

LAND USE SURVEY TECHNIQUES

INTRODUCTION.

Before Catchment Conservation Planning, Farm and Project Planning or Settlement Planning can be undertaken, it is necessary to survey the area concerned in order to find out the present land use and its potential for future development. The survey is essentially a fact collecting exercise and all data relevant to the area should be collected. In land use planning work surveys and studies are necessary to collect information on the physical, economic and social aspects of the area to be planned. This chapter concerns itself mainly with the collection of information about the physiography and the soil and water data.

TYPES OF SURVEY

The intensity of data collection in the field depends on what type of land use is envisaged for the survey area, i.e. whether the land use is to be intensive or extensive. Large areas can be surveyed extensively in order to produce the overall physiographic picture of the area. Very little ground checking is required and the majority of survey is done by using photo-interpretation techniques. Planning of intensive schemes such as for an irrigation layout, involves highly detailed and intensive soil and water surveys and contour mapping.

The major types of survey can be broken down as follows:

- Reconnaissance survey
- Semi-detailed survey
- Detailed survey (irrigation survey, farm plan survey, settlement plan survey)

Reconnaissance surveys

These are concerned with broad inventories of land resources and development possibilities worthy of more intensive investigation. They involve a large amount of photo analytical work with some spot checking in the field. All field information obtained must be recorded.

These surveys should be conducted on the following lines:

- The area should be defined in writing and on the available maps. Boundaries should, if possible, be drawn along catchment boundaries.

- All information about the area should be collected. (Forestry reports and previous surveys etc.)
- A complete and accurate photo-analytical survey of the area should be done to establish the following :
 - Arable zones
 - Non-arable zones
 - Major access routes (existing)
 - Major crest lines
 - Possible dam sites and canal take-off points
 - Extent of cultivation and habitation
 - Delineation of areas that show particular promise for dry land and/or irrigation farming or for animal production
- A very broad reconnaissance ground survey to check arable areas, resulting in a rough zoning of soils into high, medium and low potential soils. This can be accomplished either by checking on old surveys (if existing), or by spot checks or by putting a traverse line through the arable zone, and pitting and/or augering down its length
- During the dry season hydrological measurement of river flow etc., should if possible be made of those rivers which could command land for irrigation.
- Maps should be produced at a scale suited to intensity of survey and use in question. See table 10. The maps should give information on all relevant data as set out above.

Having completed a reconnaissance survey it is possible to select suitable areas for more detailed studies depending on future objectives.

Semi-detailed surveys

These are designed to produce a more detailed land use map showing areas of high and low agricultural potential. They are suitable for Catchment Conservation Planning and the preliminary planning of major agricultural schemes. More detailed survey is required for individual farm plans, settlement schemes or irrigation projects.

Semi detailed surveys should be carried out in three main stages; preliminary photo-interpretation, soil survey in the field and final photo-interpretation and production of a land capability map.

Preliminary photo-interpretation:

Before the survey team goes into the field a preliminary photo-interpretation must be done in the office. Using stereo-pairs

the following information should be delineated :

- Dambos and other drainage lines
- Crests and important slope breaks
- Hills that can be classified as unsuitable land for agriculture
- Areas of non-arable potential
- Existing and potential dam and weir sites
- Existing roads and village sites
- The limits of cultivated lands including plantations and orchards
- Potential arable land

All the information should be transferred to either a mosaic or to a transparency of 1:50,000 topo map, enlarged or reduced to photo-scale. The area could also be divided into zones of similar physical characteristics e.g. similar topography, soils, vegetation and drainage patterns.

Soil survey in the field:

Once the mapping units have been determined from photo-interpretation then it is necessary to check each individual unit in the field. This can be done either by taking selective pit samples within the area or a traverse line can be put in across the mapping unit and auger holes can be sited along the traverse line at intervals depending on the size of the mapping units. For most areas auger holes 300 m apart are adequate. The latter method of a line across the mapping unit is preferable because then any catena effect within the mapping unit can be picked out. It is often necessary to alter or modify mapping unit boundaries following the field inspection.

Final photo-interpretation and soil map production:

Having collected all the relevant data and once having plotted the soil codes on to the photographs, the codes are then classified into land capability classes and mapping units of these classes are then demarcated with the aid of photo-interpretation. The final map should be produced on a transparency and at a later date be transferred to the field mosaic. On the map or mosaic each mapping unit should have a typical soil code and the land capability class for the particular mapping unit.

Each map or mosaic should have a bar scale, north point and as well a degree reference.

Detailed surveys

These are designed to provide highly accurate information on the soils, vegetation and contours in a limited area and allow detailed

planning of individual farms, projects and settlements to take place. They are carried out in a similar way as semi-detailed surveys using the same three stages, but the intensity of data collection in the field is increased.

The intensity of the survey should be so adjusted as to suit the purpose for which the land is required. The detailed survey traverse lines should not exceed 300 m apart. They may be as close as 100 m. Observation points on a traverse line may be at 300 m, 150 m or even at 50 m depending upon the factors mentioned above. If relatively small farm units of 5 ha are planned then observations should be such as to include at least one for 2 ha. If 50 ha units are planned then less observation may be required.

Observation points are simply points at which you observe the soil. They may consist of augering to a depth of 120 cm either by hand or with the power equipment, or as commonly done in the past, by pits. In the following discussion the latter method is described, however, any of these methods may be used.

Surveys for irrigation should be carried out with assistance from Headquarters or the Soil Survey staff. Land which is thought to be irrigable could first of all be surveyed on a reconnaissance basis to determine the areas with the highest potential. From this survey, an intensive survey of the selected areas can be carried out.

SOIL SURVEY TECHNIQUES

With the expansion of the Soil Survey Unit, the low intensity soil surveys such as reconnaissance and semi-detailed surveys are now usually being carried out by Soil Survey staff. The more detailed soil surveys on farms and small schemes are usually carried out by the planning staff with the assistance of the Soil Survey Unit.

Soil information is collected by studying the soil characteristics from augerings. Augerings are made along traverse lines. Their density depend on the intensity of the survey and complexity of the soil pattern. (See table 10). Augerings are made to a depth of 120 cm or down to hard rock or gravels whichever is shallower.

Individual pit siting

The art of good pit siting is to predict the final soil mapping units and then to site pits within these mapping units. Since soil changes are often reflected in changes in the type of natural vegetation and in the colour of the topsoil, the demarcation of

homogeneous areas on the mosaic or map is an important first step in making these predictions and deciding on the position of the pits.

When siting pits within homogeneous areas the following points should be noted:

- Pits should be sited within all except very small homogeneous areas of potential arable land. A number of pits should also be sited in the larger dambos and summer grazing areas. This will give a guide as to the best use of these areas, as for instance the potential for grazing, drainage or afforestation.
- In small homogeneous areas, where only one pit can be sited, the pit should be towards the centre of the area. This applies also to long narrow homogeneous areas.
- In large homogeneous areas on fairly flat land, some pits should be cited towards the edge of the areas in order to give an idea of the extent of the type of soil as well as a few towards the centre of the area to confirm that the block is uniform.
- Transitional zones between two areas should be avoided as the soil in these zones is likely to be representative of neither of these two areas.
- Where large apparently homogeneous areas occur, extending from a position of high to low relief then the possible catenary succession of soils down the slope should be taken into account and pits sited accordingly.
- Pits should not be sited exactly on the crest of a narrow ridge nor exactly on the slope break on the shoulders of the ridge as a narrow belt of shallow soils may occur in these positions.

Traverse pit siting

Traverse lines are parallel lines put in on the ground on the same magnetic bearing. Pits are sited at fixed distances along each line thus producing an even cover or grid of pits over the survey area. The intensity of pitting may be altered by varying the distance between traverse lines and varying the distance between pits on the line.

Traverse lines are normally put in at right angles from a base line which ideally should run parallel to the main drainage. In this way the traverse lines will run across drainage lines/ geological structure, and any catenary effect of soils from one drainage line to the next will be picked up. In some cases it is necessary to cut a base line, but in many cases an existing road can be used. Traverse lines should total between 8,000 and 10,000 m for a convenient day's work. Box traverses which start and finish on the same base line are most convenient.

The traverses can be laid out by junior staff on pre-arranged compass bearings across the drainage pattern, trees being blazed to mark the traverse line and numbered pegs placed at suitable intervals so that the exact distance of any feature from the start of the line can be estimated. Measurements can be made using a 50 m survey chain or a cyclometer wheel. A traversing team consists of a compass man and four labourers. In the course of his traversing the leader records in his notebook the distance of outstanding features that later can be checked on the photographs.

Soil and vegetation are recorded on the system described in Chapter 2 using the printed 'Soil Survey Proforma Sheet' for auger traversing. (See page 64). A traverse log sheet should also be kept to record any changes or features that are apparent as one walks down the line and their distance on the line. In this way soil and other boundaries can be accurately determined.

It is essential when in the field to have the relevant photographs which cover the land area being surveyed so that the traverse line can be accurately marked in the photographs. The surveyor should be able to pick himself out on the photograph and mark the point and distance with a chinograph pencil. This is particularly important in the reconnaissance type of survey where the large distances involved are likely to lead to errors.

Two types of soil augers are used depending on the condition of the soil. The barrel type "Riverside" auger is best suited to hard dry soils of a wide range of textures. The so-called "Dutch" auger or "Edelman" auger slightly twisted open type auger is suitable for sticky soils. Both auger types can be provided by the Soil Survey Unit, Mr. Makulu.

Other basic equipment includes a Munsell Color Chart, trowel, two metre measuring tape, plastic water bottle, pencils, notebook and abney level.

Mapping of recorded information

If individual pit sitings have been made, each pit is marked on the photograph with its code description and a final photo interpretation is carried out to determine the soil boundaries.

If a traverse system has been employed, there will be more information to be plotted since recordings have been taken along the whole length of the line of the traverse.

The traverse line is first put on to the photograph in faint chinograph pencil by joining up the points at which the surveyor was able to pick himself up and had marked on the photographs whilst in the field. The starting point and finishing point of the traverse line is then determined and the full line drawn on the photograph. When this line is measured with the correct scale rule, it is often found that the distance on the photograph is less than

the actual distance covered on the ground. This is due to the effect of the topography since the photographic scale is a flat scale whilst the distance travelled on the ground includes vertical distances encountered by hills and valleys. Thus the more even the topography, the more nearly the photoscale will approach the ground scale.

To overcome this difficulty, the information contained on the traverse line is first plotted on a piece of paper at ground scale. This information includes data from the soil survey proforma sheet and the traverse log sheet. The length of the line on the photograph is then measured and this distance is drawn on the same sheet as the horizontal ground scale but at an angle to it. All the ground scale positions are plotted on the photoscale line by joining up the ends of the two scale lines and running a set of parallel lines parallel to the end line. (See fig. 6).

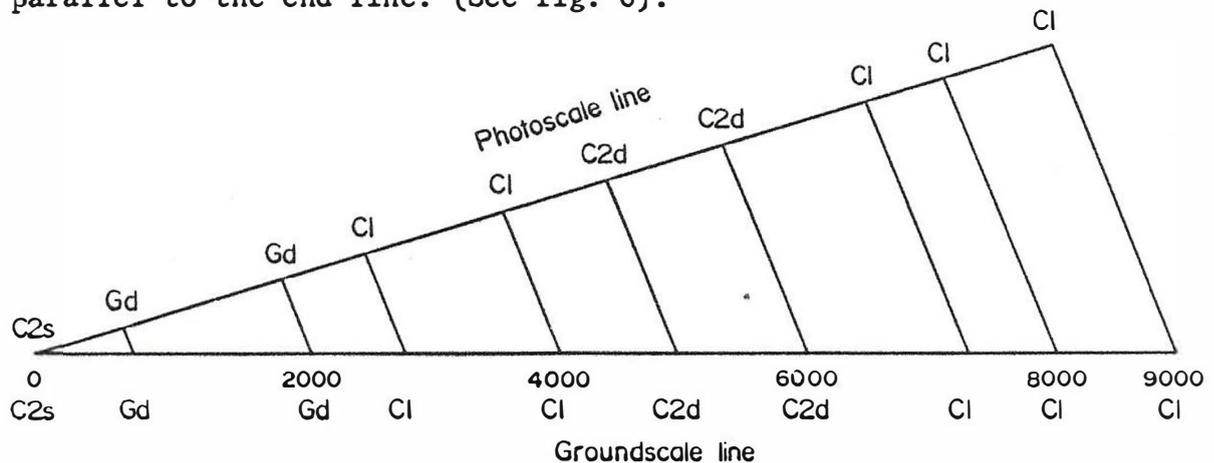


Figure 6 : Transference of information from ground scale line to photo scale line

Also on to the photo scale line can be plotted, in different colours, the different lengths of the traverse line indicating arable and non-arable portions. A tracing of this photo scale line is then taken, the tracing placed on the traverse line marked on the photographs, and the relevant information pin-pricked on to the air photo.

With the data now on the photographs the final photo interpretation can be carried out to finalise all the arable mapping units.

The traverse line can be permanently marked in on the photograph by faintly scratching the surface of the photo with a pin or compass point. Black chinograph pencil is then rubbed into the scratch and when the surplus chinograph is removed with benzine a permanent fine black line remains representing the traverse line. The number of the line should be marked at each end by white or black ink.

The information on each photograph must now be transferred to the final map either by direct visual transference, as on to a mosaic, or by tracing on to a transparent photo-scale enlargement of the ordinance survey map. This tracing can then be either reduced or enlarged to whatever scale is required.

The final land capability map should be produced using the land capability classes as set out in Chapter 2.

All the information recorded on the survey should be carefully filed in a logical sequence including all Soil Survey Proforma Sheets, traverse log sheets and soil pit description sheets, so that if any checking is required or any information contained in the initial data but not recorded on the land capability map, then this information can easily be obtained.

Table 10: Recommendations for map scales and intensity of land classification and soil observation points at various survey intensity levels and various major uses

Survey level	Suitable field mapping scale	Suitable publication mapping scale	Degree of land capability classification	Average distance between traverse lines	Area to be covered per month per team	Major uses
Rapid reconnaissance (Very low intensity)	1:100,000 to 1:250,000	1:250,000 to 1:1,000,000	Arable, grazing and unsuitable land	Observation along roads	25,000 ha	Feasibility studies Determination of areas for further studies
Reconnaissance (low intensity)	1:50,000 to 1:100,000	1:100,000 to 1:250,000	Association of clayey or sandy soils. Summer or winter grazing and unsuitable lands	1 - 3 km	15,000 - 25,000 ha	National and Provincial development planning
Semi-detailed (medium intensity)	1:20,000 to 1:50,000	1:30,000 to 1:100,000	Land classes and possibly subclasses	300-1000 m	5,000 - 10,000 ha	District Planning Catchment Conservation Settlement Planning
Detailed (high intensity)	1:5,000 to 1:20,000	1:10,000 to 1:30,000	Land classes and subclasses	100-300 m	1,000 - 5,000 ha	Irrigation schemes Farm planning Settlement schemes
Very detailed (very high intensity)	1:1,000 to 1:10,000	1:5,000 to 1:10,000	Land classes and subclasses	50 -100 m	500-1,000 ha	Small scale irrigation schemes. Research plots

SOIL SURVEY PROFORMA SHEET

SURVEYOR:		AREA:			TRAVERSE No.	BEARING	DATE
1. DISTANCE ALONG TRAVERSE		m.	m.	m.	m.	m.	m.
2. TEXTURE AND THICKNESS	20cm.	0 10 15 20	A, X, B, L, C, D, E, F, G,	0 10 15 20	0 10 15 20	0 10 15 20	0 10 15 20
OF	40 cm.		A, X, B, L, C, D, E, F, G,				
TOPSOIL	60 cm.		A, X, B, L, C, D, E, F, G,				
(INcm.)	90 cm.		A, X, B, L, C, D, E, F, G,				
3. EFFECTIVE DEPTH	(INcm. OR CODE)	> 90 = 1 60-90 = 2 30-60 = 3 < 30 = 4					
4. COLOUR AT 50 cm.							
5. HINDRANCE TO CULTIVATION		g, m, r,					
6. LIMITING MATERIAL		H, L, R,					
7. MOTTLING (DEPTH INcm.)							
8. WETNESS CLASS		0, W1, W2, W3,					
9. EROSION CLASS							
10. SLOPE CLASS		0, A, B, C, D, E,					
	READING						
11. OUTCROPS (IN %)		< 1, 1-5 5-10 > 10					
12. PARENT MATERIAL							
13. LIMITATION SYMBOL		d, e, f, g, m, r, s, t, w, z,					
14. LAND CLASS							
15. CODE		_____	_____	_____	_____	_____	_____
16. VEGETATION TYPE							
	SPECIES						
	GROWTH	w, m, p,					
	SPACING	d, m, o,					
17. ANTHILLS	ABUNDANCE	m, c, f,					
	SIZE	l, m, s,					
18. REMARKS							

EXPLANATION OF ABBREVIATIONS

2. Texture

A - sand L - loam E - sandy clay
X - loamy sand C - sandy clay loam F - clay
B - sandy loam D - clay loam G - cracking clay

*I - silty clay
J - silty clay loam
K - silty loam*

5. Hindrance to cultivation

g - gravels or stones occupying more than 1% of surface area
m - termite mounds occupying more than 1% of surface area
r - rock or laterite outcrop occupying more than 1% of area

6. Limiting material in subsoil

H - hardpan L - laterite R - weathered rock or rock

8. Wetness class

O - no wetness apparent or mottles deeper than 90 cm
W1- mottles starting between 60 - 90 cm depth
W2- mottles starting between 30 - 60 cm depth
W3- mottles and rusty root channels within 30 cm from surface

9. Erosion class

O - no apparent erosion
E1- slight sheet erosion
E2- moderate sheet erosion or slight gullyng
E3- severe sheet erosion or gullyng

10. Slope class and reading

<u>Class</u>	<u>Slope percent</u>	<u>Slope degree</u>
O	less than 1%	less than 30'
A	1 - 3%	30' - 1°40'
B	3 - 5%	1°40' - 2°50'
C	5 - 8%	2°50' - 4°30'
D	8 - 12%	4°30' - 6°50'
E	more than 12%	more than 6°50'

Abney levels usually read slope degrees

13. Limitation symbol

d - depth to a limiting layer m - large termite mounds
e - erosion s - slope
f - fertility t - texture
g - gravelly or stony topsoil w - wetness
r - rock outcrops, boulders or z - gravelly or stony subsoil
irregular surface relief

16. Vegetation

<u>Growth</u>	<u>spacing</u>
v - vigorous	d - dense
m - medium	m - medium
p - poor	o - open

17. Anthills

<u>abundance</u>	<u>size</u>
m - many	l - large
c - common	m - medium
f - few	s - small

18. Remarks (continued)

Land classes

The LUS land classification system assumes that, where conditions are suitable, farmers will prefer to use land for arable cropping; and that where conditions are unsuitable for arable cropping, they will use the land for grazing (mainly cattle) unless it is too wet, rocky, or otherwise physically unsuitable for such use. Unsuitability for farming on the grounds of remoteness from roads or markets, lack of water or presence of tsetse fly is not considered in the classification.

There is a primary division into arable, marginal arable, grazing and unsuitable. Below this level arable and marginal arable lands are subdivided into clayey and sandy soils as well as according to limitation. Grazing and unsuitable lands are subdivided according to limitation. These subgroups and their subdivisions are defined under appropriate headings below.

Clayey and sandy soils

Arable and marginal arable lands are subdivided into clayey and sandy soils since these tend to have different management requirements and to be suitable for different kinds of crops.

Clayey soils:

This subgroup includes all arable soils with a sandy clay loam or heavier topsoil texture. The symbol 'C' is used for these. Heavy topsoil texture is the sole criterion for recognition of C-soils.

Subsoil colours in C-class soils are generally red or reddish brown where soil drainage is good, but may be dark brown, olive-brown or dark grey where the drainage is less satisfactory. The parent materials are generally basic rocks such as limestones, calc-silicate schist, gabbro, diorite and calcareous shales. Clay alluvium is also included.

The natural vegetation associated with these soils is usually woodland dominated by species of Acacia, Combretum, Albizia (amara, harveyi), Terminalia (except T. Sericea), Afrormosia (Pericopsis) or Piliostigma. (it should be noted, however, that Acacia and Combretum vegetation is common on sandy soils in low rainfall areas in the south). The associated grasses are usually tall Hyparrhenias and Andropogons. Tall Brachystegia woodland occurs on red clays in the higher rainfall areas of Zambia.

Sandy soils:

This subgroup for which the symbol 'S' is used, includes all soils with a topsoil texture lighter than sandy clay loam i.e. sand, loamy sand, sandy loam, silt loam, loam subsoils of 'S' soils are usually yellowish brown to yellowish red, and range in texture from sand to clay. These soils are generally developed over granites, acid gneisses, mica-schists, phyllites, quartzites and sandstones, or in colluvium/alluvium derived from such rocks.

The main vegetation type on S-class soils is Brachystegia-Julbernardia woodland. Grass cover under the trees is often poor, but vigorous growth of Hyparrhenia often takes over when the woodland is cleared. In high rainfall areas, very tall grasses and bracken may take over on cleared land to form the 'chipya' type. Sandy soils over basic rocks may have Acacia-Combretum vegetation in areas of moderate and low rainfall.

Definitions of land classes

The division into land classes is based on the freedom of choice of crops and management practices. This division reflects the degree of limitation present. The long-term safe use of land should be the guiding principle. This conservation of resources viewpoint is used in dividing into arable, marginal arable, grazing and unsuitable land, while the subdivision into clayey and sandy soil is based more on a crop and management suitability concept.

Arable land

Arable land is suitable for intensive use on a sustained economic basis. The farmer is free to choose annual or semi-perennial cultivated crops. The soils in this class have a certain degree of self-control which means that they are buffered against abrupt changes in the environmental factors, like too much or too little rain. The highest long-term production will be obtained under a suitable crop rotation.

Classes C1, S1 Good arable land:

Land capable of being maintained at a high level of productivity under an intensive cropping system. There are no special limitations, but good management should include normal soil conservation practices, adequate use of fertilisers and lime as well as a suitable rotation.

Classes C2, S2 Moderately good arable land:

Land capable of being maintained at a high level of productivity under an intensive cropping system, but requiring special attention to soil conservation or management because of moderate limitations; or land capable of being maintained at only a moderate level of productivity due to limitations of depth, texture, wetness etc. Response to improvements in management is high.

Marginal arable land

Marginal arable land does not support a long-term intensive use of the land for arable crops without great risk of poor yields in dry or wet years, limited freedom of choice of crops or management or high degree of environment control. Introduction of ley (grass or grass/legume) in the rotation is generally recommended. The net income over a period of years tends to be low.

Classes C3, S3 Poor arable land:

Land with severe limitations for cultivation which either greatly increase the costs of production (due to cost of erosion control, drainage, liming etc.) or reduce yields to marginal levels (due to droughtiness, wetness, salinity, difficulty of seed-bed preparation etc.) or severely restrict the range of crops that can be grown satisfactorily.

Class S4, (no class C4) Very poor arable land:

This class is restricted to deep Barotse sands or other very deep sands occurring in moderate to high rainfall areas (probably more than 800 mm annually). These soils are easily cultivated but because of extremely low fertility and droughtiness, the range of crops that can successfully be grown is severely limited and does not include any of the general agricultural crops. It would be uneconomic to apply improvements to such soils which would make them suitable for medium or large-scale commercial farming of general arable crops. (Cassava is possibly the only field crop suitable for commercial production on such soils; intensive vegetable production under irrigation may also be possible on certain soils).

This class generally has only one serious limitation: texture. It is a S4t.

Table : Criteria for determining arable land classes

Land class Sub division criteria	Arable				Marginal arable		
	Good arable		Moderately good arable		Poor arable		Very poor arable
Clayey - sandy class	C1	S1	C2	S2	C3	S3	S4
Min. effective depth (cm)	90	90	60	60	30	30	90
Min. texture 0 - 20 cm	C	X	C	A	C	A	A
Min. texture upper subsoil 20 - 40 cm	C	B	B	X	X	A	A *
Min. texture subsoil 40 - 60 cm	C	B	B	B	X	X	A *
Max. hindrance to cultivation %	1	1	5	5	10	10	5
Max. slope class	A	A	B	B	C	C	C
Max. erosion	-	-	E1	E1	E2	E2	E2
Max. wetness class	-	-	W1	W1	W2	W2	W2**

* Not heavier than X, even in 60 - 90 cm depth

** W3 in Wet Litongo soils

Note: Topsoils with textures A, X, B, K, L are included in the S-soils. Heavy clay G, is not accepted in topsoils of C1 and C2.

Texture

A - sand
X - loamy sand
B - sandy loam

L - loam
C - sandy clay loam
D - clay loam

E - sandy clay
F - clay
G - cracking clay

I - silty clay
J - silty clay loam
K - silty loam

Wetness class

O - no wetness apparent or mottles deeper than 90 cm
W1- mottles starting between 60 - 90 cm depth
W2- mottles starting between 30 - 60 cm depth
W3- mottles and rusty root channels within 30 cm from surface

Erosion class

O - no apparent erosion
E1- slight sheet erosion
E2- moderate sheet erosion or slight gullyng
E3- severe sheet erosion or gullyng

- H - Hardpan. This is a layer of compact soils, usually found in the subsoil of solonchic (sodium affected) soils. The layer is dense and hard, both when dry and wet. It is not merely a subsoil layer which is very hard when dry but which would become soft or friable when moist; nor is it a densely packed gravel or concretionary layer, which is indicated by another symbol.
- L - Laterite. This includes sheet laterite (ironpan) or densely-packed ironstone concretions sufficiently hard or compact to restrict root development or seriously reduce moisture-holding capacity.
- R - Weathered rock or rock. Weathered or partially decomposed rock sufficiently dense to restrict root development or with sufficient little-weathered rock present to restrict moisture-holding capacity: as well as hard rocks. See page 17 for calculating effective depth.

If two kinds of limiting material occur within the soil profile down to 120cm, the symbol for the most limiting material will be given. A water-table is not recorded as a limiting factor in the upper line of the code. This information is provided in the symbol for wetness given in the lower line of the code.

Slope

The slope of the land surrounding the sampling point or within the mapping unit is measured by Abney level and recorded by use of the following symbols:

- | | | | | |
|---|---|---|----|---------------------------------------|
| O | - | 0-1% | or | 0 - 30' |
| A | - | 1-3% | or | 30'-1 ^o 40' |
| B | - | 3-5% | or | 1 ^o 40'-2 ^o 50' |
| C | - | 5-8% | or | 2 ^o 50'-4 ^o 30' |
| D | - | 8-12% | or | 4 ^o 30'-6 ^o 50' |
| E | - | More than 12% or more than 6 ^o 50' | | |

Erosion

Visible evidence of soil erosion at or in the vicinity of the sampling point, or within the mapping unit, is indicated by the following symbols:

- - No apparent erosion
- E1 - Slight erosion. Slight loss of topsoil by sheet erosion.
- E2 - Moderate erosion. Loss of topsoil by sheet erosion or slight gullying by small run-off channels (rills); or presence of a few large gullies at very wide intervals not sufficient to interfere with cultivation on a normal field scale.
- E3 - Severe or very severe loss of topsoil by sheet erosion exposing the subsoil; or presence of many small and/or large gullies sufficient to hinder or prevent normal cultivation.

The following symbols are used to indicate wetness characteristics:

- - No wetness apparent. The soil is well to excessively drained. Water is removed sufficiently quickly from the soil surface and rooting zone so that plant growth is not restricted by waterlogging. A well drained soil is usually strong brown to red in colour but may be yellower or paler in sands.
- W1 - Slight wetness. The soil is moderately well drained. It is wet for short periods following heavy rainfall or the water table rises to between 60 - 90 cm from the ground surface during the rainy season. Drainage is sufficiently impeded to prevent the cultivation of deep-rooting crops or crops particularly sensitive to wetness (e.g. cotton, Virginia tobacco, some vegetables). Moderately well drained soils generally have some grey mottles present between 60 - 90 cm (as well as yellow, brown or red mottles); or if grey mottles are absent from this layer, the soils have yellow-brown or pale brown colours dominant between 30 - 90 cm in loamy or clay soils (Munsell colour hues 10 YR or 2.5 Y and chromas of 4 or higher).
- W2 - Moderate wetness. The soil is imperfectly drained. It is wet for considerable periods during the growing season. Conditions are too wet for normal dry-land crops unless these are cultivated on high ridges or beds, or unless artificial drainage is provided. Imperfectly drained soils are generally predominantly grey or dark grey throughout the subsoil or have grey mottles (together with yellow, brown or red mottles) starting at between 30 - 60 cm from the ground surface. Rusty root channels are usually absent from the topsoil, but may be present where water has stood on the soil surface in cultivated fields. Chromas of the matrix colour are generally below 4.
- W3 - Severe wetness. The soil is poorly or very poorly drained: i.e. it is wet for most or all of the growing season, preventing the cultivation of dry-land crops (without artificial drainage). Cultivation of rice and dry-season grazing may be possible. The soils are usually grey or dark grey throughout the subsoil and may be black or peaty in the topsoil. Rusty root channels are visible in the topsoil within 30 cm from the ground surface.