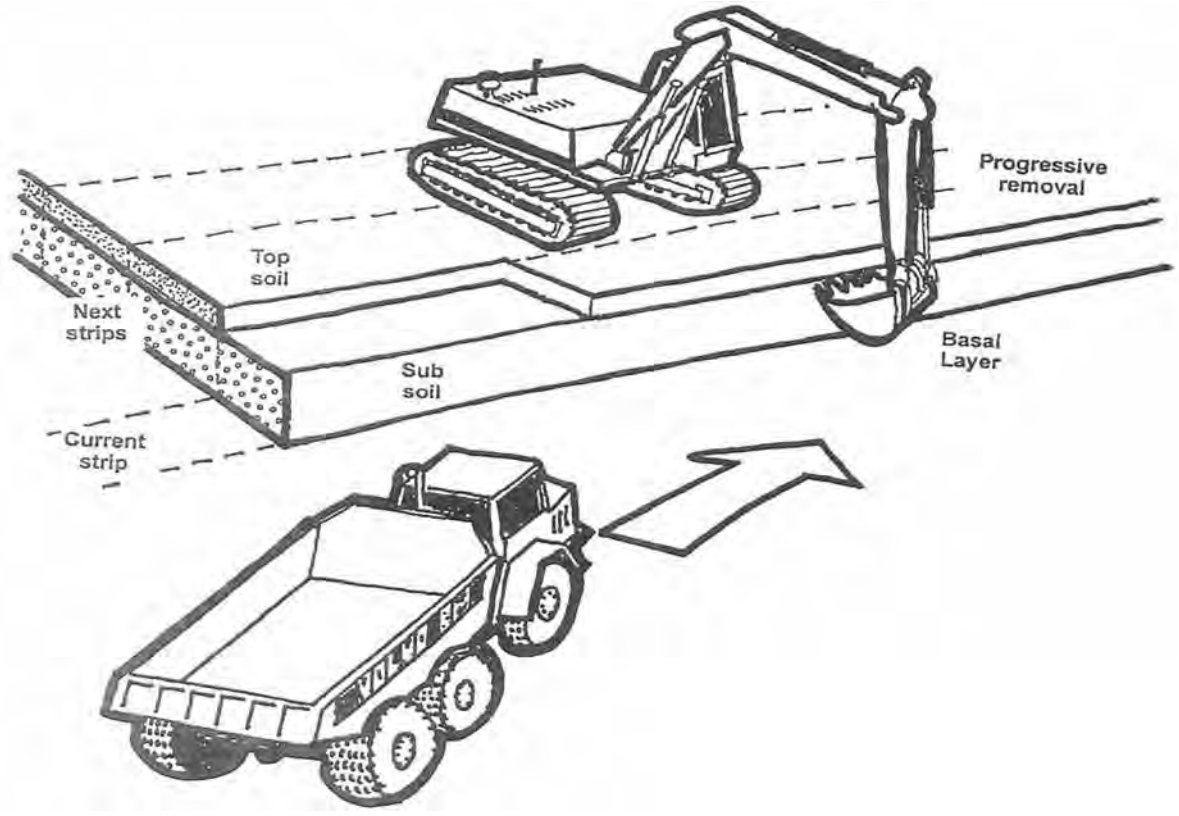


Figure 1.2 Stripping with excavators and dump trucks: Removal of top soil from a strip

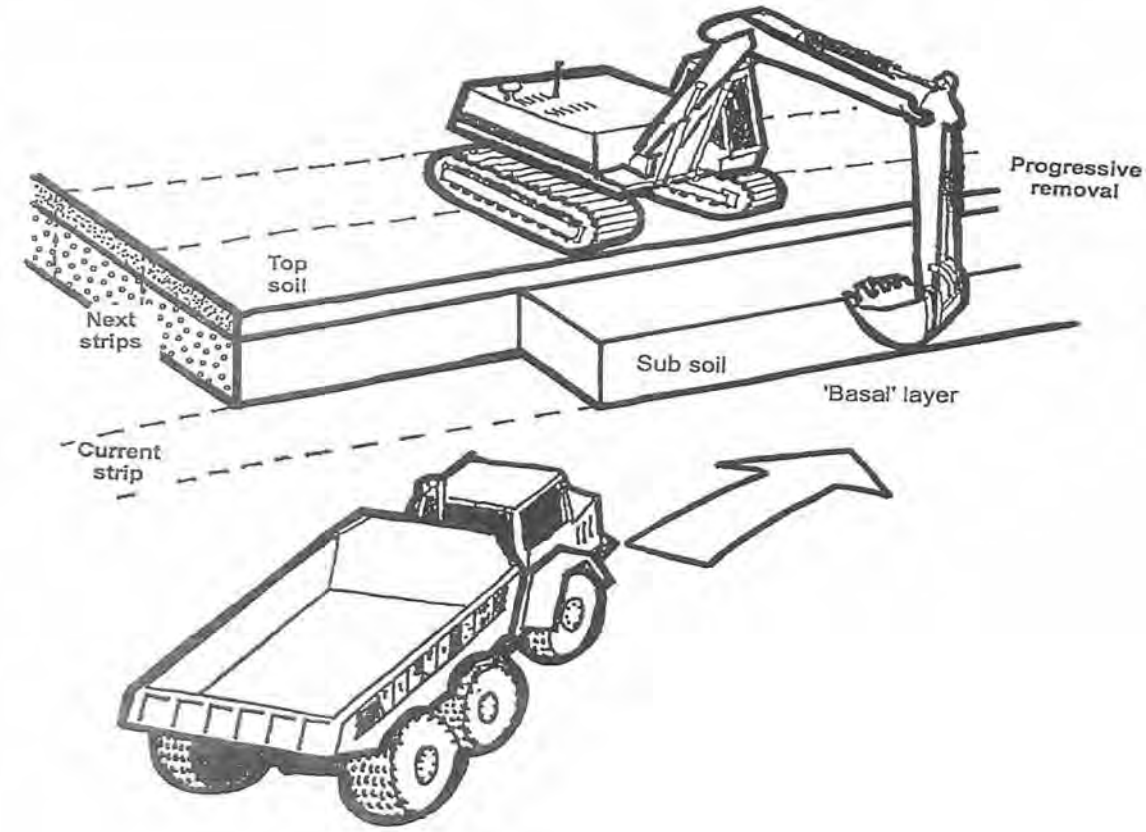


Figure 1.3 Stripping with excavators and dump trucks:
Removal of the subsoil from a strip

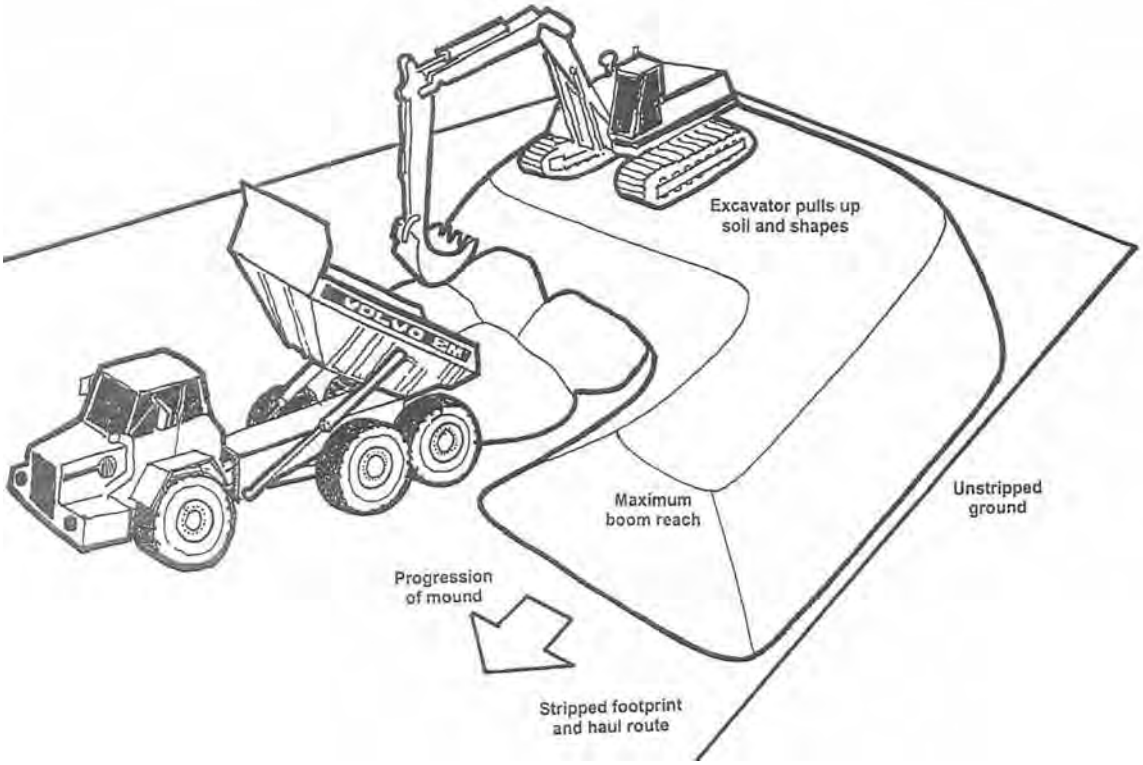


Figure 2.1 Soil Storage mound construction with excavators and dump trucks:
Single tier mound

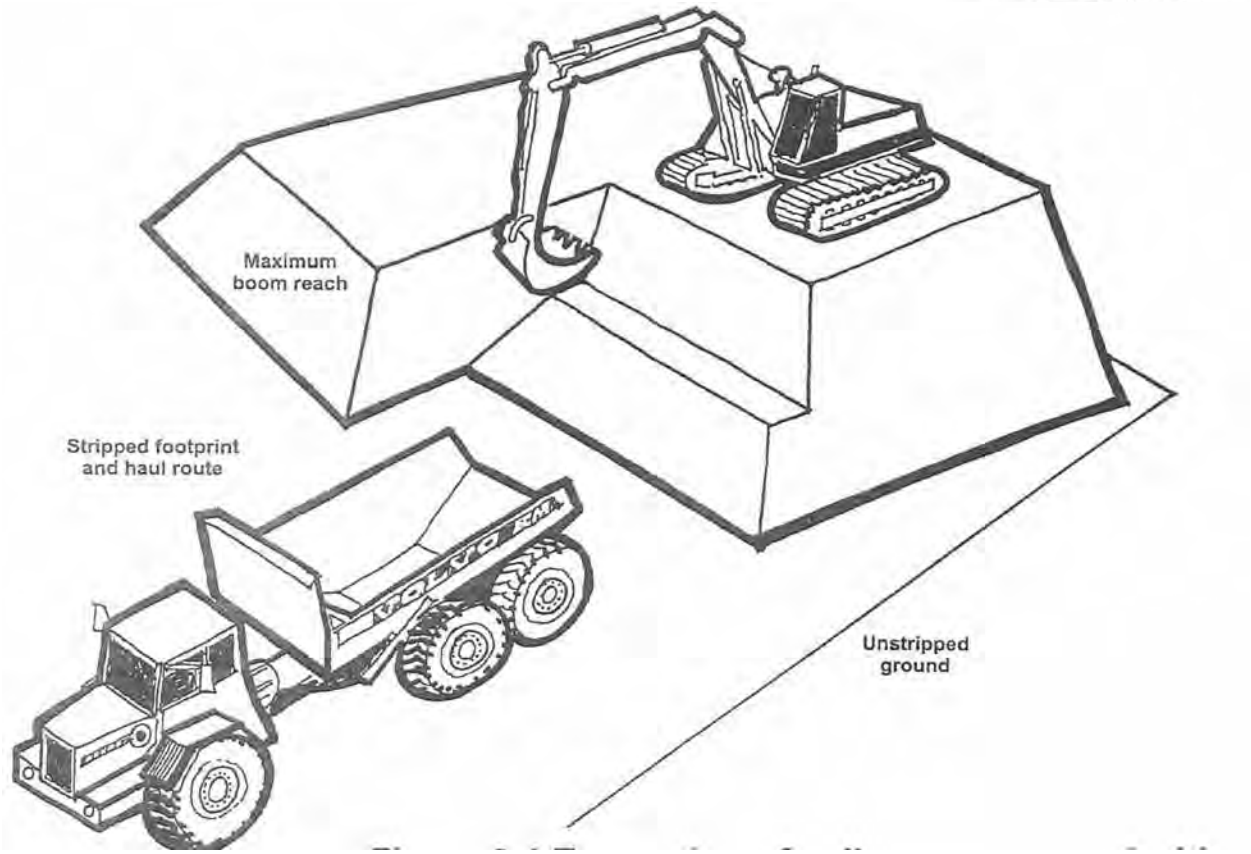


Figure 3.1 Excavation of storage mound with excavators and dump trucks: Single tier mound

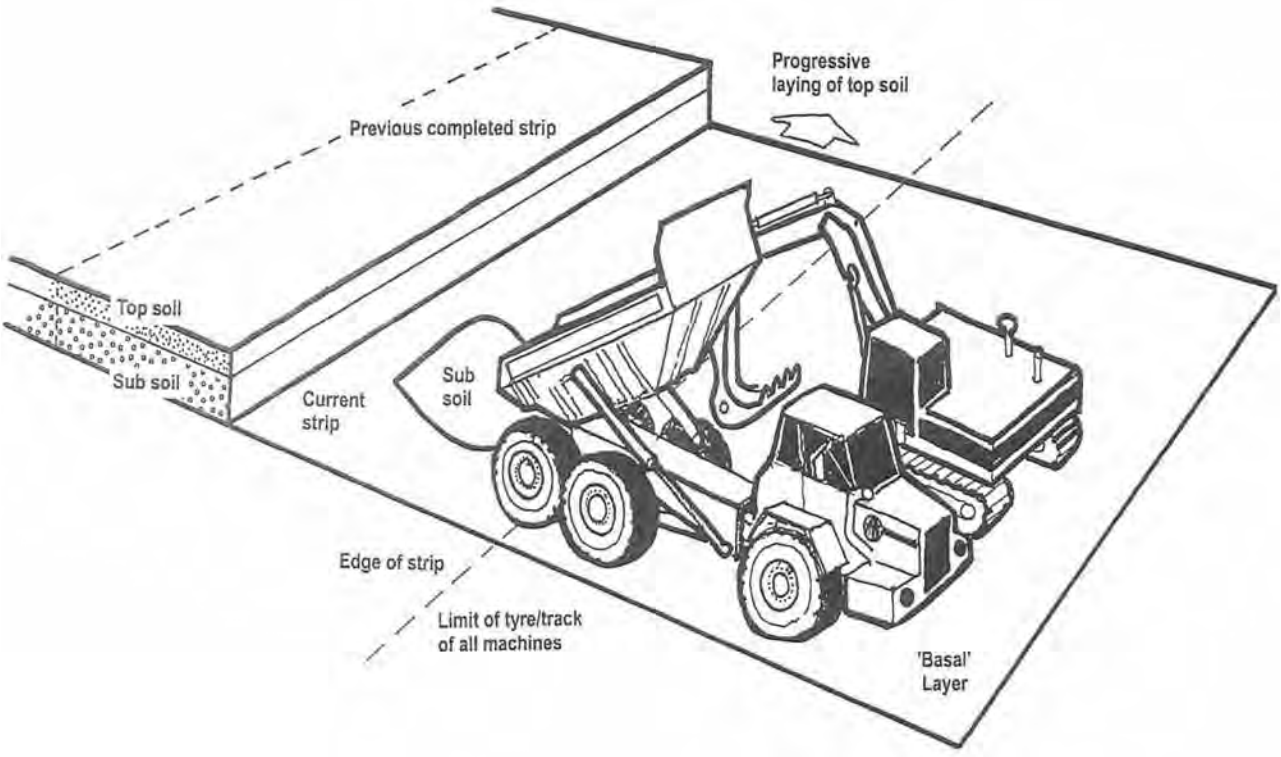


Figure 4.1 Soil replacement with excavators and dump trucks: Sub soil layer

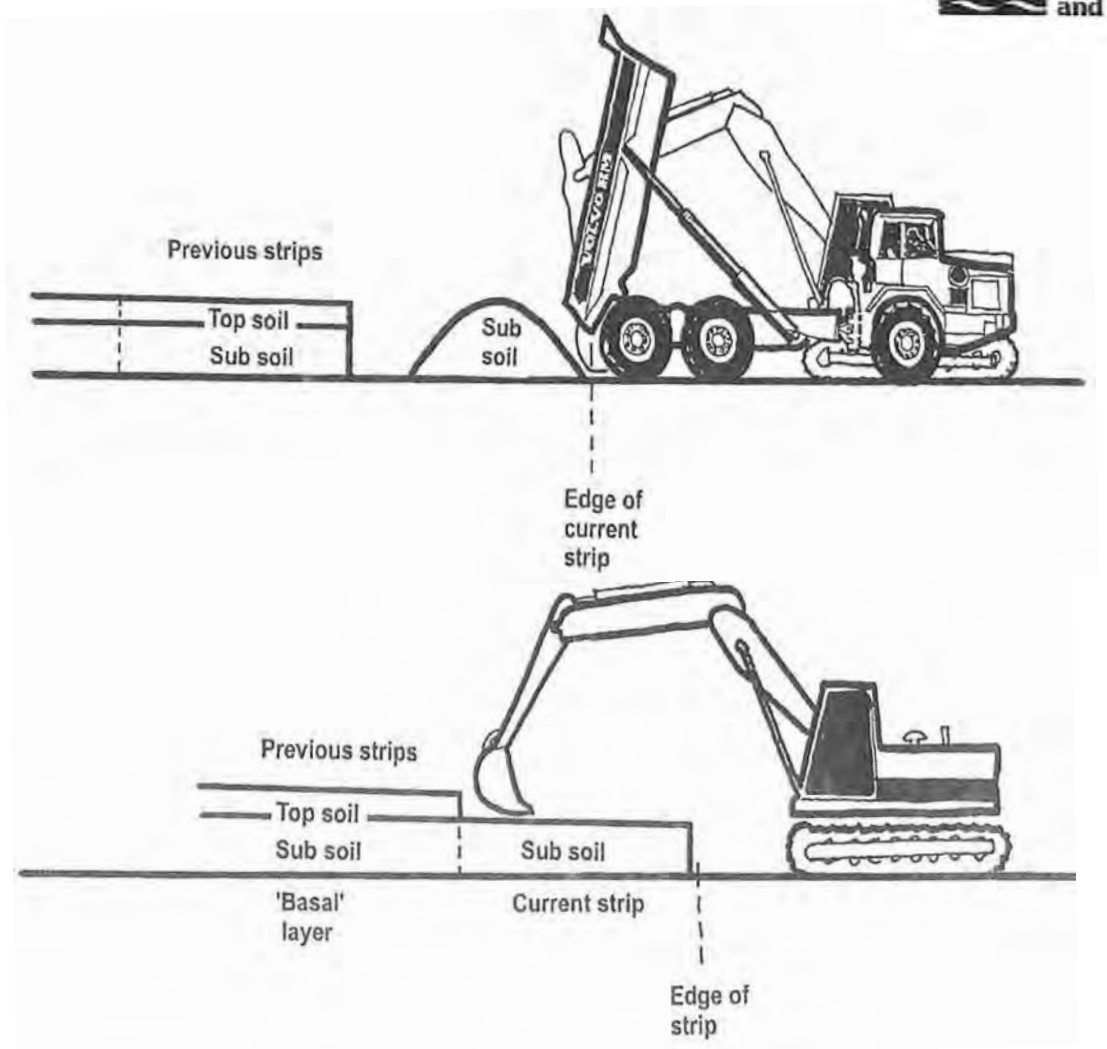


Figure 4.2 Soil replacement with excavators and dump trucks: Sub soil layer

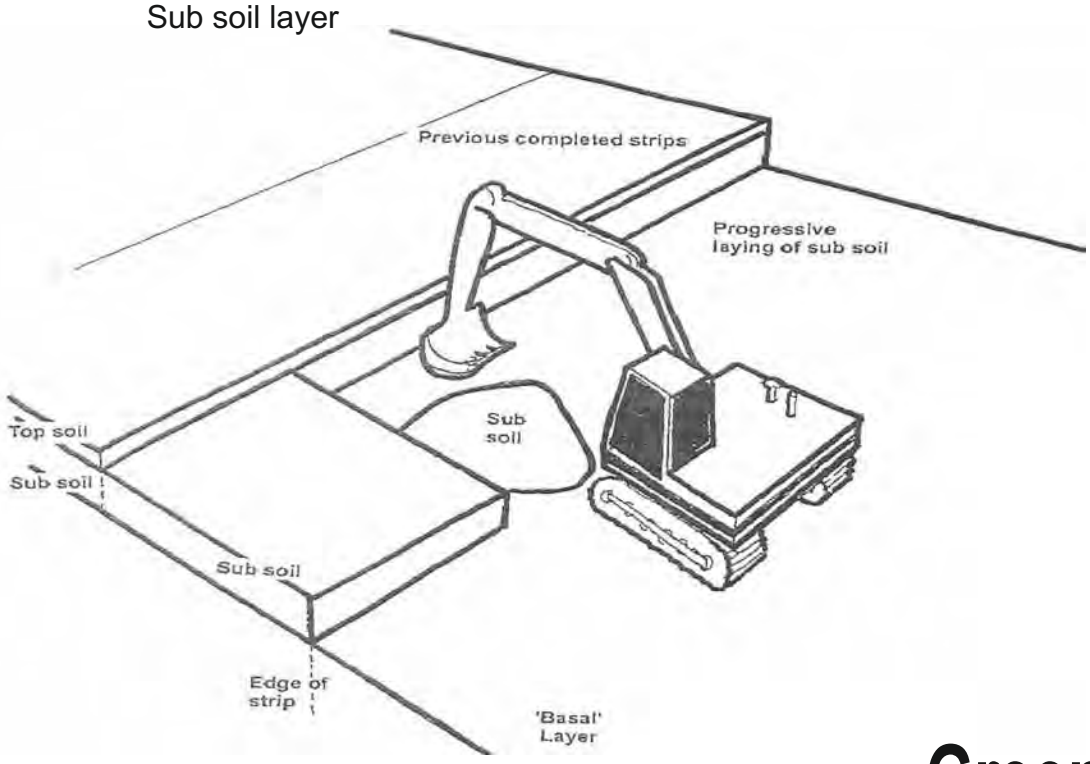
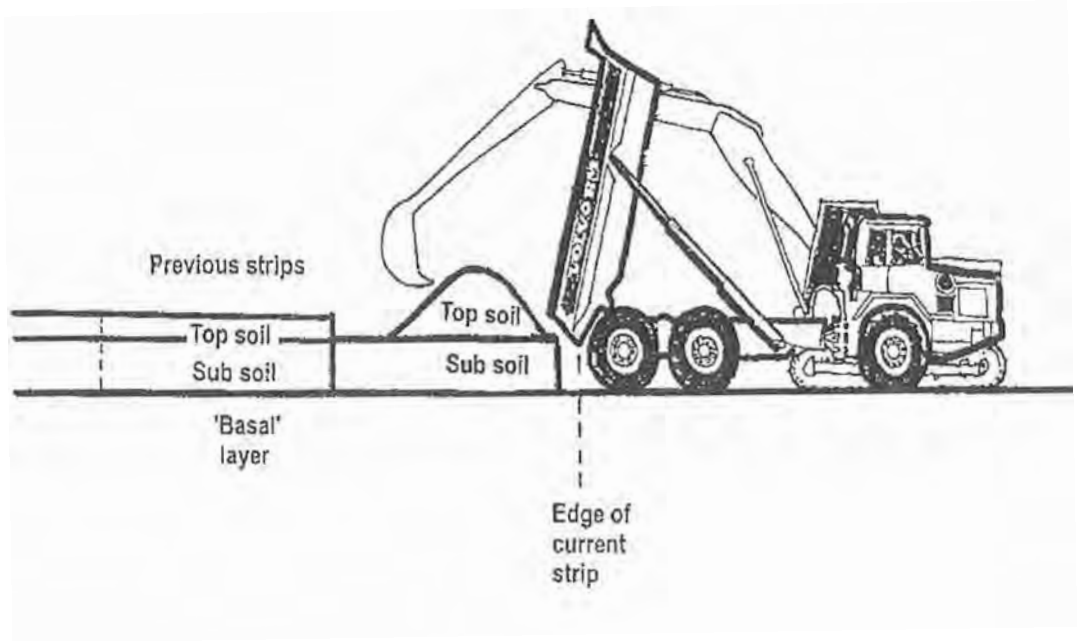


Figure 4.3 Soil replacement with excavators and dump trucks: Sub soil progressively laid



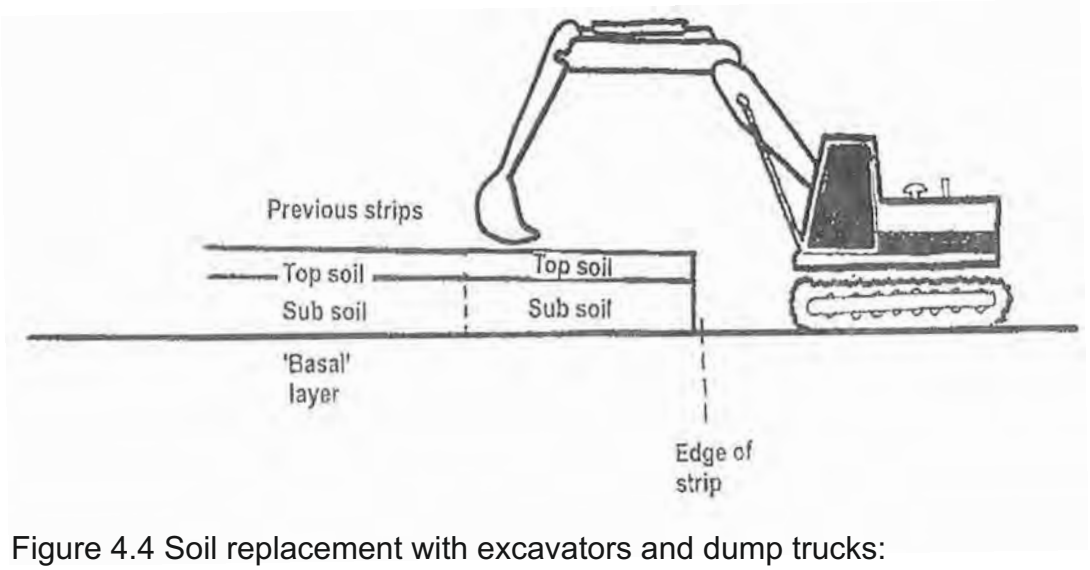


Figure 4.4 Soil replacement with excavators and dump trucks:
Top soil layer

Land at Wallingford, Oxfordshire:

The Soil Resources and Agricultural Land Classification

Survey and Report by
Rodney Burton BA MSc

August 2016

for **Greenfield Associates**

Contract No. 16.06.124/gfa/SU6087

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EXECUTIVE SUMMARY

Introduction

The survey area (Figure 1) south of Wallingford, Oxfordshire, covers 19 ha of land, partly on the low-lying river terrace adjacent to Reading Road in the west, and partly on the floodplain of the River Thames in the east. The terrace has loamy soil overlying sandy limestone gravels and the floodplain has deep clayey river alluvium prone to flooding.

Fieldwork, which was undertaken on the 7th June 2016, consisted of recording soil profiles at 19 observation sites (Figure 1) taken by coring with a hand-held auger to 120 cm depth. A network of pre-determined auger bore investigation sites to be surveyed was selected at a 100-metre interval which represents one observation point per hectare.

The Soil Resources

The Terrace:
The terrace surface is at 44–46.5 metres above Ordnance Datum (aOD). Calcareous **limestone gravels** in a loamy or sandy soil matrix form the underlying lower subsoil of the terrace area. There is a varying thickness of superficial **loamy drift** forming the ploughed topsoil (25–30 cm thick) and upper subsoil (to 45–85 cm depth) of mainly medium and heavy clay loam texture. The main soil types are the well drained calcareous Badsey and non-calcareous Ludford series (Wetness Class I, Appendix 2).

The Floodplain:
Riverine **alluvium** forms the land in the eastern part of the survey site at 43–44 m aOD adjacent to the river. The dominant soil type occurrence is the clayey, stoneless Thames series with a slowly permeable subsoil at shallow depth and seasonally waterlogged (Wetness Class III), or waterlogged for long periods in winter (Wetness Class IV).

Agricultural Land Classification (ALC)

Climatic conditions are not limiting.

Of **site conditions, gradient, microrelief** and soil **pattern** are not limiting.

Flooding by the River Thames as the channel capacity is exceeded is a major feature affecting the land use and hence land quality of the Floodplain. Maps of long-duration, recorded flood events are presented (Figure 3). Frequent long winter floods over slowly permeable soils limits the functional floodplain to Grade 4. The eastern part of the slightly higher terrace with permeable soils is considered to have a less restricted limitation of Grade 2.

At none of the observations sites is there a direct limitation from **topsoil texture and structure** or **soil depth**. **Topsoil stone content** limits two disturbed observation sites to Subgrade 3a and 3b. **Chemical conditions** are not directly limiting.

There are some **soil and wetness limitations**. Most of the terrace has loamy permeable soils of Wetness Class (WC) I and no wetness/texture limitation. The floodplain has clayey slowly permeable soils of WC III & IV and a wetness/texture limitation of Subgrades 3a & 3b, depending on topsoil texture and depth to a slowly permeable layer.

The soils of the terrace have **droughtiness limitations**, in most cases for both wheat and potato crops of Grade 2. The disturbed, stony soils are very droughty and limited for both crops to Subgrades 3b and 3a. The alluvial soils of the floodplain, although cropped with grass and little suited to wheat and potato cropping under current flooding and under-drainage conditions, have droughtiness limitations mainly to Grade 2, with some Subgrade 3a for the potato crop

Each of the 19 observation sites has been assessed for its Grade according to all of the possible limitations, and an overall Grade has been allocated to each one based on the 'most limiting factor' principle. These allocations are summarised in Table 2 and the distribution is mapped in Figure 4.

ALC Grades and Subgrades for the proposed development site. (Table 7)

Grade	ha	%
1	0.00	0.0
2	8.36	44.0
3a	0.77	4.1
3b	0.44	2.3
4	9.18	48.3
unsurveyed / non-ag	0.25	1.3
Total	19.00	100.0

Best and most versatile land (BMV) is defined as Grades 1, 2 and 3a and this comprises 9.13 ha or 48.1% of the proposed development site.

The Soil Resources and Agricultural Land Classification

of land at White Cross Farm, Wallingford, Oxfordshire

by Rodney Burton, BA, MSc
Agricultural, Archaeological & Environmental Consultant, Cambridge

1. Introduction

1.1 Greenfield Associates Ltd commissioned a soil survey and land evaluation for a proposed development on land at White Cross Farm south of Wallingford, Oxfordshire. The survey has provided information for a soil resource inventory, from which an agricultural land classification (ALC) assessment has been made to determine the distribution of Grades and Subgrades across the land. This document reports on the results of the survey.

1.2 The survey area, shown in Figure 1, covers approximately 19 ha of land in total. Access to the survey site in the west is by a track extending from Reading Road at OS Grid Ref. SU 6035 8782. From 60–110 m in from the road there is a yard area with a barn.

2. Landscape and Geology

2.1. The site has two distinctive landscape facets which have very different geology and soils, a **river terrace** in the west and a **floodplain** in the east (Figure 1), with a sharp north-south divide down the centre of the study site between the two.

2.2 The **river terrace** is the low-lying 'first terrace' of the Thames, classified as the 'Northmoor Sand and Gravel Member - Upper Facet' by the British Geological Survey, formed of sand and **sandy limestone gravel**. There are subtle differences in surface elevation across the terrace at 44–46.5 m above Ordnance Datum (aOD), with higher ground along the west. At the eight investigation sites studied, the limestone gravels form a distinct lower subsoil at 45–85 cm depth but are covered by a loamy topsoil and upper subsoil formed in a sheet of solifluction drift. The terrace was in arable use in the large field south of the barn with a barley crop at the time of the survey, and grass in the smaller field to the north.

2.3 The **floodplain** beside the River Thames is generally flat and lies at 43–44 metres aOD. It is subject to flooding by the river and performs the role of a functional floodplain, i.e. 'land where water *has* to flow or be stored in times of flood' (Department for Communities and Local Government 2012). The geology is of **river alluvium** created by the settling of fine sediment over the millennia at times of flood in which clayey soils have developed. The soil profile has a high water table throughout much of the year. The land is in permanent pasture with more marshy conditions at the wider northern end. With a thin natural topsoil of 5–12 cm, most of the floodplain has not been ploughed, except possibly at the narrow southern end.

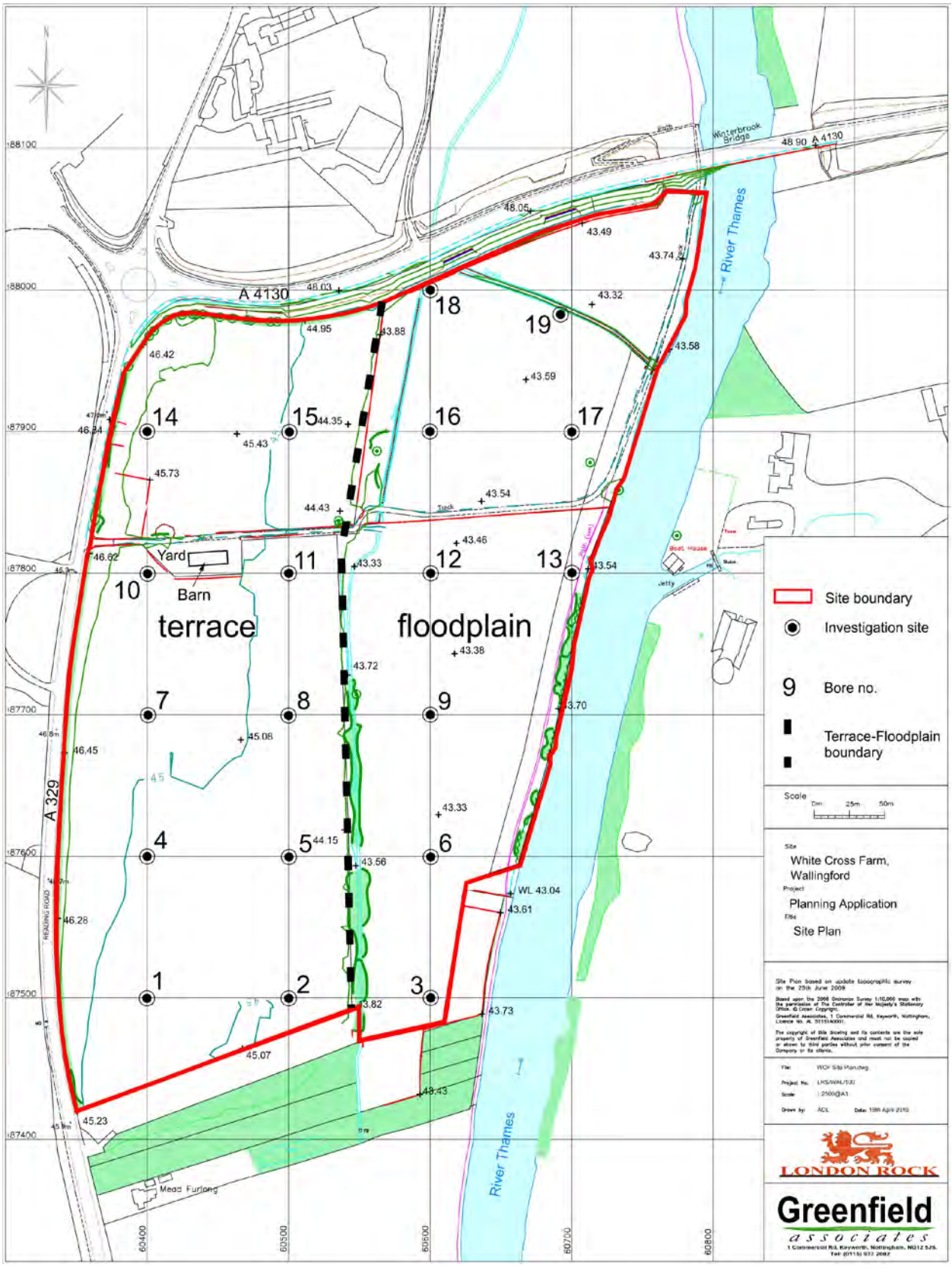


Figure 1. **Plan of the survey site and location of the numbered soil investigation sites.**

3. Survey Methods

3.1 Fieldwork, which was undertaken on 7th June 2016, consisted of recording soil profiles at 19 observation sites (Figure 1) taken by coring with a hand-held auger to 120 cm depth. A network of pre-determined auger bore investigation sites was superimposed upon a map of the land to be surveyed at a 100-metre interval largely at intersects of the Ordnance Survey grid to avoid bias in choosing investigation sites; this represents one observation point per hectare. Each investigation site was located by readings from a hand-held global positioning satellite (GPS) receiver calibrated to the OS grid reference system. One site (19) was moved because of access difficulties. On the terrace, further information was gathered by inspecting trial pits and trenches excavated by an archaeological team.

3.2 Soil profile properties such as texture, structure, colour and mottling, the presence of carbonate (free lime), drainage status, stones and the presence of a slowly permeable layer (SPL) were recorded in accordance with the Soil Survey Field Handbook (Hodgson 1997) and the MAFF Agricultural Land Classification (1988) criteria and guidelines. Soil texture was determined by hand texturing by an experienced operative, rubbing a moist sample of soil between the thumb and fingers to detect proportions of sand, silt, clay and organic matter. Soil and mottle colours were compared with the Munsell Color Charts. Calcium carbonate content was assessed by applying weak (10%) hydrochloric acid, observing the effervescence and relating this to the simplified scheme in the Soil Survey Field Handbook.

3.3 Information gathered on site characteristics, gradient, flood risk and the climate record completed the data required for an ALC assessment for each observation site. By extrapolation, an ALC map (Figure 2) has been produced for the proposed development area.

The Soil Resources

4. Sources of Information

4.1 Two published information sources were consulted prior to the field survey:

- Geological mapping by the British Geological Survey at 1:50,000 scale, available online as the Geology of Britain viewer at http://mapapps.bgs.ac.uk/geologyofbritain/home.html.
- The National Soil Map of the Soil Survey and Land Research Centre (SSLRC, formerly the Soil Survey of England and Wales) at 1:250,000 scale (Sheet 6) and the accompanying, explanatory soil bulletin for South East England (SSLRC 1983, 1984) http://www.landis.org.uk/data/natmap.cfm.

4.2 In this case, the geological mapping at 1:50,000 scale provides a more detailed picture of the substrate which forms the soil parent material and subsoils of the survey area, and the formations are briefly described in § 2.

4.3 The National Soil Map shows two soil associations occurring across the survey area: for the river alluvium of the floodplain, Thames association, and for the river terrace gravel, Sutton 2 association. Each association is named after the dominant soil type (soil series) and ancillary soil series are indicated in the key booklet accompanying the map (SSLRC 1983). Table 1 gives the main characteristics of the soils of these associations as they are mapped nationally and this has been confirmed that they are also representative of the study site except Sutton series is largely replaced by its calcareous version, Badsey series.

Table 1 The main soil types occurring at the proposed development site. Source: National Soil Map (SSLRC 1983).

Map Symbol	Soil Association	Ancillary subgroups and soil series	Geology	Soil and site characteristics
571v	SUTTON 2	571 Rougemont, Maplestead, Ludford 541 Wick	River terrace gravel	Well drained medium and light loamy soils usually over gravel with a calcareous matrix.
814a	THAMES	813 Fladbury 533 Uffington	River alluvium	Stoneless mainly calcareous clayey soils affected by groundwater. Flat land. Risk of flooding.

4.4 Soil Resources of the Terrace

4.4.1 The underlying limestone gravels form the lower subsoil of much of the terrace area and there is a varying thickness of superficial drift forming the topsoil and upper subsoil of mainly medium loamy texture (clay loam). At the investigation sites on the terrace the loamy drift thickness was recorded as being between 45 and 85 cm thick, but the distribution across the terrace could not be predicted by interpolation, with differences being localised, as indicated in the trenches dug for archaeological investigation (Photos 1 and 2). Of the ten bores made across the terrace, four were of the calcareous Badsey series soil over limestone gravel and four of the deeper non-calcareous Ludford series.

4.4.2 Typical soil profile of Badsey series (observation 11) in solifluction drift over limestone sand and gravel:

Topsoil 0–25 cm Ap horizon	Dark brown (10YR3/3) medium clay loam (MCL) with few stones, moderately firm soil strength, non-calcareous;
Upper subsoil 25–60 cm Bw horizon	Yellowish brown (10YR5/6), unmottled, heavy clay loam (HCL), few passing down to many stones, moderate medium subangular blocky structure, very firm soil strength, calcareous;
Lower Subsoil 60–120 cm 2BCu horizon	Yellowish brown (10YR5/5), unmottled, sandy clay loam (SCL), many to abundant small and medium limestones and hard stones, weak coarse subangular blocky structure, very porous, moderately firm soil strength, very calcareous.

Note: although the topsoil (plough layer) is non-calcareous the upper subsoil is calcareous within 40 cm depth.

4.4.3 Typical soil profile of Ludford series (observation 4) in thick loamy drift, where the limestone gravels occur below 80 cm depth:

Topsoil 0–27 cm Ap horizon	Brown (10YR4/3) slightly stony medium clay loam (MCL), moderately weak soil strength, non-calcareous;
Upper subsoil 27–55 cm Bt1 horizon	Yellowish brown (10YR5/5), unmottled, slightly stony heavy clay loam (HCL), moderate medium subangular blocky structure, very firm soil strength, non-calcareous;
Upper subsoil 55–75 cm Bt2 horizon	Dark yellowish brown (10YR4/4), unmottled, slightly stony clay (C), moderate coarse angular blocky and prismatic structure, very firm soil strength, non-calcareous;
Lower subsoil 75–85 cm Bt(g) horizon	Yellowish brown (10YR5/6), heavy clay loam (HCL) with common medium and coarse yellowish brown (10YR5/8) mottles, common small and medium hard stones, moderate coarse angular blocky structure, very firm soil strength, non-calcareous;
Lower subsoil 85–120 cm 2BCu horizon	Yellowish brown (10YR5/5), unmottled, sandy clay loam (SCL), many to abundant small and medium limestones and hard stones, weak coarse subangular blocky structure, very porous, moderately firm soil strength, very calcareous.

4.5 Soil Resources of the Floodplain

4.5.1 Riverine alluvium forms the whole of the low-lying land in the eastern part of the survey site between the river and the north–south aligned ditch. The main soil type occurrence is the clayey, stoneless Thames series (8 out of 9 bores), with a slowly permeable subsoil at shallow depth and seasonally waterlogged (Wetness Class III, Appendix 2) or waterlogged for long periods in winter (Wetness Class IV). Permeable sandy limestone gravel underlies the alluvium at variable depth, shallowest in the west where the floodplain abuts the terrace. It appears that over most of the floodplain, the soil has not been ploughed, leaving a thin, darkened topsoil of only 5-12 cm thickness.

4.5.2 Typical soil profile of Thames series (observation 6) in alluvium:

Topsoil 0–7 cm Ah horizon	Very dark greyish brown (10YR3/2) stoneless organic loam (oL), moderately weak soil strength, non-calcareous;
Upper subsoil 7–43 cm Bg horizon	Light yellowish brown (2.5YR6/4), with many medium strong brown (7.5YR5/8) and light olive grey (5Y6/2) mottles, stoneless silty clay (ZC), moderate coarse subangular blocky structure passing down to prismatic, moderately firm soil strength, slowly permeable from 22 cm depth, very calcareous;
Lower subsoil 43–120 cm Cg horizon	Light olive grey (5Y6/2) passing down to greenish grey (5BG6/1) with common medium strong brown (7.5YR5/8) mottles, stoneless silty clay (ZC), structureless massive, very weak (soft) soil strength, slowly permeable throughout, non-calcareous;

Note: the alluvium is more than 120 cm thick over sandy or loamy/gravelly terrace deposits; in places the topsoil is calcareous; a water table occurred in the lower subsoil at 110 cm after coring and was slowly rising during profile recording.

4.5.3 Adjacent to the river, the subsoil is able to drain towards the near-vertical bank above a lower river level. A narrow strip of land has a similar clayey texture to Thames series but with a deeper, better-structured upper subsoil and less colour mottling, indicative of lower seasonal water tables (Uffington series).

Photo 1. Exposed soil profile of Badsey series on the terrace. A dark brown medium clay loam topsoil (plough layer) overlies a yellowish brown upper subsoil. The marker bands on the auger shaft are 10 cm apart and the lower end of the auger is resting on the surface of the lower subsoil, a sandy clay loam with abundant limestone stones.

Photo 2. Exposed soil profile of Badsey series on the terrace in an archaeological trench. There are undulations in the surface of the pale coloured lower subsoil of limestone gravels.

The Agricultural Land Classification (ALC)

5. Introduction

5.1 The assessment has been made in accordance with the revised guidelines and criteria (MAFF 1988, Natural England 2012) for Agricultural Land Classification. The scheme provides a framework for classifying land according to the extent to which its physical or chemical characteristics impose long-term limitations on agricultural use. It allows the relative potential of land for agricultural use to be assessed and compared. The principal physical factors influencing agricultural production are climate, site and soil. These factors together with interactions between them form the basis for classifying land into one of five grades (Appendix 2).

5.2 The grading does not necessarily reflect the current economic value of land, land use, range of crops, suitability for specific crops or level of yield. Likewise, the size, structure and location of farms, the standard of fixed equipment and the accessibility of land do not affect grading although they may influence land-use decisions.

5.3 A Provisional Agricultural Land Classification for England at 1:250,000 scale is available from the Natural England (2010) website. It has been digitised from the published 1:250,000 maps, which were in turn compiled from the published 1 inch to 1 mile (1:63,360-scale) maps. Having been compiled on pre-MAFF 1988 criteria and where Grade 3 was not divided into Subgrades 3a and 3b, these maps are no longer considered to show the accurate Grade of the land and should not be enlarged to a better scale than 1:250,000 for this purpose.

5.4 The Provisional ALC map shows land on the western side (terrace) to be Grade 2 with land on the eastern side of the survey site (alluvium) as Grade 4.

5.5 Land on river terrace deposits and marly chalk to the north west of the site and west of Winterbrook, centred on Grid Ref. SU 6014 8847, has been classed as Grade 2 with a thin strip of Subgrade 3a land beside Bradford's Brook (SU 6021 8875). This information is available from the Multi-Agency Geographic Information for the Countryside website (MAGIC 2016).

5.6 In this survey, each soil investigation site has been assessed separately on its merits using the principle of most limiting factor to obtain the overall grade. These assessments have been combined to form a detailed classification for the whole of the surveyed area. This detailed re-assessment supersedes the ‘Provisional’ version. The summary data on site location, soil characteristics and ALC grade/subgrade limitations are presented in Table 2.

Site/location				Soil characteristics						ALC Grade/Subgrade limitations					
Easting	Northing	Auger bore	Land use	Soil Series	Soil symbol	Soil subgroup	Topsoil texture *	SPL depth (cm)	Wetness Class	Wetness + Texture	Stones	Drought wheat	Drought potatoes	Flooding	Overall Grade
460400	187500	1	barley	Ludford	LF	5.71	MCL		1	1	1	2	2	1	2
460500	187500	2	non-ag	disturbed			SCL (ca)		1	1	3b	3b	3b	2	3b
460600	187500	3	grass	Thames	Ts	8.14	HZCL	38	3	3b	1	2	2	4	4
460400	187600	4	barley	Ludford	LF	5.71	MCL		1	1	1	2	2	1	2
460500	187600	5	barley	Badsey	Ba	5.11	MCL (ca)		1	1	3a	3a	3a	2	3a
460600	187600	6	grass	Thames	Ts	8.14	HZCL (ca)	22	4	3b	1	2	3a	4	4
460400	187700	7	barley	Ludford	LF	5.71	MCL		1	1	1	1	2	1	2
460500	187700	8	barley	Sutton	Sv	5.71	MCL		1	1	1	2	2	2	2
460600	187700	9	grass	Thames	Ts	8.14	ZC	37	3	3b	1	2	3a	4	4
460400	187800	10	barley	Ludford	LF	5.71	HCL		1	2	1	2	2	1	2
460500	187800	11	barley	Badsey	Ba	5.11	MCL		1	1	1	2	2	2	2
460600	187800	12	grass	Thames	Ts	8.14	HZCL (ca)	27	3	3a	1	2	2	4	4
460700	187800	13	grass	Uffington	Uf	5.33	HZCL (ca)	45	3	3a	1	2	2	3b	3b
460400	187900	14	grass	Badsey	Ba	5.11	MCL (ca)		1	1	1	2	2	1	2
460500	187900	15	grass	Badsey	Ba	5.11	MCL		1	1	1	2	2	2	2
460600	187900	16	marsh	Thames	Ts	8.14	HZCL (ca)	32	4	3b	1	2	3a	4	4
460700	187900	17	grass	Thames	Ts	8.14	HZCL (ca)	28	4	3b	1	2	2	4	4
460600	188000	18	marsh	Thames	Ts	8.14	HZCL (ca)	36	4	3b	1	1	2	4	4
460700	188988	19	marsh	Thames	Ts	8.14	ZC (ca)	40	3	3a	1	2	2	4	4

* average over 25 cm depth

(ca) calcareous

Table 2. **Site, soil characteristics and ALC limitations – data summary.**
On alluvial soils (Thames & Uffington series) the Topsoil texture is averaged over 25 cm.

6. Investigation Results

6.1 **Climatic limitations**: Climatic details are provided in Table 3. Average annual rainfall for the area is calculated at 616 mm. There is a winter field capacity period, when the soil is fully recharged with water and susceptible to trafficking and structure damage, of 134 Field Capacity Days (FCD). During the growing season a large moisture deficit (MDM) builds up, the mean maximum deficit for wheat being 116 mm and for potatoes 110 mm. Climatic conditions are not limiting with all of the site able to qualify as Grade 1.

Table 3.

White Cross Farm, Wallingford, Oxon
ALC Computer-generated Agricultural Climate Report

Interpolated site values

Grid Ref	ALT m	AAR mm	LAAR mm/m	ASR mm	LASR mm/m	AT0	ATS	MDM WHT	MDM POT	FCD	BEST GRADE
SU 6050 8770	45	616	1.0	309	0.50	1468	2434	116	110	134	1

KEY

ALT	Altitude in metres
AAR	Average annual rainfall in mm
LAAR	Lapse rate for average annual rainfall in mm/metre
ASR	Average summer rainfall (April to September) in mm
LASR	Lapse rate for summer rainfall in mm/metre
AT0	Accumulated temperature above 0° C (January to June)
ATS	Accumulated temperature above 0° C (April to September)
MDM WHT	Moisture deficit for winter wheat in mm (from regressions on ATS and ASR)
MDM POT	Moisture deficit for potatoes in mm (from regressions on ATS and ASR)
FCD	Median duration of field capacity in days, when the soil moisture deficit is zero

The BEST GRADE gives the overall climatic assessment in terms of most limiting ALC Grade for the site.
FCD data are used in calculations for soil wetness.
MDM figures are used in assessments of moisture balance and droughtiness.

Determination of Wetness Class (WC)

using depth to gleying (distinct mottling) and to a slowly permeable layer (SPL) at least 15 cm thick below 35 cm depth

for 134 Field Capacity Days (FCD)

where gleying starts within 40 cm depth, and where SPL starts within 80 cm depth		where gleying starts between 40-70 cm depth, and where SPL starts within 80 cm depth	
SPL within 36 cm	= WC IV	SPL within 45 cm	= WC III
SPL within 64 cm	= WC III	SPL deeper than 45 cm	= WC II
SPL deeper than 64 cm	= WC II		

6.2 Site limitations

6.2.1 The slopes are negligible and **Gradient** is not limiting. **Microrelief** and soil **Pattern** are not limiting.

6.2.2 **Flooding** by the River Thames as the channel capacity is exceeded is a major feature affecting the land use and hence land quality of the floodplain and to a lesser extent the terrace. The nature of the topography means there are no natural barriers to river flood water spreading across the whole floodplain.

6.2.3 The Environment Agency has published maps of flood risk from rivers and the sea, and from surface flooding. Figure 2 shows the extent of the 'high probability' risk zone of flooding from the Thames and tributaries occupying the whole of the functional floodplain in the survey area and extending across more than half of the terrace to an elevation of 45 m OD. Definitions of the Flood Zones are given in Table 4.

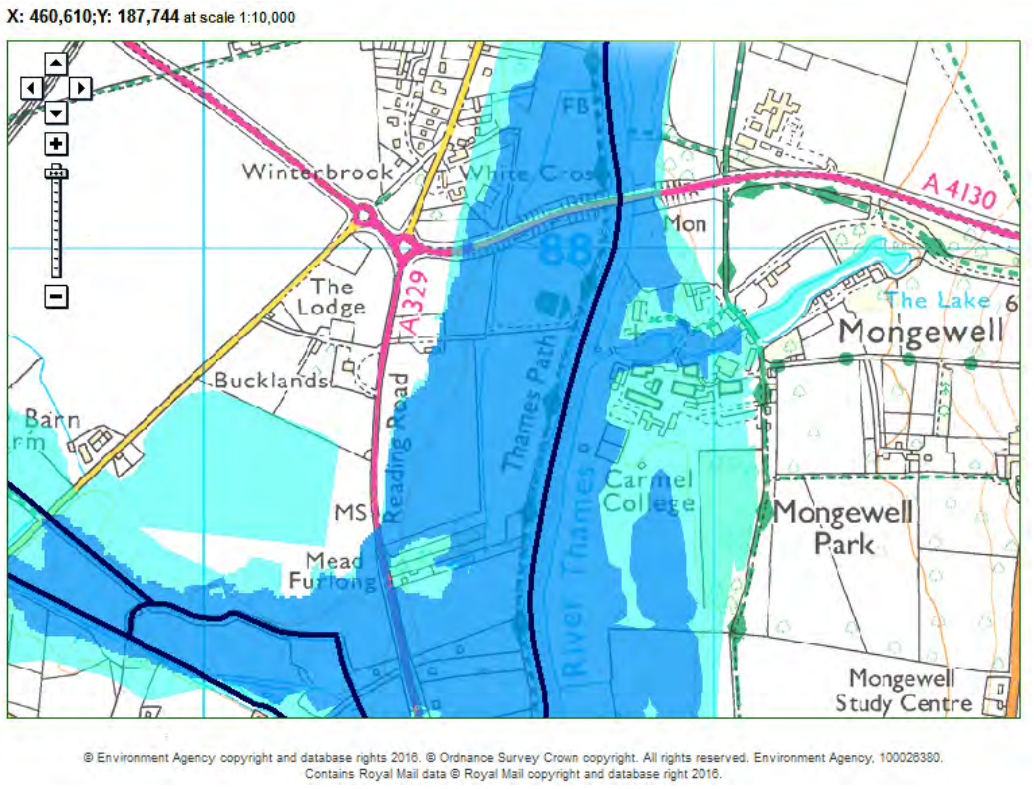


Figure 2. Environment Agency Flood Risk Map from Rivers and Sea.
Key: dark blue Flood Zone 3; pale blue Flood Zone 2

Table 4. Flood Zone Definitions.

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding (Land shown in dark blue on the Flood Map)
Zone 3b The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. (Not separately distinguished from Zone 3a on the Flood Map)

6.2.4 Risk from surface flooding alone is confined to the watercourses (ditches).

6.2.5 For Agricultural Land Classification purposes the risk of flooding may be significant in affecting the choice of crops to be grown, because at certain times of the year it can have a detrimental effect on yield, and may give rise to soil management problems. However, the extent, duration, frequency and timing of flooding can be difficult to establish precisely. The overall effect of flooding depends on a range of circumstances. The after-effects of inundation depend in part on soil type and will generally be more serious on impermeable soils such as Thames series, which remain saturated for longer periods than permeable soils. The time of year at which flooding occurs is particularly significant. Floods which occur in summer are generally more damaging than winter floods because the crop root systems are active and more likely to be affected by waterlogging. Crops vary in their tolerance to flooding and this is reflected in the stricter limits on high quality land where flexibility of cropping is required (MAFF 1988, p.14-16).

6.2.6 The guidelines given by MAFF (1988, Tables 2 and 3) in Tables 5 and 6 take account of frequency, duration and timing of flooding and apply to soils of good or moderate permeability. Further downgrading may be justified where flooding affects soils of low permeability. The year is divided into two parts, with a long 'summer' period which includes the spring sowing and late autumn harvesting seasons. When grading land, the flood limitation is assessed separately for the summer and winter seasons and, applying the 'most limiting factor' principle, either assessment can determine the grade. Information on flooding at a local scale is often fragmentary and the assessment may have to be based on local knowledge, together with any information or advice which can be obtained from official statistics. Most weight should be given to the predicted long-term risk, or the return periods used in the design of flood protection schemes, rather than to the average incidence of flooding in recent years, which may have been influenced by atypical climatic conditions.

Table 5. Grade according to flood risk in summer

Grade/ Subgrade	Flood limits	
	frequency	*duration*
1	very rare	short
2	rare	short
3a	very rare	medium or long
or	rare	medium
or	occasional	short
3b	rare	long
or	occasional	medium
4	occasional	long
or	frequent	short or medium
5	frequent	long

Table 6. Grade according to flood risk in winter

Grade/ Subgrade	Flood limits	
	frequency	*duration*
1	rare	short
2	rare	medium
or	occasional	short
3a	rare	long
or	occasional	medium
or	frequent	short
3b	occasional	long
or	frequent	medium
4	frequent	long

The terms used in Tables 5 and 6 are defined as follows:

Season	
summer	mid March to mid November
winter	mid November to mid March

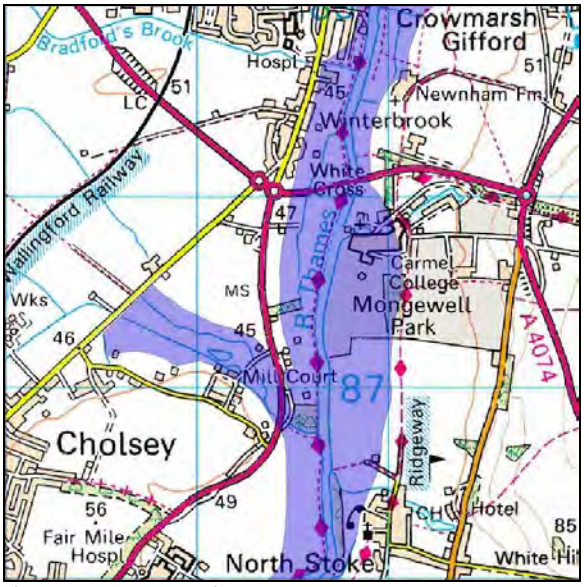
Duration	
short	not more than 2 days (48 hours)
medium	more than 2 but not more than 4 days
long	more than 4 days

Frequency	
very rare	not more than once in 15 years
rare	once in 10 to once in 14 years
occasional	once in 3 to once in 9 years
frequent	more than once in 3 years

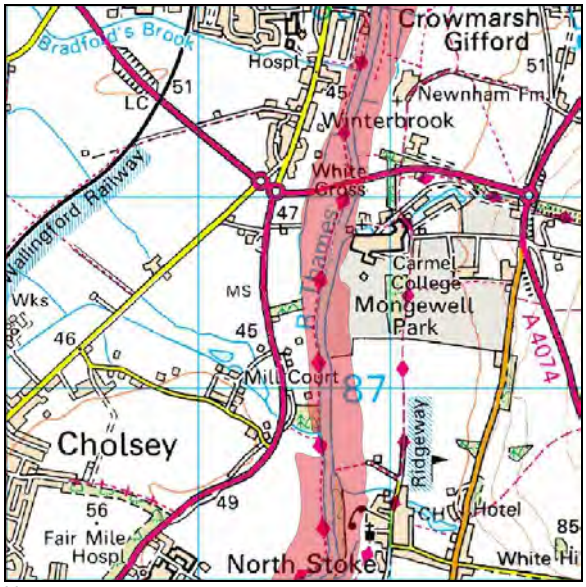
6.2.7 As a guide to the process of assessment, analysis has been made of the Environment Agency's Recorded Flood Outlines geographic information system (GIS) layer file which shows all their records of historic flooding from rivers, the sea, groundwater and surface water. Each individual Recorded Flood Outline contains a consistent list of information about the recorded flood.

6.2.8 "*Records began in 1946 when predecessor bodies to the Environment Agency started collecting detailed information about flooding incidents, although we may hold limited details about flooding incidents prior to this date. The absence of coverage by Recorded Flood Outlines for an area does not mean that the area has never flooded, only that we do not currently have records of flooding in this area. It is also possible that the pattern of flooding in this area has changed and that this area would now flood or not flood under different circumstances. The Recorded Flood Outlines take into account the presence of defences, structures, and other infrastructure where they existed at the time of flooding. It includes flood extents that may have been affected by overtopping, breaches or blockages.*" Attribution statement: © Environment Agency copyright and/or database right 2015. All rights reserved.

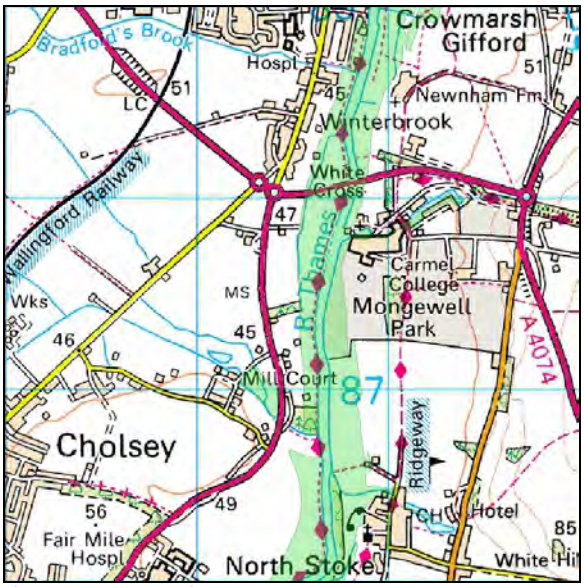
Figure 3. River Thames recorded flood events south of Wallingford from 1947



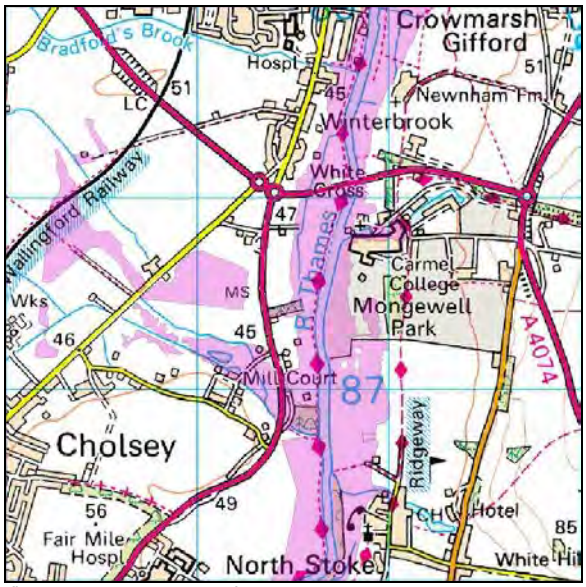
a). Event 2194: March 1947



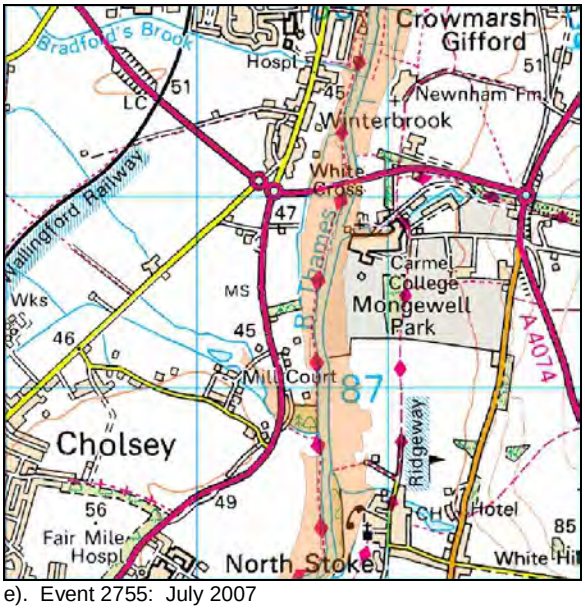
b). Event 2202: August 1977



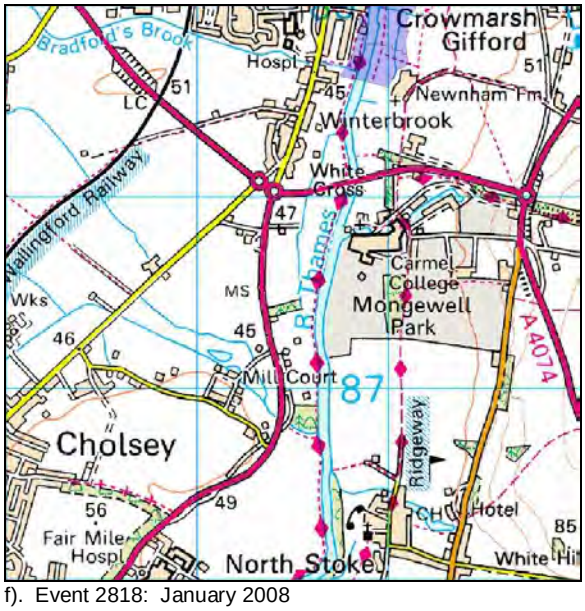
c). Event 2204: February 1979



d). Event 2217: December 2002–January 2003



e). Event 2755: July 2007



f). Event 2818: January 2008

Source: Environment Agency https://data.gov.uk/dataset/recorded-flood-outlines1

6.2.9 The events depicted in Figure 3 relate to major flooding episodes with a **duration** of more than 4 days, *i.e.* 'long' in ALC terms. There is a mix of defined winter and summer events with 'frequent' winter events and 'occasional' summer events being the perceived **frequency** on the **functional floodplain**. Frequent long winter floods would limit the Floodplain to Grade 4, in keeping with the designation on the Provisional ALC map. The events of Aug 1977, Feb 1979 and July 2007 (Figure 4, b, c and e) are shown as entirely confined to the floodplain without encroaching on the terrace. Because of the lesser risk of the lower, eastern part of the terrace to flooding, this has been assessed as having a limitation to Grade 2.

6.3 Soil limitations

6.3.1 At none of the observations sites is there a direct limitation from **topsoil texture** and **structure** or **soil depth**. **Topsoil stone content** of hard stones is limiting to Subgrade 3a around investigation site 5, and to Subgrade 3b around site 2, both sites having been disturbed with artefacts of concrete and brick being common on the surface.

6.3.2 However, many observation sites are affected to variable degrees by '**soil and interactive limitations**', including soil (subsoil) texture and structure, soil wetness and soil droughtiness.

6.3.3 **Soil texture and structure**: these features have a major influence on water retention and movement in a soil, and on workability, trafficability and suitability as a growing medium. They are significant parameters in the assessment of wetness and droughtiness and are included in the soil datasets in Appendix 1, where Texture is given as a standard alphabetic code, explained in Appendix 2 (soil texture and abbreviations) and structure is categorised as 'topsoil', 'good', 'moderate' or 'poor' (MAFF 1988, Figures 9–11).

6.3.4 **Soil wetness**: A soil wetness limitation exists where the soil water regime adversely affects plant growth or imposes restrictions on cultivations. Permeable soils are affected by wetness where there is a ground-water table that cannot be removed by normal field drainage improvements. In less permeable soils the degree of waterlogging depends partly on the depth at which the soil becomes slowly permeable, and responsible for maintaining a perched water table, defined as having a lateral hydraulic conductivity of less than 10 cm a day, but in the field by observations on soil colour (denoting the natural water regime observed by gleying) and soil structure.

6.3.5 The soil wetness assessment has taken into account the local climate (as the number of Field Capacity Days as computed in Table 3), the soil wetness class (Appendix 2), and the texture of the topsoil (Appendix 1), according to the MAFF guidelines. For each observation site the allocated **Wetness Class (WC)** is given in the Table 2 data summary. To assess the wetness class the guidelines distinguish soils with different 'gleying' features (evident as distinct colour mottles). Wetness Class determination for soil types is based on the climatic parameter of Field Capacity Days (FCDs, Table 3) and the depth to a Slowly Permeable Layer (SPL) thicker than 15 cm (MAFF 1988, Figure 7, Tables 12 & 13) and the calculations are presented in Table 3. Where these requirements are not met the soil is Wetness Class I.

6.3.6 A **wetness limitation** arises with various combinations of texture, Wetness Class and climate (as FCDs) (MAFF 1988, Tables 6 & 7). For example, at observation site 6 on the floodplain, Thames series soil type, the soil has a calcareous, heavy silty clay loam (HZCL) topsoil, a thick slowly permeable layer starting at 22 cm depth and is classed as WC IV (4) so is limited to Subgrade 3b in an area with 134 FCDs. Table 2 summarises the range of topsoil textures and Wetness Classes occurring in the study area and states the Grade limitation for the topsoil texture/wetness class combination.

6.3.7 The terrace has calcareous and non-calcareous medium clay loam (MCL) topsoils in permeable material and Wetness Class I and hence no texture/wetness limitation (Grade 1). The sole exception is observation site 10 with a heavy clay loam (HCL) topsoil that places it into Grade 2.

6.3.8 The floodplain has clayey slowly permeable soils of WC III & IV and a wetness/texture limitation of Subgrades 3a & 3b.

6.3.9 **Droughtiness**: To achieve full yield potential, a crop requires an adequate supply of soil moisture throughout the growing season. Droughtiness becomes a limitation in areas of low rainfall and where the soil has only small reserves available to plants. The ALC system uses calculations for two reference crops, winter wheat and maincrop potatoes, assuming a full crop rooting depth (120 cm for wheat and 70 cm for potatoes) for the two crop models. Assessments (Appendix 1) were calculated layer by layer for all of the 19 soil investigation sites using crop-adjusted available water capacity (AP) and moisture deficit (MDM), based on the actual soil profile characteristics (texture, structure and stone content), as recorded in the field. The droughtiness limitations are summarised in Table 2.

6.3.10 All of the soils of the terrace have droughtiness limitations, in most cases for both crops of Grade 2. The disturbed, stony soils at sites 2 & 5 are very droughty and limited for both crops to Subgrades 3b and 3a, respectively.

6.3.11 The alluvial soils of the floodplain, although cropped with grass and little suited to wheat and potato cropping under current flooding and under-drainage conditions, have a range of available water capacities for the theoretical crop calculations and droughtiness limitations mainly to Grade 2, with some Subgrade 3a for the potato crop (Table 2).

6.4 Conclusions

6.4.1 Each observation site has been assessed for its Grade according to all of the possible limitations, and an overall Grade has been allocated to each one based on the 'most limiting factor' principle. These allocations are given in Table 2 and the distribution is mapped in Figure 4.

6.4.2 Of the total 19 ha the division into the Grades and Subgrades is given in Table 7:

Table 7. ALC Grades and Subgrades for the proposed development site.

Grade	ha	%
1	0.00	0.0
2	8.36	44.0
3a	0.77	4.1
3b	0.44	2.3
4	9.18	48.3
unsurveyed / non-ag	0.25	1.3
Total	19.00	100.0

6.4.3 **Best and most versatile land (BMV)** is defined as Grades 1, 2 and 3a and this comprises 9.13 ha or 48.1% of the proposed development site.

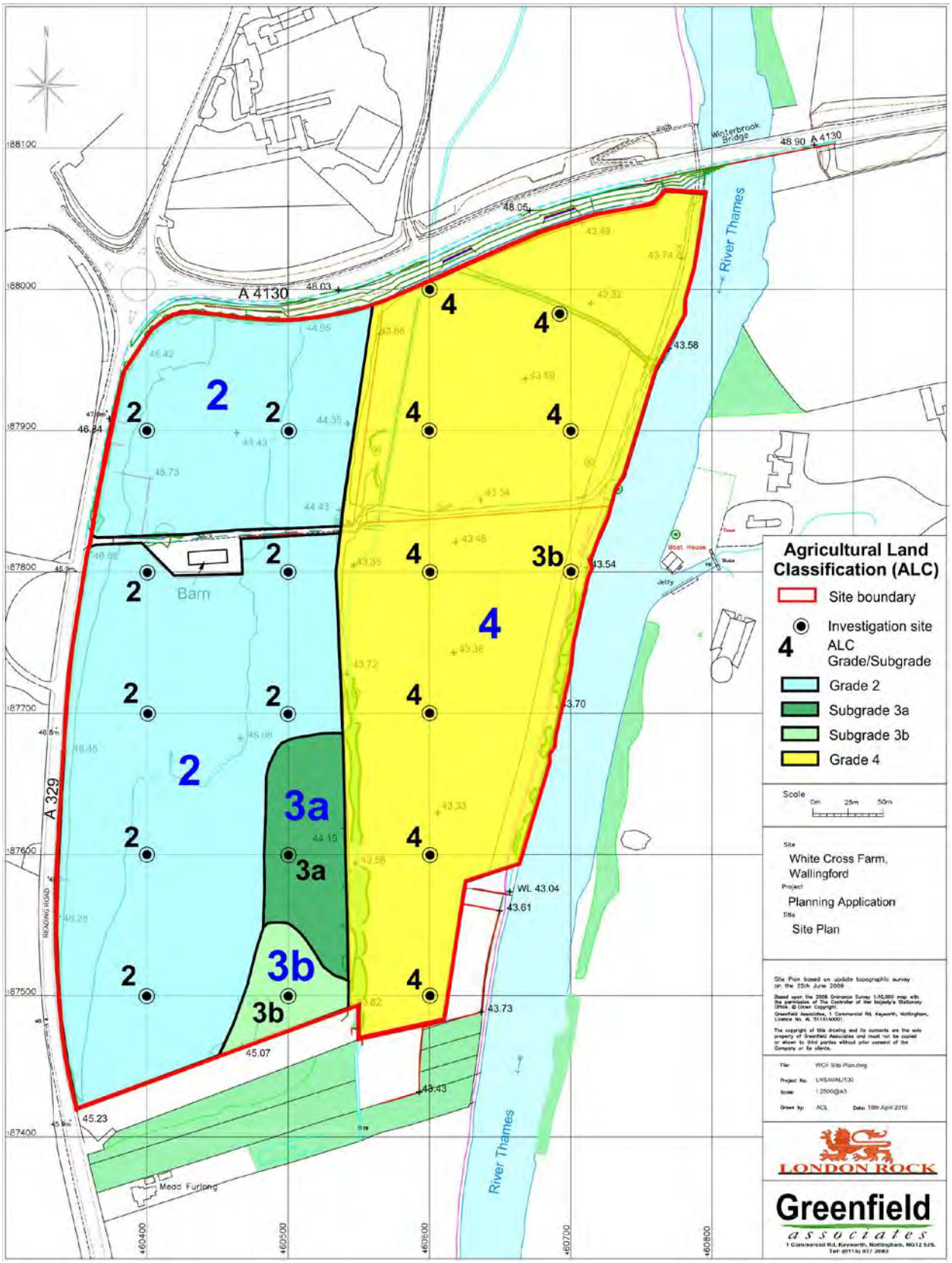


Figure 4. **Agricultural Land Classification (ALC) map of the Wallingford survey site.**

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APPENDIX 1 Soil Profile Details, Available Water and Moisture Balance Calculations (Droughtiness) for Winter Wheat & Potatoes

Site: White Cross Farm, Wallingford

From Site Climatic Data:
Altitude: **45 m aOD**
MD Potatoes: **110.0 mm**
MD Winter Wheat: **116.0 mm**

Profile: 1 Ludford series Altitude 44.7 m

Profile Details							
Depth From (cm)	Depth To (cm)	Texture	Stone1 %	Stone1 Type	Stone2 %	Stone2 Type	Structure
0	25	MCL	3	HR	0		TS
25	50	HCL	2	HR	0		M
50	63	HCL	2	HR	0		M
63	87	HCL	4	HR	0		M
87	100	C	10	HR	0		M
100	120	C	15	HR	20	ODL	M

	MD	AP	MB	ALC
Potatoes:	110.0	114.2	4.2	**G2**
Wheat:	116.0	140.0	24.0	**G2**

Profile: 2 disturbed Altitude 45.0 m

Depth From (cm)	Depth To (cm)	Texture	Stone1 %	Stone1 Type	Stone2 %	Stone2 Type	Structure
0	30	SCL	20	HR	5	ODL	TS
30	120	SCL	35	HR	20	ODL	M

	MD	AP	MB	ALC
Potatoes:	110.0	71.1	-39.0	**G3b**
Wheat:	116.0	92.2	-23.8	**G3b**

Profile: 3 Thames series Altitude 43.75 m

Depth From (cm)	Depth To (cm)	Texture	Stone1 %	Stone1 Type	Stone2 %	Stone2 Type	Structure
0	26	HZCL	0		0		TS
26	38	ZC	0		0		M
38	60	ZC	0		0		P
60	120	ZC	0		0		P

	MD	AP	MB	ALC
Potatoes:	110.0	105.8	-4.2	**G2**
Wheat:	116.0	130.8	14.8	**G2**

Profile: 4 Ludford series Altitude 45.0 m

Depth From (cm)	Depth To (cm)	Texture	Stone1 %	Stone1 Type	Stone2 %	Stone2 Type	Structure
0	27	MCL	2	HR	0		TS
27	55	HCL	2	HR	0		M
55	75	C	2	HR	0		M
75	85	HCL	10	HR	0		M
85	120	SCL	15	HR	20	ODL	M

	MD	AP	MB	ALC
Potatoes:	110.0	115.2	5.2	**G2**
Wheat:	116.0	138.6	22.6	**G2**

Profile: **5** Badsey series Altitude 44.15 m

Depth From (cm)	Depth To (cm)	Texture	Stone1 %	Stone1 Type	Stone2 %	Stone2 Type	Structure
0	25	MCL	20	HR	0		TS
25	35	MCL	20	HR	0		M
35	120	SCL	15	HR	20	ODL	M

	MD	AP	MB	ALC
Potatoes:	110.0	87.0	-23.1	**G3a**
Wheat:	116.0	115.8	-0.2	**G3a**

Profile: **6** Thames series Altitude 43.3 m

Depth From (cm)	Depth To (cm)	Texture	Stone1 %	Stone1 Type	Stone2 %	Stone2 Type	Structure
0	7	OL	0		0		TS
7	22	ZC	0		0		M
22	43	ZC	0		0		P
43	75	ZC	0		0		P
75	100	ZC	0		0		P
100	120	ZC	8	HR	0		P

	MD	AP	MB	ALC
Potatoes:	110.0	99.7	-10.3	**G3a**
Wheat:	116.0	123.7	7.7	**G2**

Profile: **7** Ludford series Altitude 45.5 m

Depth From (cm)	Depth To (cm)	Texture	Stone1 %	Stone1 Type	Stone2 %	Stone2 Type	Structure
0	27	MCL	1	HR	0		TS
27	50	MCL	1	HR	0		M
50	80	HCL	1	HR	0		M
80	120	MSZL	0		0		M

	MD	AP	MB	ALC
Potatoes:	110.0	116.3	6.3	**G2**
Wheat:	116.0	158.3	42.3	**G1**

Profile: **8** Sutton series Altitude 44.9 m

Depth From (cm)	Depth To (cm)	Texture	Stone1 %	Stone1 Type	Stone2 %	Stone2 Type	Structure
0	27	MCL	5	HR	0		TS
27	48	HCL	5	HR	0		M
48	60	HCL	25	HR	0		M
60	120	SCL	10	HR	30	ODL	M

	MD	AP	MB	ALC
Potatoes:	110.0	103.3	-6.7	**G2**
Wheat:	116.0	130.1	14.1	**G2**

Profile: **9** Thames series Altitude 43.4 m

Depth From (cm)	Depth To (cm)	Texture	Stone1 %	Stone1 Type	Stone2 %	Stone2 Type	Structure
0	5	MZCL	0		0		TS
5	15	ZC	0		0		M
15	37	ZC	0		0		M
37	54	ZC	0		0		P
54	85	ZC	0		0		P
85	120	ZC	10	HR	10	ODL	M

	MD	AP	MB	ALC
Potatoes:	110.0	97.1	-12.9	**G3a**
Wheat:	116.0	121.2	5.2	**G2**

Profile: **10** Ludford series Altitude 45.5 m

Depth From (cm)	Depth To (cm)	Texture	Stone1 %	Stone1 Type	Stone2 %	Stone2 Type	Structure
0	25	HCL	2	HR	0		TS
25	54	HCL	2	HR	0		M
54	80	MSZL	0		0		M
80	120	SCL	15	HR	20	ODL	M

	MD	AP	MB	ALC
Potatoes:	110.0	116.9	6.9	**G2**
Wheat:	116.0	144.6	28.6	**G2**

Profile: **11** Badsey series Altitude 44.5 m

Depth From (cm)	Depth To (cm)	Texture	Stone1 %	Stone1 Type	Stone2 %	Stone2 Type	Structure
0	25	MCL	5	HR	0		TS
25	53	HCL	5	HR	0		M
53	60	HCL	12	HR	12	ODL	M
60	120	SCL	15	HR	20	ODL	M

	MD	AP	MB	ALC
Potatoes:	110.0	105.2	-4.8	**G2**
Wheat:	116.0	132.5	16.5	**G2**

Profile: **12** Thames series Altitude 45.0 m

Depth From (cm)	Depth To (cm)	Texture	Stone1 %	Stone1 Type	Stone2 %	Stone2 Type	Structure
0	12	HZCL	0		0		TS
12	27	ZC	0		0		M
27	48	ZC	0		0		M
48	68	ZC	0		0		P
68	120	HCL	15	HR	0		P

	MD	AP	MB	ALC
Potatoes:	110.0	102.9	-7.1	**G2**
Wheat:	116.0	123.1	7.1	**G2**

Profile: **13** Uffington series Altitude 43.5 m

Depth From (cm)	Depth To (cm)	Texture	Stone1 %	Stone1 Type	Stone2 %	Stone2 Type	Structure
0	30	HZCL	0		0		TS
30	45	ZC	0		0		M
45	80	ZC	0		0		P
80	96	ZC	0		0		P
96	120	ZC	0		0		P

	MD	AP	MB	ALC
Potatoes:	110.0	109.5	-0.5	**G2**
Wheat:	116.0	134.5	18.5	**G2**

Profile: **14** Badsey series Altitude 45.3 m

Depth From (cm)	Depth To (cm)	Texture	Stone1 %	Stone1 Type	Stone2 %	Stone2 Type	Structure
0	32	MCL	3	HR	0		TS
32	45	HCL	3	HR	0		M
45	70	MSZL	5	HR	5	ODL	M
70	120	SCL	15	HR	20	ODL	M

	MD	AP	MB	ALC
Potatoes:	110.0	115.1	5.1	**G2**
Wheat:	116.0	140.0	24.0	**G2**

Profile: **15** Badsey series Altitude 45.0 m

Depth From (cm)	Depth To (cm)	Texture	Stone1 %	Stone1 Type	Stone2 %	Stone2 Type	Structure
0	25	MCL	5	HR	0		TS
25	45	MCL	5	HR	0		M
45	60	MCL	12	HR	12	ODL	M
60	120	SCL	15	HR	20	ODL	M

	MD	AP	MB	ALC
Potatoes:	110.0	103.2	-6.8	**G2**
Wheat:	116.0	130.8	14.8	**G2**

Profile: **16** Thames series Altitude 43.6 m

Depth From (cm)	Depth To (cm)	Texture	Stone1 %	Stone1 Type	Stone2 %	Stone2 Type	Structure
0	7	MSZL	0		0		TS
7	32	ZC	0		0		M
32	48	ZC	0		0		P
48	78	ZC	0		0		P
78	86	SCL	10	HR	0		P
86	120	CSL	15	HR	0		M

	MD	AP	MB	ALC
Potatoes:	110.0	96.4	-13.6	**G3a**
Wheat:	116.0	129.8	13.8	**G2**

Profile: **17** Thames series Altitude 43.6 m

Depth From (cm)	Depth To (cm)	Texture	Stone1 %	Stone1 Type	Stone2 %	Stone2 Type	Structure
0	7	OL	0		0		TS
7	28	ZC	0		0		M
28	68	ZC	0		0		P
68	120	ZC	0		0		P

	MD	AP	MB	ALC
Potatoes:	110.0	101.5	-8.5	**G2**
Wheat:	116.0	126.5	10.5	**G2**

Profile: **18** Thames series Altitude 43.6 m

Depth From (cm)	Depth To (cm)	Texture	Stone1 %	Stone1 Type	Stone2 %	Stone2 Type	Structure
0	7	OL	0		0		TS
7	26	HZCL	0		0		M
26	36	ZC	0		0		M
36	42	OL	0		0		P
42	89	ZC	0		0		P
89	120	HCL	10	HR	0		M

	MD	AP	MB	ALC
Potatoes:	110.0	117.3	7.3	**G2**
Wheat:	116.0	148.7	32.7	**G1**

Profile: **19** Thames series Altitude 43.3 m

Depth From (cm)	Depth To (cm)	Texture	Stone1 %	Stone1 Type	Stone2 %	Stone2 Type	Structure
0	5	OL	0		0		TS
5	40	ZC	0		0		M
40	63	ZC	0		0		P
63	120	HZCL	0		0		P

	MD	AP	MB	ALC
Potatoes:	110.0	102.5	-7.5	**G2**
Wheat:	116.0	121.8	5.8	**G2**

KEY

For **Texture** codes see Appendix 2
Stone Types: HR = hard rocks, flint, quartzite, quartz; ODL = soft rocks, limestone, oolitic/dolomitic
Structure: TS = topsoil; G = good structure; M = moderate structure; P = poor structure
MD Climatic **Moisture Deficit** in mm for the crop at that site
AP Crop-adjusted **Available Water Content** in mm for the soil profile
MB **Moisture Balance** (AP–MD) in mm for the crop in the soil profile at that site
ALC The Agricultural Land Classification **Grade** or **Subgrade** based on the Droughtiness calculation for the winter wheat and potato crop – the lower Grade/Subgrade defines the limitation for Droughtiness

For an explanation of the calculation of Available Water (AP) and climatic Moisture Deficit (MD) data see MAFF 1988, Appendix 4 and 1, respectively. For an explanation of Droughtiness see MAFF 1988, p.19-21.

Series refers to the named Soil Type in the National Soil Classification of the National Soil Resources Institute (NSRI) of Cranfield University, formerly the Soil Survey of England and Wales (SSEW). The following five soil series have been recorded on the Application site during the ALC investigation:

Classification of Soil Types (***MAJOR GROUP***, ***Group***, **Sub-group**, SERIES – symbol - definition)

5. BROWN SOILS

5.1 Brown calcareous earths

5.11 Typical brown calcareous earths

BADSEY	Ba	medium loamy material over calcareous gravel

5.3 Brown calcareous alluvial soils

5.33 Pelogleyic brown calcareous alluvial soils

UFFINGTON	Uf	clayey river alluvium

5.7 Argillic brown earths

5.71 Typical argillic brown earths

LUDFORD	LF	medium loamy drift with siliceous stones
SUTTON	Sv	medium loamy material over calcareous gravel

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8. GROUND-WATER GLEY SOILS

8.1 Alluvial gley soils

8.14 Pelo-calcareous alluvial gley soils

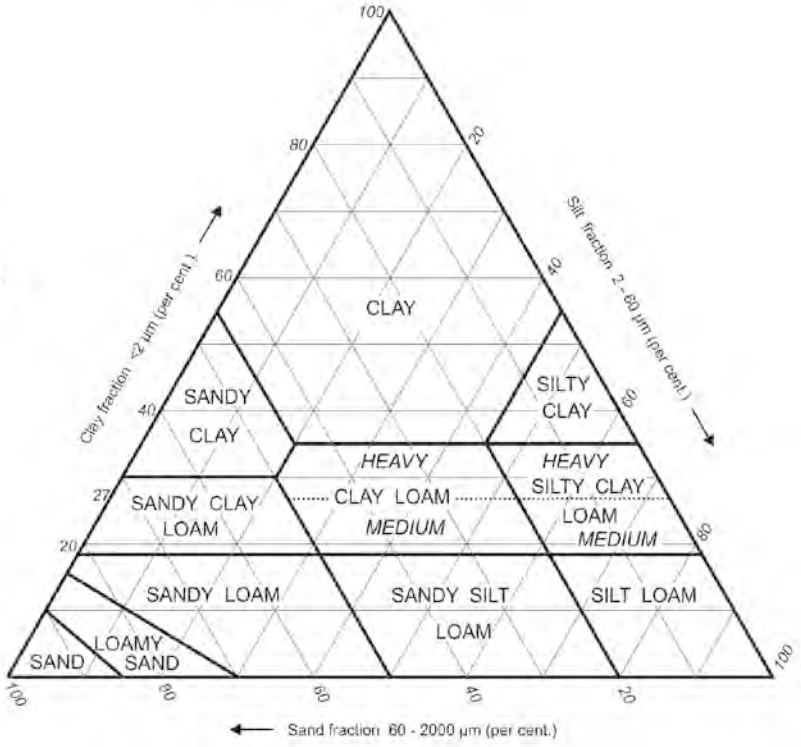
THAMES	Ts	clayey river alluvium

APPENDIX 2 Soil and ALC Terminology

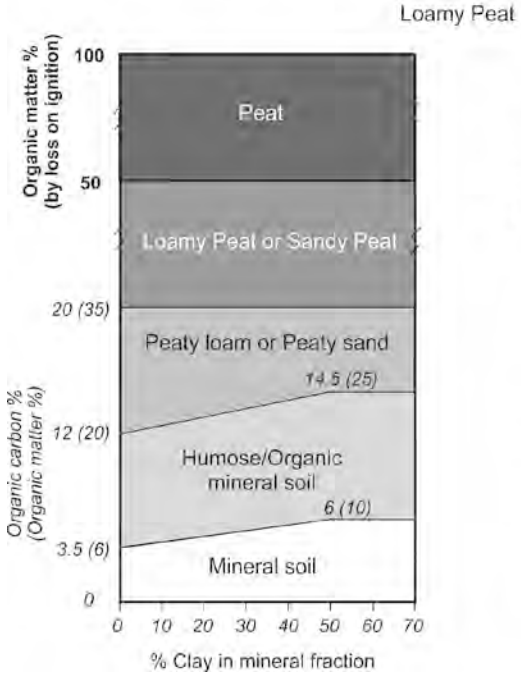
Texture Classification and Abbreviations

SUBGROUPS

PARTICLE-SIZE CLASSES
mineral soils,
with limiting percentages
of sand, silt and clay fractions



ORGANIC MATTER STATUS



Texture abbreviations

C	clay	S	sand
HCL	heavy clay loam	LS	loamy sand
MCL	medium clay loam	SL	sandy loam
ZC	silty clay	SCL	sandy clay loam
HZCL	heavy silty clay loam	SC	sandy clay
MZCL	medium silty clay loam	SZL	sandy silt loam
ZL	silt loam		
F	fine grade sand	M	medium grade sand
C	coarse grade sand		
HP	humified peat	MP	mesic (semi-fibrous) peat
FP	fibrous peat		
LP	loamy peat	PL	peaty loam
SP	sandy peat	PS	peaty sand
h/O	humose/organic (mineral soil)		

additional Class used, OL = organic loam

Definition of Soil Wetness Classes

Wetness Class	Descriptive Terms	Duration of Waterlogging [1].
Class I	*Rarely wet* Well Drained	The soil profile is not wet within 70 cm depth for more than 30 days in most years [2].
Class II	*Seldom wet* Slight seasonal waterlogging	The soil profile is wet within 70 cm depth for 30-90 days in most years.
Class III	*Occasionally wet* Seasonally waterlogged	The soil profile is wet within 70 cm for 90-180 days in most years.
Class IV	*Commonly wet* Waterlogged for long periods in winter	The soil profile is wet within 70 cm depth for more than 180 days, but not wet within 40 cm depth for more than 180 days in most years.
Class V	*Usually wet* Severely waterlogged	The soil profile is wet within 40 cm depth for more than 180 days, and is usually wet within 70 cm for more than 335 days in most years.
Class VI	*Permanently wet* Permanently waterlogged	The soil profile is wet within 40 cm depth for more than 335 days in most years.

Notes:

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.

Sources:
Soil Survey Field Handbook – J.M. Hodgson, Soil Survey and Land Research Centre, 1997
Revised Guidelines and Criteria for Grading the Quality of Agricultural Land- MAFF, 1988.

Data on the duration of waterlogging at a given site are rarely available. Wetness classes are, therefore, assigned in field survey by assessing soil texture, structure and gley morphology (*i.e.* colour mottling) in conjunction with climatic data.

Agricultural Land Classification System

The Agricultural Land Classification of England and Wales (MAFF, 1988) provides a framework for classifying land according to the extent to which its physical or chemical characteristics impose long-term limitations on agricultural use. The limitations can operate in one or more of four principle ways: they may affect the range of crops which can be grown, the level of yield, the consistency of yield and the cost of obtaining it. The classification gives considerable weight to the flexibility of cropping, whether actual or potential, but the ability of some land to produce consistently high yields of a somewhat narrower range of crops is also taken into account.

The principal factors influencing agricultural production are climate, site and soils. The main climatic factors which are taken into account are temperature and rainfall, although account is also taken of exposure, aspect and frost risk. The site factors used in the classification system are gradient, microrelief and flood risk. Soil characteristics of particular importance are texture, structure, depth and stoniness. In some situations where chemical properties may influence the long-term potential of the land, these are taken into account.

These factors result in varying degrees of constraint on agricultural production. They can act either separately or in combination, the most important interactive limitations being soil wetness and droughtiness. The grade or subgrade of the land is determined by the most limiting factor present. Five grades of land are recognised ranging from Grade 1 – land of excellent quality, to Grade 5 – land of very poor quality. Grade 3, which constitutes about half the agricultural land in England and Wales is divided into two subgrades designated 3a and 3b.

Details of the ALC system are contained in the Revised Guidelines and Criteria for grading agricultural land in England and Wales (MAFF, 1988). Descriptions of the grades and subgrades are shown below.

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 or horticultural crops can usually be grown but on some land of this 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 land.

Grade 3: Good to Moderate Quality Land

Land with moderate limitations which affect the choice of crops, the 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

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 the 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 severe limitations which restrict use to permanent pasture or rough grazing, except for occasional pioneer forage crops.

Grades 1, 2 and Subgrade 3a are together termed '**Best and Most Versatile**' (BMV) land.