

# Soil classification and mapping

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## Summary

- **Web-based access to information on your soil on your farm is described.**
- **Examples show you how soil is classified and mapped.**
- **Soil types are described and distribution of sands and loamy sands across Scotland are mapped.**
- **Some FAS/SRUC technical notes link P and trace element status with different sets of soil properties including parent material, texture and pedological drainage status.**

## 1. Introduction

Scotland's soils have been comprehensively surveyed, classified, and studied over the past 85 years. Understanding and using this information has been difficult in the past due to its complexity and the accessibility of information. The development of web based tools has changed this and The James Hutton Institute (<https://www.hutton.ac.uk>), who hold the National Soils Database for Scotland, have created the Soilfinder (<https://soilfinder.hutton.ac.uk>) website which allows you to access information on your soils. There are now separate apps for iPhone (<https://apps.apple.com/gb/app/soil-finder/id581872368>) and Android (<https://play.google.com/store/apps/details?id=uk.ac.hutton.sifss&hl=en&gl=US>) for you to find out what soil type is in your area, discover the differences in soil characteristics between cultivated and uncultivated soils, and also to examine a range of key soil properties.

This technical note can be used along with PLANET Scotland (<http://www.planet4farmers.co.uk/>), a software tool designed for routine use by Scottish farmers and advisers to plan and manage lime and nutrient use on individual fields. The Defra Nutrient

Management Planning Tool is on-going and will replace PLANET Scotland by 2025 and be free to use.

There is also on-going work that will make the information relevant to how we manage our soil daily. Some FAS/SRUC technical notes link trace element status with soil parent material, texture and pedological drainage status; and rates of phosphate fertiliser to build up and run down soil P status with a different set of soil properties. For more information, see <http://www.fas.scot/technical-notes/>

## 2. Soil classification

One key step in making use of soils information on your farm is to be able to understand how soil is classified and mapped. The Soil Survey of Scotland classifies soils within a hierarchy based on the dominant processes that form the soil and the degree of soil development.

When soils are arranged according to the dominant soil forming processes, the top level is called the

Division – examples of Divisions include Leached soils and Gleyed soils, whose distribution across the country is shown in figures 1a and 1b.

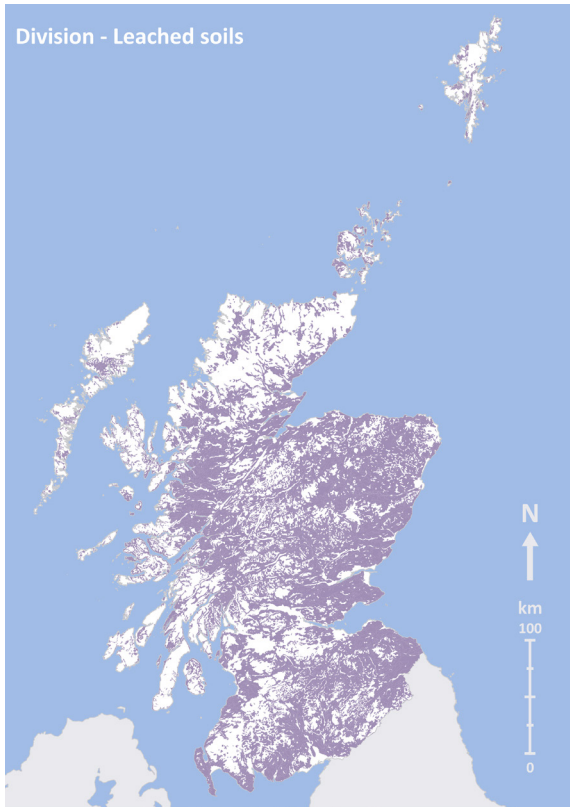


Figure 1a - Distribution of Leached soils across Scotland



Figure 1b - Distribution of Gleyed soils across Scotland

These soils are then subdivided into Major Soil Groups where soils are formed by similar processes and are at a similar stage of development. Examples include Brown Soils and Gleys. See figures 2a and 2b for examples of where they occur.

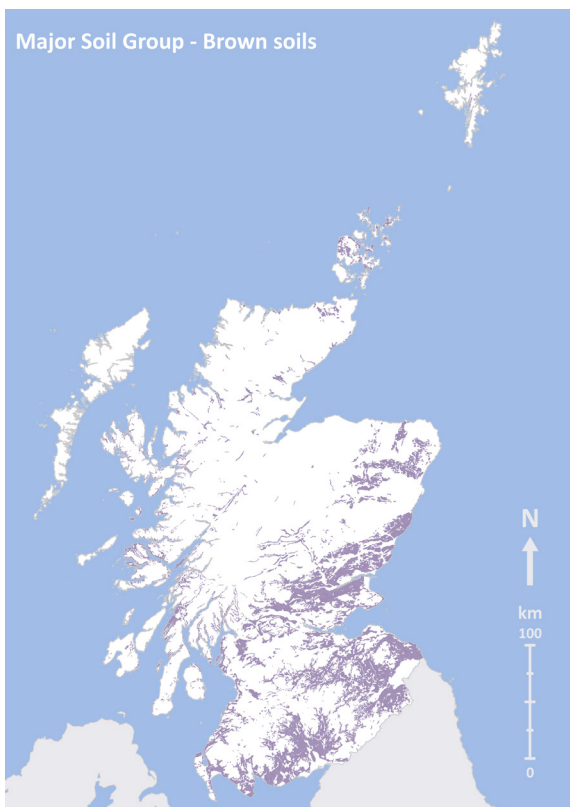


Figure 2a - Distribution of Brown soils across Scotland

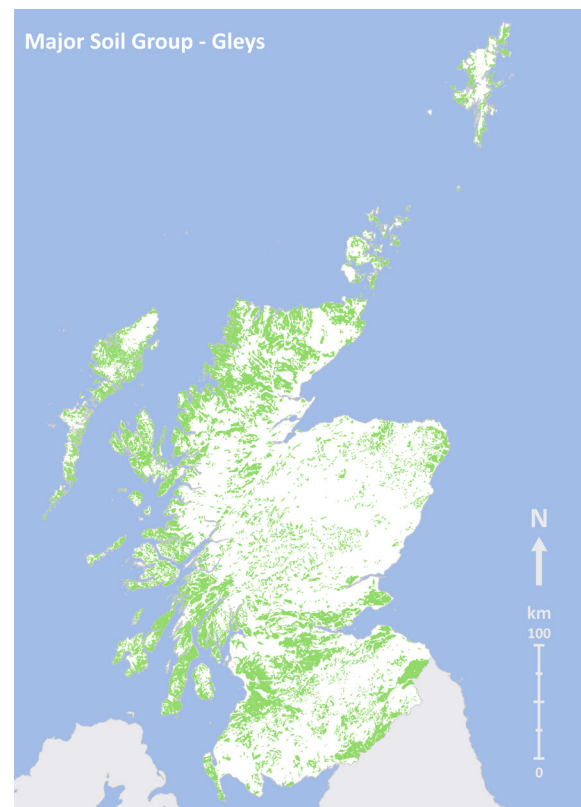


Figure 2b - Distribution of Gleys across Scotland

These are then classified into Major Soil Subgroups where the sequences of soil horizons (layers) are generally similar. Examples are Brown earths and Noncalcareous gleys, and pictures of these two contrasting soil types (figures 3a and 3b), as well as maps of their distribution across Scotland (figures 4a and 4b), are shown.



Figure 3a - Brown earths can be free or imperfectly draining, with a brown or reddish-brown colour. A dark-coloured surface A horizon (or Ah where h denotes enriched with humus) overlies subsoil (B) horizon(s) with distinctive brown or reddish-brown colours which gradually lighten as the organic matter and iron contents decrease with depth. Brown earths are amongst the most fertile soils in Scotland and are used extensively for agriculture. Significant growth rates of trees can be obtained within sheltered sites.



Figure 3b - Noncalcareous gleys are imperfect or poor draining soils where, due to waterlogging, the subsoil is deprived of oxygen causing iron compounds which normally give soils yellow or reddish-brown colours to change to ones which give the soil a grey or bluish-grey colour. In their natural state, noncalcareous gleys support a range of plant species often used for rough grazing or forestry. Drainage allows many noncalcareous (and some other mineral) gleys to be developed for agricultural, often as productive arable land or grassland for cattle. However, gleys with an organic layer at the surface – peaty gleys, which are extensive in NW Scotland - are of limited agricultural use.



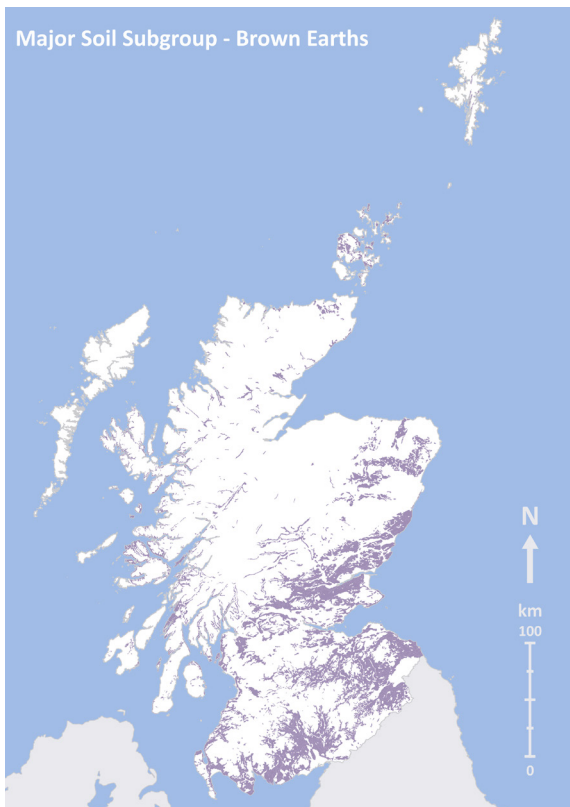


Figure 4a - Distribution of Brown earths across Scotland

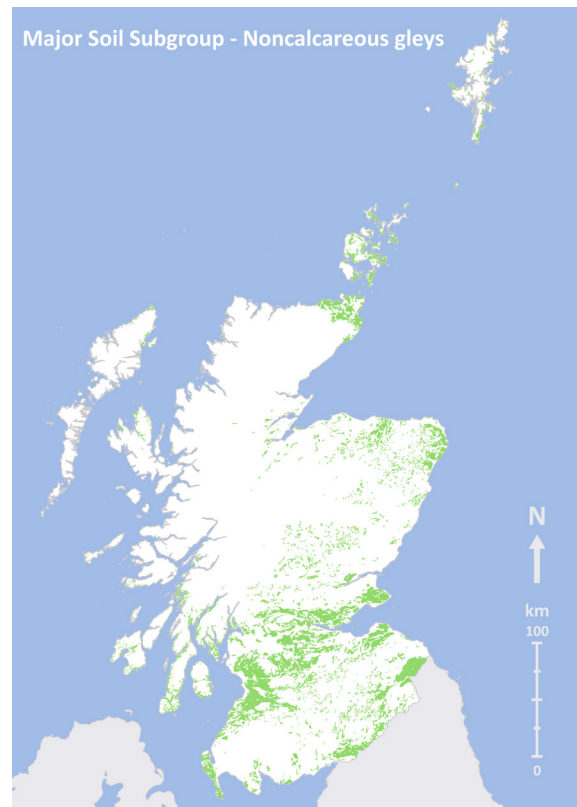


Figure 4b - Distribution of Noncalcareous gleys across Scotland

The final level in the hierarchy is the Soil Series where soils with a similar type and sequence of horizons are developed on similar parent material and are defined in terms of their natural drainage characteristics (free, imperfect, poor or very poor), their Major Soil Subgroup and their parent material. For more information on soil classification see <https://www.hutton.ac.uk/learning/soilshutton/soil-classification>

### 3. Soil mapping

In Scotland, the soils are relatively young and closely associated with local geology. Therefore, those Soil Series that have developed on the same parent material often have features in common such as soil texture or trace elements that have been inherited from that parent material. The soil maps group individual Soil Series that have developed on the same parent materials into Soil Associations reflecting early research into the effects of trace element deficiencies in crops and animals which are often closely related to the soil parent rock types.

Soil Associations are mostly separated based on the rocks from which the soil parent materials have been derived. For example, soils developed on drifts derived from Lower Paleozoic greywackes and shales are placed in the Etrick Association, whereas those on drifts derived from Carboniferous sandstones, shales and limestones belong to the Rowanhill Association – maps of their distribution are shown in figures 5a and 5b.



Figure 5a - Distribution of Ettrick soil association across Scotland

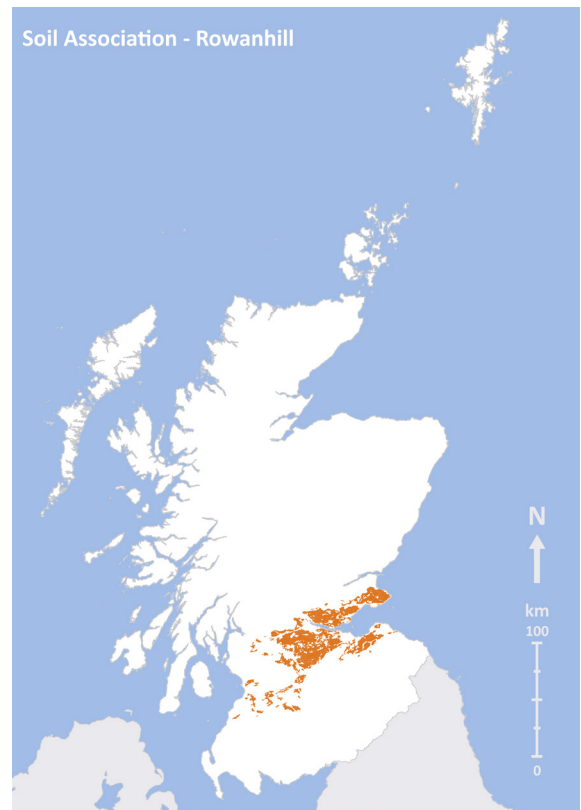


Figure 5b - Distribution of Rowanhill soil association across Scotland

Soil Series are typically named after the area in which the soil was first surveyed e.g. Linhope Series or Caprington Series (coverage shown in figures 6a and 6b respectively), and, due to the influence of the parent material, they are often very similar in terms of texture, depth, and mineralogy. There are over 800 separate series mapped in Scotland.

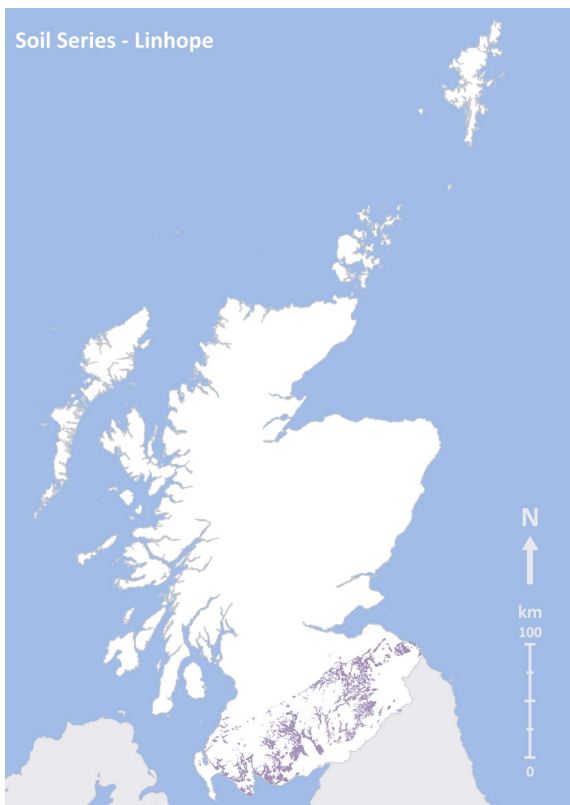


Figure 6a - Distribution of Linhope soil series across Scotland

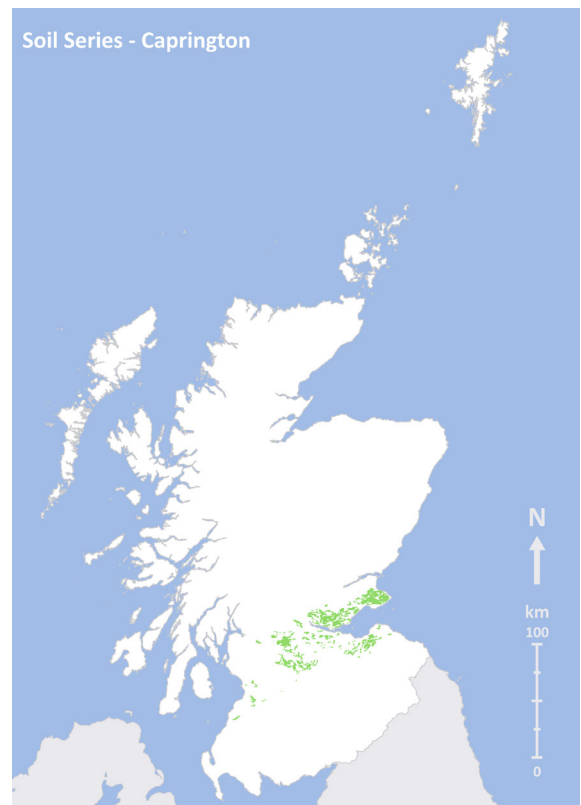


Figure 6b - Distribution of Caprington soil series across Scotland

## 4. PLANET Scotland software tool

In the PLANET Scotland software tool field-level records to meet Nitrate Vulnerable Zone (NVZ) compliance requirements and field-level nutrient and lime recommendations based on SRUC technical notes are provided. In the development of NVZ Action Programme Rules, it was agreed that leaching risk of nitrate diminishes from November on sandy soils but occurs for longer on heavier soils. A simplified approach to soil types is taken (Table 1), where mineral soils (<15% organic matter) are grouped into shallow soils (<40cm depth), sands, sandy loams, and other mineral soils. Soils with <15% organic matter are grouped into humose (between 15 and 35% organic matter) and peaty soils (>35% organic matter) which can be confirmed by laboratory analysis.

**Table 1. Soil category assessment**

Soil type	Description of soils within category	Properties
<b>Shallow soils</b>	All mineral soils which are less than 40cm deep.	Soils are less able to retain or supply N at depth.
<b>Sands</b>	Soils which are sand (S) and loamy sand (LS) textures to a depth of more than 40cm.	Soils have poor water-holding capacity and retain little N.
<b>Sandy loams</b>	Soils which are sandy loam (SL) texture to a depth of more than 40cm.	Soils have moderate ability to retain N and allow average rooting depth.
<b>Other mineral soils</b>	Soils with less than 15 percent organic matter that do not fall into the sandy or shallow soil category, i.e. silty and clay soils.	Soils can retain more N than lighter soils and allow rooting to greater depth.
<b>Humose soils</b>	Soils with between 15 and 35 percent organic matter. These soils are darker in colour, stain the fingers black or grey, and have a silky feel.	Soils can retain more N than mineral soils and have higher N mineralisation potential.
<b>Peaty soils</b>	Soils that contain more than 35 percent organic matter.	Soils have very high N mineralisation potential.

Note: the classification of soils based on organic matter content varies between systems – PLANET Scotland and the Soil Survey of Scotland classification (used in SIFSS) have different thresholds between classes.

‘Sands’ include soils which are sand and loamy sand textures. ‘Other mineral soil’ textures include sandy silt loam, silt loam and clay soils (>18% clay content). Example maps showing the distribution of sands and sandy loams nationally (figures 7a and 7b) are presented below.

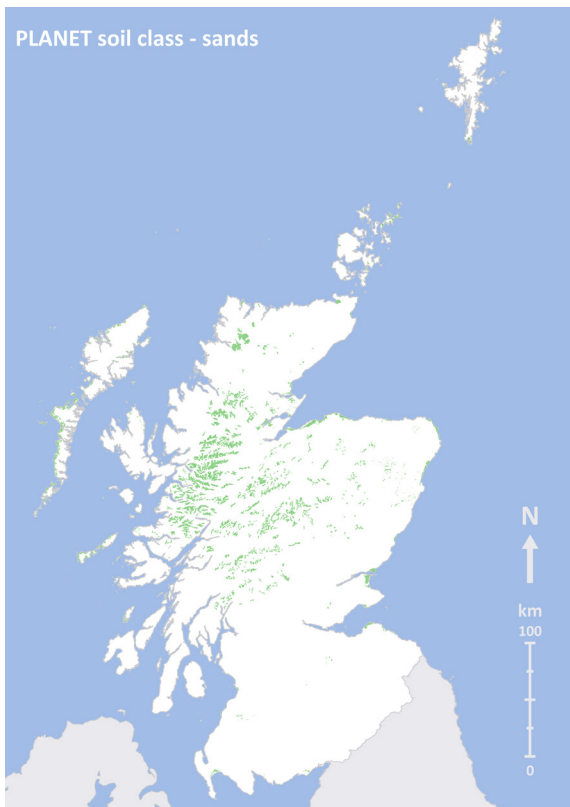


Figure 7a - Distribution of sand soils across Scotland



Figure 7b - Distribution of sandy loam soils across Scotland

In farming practice light soil is a term used to describe sands and sandy loams; medium soils include sandy silt loam and silt loam, while heavy soils are clay soils. These soil texture classes are described in section 5 in this technical note.

The soil profile should be assessed to rooting depth. Where the soil varies and more than one category occurs within a field, it may be practical to alter the rate of fertiliser N to suit the different soil categories. If this is impractical, and the field is to be treated uniformly, you should select the soil category that covers the largest part of the field. Shallow soils and sands have poor water-holding capacity and retain little N. Sandy loams and other mineral soils can retain more N than lighter soils and allow rooting to greater depth. Organic soils can retain more N than mineral soils and have higher N mineralisation potential. More details on how to use this N information is given in the appropriate Technical Notes on N application rates to different crops, available to download from the FAS or SRUC websites.

## 5. Soil texture

Soil texture, which is defined by the proportion of sand, silt and clay sized particles in mineral soils, cuts across major soil groups and sub-groups. For example, a cultivated podzol and a brown earth can both appear in the 'sandy loams' class. Soil texture can be determined in two main ways:

Laboratory analysis followed by classification using the texture triangular diagram. This diagram can be found on the AHDB website (<https://ahdb.org.uk/knowledge-library/how-to-determine-soil-texture>).

For most practical purposes texture classes of mineral soils can be identified by hand texturing by the method shown on the AHDB website on the same page as above.

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