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RECORDING SOIL PROFILE DESCRIPTIONS FOR COMPUTER RETRIEVAL

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This paper appeared first in 1974 as Merlewood Research and Development Paper No 55. Since then, experience in the use of the soil profile record sheet in the field, especially by Paul Stevens of Bangor, has suggested various modifications. Furthermore, Merlewood has acquired a PDP 11 computer to replace the original PDP 8, and other ITE stations have also acquired PDP 11's. These considerations have necessitated a complete revision of the paper.

The Soil Science Subdivision will arrange short field training courses for groups of individuals in ITE who need to record soil profile descriptions.

C O N T E N T S

1 INTRODUCTION

Traditionally, pedologists record soil profile descriptions on forms which contain boxes for site characteristics such as altitude, slope, aspect, geology, and columns in which the observer can enter certain properties of the individual horizons, eg, colour, texture, type and quantity of stones and roots. Observers generally use standard terms, such as those given in the handbook of the Soil Survey of England and Wales (Hodgson, 1974). However, the information contained in such record sheets can only be recovered by reading each sheet, and this limits the recovery of information, especially if a large number of profiles is being examined. Muir and Hardie (1962) described a system using conventional edge-punched cards to record soil data, and Rudeforth and Webster (1973) used punched feature (optical coincidence) cards for the same purpose. However, both of these systems require manual sorting to recover the information.

Soil profile descriptions are the basic building blocks for a whole range of pedological and ecological studies, for example in monitoring changes in soils and vegetation which occur naturally in time, or in response to management, in studying relationships between soils and vegetation in natural and semi-natural habitats, as well as in land capability and land use studies. It is therefore essential that, once the soil profile description is recorded, the information is readily and speedily accessible. Thompson (1979) has discussed the practical advantages of using a standardized and computerized soil data storage system.

The examination of records containing soil profile information, and the extraction of pre-selected types of information, is a good example of the routine file-handling work which can be handled speedily and efficiently by even a small electronic computer. However, in order to introduce the information into the computer and subsequently to recover it it is necessary for the information to be suitably coded. When the original version of the present paper (Howard *et al*, 1974) was published, there did not appear to be any published method for recording soil profile descriptions in such a way that they could be easily coded for computer storage and retrieval, although several papers had been published on subsequent handling of the information (eg, John, Lavkulich and Zoost 1972; John, van Laerhoven and Sprout 1972). We designed a soil profile description sheet which records information in such a way that it can be punched on to paper tape. We think that this type of recording sheet has certain other advantages over the traditional soil profile recording sheet. For example, in the present system, the observer is forced to make decisions between standard descriptive terms, rather than to use his own words as in the traditional system. The present system imposes, on the recording of soil profile data, order and structure which are, in themselves, valuable. This makes it easier to compare profiles, especially if they have been recorded by different people.

The standard descriptive terms must, of course, be used in the same way by all observers. The amount of coding which the observer has to do in the field is kept to a minimum. However, it is advisable that the observer should familiarize himself with the soil profile recording form and coding systems before using them in the field.

It is difficult to say precisely how many soil profiles are required before the information is worth punching into a computer, much depends on the use to which the information is to be put, and whether or not more soil profile descriptions are likely to be gathered in the future.

The programs for handling the information entered on the soil profile record sheet are written in BASIC, an easy-to-learn conversational language which has been developed specifically for time-sharing systems. This paper describes the format of our soil profile recording sheet and outlines the way in which the coded information is punched on to paper tape and then transferred for machine storage, and the way in which programs written in BASIC can be used to retrieve, tabulate and sort the information. Some practical examples are given of how the system is developing and of how flexible and interactive the system is likely to be when it is completed. A detailed manual describing the coding and punching of the data and the use of the computer programs is also available from D. M. Howard

Soon after our paper first appeared, a new edition of the Soil Survey of England and Wales Handbook was published (Hodgson, 1974). This not only included a form for recording soil profile descriptions for computer storage and retrieval, but also differed from the previous handbook in the way in which certain features were described. It was therefore necessary for us to revise Appendix 6 in Howard *et al* (1974), in which we compare our terms with those used by the Soil Survey of England and Wales, and with those used by FAO. Hodgson (1978) includes a discussion of the site and soil description systems used in a number of countries. The form used by the Soil Survey of England and Wales requires the observer to enter a code for each feature. We think that our form has certain advantages for ITE, for example, some observers may not spend sufficiently long periods in the field to become familiar with detailed coding systems. With our form, there is very little need to look up codes in the field.

The classification currently being used by the Soil Survey of England and Wales was recently outlined by Avery (1973), and is given in Appendix 3. In this classification, soils are given key numbers at the differing levels of classification (Soil Major Group, Group, and Sub-Group provide three levels used), eg.

5 Brown soils   5.4 Brown earths   5.43 gleyic brown earth
(*sensu stricto*)

and this therefore provides a suitable code for use in computer storage or processing. It is our intention to attempt to use this classification for a trial period and to enter data into the computer using the numerical code outlined above, but the full soil name may be inserted when completing the profile sheet, and the code entered later. Some of our colleagues will almost certainly continue to use soil names derived from other systems, and for the interim the intention is to recode these names according to Avery's Groupings at the editorial stage. Where alternative classification systems are used, the source should be noted.

It should be stressed that in the approach as outlined, any alternative preferred classifications or codings for vegetation type, parent material, solid geology or soils could be substituted by the user. Those used here were simply adopted during our initial trials with the form and, in the case of soils and vegetation, our aim was to utilise a published system for a discussion period. As with the soil name, a descriptive name or phrase can be used initially for "parent material" and "solid geology" and the relevant code entered later or during editing.

We regard this paper very much as a working document. When the method described here has been used in the field for some time, it is likely that some improvements will be made. The authors would welcome constructive comments from anyone interested in using the method for recording and retrieving soil profile descriptions. Soil scientists in other organizations would no doubt find it possible to adapt the programs for other computing systems.

2 THE SOIL PROFILE RECORD SHEET

The soil profile record sheet (Appendix 1) contains boxes of two types. In one type of box, the observer is required to enter a word, code, or number, while in the second type the observer enters only a tick. The record sheet begins with the site number, name, observer, date and profile number. There follows a short section of boxes which contain the features necessary for an adequate description of the area immediately around the profile, a number of whole profile features, together with two boxes for description of the L layer of the profile and three for the F layer. This section ends with boxes for land use, relief, chemical and vegetation data, and number of horizons.

The rest of the record sheet contains boxes for describing features in each horizon, the boxes for each horizon being arranged vertically. The method of filling in the boxes will now be considered in detail. We have adopted the convention that depth is measured from the observable surface, eg from the top of the L layer, if present.

The boxes in the first block of the sheet are filled in as shown below. The term 'alphanumeric characters' refers to combinations of letters, spaces, characters such as / and numbers. The data are stored in the computer in alphanumeric strings, the basic string length being chosen, for convenience, as 8 characters. In some cases (see below), two strings (16 characters) are allocated to a property. The use of alphanumeric strings means that if the information is not available, NA can be entered.

Site no. or code : 16 alphanumeric characters

Site name : 16 alphanumeric characters

Observer : 16 alphanumeric characters

Day/Month/Year : 8 alphanumeric characters

Profile number : 8 alphanumeric characters. It is useful when handling the data if the profile number has some meaning, eg, age class of trees, not recorded elsewhere on the form.

km east : 8 alphanumeric characters. This is the number of kilometres the sampling point lies to the east of zero on the National Grid. Each of the 1" Ordnance Survey maps gives some of the eastings figures with 6 digits, this number being in metres east of zero. The railway station at Grange-over-Sands would thus be given on the Ordnance Survey map as 3<u>41 2</u>00, the three digits underlined being those normally given in the usual six-figure Nat. Grid Ref. The corresponding value in km to be entered in the box would be 341·200.

If the observer feels sufficiently confident, his sampling point can thus be given to the nearest metre. This system is chosen in preference to the normal Nat. Grid Ref. because it is an absolute measure of location, and could be used to give co-ordinates in a computer plot. The observer can, if necessary, leave this box to be filled in later, and write the Nat. Grid Ref. at the top of the form.

km north	: 8	alphanumeric characters. This is similar to the km east above. The value for Grange railway station being 478 200, ie, 478.200 km.
Altitude (m)	: 8	alphanumeric characters
Slope °	: 8	alphanumeric characters
Aspect °	: 8	alphanumeric characters
Rainfall (mm)	: 8	alphanumeric characters
Surface texture	: 8	alphanumeric characters. See Appendix 2 for suggested codes.
Soil parent material	: 16	alphanumeric characters. See Appendix 2 for suggested codes.
Solid geology	: 8	alphanumeric characters. See Appendix 2 for suggested codes.
Location drainage	: 8	alphanumeric characters. See Appendix 2 for suggested codes.
Profile drainage	: 8	alphanumeric characters. See Appendix 2 for suggested codes.
Soil group or sub-group	: 8	alphanumeric characters. See Appendix 3 for suggested codes, based on the classification of Avery (1973). If the major soil group is unknown, a suitable code can be entered and changed later if necessary.
Main plant species	:	up to 8 strings each of 8 alphanumeric characters. If a species can be identified with certainty, we enter the code number used by the Biological Records Centre (see their list BRC;4). If only the genus can be identified with certainty, we enter the shortened form of the name as used on the BRC field recording card.

If a fuller description of the vegetation is required, a separate sheet can be filled in. A code can be inserted in the vegetation data box to indicate that such a sheet is available.

Vegetation type : 8 alphanumeric characters. See Appendix 4 for suggested codes.

L layer thickness (cm) : 8 alphanumeric characters.

L layer composition : Up to 8 strings each of 8 alphanumeric characters. This refers to the recognisable plant species of the layer. Use the plant species code or the shortened generic name.

F layer thickness (cm) : 8 alphanumeric characters.

Nature of F layer : 16 alphanumeric characters. See Appendix 4 for suggested words.

F layer composition : Up to 8 strings each of 8 alphanumeric characters for the plant species if recognisable. If not recognisable, enter "unknown".

Land use : 8 alphanumeric characters. See Appendix 2 for suggested codes.

Relief : 8 alphanumeric characters. See Appendix 2 for suggested codes.

Chemical data : 16 alphanumeric characters. This can be used for the batch number or other reference number of chemical analyses performed on samples collected from the profile.

Vegetation data : 16 alphanumeric characters. This can be used to cross-reference to a detailed vegetation list, if one has been prepared.

No. of horizons : 8 alphanumeric characters.

There follows a series of boxes, arranged vertically, which refer to the properties of the individual horizons:

Sample code : 16 alphanumeric characters. This is the code used for the sample collected for chemical analysis.

Horizon symbol : 8 alphanumeric characters. Suggested symbols are given in Appendix 5. If the observer is not absolutely certain of the nature of each horizon, it is better to number them 1, 2, 3. The numbers can be changed to codes later, for instance if chemical and mechanical analyses become available.

Horizon depth cm (start)	:	8 alphanumeric characters. The depth to the top of the horizon.
Horizon depth cm (end)	:	8 alphanumeric characters. The depth to the base of the horizon. The alphanumeric form allows the use of a + sign when the lower limit cannot be determined.
Lower boundary sharpness	:	8 alphanumeric characters. A two-digit code, see Appendix 5.
Munsell colour (ground) Munsell colour (ped face)	: :	Each of these consists of two boxes, each of 8 alphanumeric characters. In the first box should be entered the hue (eg, 7.5 YR). In the second box should be entered the value and chroma, separated by an oblique stroke (eg, 5/6).
Mottling	:	In this array of boxes it is only necessary to place a tick in the appropriate box for (a) frequency, (b) size, and (c) prominence, but note that the vertical columns are linked, each vertical column carrying the characteristic of one set of mottles. For definitions of frequency and size see Appendix 6, see also percentage cover charts in Hodgson (1974). The final box in each column is for mottle colour. This can be either the Munsell colour or a term such as yellowish, ochreous, black, greenish, bluish. Colour is stored as 16 alphanumeric characters. In each horizon, four sets of mottles can be described. If this is not sufficient, additional descriptions can be put in the appropriate COMMENT box. The nature of the mottle boundary edge can also be put in the COMMENT box if required.
Field texture	:	An array of boxes with three columns and five rows, one row for each class (Loam, Silt, etc). To indicate the texture, the observer should place a tick in the appropriate box, starting from the left. Thus, a sandy loam would have a tick in the 'Sand' box of the first column plus a tick in the 'Loam' box of the second column, the third column remaining empty. A silty clay loam would have a tick for silt, a tick for clay, and a tick for loam in the first, second and third columns respectively. In Appendix 1, the fourth and fifth horizons are silty loam.
Organic matter	:	Place a tick in the Low, Moderate, High, or Peaty box as appropriate. For definitions of terms, see Appendix 6. If peaty, record nature of peat (Appendix 6) in COMMENTS box.

Overall stoniness	:	This refers to the percentage cover of the exposed soil face. See percentage cover charts in Hodgson (1974), and definitions in Appendix 6.
Individual stone types	:	To describe the stones in more detail, it is only necessary to place a tick in the appropriate box for (a) quantity, (b) size, and (c) shape, but note that the vertical columns are linked, each vertical column carrying the characteristics of one stone type. For definitions see Appendix 6. See also percentage cover charts in Hodgson (1974). The final box in each column is for the lithology of the stones (Appendix 2). Space is provided for four dominant stone size/shape/lithology combinations. However, if it is essential to record more, they can be entered in the appropriate COMMENTS box.
Porosity class	:	tick appropriate box. See Appendix 6 for definitions and Hodgson (1974) for percentage cover charts.
Soil structure	:	first it is necessary to tick a box to indicate if the soil is (1) Structureless, or (2) Structur Then it is necessary to go to the appropriate category: (1) Structureless soils - for these the appropriate box is ticked, (2) Structured soils - for these, boxes are subdivided into (a) ped shape, (b) ped strength, (c) ped size. A tick is placed in the appropriate box, first for the dominant feature, then for the feature to which the soil breaks, if applicabl Using our terminology, 'angular fine' is equivalent to 'granular' and 'angular large' or 'angular medium' is equivalent to 'blocky'.

For the remaining properties, it is necessary only to place a tick in the appropriate box, except for the boxes describing the roots, which are completed in a similar way to those for stones. The terms used to describe abundance of roots are based on number per unit volume of soil (Appendix 6). For induration/compaction, if the horizon symbol has an x suffix, the program will print this as induration. If there is no x suffix, the program will print this as compaction.

An iron pan, if present, is recorded at the base of the horizon above. If an iron pan is marked as present, the following details should be recorded in the COMMENTS box:-

(a) Thickness mm.
(b) Colour (blackish, brownish, reddish, orangeish).
(c) Continuous or discontinuous.
(d) Soft or brittle.
(e) If root mat occurs on upper surface.

The last page of the record sheet contains spaces for comments. These spaces can be used to amplify previous entries in the record, and to note such things as the presence of slickensiding in Bt horizon; manganese and iron staining on stones; also crusts, efflorescences, veins, streaks, and tubes. The comments are stored as keywords in 3 x 32 alphanumeric character strings. The observer should underline the keywords which are to be stored.

3 HANDLING THE CODED INFORMATION

A Data preparation stage

The soil profile description sheets are received in the office after completion and checking by the field worker. It is desirable that each soil team should have someone who has been trained to act as an editor, as it is important at this stage that the forms should be edited before going to the punch operator. The editor should check that all the appropriate boxes have been completed correctly and that no anomalies have occurred in entering the data on to the form in the field. An example of an edited field sheet is given in the user's handbook.

B Data punching, loading, checking and file editing stage

Full details of the computer procedures and programs are given in a separate program user's handbook, only a general outline is given here. The preferred method of entering data, for storage in a virtual array file on discs, is by using program SPIONL in conjunction with a visual display unit (VDU). The program can be used with a DECwriter, but this is noisier, less convenient, and wastes paper.

Most people would find using program SPIONL in conjunction with a low-speed teletype frustratingly slow. If only a low-speed teletype is available, the user may find it preferable to punch the data on to 8 track paper tape in standard ASCII code. The punch operator should punch up a batch of forms and then take away the sheets of punched data to check them for punching errors. Punching errors are likely to occur, even with an experienced operator, and they must be expected in any data processing scheme. Minor errors, which do not hinder the reading of the data into a disk file, can be corrected later using program SPEDIT. An example of the punched data is given in the separate program user's manual. The data on paper tape are read into an ASCII file on the computer disc via the high-speed reader. Program SPIPT should then be used to rearrange the data and store them in a virtual array file.

However the virtual array file has been set up, the next step is to list it for checking. Program SPCHEK lists the contents of the file in a layout similar to that of the record sheet, for ease of checking. If editing is necessary, it can be done using program SPEDIT.

C Soil profile listing stage

Programs SPL1 and SPL2 (chained) are used to provide a listing of the decoded data in a format similar to that used by a soil scientist when writing a soil profile description by hand (Figure 1). This is probably the most convenient format in which to keep the information for general reference.

D Data retreival stage

The main purpose in developing a data retrieval system is to store sets of data in a standard format so that they can be retrieved in a variety of different ways for different purposes. Two examples are given below to indicate how data can be retrieved from the virtual array file, although many other possibilities can be explored. In both the examples given, the profile number was coded in such a way as to give the age class of the woodland in which it was located. In the first example (Figure 2), the search characteristic was the stoniness of the B horizon. The printout gives a summary table showing the number of horizons in the file in which different degrees of stoniness occur for each age class, followed by the actual profile numbers. In the second example (Figure 3), a search is carried out for surface texture, parent material, and solid geology.

E Numerical analysis of the soil profile data

The way in which the data are collected can have an important bearing on subsequent statistical and numerical analysis. Data consist of attribute scores. There are many different kinds of attributes, see for example Sneath & Sokal, 1973; Clifford & Stephenson, 1975; Williams, 1976. The most common kinds of attributes are: (i) Binary, eg presence - absence; (ii) Disordered multistate (also called nominal attributes), such as colour or rock type; (iii) Ordered multistate (also called ordinal attributes), eg, rare, common, abundant; (iv) Meristic, eg number of petals; (v) Continuous, ie, measures on a continuous scale (also called quantitative or numeric attributes).

The scale on which the attributes are scored or measured will have an important influence on the subsequent data analysis. Presence-absence and disordered multistate data are on a nominal scale. With disordered multistate data, a given individual can be referred to only one state. The states may be numbered for computational convenience, but no meaning can be attached to the order in which the states are taken. An ordinal scale is used when various levels can be established for an attribute, but the scale values establish only the order of the observations, they do not contain any information on relative distances. With ordered multistate data, for example, rare, common, abundant, could be coded as 1, 2, 3, but these scores would not represent the relative abundances, ie, the distances between the states are undefined. With interval and ratio scales, there is a concept of distance. On an interval scale, both the order and magnitude of an attribute state can be found relative to some arbitrary zero value, as in temperature scales. A ratio scale is used when the order and magnitude of an attribute state can be referred to some natural origin, as in measurement of length or weight. On such a scale, the ratios between scale values are meaningful, as are the sums and differences. Probably few biologists have much formal background in types of measurement and scales, Torgerson's (1958) book is useful for this.

Many statistical methods assume that the data are continuous and have certain specified properties. Few of the data recorded on the soil profile sheet are continuous (altitude, slope, aspect, rainfall, horizon depth). Most of the data are recorded as ordered or disordered multistate attributes, and the numerical analysis of such data presents certain problems. They cannot, for example, be used to calculate a product-moment correlation matrix or a covariance matrix, which rules out a principal component analysis. Expert advice should be sought if numerical analysis of such data is contemplated.

4 FURTHER DEVELOPMENTS

As this paper is very much a working document, we expect the system to evolve as we gain experience in its use. In particular, the type of searching procedure will depend upon specific user requirements, and programs to cover all possibilities cannot be written in advance. We would like to hear from anyone who writes programs for use with this data storage system.

The use of the comments boxes is something which will no doubt change with experience.

Our aim in the future will be to reduce the soil profile recording sheet to one folding card, which would be more convenient. We are also working on two other types of recording sheet, one to contain what we regard as the minimum amount of information which is worth collecting, the other being intermediate between that and the one described in detail here. These three sheets should cover all likely uses within ITE. Researchers outside ITE may also find them useful.

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Figure 1. **Part of a soil profile listing obtained from programs SPL1 and SPL2**

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FILENAME? SPDATA
NOS. OF 1ST & LAST RECORD SHEET TO BE LISTED? 1,1


SJ05....CLOCAENOG FOREST

OBSERVER:                 M.HORNUNG
DATE:                     22/6/78

PROFILE NO.               10302
KM E:                     300.8
KM N:                     354.8
ALTITUDE(M):              410
SLOPE(DEGREES):           3
ASPECT(DEGREES):          320
RELIEF:
     LAND FORM:           rolling hills
     POSITION:            valley side slope
     SLOPE:               convex
RAINFALL(MM):             1397

MAIN PLANT SPECIES:       2487 2136 628
COMPLETE SPECIES LIST:    recorded but not yet coded
VEGETATION TYPE:          1A17A
LAND USE:                 softwood forestry

SURFACE TEXTURE:          organic
PARENT MATERIAL:          till from
                          Ordovician and Silurian shale or mudstone

SOLID GEOLOGY:            Ordovician and Silurian shale or mudstone
LOCATION DRAINAGE:        normal
PROFILE DRAINAGE:         poorly drained
MAJOR SOIL GROUP:         7.2
CHEMICAL DATA:            sampled but not yet coded

L LAYER THICKNESS(CM):    1
L LAYER COMPOSITION:      2487
F LAYER THICKNESS(CM):    5
NATURE OF F LAYER:        layered
F LAYER COMPOSITION:      2487

NO. OF HORIZONS:          5


Oh1-6 to 11cm        sampled but not yet coded
                     10YR 2/1
                     texture - organic
                     organic matter content- peaty
                     stoneless
                     low porosity
                     massive
                     moist
                     greasy
                     roots:
                          common small fleshy
                          common small woody
                          common medium woody
                     clear smooth lower boundary
                     comments:
                          fibric to mesic
```

SITE-TULCHAN

	AGE CLASS 1	2	3	4	5
B HORIZON VERY STONY	5	7	4	6	6
B HORIZON NOT VERY STONY	4	2	5	3	3
NO B HORIZON	0	0	0	0	0

PROFILE NOS.

B HORIZON VERY STONY

10101	10103	10201	10203	10303		
20101	20102	20201	20202	20301	20302	20303
30101	30103	30301	30302			
40101	40103	40202	40203	40301	40303	
50101	50202	50203	50301	50302	50303	

B HORIZON NOT VERY STONY

10102	10202	10301	10302	
20103	20203			
30102	30201	30202	30203	30303
40102	40201	40302		
50102	50103	50201		

Figure 2. Results of a search to find profiles with different degrees of stoniness of the B horizon.

SITE- TULCHAN

		AGE CLASS				
		1	2	3	4	5
SURFACE TEXTURE	PLS	7	0	0	1	0
SURFACE TEXTURE	PSL	2	9	9	8	9
SURFACE TEXTURE	OTHER	0	0	0	0	0
PARENT MATERIAL	4PLS	7	0	0	1	0
PARENT MATERIAL	4PSL	2	9	9	8	9
PARENT MATERIAL	OTHER	0	0	0	0	0
SOLID GEOLOGY	MQA/X	9	9	9	9	9
SOLID GEOLOGY	OTHER	0	0	0	0	0

PROFILE NOS.

SURFACE TEXTURE-PLS
10101 10102 10103 10201 10202 10302 10303
40303
SURFACE TEXTURE-PSL
10203 10301
20101 20102 20103 20201 20202 20203 20301 20302 20
30101 30102 30103 30201 30202 30203 30301 30302 30
40101 40102 40103 40201 40202 40203 40301 40302
50101 50102 50103 50201 50202 50203 50301 50302 50

PARENT MATERIAL-4PLS
10101 10102 10103 10201 10202 10302 10303
40303
PARENT MATERIAL-4PSL
10203 10301
20101 20102 20103 20201 20202 20203 20301 20302 20
30101 30102 30103 30201 30202 30203 30301 30302 30
40101 40102 40103 40201 40202 40203 40301 40302
50101 50102 50103 50201 50202 50203 50301 50302 50

SOLID GEOLOGY-MQA/X
10101 10102 10103 10201 10202 10203 10301 10302 10
20101 20102 20103 20201 20202 20203 20301 20302 20
30101 30102 30103 30201 30202 30203 30301 30302 30
40101 40102 40103 40201 40202 40203 40301 40302 40
50101 50102 50103 50201 50202 50203 50301 50302 50

Figure 3. Results of a search to find profiles with specified surface texture, parent material, and solid geology.

Appendix 1.

A completed (fictitious) soil profile record sheet.

1.

SOIL PROFILE DESCRIPTION

Draft 8

Site No.	Site name	Observer	Day	Month	Year	Profile No.
SJ05	CLOCAENOG FOREST	M. HORNUNG	22	6	78	10302

Km E: 300·8	Surface texture: O	Main plant species: Sitka spruce, Vacc. myrtillus, Deschampsia flexuosa	
Km N: 354·8	Parent material: 4 (SZX/b)		
Altitude (m): 410	Solid geology: SZX/b	Vegetation type: 1A17A	F layer thickness (cm): 5
Slope (°): 3	Location drainage: 2	L layer thickness (cm): 1	Nature of F layer: Layered
Aspect (°): 320	Profile drainage: 4	L layer composition: Spruce needles	F layer composition: Spruce needles
Rainfall (cm): 1397	Soil Group or Sub-Group: 7-2		

Land use	Relief	Chemical data	Vegetation data	No. of horizons
4·1	4/3/4			5

Sample code					
Horizon symbol	Oh1	Oh2	Oh3	Eag	Bg
Horizon depth cms (start)	6	11	20	31	41
" " " (end)	11	20	31	41	68
Lower boundary sharpness	36	36	36	36	36
Munsell colour (ground)	10YR 2/1	5YR 2·5/2	5YR 2·5/1	10YR 5/2	10YR 7/4
Munsell colour (ped face)		5YR 2·5/2	5YR 2·5/1	10YR 3/2	

MOTTLING

		Oh1				Oh2				Oh3				Eag				Bg			
A. FREQUENCY																					
Absent	0	✓				✓				✓				✓							✓
Few	1																		✓		
Common	2																	✓		✓	
Abundant	3																				
B. SIZE																					
Very fine	4																				
Fine	5																			✓	
Medium	6																	✓			
Large	7																		✓		
C. PROMINENCE																					
Faint	1																				
Distinct	2																	✓	✓	✓	
Prominent	3																				
D. COLOUR																		10YR 6/6	10YR 6/6	10YR 6/6	

2.

FIELD TEXTURE

Organic	1	✓			✓			✓								
Sand	2															
Loam	3											✓			✓	
Silt	4										✓			✓		
Clay	5															

ORGANIC MATTER

Low	1				✓	✓
Moderate	2					
High	3					
Peaty	4	✓	✓	✓		

OVERALL STONINESS

Stoneless	0	✓	✓	✓		
Slightly stony	1				✓	✓
Stony	2					
Very stony	3					
Extremely stony	4					

INDIVIDUAL STONE TYPES

Gravel (0.2-1.0 cm) Medium (5-10 cm) Very large (20-60 cm)
Small (1-5 cm) Large (10-20 cm) Boulder (>60 cm)

A. QUANTITY																					
Absent	0	✓				✓				✓					✓						
Few	1													✓				✓	✓		
Common	2																				
Abundant	3																				
B. SIZE																					
Gravel	4																				
Small	5																		✓		
Medium	6													✓				✓			
Large	7																				
Very large	8																				
Boulder	9																				
C. SHAPE																					
Angular	1																				
Subangular	2													✓				✓	✓		
Rounded	3																				
Platy	4																				
D. LITHOLOGY														SZX/b				SZX/b	SZX/b		

POROSITY CLASS

Low	1	✓	✓		✓	✓
Moderate	2			✓		
High	3					
Very high	4					

3.

SOIL STRUCTURE

	Code	1	2	3	4	5
Soils structureless	1	✓				
Soils structured	2		✓	✓	✓	✓

1. STRUCTURELESS SOILS

	Code	1	2	3	4	5
Single grain	1					
Massive	2	✓				

2. STRUCTURED SOILS

D = DOMINANT B = BREAKING TO

A. PED SHAPE

	Code	1 D	1 B	2 D	2 B	3 D	3 B	4 D	4 B	5 D	5 B
Crumb	1										
Subangular	2									✓	
Angular	3			✓							
Platy	4										
Prismatic	5					✓		✓			

B. PED STRENGTH

	Code	1 D	1 B	2 D	2 B	3 D	3 B	4 D	4 B	5 D	5 B
Weak	6			✓						✓	
Moderate	7					✓					
Strong	8							✓			

C. PED SIZE

	Code	1 D	1 B	2 D	2 B	3 D	3 B	4 D	4 B	5 D	5 B
Fine	1										
Medium	2										
Coarse	3			✓						✓	
Very coarse	4					✓		✓			

CUTANS

	Code	1	2	3	4	5
Absent	0	✓	✓	✓		✓
Clay	1					
Sesquioxide	2					
Organic	3				✓	

MOISTURE ON SAMPLING

	Code	1	2	3	4	5
Dry	1					
Moist	2	✓	✓	✓	✓	✓
Wet	3					
Waterlogged	4					

HANDLING CONSISTENCY AT FIELD MOISTURE

	Code	1	2	3	4	5
Loose	1					
Very friable	2					
Friable	3					
Firm	4					
Very firm	5					
Greasy	6	✓	✓	✓	✓	✓
Sticky	7					
Plastic	8					
Very plastic	9					

4.

INDURATION/COMPACTION

	Code	1	2	3	4	5
Absent	0	✓	✓	✓	✓	✓
Weak	1					
Moderate	2					
Strong	3					

CEMENTATION

	Code	1	2	3	4	5
Absent	0	✓	✓	✓	✓	✓
Weak	1					
Strong	2					

ROOTS

A. QUANTITY

fine (<1 mm diam.) small (1-3 mm) medium (3-10 mm) large (10-30 mm) very large (>30 mm)

	Code	1	2	3	4	5
Absent	0	large/very large ✓	medium ✓	medium ✓	medium ✓	
Rare	1		fine ✓			small ✓, medium ✓
Few	2			fine ✓, small ✓	fine ✓, small ✓	fine ✓
Common	3	fine ✓, small ✓, medium ✓	small ✓			
Abundant	4					

B. SIZE

	Code	1	2	3	4	5
Fine	5					
Small	6	fine ✓, small ✓		small ✓	fine ✓	medium ✓
Medium	7	medium ✓	fine ✓, small ✓	fine ✓	small ✓	fine ✓
Large	8					small ✓
Very large	9					

C. TYPE

	Code	1	2	3	4	5
Fibrous	1		fine ✓			
Fleshy	2	fine ✓				
Woody	3	small ✓, medium ✓	small ✓	fine ✓, small ✓	fine ✓, small ✓	fine ✓, small ✓, medium ✓
Rhizomatous	4					

CONCRETIONS

	Code	1 Fe/Mn	1 Ca	2 Fe/Mn	2 Ca	3 Fe/Mn	3 Ca	4 Fe/Mn	4 Ca	5 Fe/Mn	5 Ca
Absent	0	✓	✓	✓	✓	✓	✓		✓	✓	✓
Few	1							✓			
Common	2										
Abundant	3										

EFFERVESCENCE WITH ACID (<2 mm)

	Code	1	2	3	4	5
No reaction	0	✓	✓	✓	✓	✓
Reaction	1					

LARGE EARTHWORMS, CASTS, OR BURROWS

	Code	1	2	3	4	5
Not observed	0	✓	✓	✓	✓	✓
Observed	1					

IRON PAN

	Code	1	2	3	4	5
Absent	0	✓	✓	✓	✓	✓
Present	1					

COMMENTS BOX USED

	Code	1	2	3	4	5
No	0					
Yes	1	✓	✓	✓	✓	✓

COMMENTS

Horizon 1

Fibric to mesic.

Horizon 2

Much denser than Oh1
Mesic to amorphous

Horizon 3

Also much denser than Oh1.
Structural units obvious when digging.
Mesic to amorph.
In some of sampling pits prismatic peds
had black faces with dark brown to dk. reddish brown
colours internally.

Horizon 4

In detail colour has a grey ground with
a dense mosaic of black lines from old roots.
Stones all rotten.

Horizon 5

Stones rotten
Criss crossed by a network of dead, med. fibrous roots.

Appendix 2: Suggested codes for surface texture, parent material, rock and stone types, location and profile drainage, land use, and relief.

The terms "Surface texture" and "Parent Material" are included because they can be useful in sorting. With Soil Group, they will help to identify a soil down to series level, thus facilitating rapid location of closely similar soils from geographically distinct areas. The term "parent material" has been used on the record sheet as most ecologists are familiar with it, although the term is now little used by pedologists.

2.1 Surface Texture

The codes used to indicate texture can also be used as optional suffixes to enlarge upon the parent material:

O - organic
C - clayey
Z - silty
S - sandy
L - loamy
P - pebbly

"Mixed textures" are indicated by a combination of the symbols, eg silty clay loam, ZCL, stony sandy loam, PSL.

2.2 Parent Material

"In situ" parent material

1 *"In situ"* bedrock

1H Hard
1W Weathered or soft (eg decomposed dolerite or clays)
1F Fragmented (eg *in situ* frost-shattered material)

"Transported" parent materials

2 Scree

2B Block scree (more than 20 cm)
2K Cobble scree (5-20 cm)
2P Pebble scree (1-5 cm)
2G Gravel scree (less than 1 cm)

3 Head
4 Till
5 Fluvio-glacial deposits
6 Raised beach
7 Loess
8 Blown Sand
9 Alluvium
10 Peat

Types 2 to 9 inclusive can be enlarged upon by using the texture code listed above, eg glacial outwash sands 5S, clay-textured till 4C, silty texture alluvium 9Z. They can also be qualified by putting, in brackets, the geological nature of the material, eg Till derived from Silurian mudstones would be 4 (SZ/b).

The parent material may be layered. In such a case, the codes for the two materials are recorded but separated by an oblique stroke, eg 8/3PZ, blown sand over pebbly silty head.

2.3 Solid Geology and Stone Type

A code consisting of up to three characters (the third character only is, in some cases, optional) is used to designate rock type and is used as part of the code for solid geology and stone type.

The initial division is into the three major families of rocks - igneous, sedimentary and metamorphic - and the first code character is the initial letter of the relevant family, ie I, S, or M. The subdivisions within the families are mainly based on rock chemistry and grain size, and as far as possible, initial letters are used to derive the code.

We realise that this system is rather cumbersome, and leads to separate codes for rocks which will behave in a very similar way as soil parent materials, eg granite and gneiss. Consequently, the present approach may well be modified in the future. However, this system is useful for present purposes because it is flexible, and this flexibility is essential until we see the ways in which the data bank will be used. This system of coding allows for a considerable range of expertise in the observer. Thus, one recorder may be able to say little more than that a rock is igneous (IXX), whereas another may recognise it as a rhyolite (IFA).

A. Igneous Rocks:

1st character (Family)	2nd character (Grain size)	3rd character (Chemistry)
I	F (fine grained)	A (acid)
	M (medium grained)	B (basic)
	C (coarse grained)	I (intermediate)
		U (ultrabasic)
		M (ultramafic)
		K (calcareous)
		X (unknown or uncertain)

Examples:

Granite	- ICA
Basalt	- IFB
Dolerite	- IMB
Rhyolite	- IFA
Gabbro	- ICB
Andesite	- IFI
Diorite	- ICI
Peridotite	- ICU
Fine grained igneous of unknown chemistry	- IFX

B. Metamorphic Rocks:

1st character (Family)	2nd character	3rd character Chemistry (optional)
M	Z (Slate)	A (acid)
	P (Phyllite)	B (basic)
	S (Schist)	I (intermediate)
	G (Gneiss)	U (ultrabasic)
	H (Hornfels)	M (ultramafic)
	A (Amphibolite)	K (calcareous)
	Q (Quartzite)	X (unknown, or 'chemical symbol' not required)
	M (Marble)	

The second character represents a mixture of things and as such it is unsatisfactory (in fact this whole family is rather unsatisfactory): thus, some names infer grain size and texture, eg slate, schist, and gneiss, some texture alone, eg hornfels, and some chemistry, eg marble.

The third character is provided to allow subdivision of the schists, gneisses and hornfels, eg a calcareous schist MSK can be differentiated.

Because of the method of deriving the second character, the first (M) is superfluous (insofar as it conveys no further information about the rock) but has to be included to maintain continuity.

Unknown metamorphic rock	MXX
slate	MZX

C. Sedimentary Rocks:

1st character (Family)	2nd character	3rd character (optional)
S	S (Sandstone)	K (calcareous)
	A (Arkose)	F (ferritic)
	G (Greywacke)	P (phosphatic)
	Z (Shale, Mudstone)	S (siliceous)
	K (Chalk, Limestone)	X (unknown or uncertain)
	D (Dolomite)	
	P (Conglomerate, Breccia)	
	C (Clay)	

As with the metamorphic rocks, the second character is derived directly from the rock name and therefore has differing basis, eg grain size and chemistry.

Clay (C) is included to allow differentiation between Palaeozoic shales and mudstones and the Mesozoic and Cainozoic clay deposits, eg London Clay and Gault Clay.

The third character would be used mainly to subdivide sandstones.

It is realised that the above scheme does not specifically accommodate several types of sedimentary rocks and modifications are being tried.

The solid geology and stone type code is completed by an index letter used to indicate stratigraphy, and separated from the rock type code by an oblique stroke. The index letters suggested are those used by the Geological Survey and are listed below; this facilitates transfer of data from printed geological maps in a ready coded form.

m Holocene
l Pleistocene
k Pliocene
i Eocene and Oligocene
h Cretaceous
g Jurassic
f Triassic
e Permian
d Carboniferous
c Devonian
b Ordovician and Silurian
a Cambrian
x Pre-Cambrian
t Torridonian

This code will be mainly used with sedimentary rocks; as it may commonly be omitted, it is placed after the rock type code.

Examples of some full solid geology and stone type codes are as follows:

SZX/b Ordovician or Silurian shale
SKK/d Carboniferous Limestone
SSS/x Pre-Cambrian orthoquartzite
SCX/h Cretaceous clay (eg Gault Clay)

2.4 Location Drainage

The following code numbers are used:

1 Shedding
2 Normal
3 Receiving
4 Flooding (freshwater)
5 Flooding (saltwater)
6 Flushed

The observer may find it more convenient to write the appropriate word on the form in the field. In the laboratory, the code number can be substituted by the observer, or by the editor. This reduces the amount of coding to be done in the field.

2.5 Profile Drainage

This is a single digit code as follows:

1 Well-drained
2 Moderately well-drained
3 Imperfectly drained
4 Poorly drained
5 Very poorly drained

Intermediate conditions, such as "well drained to moderately well drained" can be given as the midway point, eg 1.5.

Observers may find it more convenient to enter the appropriate word on the form in the field. The word can be replaced by the code number in the laboratory either by the observer, or by the editor. This would reduce the amount of coding to be done in the field.

2.6 Land Use

The suggested codes for land use are as follows:

1. Cultivated land	1.1 fallow
	1.2 cereals
	1.3 green crops
	1.4 root crops
	1.5 horticulture
2. Improved grazing	2.1 short ley
	2.2 long ley
	2.3 permanent grass
3. Unimproved grazing	3.1 rough or moorland grazing managed primarily for sheep
	3.2 rough or moorland grazing managed primarily for grouse
	3.3 rough or moorland grazing managed primarily for deer
	3.4 lowland rough grazing managed primarily for cattle
4. Forestry	4.1 predominantly needle-leaved (softwoo
	4.2 predominantly broad-leaved (hardwood
5. Semi-natural woodland	5.1 coppice
	5.2 coppice with standards
	5.3 high forest
6. Nature reserve	
7. Military range	
8. Recreation	

Multiple use of land can be shown by an oblique stroke, eg 5.2/6 is a coppice with standards which is also a Nature Reserve.

2.7 Relief

This is given as a three-digit code with the digits separated by oblique stroke The first digit gives the general land form of the area, the second concerns the position of the profile location in the general landscape, the final digit gives the nature of the slope at the profile location. We use, at present, the codes given below. With these codes, 4/3/4 would signify that the area consisted of rolling hills and the profile was located on a convex slope on a valley side.

We can add new codes if this becomes necessary.

Land form of the area	Position in landscape	Slope
1. Lowland plain	1. Valley floor	1. Flat (horizontal)
2. Upland plateau	2. Closed depression	2. Flat (angled)
3. Undulating	3. Valley side slope	3. Concave
4. Rolling hills	4. Terrace/bench	4. Convex
5. Steeply dissected hills	5. Escarpment/cliff	5. Complex
6. Rounded mountains	6. Ridge, rounded	
7. Steeply dissected mountains	7. Ridge, angular	
	8. Col	
	9. Rounded summit	
	10. Angular summit	

APPENDIX 3 Codes for major soil groups (after Avery, 1973)

MAJOR GROUP	GROUP	SUB-GROUP
TERRESTRIAL RAW SOILS	1.1 Raw Sands	
	1.2 Raw Alluvial Soils	
	1.3 Raw Skeletal Soils	
	1.4 Raw Earths	
	1.5 Man-made Raw Soils	
HYDRIC RAW SOILS	2.1 Raw Sandy Gley Soils	
	2.2 Unripened Gley Soils	
LITHOMORPHIC (A/C/) SOILS	3.1 Rankers	3.11 Humic Ranker 3.12 Grey (Non-Humic) Ranker 3.13 Brown (Non-Humic) Ranker 3.14 Podzolic Ranker with greyish E 3.15 Stagnogleyic (fragic) Ranker
	3.2 Sand-Rankers	3.21 Typical Sand-Ranker 3.22 Podzolic Sand-Ranker 3.23 Gleyic Sand-Ranker
	3.3 Ranker-like Alluvial Soils	3.31 Typical Ranker-like Alluvial Soil 3.32 Gleyic Ranker-like Alluvial Soil
	3.4 Rendzinas	3.41 Humic Rendzina 3.42 Grey (Non-Humic) Rendzina 3.43 Brown (Non-humic) Rendzina 3.44 Colluvial (Non-Humic) Rendzina 3.45 Gleyic Rendzina 3.46 Humic Gleyic Rendzina
	3.5 Pararendzinas	3.51 Typical (Non-Humic) Pararendzina 3.52 Humic Pararendzina 3.53 Colluvial Pararendzina 3.54 Stagnogleyic Pararendzina 3.55 Gleyic Pararendzina
	3.6 Sand-Pararendzinas	3.61 Typical Sand-Pararendzina
	3.7 Rendzina-like Alluvial Soils	3.71 Typical Rendzina-like Alluvial Soil 3.72 Gleyic Rendzina-like Alluvial Soil
PELOSOLS	4.1 Calcareous Pelosols	4.11 Typical (Stagnogleyic) Calcareous Pelosol
	4.2 Non-Calcareous Pelosols	4.21 Typical (Stagnogleyic) Non-Calcareous Pelosol
	4.3 Argillic Pelosols	4.31 Typical (Stagnogleyic) Argillic Pelosol

MAJOR GROUP	GROUP	SUB-GROUP
BROWN SOILS	5.1 Brown Calcareous Earths	5.11 Typical Brown Calcareous Earth 5.12 Gleyic Brown Calcareous Earth 5.13 Stagnogleyic Brown Calcareous Earth
	5.2 Brown Calcareous Sands	5.21 Typical Brown Calcareous Sand 5.22 Gleyic Brown Calcareous Sand
	5.3 Brown Calcareous Alluvial Soils	5.31 Typical Brown Calcareous Alluvial Soil 5.32 Gleyic Brown Calcareous Alluvial Soil
	5.4 Brown Earths (<u>sensu stricto</u>)	5.41 Typical Brown Earth 5.42 Stagnogleyic Brown Earth 5.43 Gleyic Brown Earth 5.44 Ferritic Brown Earth 5.45 Stagnogleyic Brown Earth
	5.5 Brown Sands	5.51 Typical Brown Sand 5.52 Gleyic Brown Sand 5.53 Stagnogleyic Brown Sand 5.54 Argillic Brown Sand 5.55 Gleyic Argillic Brown Earth
	5.6 Brown Alluvial Soils	5.61 Typical Brown Alluvial Soil 5.62 Gleyic Brown Alluvial Soil
	5.7 Argillic Brown Earths	5.71 Typical Argillic Brown Earth 5.72 Stagnogleyic Argillic Brown Earth 5.73 Gleyic Argillic Brown Earth
	5.8 Paleo-Argillic Brown Earths	5.81 Typical Paleo-Argillic Brown Earth 5.82 Stagnogleyic Paleo-Argillic Brown Earth
PODZOLIC SOILS	6.1 Brown Podzolic Soils	6.11 Typical (Non-Humus) Brown Podzolic Soil 6.12 Humic Brown Podzolic Soil 6.13 Paleo-Argillic Brown Podzolic Soil 6.14 Stagnogleyic Brown Podzolic Soil 6.15 Gleyic Brown Podzolic Soil
	6.2 Humic Cryptopodzols	6.21 Typical Humic Cryptopodzols
	6.3 Podzols (<u>sensu stricto</u>)	6.31 Typical (Humo-Ferric) Podzol 6.32 Humus Podzol 6.33 Ferric Podzol 6.34 Paleo-Argillic (Humo-Ferric) Podzol 6.35 Ferri-Humic Podzol
	6.4 Gley-Podzols	6.41 Typical (Humus) Gley-Podzol 6.42 Humo-Ferric Gley Podzol 6.43 Stagnogley-Podzol 6.44 Humic (Peaty) Gley-Podzol
	6.5 Stagno-Podzols	6.51 Ironpan Stagno-Podzol 6.52 Humus-Ironpan Stagno-Podzol 6.53 Hardpan Stagno-Podzol 6.54 Ferric Stagno-Podzol

MAJOR GROUP	GROUP	SUB-GROUP
SURFACE-WATER GLEY SOILS (Stagnogley sensu lato)	7.1 Stagnogley Soils (sensu stricto Pseudogley)	7.11 Typical (Argillic) Stagnogley Soil
		7.12 Pelo-Stagnogley Soil
		7.13 Cambic Stagnogley Soil
		7.14 Paleo-Argillic Stagnogley Soil
		7.15 Sandy Stagnogley Soil
	7.2 Stagnohumic Gley Soils	7.21 Cambic Stagnohumic Gley Soil
		7.22 Argillic Stagnohumic Gley Soil
		7.23 Paleo-Argillic Stagnohumic Gley Soil
		7.24 Sandy Stagnohumic Gley Soil
GROUND-WATER GLEY SOILS	8.1 Alluvial Gley Soils	8.11 Typical (Non-Calcareous) Alluvial Gley Soil
		8.12 Calcareous Alluvial Gley Soil
		8.13 Pelo-(Vertic) Alluvial Gley Soil
		8.14 Pelo-Calcareous Alluvial Gley Soil
		8.15 Sulphuric Alluvial Gley Soil
	8.2 Sandy Gley Soils	8.21 Typical (Non-Calcareous) Sandy Gley Soil
		8.22 Calcareous Sandy Gley Soil
	8.3 Cambic Gley Soils	8.31 Typical (Non-Calcareous) Cambic Gley Soil
		8.32 Calcaro-Cambic Gley Soil
		8.33 Pelo-(Vertic) Cambic Gley Soil
	8.4 Argillic Gley Soil	8.41 Typical Argillic Gley Soil
		8.42 Sandy-Argillic Gley Soil
	8.5 Humic-Alluvial Gley Soils	8.51 Typical (Non-Calcareous) Humic-Alluvial Gley Soil
		8.52 Calcareous Humic-Alluvial Gley Soil
		8.53 Sulphuric Humic-Alluvial Gley Soil
	8.6 Humic-Sandy Gley Soils	8.61 Typical Humic-Sandy Gley Soil
	8.7 Humic Gley Soils (sensu stricto)	8.71 Typical (Non-Calcareous) Humic Gley Soil
		8.72 Calcareous Humic Gley Soil
		8.73 Argillic Humic Gley Soil
MAN-MADE SOILS	9.1 Man-made Humus Soils	9.11 Sandy man-made Humus Soils
		9.12 Earth Man-made Humus Soils
	9.2 Disturbed Soils	
PEAT (ORGANIC) SOILS	10.1 Raw Peat Soils	10.11 Raw Oligo-Fibrous Peat Soil
		10.12 Raw Eu-Fibrous Peat Soil
		10.13 Raw (Unripened) Oligo-Amorphous Peat Soil
		10.14 Raw (Unripened) Eutro-Amorphous Peat Soil
	10.2 Earthy Peat Soils	10.21 Earthy Oligo-Fibrous Peat Soil
		10.22 Earthy Eu-Fibrous Peat Soil
		10.23 Earthy Oligo-Amorphous Peat Soil
		10.24 Earthy Eutro-Amorphous Peat Soil
		10.25 Earthy Sulphuric Peat Soil

Appendix 4: Codes for vegetation type, plant species, and nature of F layer.

A Vegetation type

The coding system recommended for general use is that of Fosberg, which is given by Peterken (1967). The source should be consulted for full details, including a key for the identification of the types. An abbreviated form of the classification is given below, with emphasis on the types most likely to be found in Britain. Some workers find the term 'savanna' difficult to accept in a British context, although there seems to be no logical objection to the term. Those who so prefer may mentally substitute the term 'parkland'.

1 Closed Vegetation (crowns or peripheries of plants touching or overlapping).

1A Forest (closed woody vegetation, 5 m or more tall).

1A1 Evergreen forest (at least the canopy layer with no significant leafless period).

7 Evergreen narrow sclerophyll forest (needle-leaved forest).

(A) Resinous evergreen narrow sclerophyll forest (dominantly coniferous, eg *Pinus*, *Picea* forests)

1A2 Deciduous forest (at least the canopy layer bare of leaves for a period during cold or dry season)

1 Winter-deciduous orthophyll forest (hardwood forest, eg *Fagus* and *Quercus* forests)

2 Deciduous swamp forest (eg *Alnus*)

1B Scrub (closed woody vegetation 5 m or less tall)

1B1 Evergreen scrub

7 Straight evergreen narrow sclerophyll scrub (not especially gnarled, eg *Juniperus*).

8 Microphyllous evergreen scrub (often thorny).

(A) Green microphyllous evergreen scrub (eg Broom, gorse).

1B2 Deciduous scrub

1 Deciduous orthophyll scrub.

(A) Mesophyllous deciduous orthophyll scrub (eg *Salix*, *Crataegus*).

2 Deciduous swamp scrub

(A) Mesophyllous deciduous orthophyll swamp scrub (eg *Alnus*).

1C Dwarf scrub (closed predominantly woody vegetation less than 0.5 m tall).

1C1 Evergreen dwarf scrub.

2 Evergreen broad sclerophyll dwarf scrub

(A) Mesophyllous broad sclerophyll dwarf scrub (eg *Arctostaphylos uva-ursi* mat)

(B) Microphyllous evergreen dwarf scrub (without significant peat accumulation, eg some *Calluna*?)

(C) Microphyllous evergreen dwarf heath (with peat accumulation, eg *Empetrum* heath, *Loiseleuria* heath)

1C2 Deciduous dwarf scrub

1 Deciduous orthophyll dwarf scrub

(A) Deciduous orthophyll dwarf scrub (without significant peat accumulation, eg lowbush *Vaccinium* scrub)

(B) Deciduous orthophyll dwarf heath (with peat accumulation, eg *Vaccinium myrtillus* heath).

1D Open forest with closed lower layers (trees with crowns not touching, crowns mostly not separated by more than their diameters)

1D1 Evergreen open forest with closed lower layers

2 Open evergreen swamp

(A) Open narrow sclerophyll swamp (open conifer forest on swamp, eg spruce)

4 Open evergreen narrow sclerophyll forest

(A) Resinous open evergreen narrow sclerophyll forest (eg open conifer forests)

1D2 Open deciduous forest with closed lower layers

1 Open deciduous orthophyll forest (eg open hardwood forest)

2 Open deciduous swamp

(A) Open broad orthophyll swamp (eg open hardwood forest swamp)

3 Open deciduous narrow sclerophyll forest (eg open *Larix* forest)

1E Closed scrub with scattered trees

1E1 Closed evergreen scrub with scattered trees (at least shrub layer evergreen)

1E2 Closed deciduous scrub with scattered trees

1 Deciduous orthophyll scrub with trees

1F Dwarf scrub with scattered trees

1F1 Evergreen dwarf scrub with scattered trees

1 Microphyllous evergreen dwarf scrub with trees (without significant peat formation, eg *Calluna* heath with *Pinus*)

2 Microphyllous evergreen heath with trees (with peat accumulation)

1F2 Deciduous dwarf scrub with trees

1 Deciduous heath with trees (with significant peat accumulation, eg *Vaccinium* phase of heath birch forest)

1G Open scrub with closed ground cover

1G1 Open evergreen scrub with closed ground cover

4 Open microphyllous evergreen scrub (eg broom, gorse)

1G2 Open deciduous scrub with closed ground cover

1 Open deciduous orthophyll scrub with closed ground cover (eg *Betula, Salix*)

1H Open dwarf scrub with closed ground cover

1H1 Open evergreen dwarf scrub with closed ground cover

3 Open evergreen microphyllous dwarf scrub (eg open *Erica* and *Calluna* heath lower phases)

1H2 Open deciduous dwarf scrub with closed ground cover

1I Tall savanna (closed grass or other herbaceous vegetation 1 m or more tall, with scattered trees)

1I1 Evergreen savanna (trees evergreen)

1 Evergreen orthophyll savanna (eg bracken with scattered conifers?)

1I2 Deciduous tall savanna (trees deciduous)

1 Deciduous orthophyll savanna (eg bracken with scattered hardwoods?)

1J Low savanna (herbaceous vegetation less than 1 m tall, with scattered trees)

1J1 Evergreen low savanna (trees evergreen)

1 Evergreen orthophyll low savanna (ie scattered conifers with low closed grass or herb layer)

1J2 Deciduous low savanna

1 Deciduous orthophyll low savanna (ie scattered deciduous trees with low closed grass or herb layer)

1K Shrub savanna (closed grass or other herbaceous vegetation with scattered shrubs)

1K1 Evergreen shrub savanna

3 Evergreen narrow sclerophyll shrub savanna

(A) Resinous evergreen narrow sclerophyll shrub savanna (eg *Juniperus communis* savanna)

1K2 Deciduous shrub savanna

1 Deciduous orthophyll shrub savanna (eg successional stages of deciduous shrub on grassland)

4 Mesophyllous deciduous thorn shrub savanna (eg *Crataegus*?)

1L Tall grass (closed herbaceous vegetation exceeding 1 m in height, predominantly graminoid)

1L1 Evergreen tall grass (shoots remaining green the year round)

2 Tall evergreen graminoid marsh (eg *Scirpus*, *Typha*)

1L2 Seasonal tall grass (turning brown in dry season or winter, often burned)

1M Short grass (closed herbaceous vegetation, less than 1 m tall, predominantly graminoid)

1M1 Evergreen short grass

1M2 Seasonal short grass

1 Seasonal orthophyll meadows (short grass, eg most temperate zone pastures)

2 Seasonal orthophyll marsh (eg salt marsh)

1N Broad-leafed herb vegetation (closed vegetation, predominantly of broad-leafed herbaceous plants)

1N1 Evergreen broad-leafed herb vegetation

1N2 Seasonal broad-leafed herb vegetation

2 Seasonal fern meadow (eg bracken brake)

1O Closed bryoid vegetation

1O1 Closed bryophyte vegetation

1O2 Closed lichen vegetation

1P Submerged meadows

1P1 Evergreen submerged meadows

1P2 Seasonal submerged meadows

1 Seasonal watergrass (eg *Zostera marina*, temperate coasts)

1Q Floating meadows

2 Open Vegetation (plants or tufts of plants not touching, but crowns not separated by more than their diameters; plants, not substratum, dominating landscape)

These are mostly steppe vegetation types and are not likely to be encountered in Britain, or at least only in exceptional circumstances

2I Open submerged meadows

2I2 Seasonal open submerged meadows

1 Seasonal watergrass (eg *Zostera*, open phases)

3 Sparse Vegetation or Desert (plants so scattered that the substratum dominates the landscape)

In Britain this type may be found in some situations, eg sand dunes

In dealing with forestry plantations, it is likely that some stretching of definition will be necessary, eg young trees may be classed as shrubs for convenience, but this will be obvious from the species list. It is also possible that additional subtypes may be necessary.

B Plant species

For these we recommend the coding system used by the Biological Records Centre and given in their list Plants BRC; 4. Most of the plants likely to be encountered are listed (with codes) on the BRC Record Card. If a species cannot be identified with confidence, a shortened form of the generic name (eg see BRC recording card) can be entered and a specimen should be collected for identification. As the BRC list does not contain introduced forestry species, we have added codes for those most likely to be found (Table 4.1).

C Nature of F layer

The following terms are suggested:

loose : plant remains loose and friable, not coherent
layered : plant material in the F layer peels off in definite layers
matted : plant remains firmly matted into one layer
rooty : mostly dead roots
fibrous : consisting mostly of fibrous plant remains eg midribs.

The terms can be used in combination, up to the maximum of 16 characters. For example, a layer might be both matted and fibrous, this would be entered as matted fibrous. Or it is possible that there is layering in the F layer, possibly caused by a change in land use. This can be recorded as loose/matted ie loose overlying matted.

Appendix table 4.1

Codes for forestry trees not included in the BRC list.

Species	Common name	Code
Abies grandis	Grand fir	2950
Abies procera	Noble fir	2951
Cedrus deodora	Deodar	2952
Chamaecyparis lawsoniana	Lawson cypress	2953
Cupressocyparis leylandii	Leyland cypress	2954
Larix X eurolepis	Dunkeld hybrid larch	2955
Larix europaea	European larch	see *L. decidua*
Larix kaempferi (= leptolepis)	Japanese larch	2956
Picea sitchensis	Sitka spruce	2487
Pinus contorta	Lodgepole pine	2957
Pinus nigra maritima	Corsican pine	see *P. nigra* spp *laricio*
Thuja plicata	Western red cedar	2481
Tsuga heterophylla	Western hemlock	2958
Nothofagus obliqua	Roblé	2975
Nothofagus procera	Rauli	2976
Quercus rubra	Red oak	2977

Appendix 5: Codes for horizon boundary sharpness and type, and horizon nomenclature.

3.1 Horizon Boundary Sharpness and Type

This is a 2-digit code, the first digit indicates CLARITY, as follows:

1. Sharp (changes in less than 0.5 cm)
2. Abrupt (changes within 0.5 to 2.5 cm)
3. Clear (changes within 2.5 to 6 cm)
4. Gradual (changes within 6 to 13 cm)
5. Diffuse (changes more than 13 cm)

The second digit indicates the type of boundary, as follows:

6. Smooth
7. Wavy
8. Irregular
9. Broken

(see Hodgson, 1974 p 64).

3.2 Horizon Nomenclature

This usage was recommended in R and D Paper No 55, and it is still recommended at the time of writing; it is in general conformity with a currently widely - employed system, though it differs from the convention used in Britain by many workers in past years. It is based on capital letter "Master Horizons", small letter horizon sub-classes, and a number of numerical indices.

Master Horizon Symbols

O - Horizon which, although it may contain some mineral admixture, is dominated by the organic fraction (loss-on-ignition values greater than 30%).

A - Horizon at or near the soil surface, consisting of an intimate mixture of organic and mineral material, failing to fulfil the definition of the O master horizon (loss-on-ignition values less than 30%).

E - Horizon below O or A horizons from which sesquioxides (Fe and Al) and/or clay have been removed.

B - Sub-surface horizon of mineral material, modified by physical, chemical or biological alteration so that it is differentiated by structure, colour or texture from horizons above or below.

C - Mineral matter which has been little altered by pedological processes other than gleying (due to waterlogging) or the accumulation of secondary salts (typically of Ca or Na).

R - Unaltered rock, which, even when moist, is too hard to be dug with a spade.

Intergrades between master horizons may be indicated as A/B, B/C, etc. Only suffixes given below as applicable to all horizons would be applied to such intergrade horizons.

Numerical Prefixes and Suffixes

Arabic number prefixes are used to indicate buried soil profiles or horizons. By convention, 1 is omitted, for example a sand-dune section might show horizons A, C, 2A, 2C, 3A, 3C.

Roman number prefixes are used to indicate original geological (rather than pedological) discontinuities within the soil profile. For example, wind-blown sand may overlie boulder-clay giving a horizon sequence of A, E, B, IIC.

Arabic number suffixes are used where a master horizon is subidivded on grounds other than those indicated by addition of letter suffixes. In such cases one might have A1, A2, B1, B2, B3, C1. This usage could cause confusion with other horizon nomenclatures still found in use in which number suffixes were used in the way letters are here (eg, Ea is equivalent to old A_2. Care should be taken in equating horizons from the literature with those indexed as recommended here).

Subordinate Horizon Symbols

Suffixes applicable to any Master Horizon

gg - horizon dominated by structural and colour effects resulting from long-term waterlogging
g - horizons showing evidence in structural and colour effects of the influence of moderate periods of waterlogging
c - horizon containing residual calcium carbonate
k - horizon containing deposits of secondary calcium carbonate
n - horizon containing excess of sodium in the exchangeable cations, or free sodium chloride
x - horizon having a massive consistency due to induration

Suffixes applicable to O Horizons

o - horizon having a loss-on-ignition value greater than 60% and a thickness greater than 15 cm (peaty layer)
l - horizon of little altered plant remains
f - horizon of partially broken down and decomposed plant remains which are still recognisable to the naked eye
h - horizon of decomposed humified plant remains with no original macroscopic structure recognisable
p - ploughed or otherwise cultivated horizon

Suffixes applicable to A Horizons

h - horizon visibly darkened by having a high content of organic matter while not fulfilling the requirements for the O master horizon
he - as for h, but also including bleached sand grains or rock fragments
p - ploughed or otherwise cultivated horizon
an - surface horizon artificially deepened or modified by the addition of material by man

Suffixes applicable to E Horizons

a - horizon which has suffered loss of sesquioxides
b - horizon which has suffered loss of clay-size material

Suffixes applicable to B Horizons

h - horizon with level of humic organic matter which is high compared to horizons above and below

- s - horizon with levels of sesquioxides (Fe and/or Al) which are high compared to horizons above and below
- t - horizons with clay content which is high compared to horizons above and below
- f - thin iron pan

Suffixes applicable to C Horizons

- r - horizon predominantly composed of shattered or weathered material derived from underlying solid rock (R horizon).

APPENDIX 6. Comparison of descriptive forms used by I.T.E., Soil Survey of England and Wales, and F.A.O.

INSTITUTE OF TERRESTRIAL ECOLOGY	SOIL SURVEY OF ENGLAND AND WALES	F.A.O.
Drainage Class		
Very poorly drained Poorly drained Imperfectly drained Moderately well drained Well drained	Not recorded	Very poorly drained Poorly drained Imperfectly drained Moderately well drained Well drained Somewhat excessively drained Excessively drained
Location (= site) Drainage		
Shedding Normal Receiving Flooding - freshwater Flooding - saltwater Flushed	Not recorded	Not recorded
Lower Boundary Sharpness		
Sharp <0.5 cm Abrupt 0.5-2.5 cm. Clear 2.5-6.0 cm Gradual 6-13 cm Diffuse >13 cm	Sharp <0.5 cm Abrupt 0.5-2.5 cm. Clear 2.5-6.0 cm Gradual 6-13 cm Diffuse >13 cm	Width of boundary: Abrupt <2 cm Clear 2-5 cm Gradual 5-12 cm Diffuse >12 cm
Nature of Boundary		
Smooth Wavy Irregular Broken	Smooth Wavy Irregular Broken	"Topography of Boundary" Smooth Wavy Irregular Broken
Colour		
Matrix, ped face and root channels recorded	Matrix, ped face and root channels recorded	Matrix, ped face and root channels recorded
Mottles		
Colour Colours of up to four groups of mottles recorded as Munsell codes or descriptively	Recorded as Munsell code	(Also suggests recording this)

INSTITUTE OF TERRESTRIAL ECOLOGY	SOIL SURVEY OF ENGLAND AND WALES	F.A.O.
Frequency (= Abundance) % cover Absent Few < 2 Common 2-20 Abundant > 20 (When no definite matrix colour, matrix box left blank and mottles only recorded)	% cover None Few < 2 Common 2-20 Many 20-40 Very Many > 40	% cover Few < 2 Common 2-20 Many > 20 (When no definite matrix, colours listed followed by word "mottled")
Size (mm) Very fine < 2 Fine 2-5 Medium 5-15 Large > 15	(mm) Extremely fine < 1 Very fine 1-2 Fine 2-5 Medium 5-15 Large > 15	(mm) Fine < 5 Medium 5-15 Coarse > 15
Contrast with matrix colour Faint Distinct Prominent	Mottle Contrast Faint Distinct Prominent	contrast: Faint Distinct Prominent
Mottle Sharpness Not recorded	Boundary Sharpness: Diffuse > 2 mm Clear < 2 mm Sharp = Knifedged	
Organic Matter (= Organic Matter + peat)		
% Low < 8 Moderate 8-25 High 25-40 Peaty 40+	Organic Matter Status Organic horizons (F, H, and O) have: a) > 30% OM if mineral fraction has ≤ 50% clay b) > 20% OM if mineral fraction has no clay O - Horizons Peat > 50% OM loss on ignition Sandy peat 20-50% OM and > 50% sand in mineral fraction Loamy peat 20-50% OM and < 50% sand Mineral horizons Humose if: > 12% OM and mineral fraction has > 50% clay > 8% OM if mineral fraction has no clay	Not recorded

<table>
<tr><th>INSTITUTE OF TERRESTRIAL ECOLOGY</th><th>SOIL SURVEY OF ENGLAND AND WALES</th><th>F.A.O.</th></tr>
<tr><td colspan="3"><u>Stones</u></td></tr>
<tr>
<td>
<table>
<tr><th>Stoniness</th><th>% Cover</th></tr>
<tr><td>Stoneless</td><td><1</td></tr>
<tr><td>Slightly stony</td><td>1-5</td></tr>
<tr><td>Stony</td><td>5-20</td></tr>
<tr><td>Very stony</td><td>20-50</td></tr>
<tr><td>Extremely stony</td><td>>50</td></tr>
</table>
</td>
<td>
<table>
<tr><th>Stone Abundance</th><th>% Cover</th></tr>
<tr><td>Stoneless</td><td><1%</td></tr>
<tr><td>Very slightly stony</td><td>1-5%</td></tr>
<tr><td>Slightly stony</td><td>6-15</td></tr>
<tr><td>Moderately stony</td><td>16-35</td></tr>
<tr><td>Very stony</td><td>36-70</td></tr>
<tr><td>Extremely stony</td><td>>70</td></tr>
</table>
</td>
<td>
"Stoniness" term to be used as a prefix to the textural class
<table>
<tr><th rowspan="2">% of large particles</th><th colspan="3">Size of particles (cm)</th></tr>
<tr><th>0.2-7.5</th><th>7.5-25</th><th>>25</th></tr>
<tr><td>2-15</td><td>slightly gravelly</td><td>sl stony</td><td></td></tr>
<tr><td>15-50</td><td>gravelly</td><td>stony</td><td>bouldery</td></tr>
<tr><td>50-90</td><td>very gravelly</td><td>very stony</td><td>very bouldery</td></tr>
<tr><td>90</td><td>gravel</td><td>stones</td><td>boulders</td></tr>
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</tr>
<tr><td colspan="3">Terms applied to "types" of stones present</td></tr>
<tr>
<td>Up to four stone "types" can be listed and for each of these, abundance, size, shape and lithology is noted.</td>
<td>"Dominant" and "Subordinate" stones noted and for each size shape and lithology recorded</td>
<td>Handbook states that: "Ideally the description of such particles (i.e. 2 mm) should include information on their abundance, size, shape and nature."</td>
</tr>
<tr>
<td>Abundance
Absent
Few
Common
Abundant
(No quantitative limits fixed as yet)</td>
<td>Not noted</td>
<td>
<table>
<tr><th></th><th>% volume</th></tr>
<tr><td>Very few</td><td><5</td></tr>
<tr><td>Few</td><td>5-15</td></tr>
<tr><td>Frequent</td><td>15-40</td></tr>
<tr><td>Very Frequent</td><td>40-80</td></tr>
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</td>
</tr>
<tr>
<td>Size
<table>
<tr><th></th><th>(cm)</th></tr>
<tr><td>Gravel</td><td>0.2-1.0</td></tr>
<tr><td>Small</td><td>1-5</td></tr>
<tr><td>Medium</td><td>5-10</td></tr>
<tr><td>Large</td><td>10-20</td></tr>
<tr><td>Very Large</td><td>20-60</td></tr>
<tr><td>Boulder</td><td>>60</td></tr>
</table>
</td>
<td>
<table>
<tr><th></th><th>(cm)</th></tr>
<tr><td>Very small</td><td>0.2-0.6</td></tr>
<tr><td>Small</td><td>0.6-2.0</td></tr>
<tr><td>Medium</td><td>2-6</td></tr>
<tr><td>Large</td><td>6-20</td></tr>
<tr><td>Very large</td><td>20-60</td></tr>
<tr><td>Boulders</td><td>>60</td></tr>
</table>
</td>
<td>
<table>
<tr><th></th><th>(cm)</th></tr>
<tr><td>Gravel</td><td>0.2-7.5</td></tr>
<tr><td>Stones</td><td>7.5-25</td></tr>
<tr><td>Boulders</td><td>>25</td></tr>
</table>
</td>
</tr>
<tr>
<td>Shape
Angular
Subangular
Rounded
Platy</td>
<td>Angular
Subangular
Subrounded
Rounded
Platy and tabular may be used to qualify the rounded class</td>
<td>Angular
Rounded
Flat</td>
</tr>
<tr>
<td>Lithology
Recorded as the code listed for rock types</td>
<td>Recorded using special code</td>
<td>Recorded if known</td>
</tr>
</table>

INSTITUTE OF TERRESTRIAL ECOLOGY	SOIL SURVEY OF ENGLAND AND WALES	F.A.O.
	Porosity	
Total void quantity Low porosity <10 Moderate porosity 10-20 High porosity 20-40 Very high porosity > 40	Porosity Class — Pores > 60 µm % of soil volume Very slightly porous < 5.0 Slightly porous 5.0-9.9 Moderately porous 10.0-14.9 Very porous 15.0-20.0 Extremely porous > 20.0 Voids Fissures Between peds, clods and fragments Very fine < 1 mm wide Fine 1-3 mm wide Medium 3-5 mm wide Coarse 5-10 mm wide Very Coarse > 10 mm wide Pores Macropores — Diameter Very fine < 0.5 mm Fine 0.5-2 mm Medium 2-5 mm Coarse > 5 mm	Pore quantity (dm^{-2}) Few 1-50 Common 51-200 Many > 200 Diameter classes (cm) Micro < 0.075 Very Fine 0.075-1.0 Fine 1-2 Medium 2-5 Coarse > 5 (Also suggest noting "continuity" "orientation", "distribution" and "morphology" of pores)
	Structure	
Initial Division: Structured Structureless Structureless split into, Massive Single grain	Apedal = Single grain or massive	
Ped shape Crumb Subangular Angular Platy Prismatic	= Structure type Platy Prismatic (+ columnar) Angular blocky Subangular blocky Granular	= Form Platy Prismatic Columnar Angular Blocky Subangular Blocky Granular Crumb
Strength Weak Moderate Strong	Ped strength Loose Weak Firm Strong Rigid	= Grade Structureless Weak Moderate Strong
Ped Size	= Structure Size	= Size

	platy	prism	blocky	crumb	(mm)
Fine	< 2	< 20	< 10	< 2	
Medium	2-5	20-50	10-20	2-5	
Coarse	5-10	50-100	20-50	5-10	
Very Coarse	> 10	> 100	> 50	> 10	

(provision to record "Dominant" structure and " Breaks to........")

INSTITUTE OF TERRESTRIAL ECOLOGY	SOIL SURVEY OF ENGLAND AND WALES	F.A.O.
	Cutans	
Absent Clay Sesquioxide Organic	Coats Kind: Unclassified Clay Sand or silt Sesquioxide Organic Carbonate Stress oriented Location : On voids ped faces around nodules Abundance: Few <10% of particular type of face coated Common 10-50% Many >50% Continuity: Patchy Discontinuous Continuous Entire Distinctness: Faint Distinct Prominent Thickness: in mm	Thickness: Thin Moderately thick Thick Quantity : Patchy Broken Continuous Nature : (Tentative in the field)
	Moisture	
Dry Moist Wet Waterlogged	Dry Moist Wet	(no specific terms suggested)
	Consistence	
(a) When dry→moist Loose Very friable	Strength Loose, Weak, Firm, Strong (can be subdivided) Rigid Characteristics of failure: Brittle Semi deformable Deformable Slightly Fluid Moderately Fluid, Very Fluid	(a) When dry: Loose Soft Slightly hard

INSTITUTE OF TERRESTRIAL ECOLOGY	SOIL SURVEY OF ENGLAND AND WALES	F.A.O.
Friable Firm Very Firm (b) When moist-wet: Sticky Greasy Plastic Very Plastic	Maximum Stickiness (after adding water: Non sticky Slightly sticky Moderately sticky Very sticky Maximum Plasticity: Non plastic Slightly plastic Moderately plastic Very plastic	Hard Very Hard Extremely Hard (b) When moist: Loose Very friable Friable Firm Very firm Extremely firm (c) When wet: Non sticky Slightly sticky Sticky Very sticky Non plastic Slightly plastic Plastic Very plastic
	Induration/Compaction	
Absent Weak Moderate Strong	No equivalent provided	Not recorded
	Cementation	
Absent Weak Moderate Strong	Cementation Class Very weakly cemented weakly cemented Strongly cemented Very strongly cemented	Weakly Strongly Very Strongly

INSTITUTE OF TERRESTRIAL ECOLOGY	SOIL SURVEY OF ENGLAND AND WALES	F.A.O.
	"Roots"	
Matrix of boxes allows nature, abundance and size of four types of roots to be recorded Quantity: per 100 cm^2 Rare 1-5 Few 5-10 Common 10-100 Abundant >100 Size: mm diameter Fine <1 Small 1-3 Medium 3-10 Large 10-30 Very large >30 Nature: Woody Fibrous Fleshy Rhizomatous	Root Abundance Roots: per 100 cm^2 Few 1-10 1 or 2 Common 10-25 2-5 Many 25-200 >5 Abundant >200 - Very fine and fine / medium and coarse Root size: Very fine <1 mm Fine 1-2 mm Medium 2-5 mm Coarse >5 mm Nature: Woody Fibrous Fleshy	Quantity None Very few Few Common Frequent Abundant (not rigidly defined) Size: Very fine <1 mm Fine 1-2 mm Medium 2-5 mm Coarse >5 mm (Not recorded)
	Earthworms, Worm Channels and Casts	
Not observed Observed	No equivalent provided	Presence of worm channels recorded
	$CaCO_3$	
Non calcareous (no effervescence) Calcareous (effervescence)	% Non calcareous < 0.5 Very slightly calcareous 0.5-1.0 Slightly calcareous 1-5 Calcareous 5-10 Very calcareous > 10	Non calcareous) slightly calcareous) Related to Calcareous)- amount of Strongly calcareous) effervescence

INSTITUTE OF TERRESTRIAL ECOLOGY	SOIL SURVEY OF ENGLAND AND WALES	F.A.O.
	Secondary Materials	
Type: $CaCO_3$ Fe/Mn % Quantity for each Few < 2 Common 2-20 Abundant > 20	Features of Pedogenic Origin (also includes 'coats') Nature Crystals Nodules Concretions Soft concretions Composition Unidentified $CaCO_3$ Calcareous Gypsum Fe-Mn Ferruginous Sodium chloride Abundance Few <2% of horizon volume Common 2-20 Many 20-40 Very many > 40 Shape Rounded Cylindrical Plate-like Irregular	Nodules are recorded and abundance, size, hardness, shape, colour and nature are noted. Abundance (% volume) Very few <5 Few 5-15 Frequent 15-40 Very frequent 40-80 Dominant > 80 Size Small < 1 cm Large > 1 cm Hardness: Soft, Hard Shape: Spherical, Irregular, Angular (Continuity and structure of pans noted)