The National Soil Map and Soil Classification

Information paper

Department: Centre for Environment and Agricultural informatics

Date: 02/07/2018

The National Soil Map and Soil Classification

Introduction

This document is designed to accompany the national soil map legend and briefly describes the constituent soil associations of the 1:250 000 (quarter inch to 1 mile) soil map of England and Wales held by Cranfield University. The soil classification, outlined briefly below, is treated more fully in Avery (1980) and in the revised classification of soil series by Clayden and Hollis (1984). The national soil map (or 'Natmap') is based on published soil maps[1] which cover a quarter of the land at scales of 1:25 000, 1:63 360 or 1:100 000 and on reconnaissance mapping of previously unsurveyed areas.

The legend shows geographic soil associations identified by the most frequently occurring soil series and by combinations of ancillary series. The map units are further identified by number codes and are coloured by dominant soil subgroups (or groups), of which sixty seven are recognised. The numbers of each code indicate the predominant major soil group, group and subgroup. Thus, association 651a is dominated by soils of the Belmont series belonging to subgroup 6.51, the *Ironpan* subdivision of soil group 6.5, *Stagnopodzols* which are part of major group 6, *Podzolic* soils.

The legend also lists for each unit:
1. The geological materials influencing soil characteristics;
2. Important soil properties and conditions affecting rooting depth cultivations and Drainage;
3. Cropping and other information;
4. Percentage and area of England and Wales covered by the soil associations.

Soil Classification and the Map Legend

The soils of England and Wales are differentiated by observable or measurable characteristics of the *soil profile*: this is a sample of the soil mantle extending from the ground surface to about 1.50m, and formed of several layers or *soil horizons*. Details of the profile characteristics used to classify soils are given by Avery (1980), but brief definitions of the more important ones used to characterize the soils in this legend are given below. They can be divided into two broad types:

Characteristics inherited from the soil parent material:-

These soils comprise:

a) *Particle-size* and *organic composition*. Soil materials with more than 20 to 30 percent organic matter, depend ing on clay content, are classed as Organic and those with less are classed as *Mineral*. The latter are divided into three *particle-size groups* according to the proportions of sand, silt and clay sized particles in the inorganic fraction <2mm, as follows:

Sandy: Percentage silt and twice percentage clay is less than 30;
Clays: More than 11 percent clay;
Loamy: Other materials of intermediate composition.

Sandy, loamy and clayey materials can also be called *Humose* if they contain >8-12 percent organic matter depending on clay content, and *very stony* if they contain >35 percent stones. Where necessary *loamy* materials are subdivided into particle-size subgroups as follows:

Coarse loamy: >20 percent sand and <18 percent clay;
Fine loamy: >20 percent sand and >18 percent clay;
Silty: < 20 percent sand with a further subdivision into:
    Coarse silty: <18 percent clay;
    Fine silty: >18 percent clay.

b) *Calcium Carbonate Content*. Materials are divided into three broad groups as follows:

Non-calcareous: <1 percent $CaCO_3$;
Calcareous: 1 to 40 percent $CaCO_3$;
Extremely calcareous (Carbonatic): >40 percent $CaCO_3$.

c) *Mineralogy*. Materials containing distinctive mineralogy affecting nutrient supply, acidity or structural stability are distinguished as follows:

Ferruginous: A large amount of iron oxides relative to the clay content;
Glauconitic: At least 5 percent glauconite present as greenish grains;
Serpentinitic: Sand fraction dominated by serpentine minerals or their weathering products;
Sulphuric: Extremely acid (dry pH <4) with significant amounts of yellow jarosite crystals and mottles.

Characteristics resulting from alteration of the original parent material by soil forming (pedogenic) processes

These soils are expressed as distinctive surface and subsurface horizons:

a) *Organic* or *organo-mineral surface horizons* resulting from the accumulation and/or incorporation of decaying plant residues. They are subdivided into *Peaty topsoils* which are composed of organic material at least 7.5cm thick; *Humose topsoils* which are composed of humose material at least 15cm thick and *Distinct topsoils* which contain at least one percent organic matter over a thickness of at least 15cm.

b) *Brownish* or *reddish 'weathered' subsurface horizons* resulting from weathering and leaching of the original material and us ually accompanied by the formation of soil structure.

c) *Prominently mottled greyish (gleyed) subsurface horizons* resulting from the reduction and partial re-oxidization of iron oxides as a consequence of periodic waterlogging.

d) *Clay enriched subsurface horizons (argillic horizons)* resulting from the deposition of clay particles washed down in suspension from overlying horizons.

e) *'Bleached' horizons* from which iron, aluminium and organic matter have been removed in solution or suspension.

f) *Black, dark brown or ochreous horizons enriched in iron and aluminium or humus or both*.

Soil profile characteristics are used to define soils at four levels in a hierarchical system, general characteristics being used at the highest level to give broad separations and more specific ones at lower levels to give increasingly precise subdivisions. The four categories are, in descending order, *major group*, *group*, *subgroup*, and *series*; the lower the category, the more precise is its definition. At *major group* level, divisions are based on the predominant pedogenic characteristics of the soil profile Soil *groups* and *subgroups* are subdivisons based on features which further define the inherent characteristics of the soil material, or modify the basic pedogenic characteristics recognized at major

group level. A soil *series*, the lowest category in the system, is a subdivision of a subgroup based on precisely defined particle-size subgroups, parent material (substrate) type, colour and mineralogical characteristics (Clayden and Hollis, 1984).

Major groups, groups and subgroups are named using words which describe the features used to distinguish them. At the lowest level of delineation however, such a nomenclature becomes unwieldy and soil series take the ir names from the places where they were first described, (e.g. the Sherborne and Wickham series). Soil 'series' may also sometimes be referred to as soil 'types'.

The complete system, including definitive characteristics of major groups, groups and subgroups is described by Avery (1980), but brief definitions of the classes appearing in the national soil map legend are given below:

1. Terrestrial raw soils: These occur in very recently formed material not significantly altered by soil forming processes They have no pedogenic horizons other than a superficial organic or organo-mineral layer less than 5 cm thick, or a buried horizon below 30cm depth. Five groups are distinguished, but only one occurs in the legend. It is not subdivided into subgroups.

1.1 Raw sands are predominantly sandy and found mainly on unvegetated or sparsely vegetated coastal sand dunes.

2. Raw gley soils: These occur in mineral material that has remained waterlogged since deposition. They may be unvegetated and are chiefly confined to intertidal flats or saltings that represent stages in the development of mature salt marshes. Two groups are recognised, but only one has been distinguished in the legend. It is not subdivided into subgroups.

2.2 Unripened gley soils are formed in waterlogged loamy or clayey material (soft mud).

3. Lithomorphic Soils: These are shallow soils in which the only significant pedogenic process has been the formation of an organic or organic-enriched mineral surface horizon. They are formed over bed-rock, or little altered, soft unconsolidated material at or within 30 cm depth. Seven groups are separated, five of which appear in the legend. They are fur ther subdivided into *typical* (unmottled); *humic* (humose or peaty topsoil); *brown* (distinct, brownish coloured topsoil); *grey* (distinct, greyish coloured topsoil); *colluvial* (in colluvium more than 40cm thick) and *gleyic* (faintly mottled) subgroups only those appearing in the legend are indicated below.

3.1 Rankers are non-calcareous soils over non-calcareous rock or massive limestone.
- **3.1.1 Humic rankers**
- **3.1.3 Brown rankers**

3.2 Sand-rankers are soils formed in non-calcareous soft, unconsolidated sandy deposits other than alluvium.
- **3.2.1 Typical sand-rankers**

3.4 Rendzinas are calcareous soils over chalk limestone or, extremely calcareous unconsolidated material.
- **3.4.1 Humic rendzinas**
- **3.4.2 Grey rendzinas**
- **3.4.3 Brown rendzinas**
- **3.4.4 Colluvial rendzinas**
- **3.4.5 Gleyic rendzinas**
- **3.4.6 Humic gleyic rendzinas**

3.6 Sand-pararendzinas are soils formed in little altered calcareous soft, unconsolidated sandy deposits other than alluvium.
- **3.6.1 Typical sand-pararendzinas**

3.7 Rendzina-like alluvial soils are formed in little altered calcareous alluvium, lake marl or tufa.
- **3.7.2 Gleyic rendzina-like alluvial soils**
- **3.7.3 Humic gleyic rendzina-like alluvial soils**

4. Pelosols: These are slowly permeable clayey soils with no prominently mottled (gleyed) subsurface horizon at or above 40cm depth. They crack deeply in dry seasons and have a coarse blocky or prismatic structure. Pelosols are divided into three groups, all of which occur in the legend.

4.1 Calcareous pelosols have a calcareous subsurface horizon and no clay-enriched subsoil.
- **4.1.1 Typical calcareous pelosols**

4.2 Non-calcareous pelosols are non-calcareous to at least 80cm and have no clay-enriched subsoil.
- **4.2.1 Typical non-calcareous pelosols**

4.3 Argillic pelosols have a clay-enriched subsoil
- **4.3.1 Typical argillic pelosols**

5. Brown soils: These are soils in which pedogenic processes have produced dominantly brownish or reddish subsurface horizons with no prominent mottling or greyish colours (gleying) above 40cm depth. They are widespread, mainly on permeable materials, at elevations below about 300m and are mostly in agricultural use. Brown soils are divided into eight groups in which the following subgroups are recognised: *typical* (with unmottled subsoil); *gleyic* (mottled, permeable subsoil); *stagnogleyic* (mottled, slowly permeable subsoil); *colluvial* (in colluvium male than 40cm thick); *ferritic* (ferruginous subsoil); *pelogleyic* (clayey, with a mottled slowly permeable subsoil) and *argillic* (clay-enriched subsoil). Only those appearing on the legend are referred to below.

5.1 Brown calcareous earths are non-alluvial loamy or clayey soils with a weathered calcareous subsoil.
- **5.1.1 Typical brown calcareous earths**
- **5.1.2 Gleyic brown calcare ous earths**
- **5.1.3 Stagnogleyic brown calcareous earths**
- **5.1.4 Colluvial brown calcareous earths**

5.2 Brown calcareous sands are non-alluvial sandy soils with a weathered calcareous subsurface horizon.
- **5.2.1 Typical brown calcareous sands**
- **5.2.2 Gleyic brown calcareous sands**

5.3 Brown calcareous alluvial soils are alluvial soils with a calcareous subsurface horizon.
- **5.3.2 Gleyic brown calcareous alluvial soils**
- **5.3.3 Pelogleyic brown calcareous alluvial soils**

5.4 Brown earths are non-alluvial loamy soils with a non-calcareous subsoil without significant clay enrichment.
- **5.4.1 Typical brown earths**
- **5.4.2 Stagnogleyic brown earths**
- **5 4.3 Gleyic brown earths**
- **5.4.4 Ferritic brown earths**
- **5.4.5 Stagnogleyic ferritic brown earths**
- **5.4.6 Gleyic ferritic brown earths**

5.5 Brown sands are non-calcareous sandy soils
- **5.5.1 Typical brown sands**
- **5.5.2 Gleyic brown sands**
- **5 5.3 Stagnogleyic brown sands**
- **5.5.4 Argillic brown sands**
- **5.5.5 Gleyic argillic brown sands**

5.6 Brown alluvial soils are loamy or clayey soils with a non-calcareous subsurface horizon developed in alluvium.
- **5.6.1 Typical brown alluvial soils**
- **5.6.2 Gleyic brown alluvial soils**
- **5.6.3 Pelogleyic brown alluvial soils**

5.7 Argillic brown earths are loamy or loamy over clayey soils with a subsurface ho rizon showing significant clay enrichment.
- **5.7.1 Typical argillic brown earths**
- **5.7.2 Stagnogleyic argillic brown earths**
- **5.7.3 Gleyic argillic brown earths**

5.8 Paleo-argillic brown earths are loamy or clayey soils with a reddish or reddish mottled clay-enriched subsoil that reflects pedogenic processes occurring before the last (Devensian) glacial period.

5.8.1 Typical paleo-argillic brown earths
5.8.2 Stagnogleyic paleo-argillic brown earths

6. Podzolic soils: These are soils with a black, dark brown or ochreous subsurface horizon resulting from pedogenic accumulation of iron and aluminium or organic matter or some combination of these. They normally form as a result of acid weathering conditions and, under natural or semi- natural vegetation, have an unincorporated acid organic layer at the surface. Of five groups recognized only four are included in the legend. They are divided into *humic*, (humose or peaty topsoil); *humo-ferric* (dark coloured humus and iron enriched subsoil); *humus* (dark coloured humus-enriched subsoil with relatively little iron); *ferric* (dark brown or ochreous iron-enriched subsoil with relatively little humus); *ironpan* (ironpan <1cm thick cemented by iron and humus); *paleo-argillic* (reddish or reddish mottled, clay-enriched subsoil - see paleo-argillic brown earths); *stagno-* (mottled slowly permeable subsoil) and *typical* subgroups. Only those appearing in the legend are indicated below.

6.1 Brown podzolic soils have a dark brown or ochreous subsoil with no overlying 'bleached' layer.

6.1.1 Typical brown podzolic soils
6.1.2 Humic brown podzolic soils

6.3 Podzols are well drained soils with a black or dark brown, compact subsurface horizon enriched in humus and normally overlain by a 'bleached' layer, but with no greyish or mottled (gleyed) horizon immediately below.

6.3.1 Humo-ferric podzols
6.3.2 Humus podzols
6.3.3 Ferric podzols
6.3.4 Paleo-argillic podzols

6.4 Gley podzols have characteristic 'bleached' and dark humus-enriched subsoil horizons directly underlain by a greyish or prominently mottled horizon resulting from periodic waterlogging.

6.4.1 Typical gley-podzols
6.4.2 Humo-ferric gley-podzols
6.4.3 Stagnogley-podzols

6.5 Stagnopodzols are mainly upland soils with a peaty topsoil and/or a periodically wet, faintly mottled bleached subsurface horizon, overlying an iron-enriched layer.

6.5.1 Ironpan stagnopodzols
6.5.2 Humus-ironpan stagnopodzols
6.5.4 Ferric stagnopodzols

7. Surface-water gley soils. These are seasonally waterlogged slowly permeable soils, prominently mottled above 40cm depth. There are only two groups and both occur in the legend. The groups are further subdivided into *typical* (clay-enriched subsoil); *pelo-* (clayey), *cambic* (no clay-enriched subsoil) and *paleo-argillic* (reddish or reddish mottled clay-enriched subsoil - see paleo-argillic brown earths) sub groups.

7.1 Stagnogley soils have a distinct topsoil. They occur widely in lowland Britain, on tills and soft argillaceous rocks.

7.1.1 Typical stagnogley soils
7.1.2 Pelo-stagnogley soils
7.1.3 Cambic stagnogley soils
7.1.4 Paleo-argillic stagnogley soils

7.2 Stagnohumic gley soils have a humose or peaty topsoil. They are mainly upland soils intermediate between stagnogleys and peats.

7.2.1 Cambic stagnohumic gley soils
7.2.3 Paleo-argillic stagnohumic gley soils

8. Ground-water gley soils: These are soils, normally developed within or over permeable materials, that have prominently mottled or uniformly grey subsoils resulting from periodic waterlogging by a

fluctuating groundwater-table. There are seven groups and all are included the legend; within them are *typical* (non-calcareous subsoils); *calcareous* or *calcaro-* (calcareous subsoil horizon within 40cm depth); *pelo-* (clayey), *argillic* (with clay-enriched subsoil) and *sulphuric* (sulphuric subsoil within 80cm - see above) subgroups.

8.1 Alluvial gley soils are developed in loamy or clayey alluvium at least 30cm thick.

8.1.1 Typical alluvial gley soils
8.1.2 Calcareous alluvial gley soils
8.1.3 Pelo-alluvial gley soils
8.1.4 Pelo-calcareous alluvial gley soils
8.1.5 Sulphuric alluvial gley soils

8.2 Sandy gley soils are predominantly sandy and developed chiefly in aeolian or glaciofluvial deposits.

8.2.1 Typical sandy gley soils

8.3 Cambic gley soils are loamy or clayey, with no significantly clay-enriched subsoil.

8.3.1 Typical cambic gley soils
8.3.2 Calcaro-cambic gley soils
8.3.3 Pelo-cambic gley soils

8.4 Argillic gley soils have a clay-enriched subsoil

8.4.1 Typical argillic gley soils

8.5 Humic-alluvial gley soils are loamy or clayey alluvial soils with a humose or peaty topsoil.

8.5.1 Typical humic-alluvial gley soils
8.5.2 Calcareous humic-alluvial gley soils

8.6 Humic-sandy gley soils are similar to sandy gley soils but have a humose or peaty topsoil; they occupy low- lying sites or depressions and are intermediate between sandy gley soils and peats.

8.6.1 Typical humic-sandy gley soils

8.7 Humic gley soils are loamy or clayey, with a humose or peaty topsoil; they also occupy low-lying sites or depressions and are intermediate between cambic and argillic clay soils and peats.

8.7.1 Typical humic gley soils
8.7.2 Calcareous humic gley soils
8.7.3 Argillic humic gley soils

9. Man made soils. These are soils formed in material modified or created by human activity. They result from abnormal management practices such as the addition of earth containing manures or refuse, unusually deep cultivation, or the restoration of soil material following mining or quarrying. The soils are not subdivided below group level and of the two groups delineated, only one is not included in the legend.

9.2 Disturbed soils are mineral soils with a distinct surface horizon formed in at least 40cm of artificially displaced material.

10. Peat soils: These are predominantly organic soils derived from partially decomposed plant remains that accumulated under waterlogged conditions. Only two groups are distinguished and both appear in the legend. They are subdivided into *Oligo-* (moist pH<4.0); *Eutro-* or *Eu-* (pH>4.0 in some part); *fibrous* (mainly fibrous or semi- fibrous); *-amorphous* (mainly humified) and *sulphuric* (sulphuric subsoil within 80cm depth - see above) subgroups.

10.1 Raw peat soils are undrained organic soils that have remained wet to within 20cm of the surface, since their formation.

10.1.1 Raw oligo-fibrous peat soils
10.1.3 Raw oligo-amorphous peat soils

10.2 Earthy peat soils are organic soils, normally drained, with a well aerated and structured, relatively firm surface horizon containing few or no recognizable plant remains.

10.2.1 Earthy oligo-fibrous peat soils
10.2.2 Earthy eu-fibrous peat soils
10.2.4 Earthy eutro -amorphous peat soils
10.2.5 Earthy sulphuric peat soils

References

Avery, B.W. (1980) Soil Classification for England and Wales (Higher Categories). Soil Survey Technical Monograph No. 14. Harpenden.

Clayden, B. and Hollis, J.M. (1984) Criteria for Differentiating Soil Series. Soil Survey Technical Monograph No. 17. Harpenden.

Notes on national soil map legend

Certain soil associations are listed in capital letters. These are named after the soil series or groups that, with similar soils, form extensive, often dominant, components of most delineations. More variable associations are shown in lower case letters; they have a number of inextensive and dissimilar soils and are named after the series which characterise them best. Estimated percentage values are given, relating soil associations to the total surface of England and Wales, including principal urban and industrial areas, (as shown on the soil map), and inland water. The total area of England and Wales is 151,207km^2.

For further information, please visit www.landis.org.uk