

The Soils Lead Co-ordination Network has been set up by the JNCC to carry out the special functions with respect to soils, and involves specialist staff in the three country agencies and the JNCC support unit and EHS in Northern Ireland.

## Soils and the Natural Heritage: a Vision by the Soils LCN for the Protection of the UK Soil Resource and Sustainable Use of Soils

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### Summary

1. The Soils Lead Coordination Network (LCN) vision for soil conservation is to ensure the sustainable use of UK soils for the benefit of habitats, species, landscapes and society, and to safeguard the diversity of the UK's soils. Fundamental to this vision is a recognition that soils are valued both for their functional roles and for the diversity of their intrinsic physical, chemical and biological features.
2. Desired long-term outcomes are: (i) maintaining the diversity and biodiversity of UK soils; (ii) controlling and when appropriate reversing loss of soil carbon and water-holding capacity; (iii) reducing accelerated soil erosion and sediment transport into watercourses; and (iv) ensuring appropriate status of soils in mitigation and remediation scenarios to control the impact of climate change. These outcomes will support the delivery of JNCC's 'desired long-term outcomes' for ecosystems, landscapes, habitats and species. They will also contribute to the development of national strategies for soil protection in Scotland, England, Wales and Northern Ireland and the implementation of the European Soil Framework Directive.
3. Through working in partnership with the country agencies and others, the Soils LCN aims to ensure the protection and enhancement of the extent and quality of the UK soils resource and to mitigate harm to soils from the impacts of

anthropogenic and natural pressures and threats on terrestrial and water habitats.

4. Key requirements in delivering the aims and objectives are raising awareness, the application of scientifically sound evidence and better integration of soil interests into wider environmental and socio-economic policies.

## Introduction

5. This paper outlines the Soils Lead Coordination Network (LCN) vision for soil conservation in the UK. It defines long-term aims and outcomes for soil conservation from a natural heritage viewpoint and identifies short- to medium-term objectives and possible activities for the LCN and in partnership with others. It is intended as a working document for wider discussion.
6. The Soils LCN was established by the Joint Nature Conservation Committee (JNCC) to promote and co-ordinate a common approach to soil conservation issues in the UK. In particular, its role is to co-ordinate the work of the country agencies on soils, represent JNCC and the country agencies in dealing with Government, other agencies and NGOs involved in soils issues at a UK level, and provide advice and information to the country agencies on European and UK soil strategy and current knowledge about soils.
7. The proposed EC Soil Framework Directive under the Soil Thematic Strategy (2006) is currently driving the development of soil protection policy in the UK. This is reflected in the progress of national soil strategies in England, Scotland and Wales and the development of a UK soil monitoring framework. Of particular interest for JNCC and the country conservation agencies are the conservation of soils for their intrinsic nature and values, their role in supporting the delivery of ecological and environmental goods and services, and their value as a carbon sink. JNCC also recognises the need for better integration of soils issues into UK environmental, social and economic policies and actions. By supporting strategic activities in these areas, the LCN will help to deliver sustainable management of soil as part of the natural heritage and enhance our understanding of the interactions among soils, habitats and people under a changing environment brought about by climate change and socio-economic pressures.
8. As part of the Strategic Vision project, JNCC is also developing 'desired long-term outcomes' for UK nature conservation over a 25-50 year timeframe. In the proposed framework, the outcomes for air, water and soils are intended to deliver the outcomes for ecosystems, landscapes, habitats and species.

## A vision and 'desired long-term outcomes' for soil conservation

9. The Soils LCN vision for soil conservation as part of the natural heritage is to **ensure the sustainable use of UK soils for the benefit of habitats, species, landscapes and society, and to safeguard the diversity of the UK's soils.**

10. Fundamental to this vision is a recognition that soils are valued both for their functional roles (e.g. support to habitats and species, provision of ecosystem services) and for the diversity of their intrinsic physical, chemical and biological features. Also implicit is the recognition that soils are by definition finite non-renewable resources that are essential to life.

11. The 'desired long-term outcomes' for soils are:

- **Maintaining the diversity and biodiversity of UK soils**

The range of soil types characteristic of the UK's geology, geomorphology and semi-natural vegetation are conserved and managed so as to maintain their geodiversity, their natural characteristics of ecosystem function capability, and their characteristic biodiversity, including the biodiversity of microbial communities.

- **Controlling and when appropriate reversing loss of soil carbon and soil water-holding capacity**

UK peatlands and organic soils are managed so as to avoid erosion due to overgrazing, burning and drying out in order to support carbon sequestration and water retention; damaged and degraded peatlands are restored to an active peat-forming state where natural conditions allow; no further extraction of peat occurs. The soils of semi-natural habitats, and of grazed vegetation, are managed so as to maintain and restore their characteristic organic content.

- **Reducing accelerated soil erosion and sediment transport into watercourses**

Agricultural and forest lands are managed so as to avoid accelerated soil erosion and soil transport by water or wind, including transport into watercourses in order to maintain soil fertility, and avoid siltation of freshwaters and reduce carbon losses. Soils under all forms of land use are managed so as to enhance their carbon sequestration.

- **Ensuring appropriate status of soils in mitigation and remediation scenarios to control the impact of climate change**

The role of soils and soil functions, and their potential responses to climate change, are fully appraised in habitat management and restoration, and in other measures adopted to mitigate the impacts of climate change.

12. These outcomes will also support the delivery of JNCC's 'desired long-term outcomes' for ecosystems, landscapes, habitats and species. In particular, soils are closely linked to:

- maintaining the desired oxygen-producing and carbon-removing capability of land areas, and the desired contribution to these of the main habitat types;
- maintaining landscapes/ecosystems to perpetuate (where necessary restore) their biodiversity, geodiversity, historic and cultural values, and to ensure these landscapes/ecosystems are valued by people and are able to support them economically;

- maintaining (and restoring) landscapes/ecosystems capable of supplying an optimal range of ecosystem services, and which enable natural processes and dynamism to operate;
- maintaining (and restoring) the connectivity and permeability of landscapes and ecosystems, so that their components support species, the viability of species populations and their ability to adjust to climate change;
- managing urban environments sustainably and enhancing the quality of life in towns and cities;
- maintaining the extent and favourable quality of semi-natural habitats, and supporting habitat restoration;
- achieving habitat mosaics needed to support the range of species populations;
- maintaining (and restoring) species diversity as viable populations through functioning ecosystems.

13. At a strategic level, the outcomes of the LCN's activities will also contribute to:

- supporting the development of national strategies for soil protection in Scotland, England, Wales and Northern Ireland; and
- supporting the implementation of the Soil Framework Directive in the statutory and regulatory systems of England, Wales, Scotland and Northern Ireland.

In turn, influencing these strategic developments will also help to deliver the LCN's and JNCC's desired outcomes.

## **Soils: a functional approach**

14. The word 'soil' means different things to different audiences. For most people it is just dirt or mud under their feet; for farming communities it is the basis for their livelihoods; for planners and developers it can be overburden or spoil; for engineers it forms the physical foundation for buildings and infrastructure. In practical terms, soil is generally defined as the top layer of the Earth's crust. It is formed by mineral particles, organic matter, water, air and living organisms. Soil is an extremely complex, variable and living medium. It forms a complex habitat for macro- and micro-organisms and there is more biodiversity in soils than in any other terrestrial ecosystems.

15. Soils in the UK cover most of the natural terrestrial world and form the foundation of all terrestrial ecosystems, supporting key processes in biomass production and mass exchange with atmospheric and hydrological systems. Conventionally, soils are recognised as providing six broad functions:

- a. **environmental interactions:** soils form a crucial link between the atmosphere, underlying geology, water resources and land use; they filter substances from water and intercept particles from the atmosphere; they remove and emit gas from the atmosphere (including the suite known as greenhouse gases); they can store carbon; and they regulate the flow of

water from rainfall to aquifers and surface water sources, vegetation and back to the atmosphere;

- b. **support of ecological habitat and biodiversity:** soils determine the nature and distribution of life; they form the basis for terrestrial ecosystems and supply water and nutrients; they form the growing medium for roots, a repository for storage of the seed bank and a habitat for soil macro- and micro-flora and fauna;
- c. **food and fibre production:** soils act as a growing medium for food crops and non-food uses such as biomass, fibre, pharmaceuticals and timber, and are the basis for livestock production;
- d. **providing raw materials** such as sand, gravel, peat, topsoil and stored water;
- e. **providing a sound platform** for development and human activity: roads, houses and other built structures; and
- f. **preservation of cultural heritage:** storing and protecting archaeological remains and cultural landscape and also evidence of environmental change.

16. A holistic understanding of soil functionality in any location requires an accurate assessment of the current status of the soil, the drivers of change to the soil status (e.g. land use change and climate change), the threats/risks to soil (e.g. contamination, planning development, loss of biodiversity, coastal realignment and coastal squeeze) and the impact of stress and the response of soil (linked to soil resilience and resistance). Because of the complexity of the soil system, the high diversity of soil types and properties and our incomplete understanding of the processes governing soil ecological and environmental services, the role and value of soil are rarely viewed in a holistic manner but usually reflect the sectoral interests of the users.

17. Discussions between JNCC and the country conservation agencies have emphasised the importance of soils in relation to:

- supporting and enhancing favourable condition of features of nature conservation interest on designated sites;
- maintaining the 'geodiversity' of soil resources in protected areas and the wider countryside;
- understanding the impact of climate change, land use and other anthropogenic pressures; and
- understanding the role of soil in the sustainable management of the natural heritage.

18. This emphasis on the functional approach does not mean that we neglect the intrinsic value of particular soil types nor of specific soil species. There are, however, significant practical barriers, both to do with the costs associated with soil survey and outstanding issues about the definition and assessment of soil conservation values and the widespread identification of soil types or soil species as special features for notification, even when considering soil within existing

Sites of Special Scientific Interest (Areas of Special Scientific Interest in Northern Ireland).

- a. Particular soil types could, in principle, be considered for notification as special features on the basis of the rarity or representativeness of their soil profiles. This information could be derived from soil survey data and maps. However, because of the spatial variability and complex dynamics of soil profile development and the limits imposed by the resolution of existing soil maps, it would be a major undertaking to identify and draw accurate boundaries around features of interest, because of the need for extensive additional field investigations.
- b. The intrinsic value of individual soil species is even more intractable. Soil biota vary in size from a few  $\mu\text{m}$  to a few cm, with the density of individuals ranging from a few millions of individuals per  $\text{cm}^2$  for micro-organisms (bacteria, fungi) to a few individuals in a handful of soil for large invertebrates (earthworms). Despite progress in molecular technology, only partial inventories of soil biodiversity have been produced at any given site and there is still limited understanding of the role and importance of most individual species or groups of organisms. At present, therefore, and for the likely foreseeable future, it is not practical to undertake an assessment of sites for soil biota based on taxonomic diversity.

19. Our approach to soil conservation also extends beyond existing soil functionalities and embraces potential benefits of restoration of degraded soil resources or changes in primary function delivered by soil ecosystems. Management decisions appropriate to both current and potential future soil functionality are difficult to achieve and often rely on identifying acceptable trade-offs between the interests of the various users of the wider countryside as well as allowing for acceptable trade-offs between various aspects of natural heritage conservation.

## **Aims and working principles**

20. The Soils LCN aims to ensure the protection and enhancement of the extent and quality of the UK soils resource and to mitigate harm to soils from the impacts of anthropogenic and natural pressures and threats on terrestrial and water habitats. This will be achieved through working in partnership with the country agencies and others to address three key requirements to:

- raise awareness among soil stakeholders and the general public of the essential roles and functions of soils in the UK;
- promote the need to adapt our conservation objectives to existing or new challenges/drivers based on scientifically sound evidence on the status, pressures, threats and impacts on UK soils, their functionality and their interactions with habitats and landscape; and
- support the delivery of better integration of soil interests into wider environmental and socio-economic policies.

21. The effective delivery of our vision and aims will be guided by the following working principles:

- consideration of the threats to and the sustainability of soils in terrestrial ecosystems through better understanding of soil and soil biodiversity processes and their roles in delivering ecological goods, land productivity and environmental services;
- promoting understanding of the linkages of soil issues with other conservation agendas in response to anthropogenic and natural changes and adoption of precautionary approaches as appropriate, especially when land management and practices change;
- promoting a risk-based approach to soil use and sustainability for targeting conservation activities;
- appropriate use of mitigation and remediation strategies in response to pressure from land use and management changes or climate change;
- working with partners to develop collaborative approaches to soil protection, and influencing partners' own strategies and policies;
- promoting appropriate access to soil and environmental data and information; and
- promoting linkages between soil research and strategy in the country agencies to support the development of best practice.

## **Specific objectives for the Soils LCN and possible short-term (5 years) activities**

22. The Soils LCN objectives should not replace country-level soils conservation objectives. The Soils LCN remit covers issues related to the coordination of UK and international soil outcomes and promoting the use of comparable and quality standards for the delivery of soil advice, information and reporting required for implementation of environmental policies and the delivery of present and likely future UK and EU reporting obligations.
23. For the Soils LCN to deliver its reporting and promoting remit, two key objectives need first to be achieved. First, we need better access to soil information and resources, and second, we need to use this information to enhance our understanding and knowledge of the relationships between soil, habitats, landscape and people.

### **Objective 1: Taking stock of existing soils information and resources**

24. Existing and newly commissioned soil information resources are held by a range of UK non-governmental public bodies, research institutes and private institutions. Some Soil Survey data are only available in hard copy; other data are accessible through GIS. Soil Survey data and its derived datasets were collected using different classification and representation systems in Scotland, England & Wales and Northern Ireland. This does not facilitate comparison and exchange of data between countries and linkage with other environmental and ecological datasets. Also, many soil data have only been published as grey literature and data sources are too often not straightforwardly useable for other

purposes or simply not freely available. Agreements covering the licensing and access to soil data by conservation agencies vary between the countries.

25. The lack of consistency in the quality of soil data and the difficulty in accessing data means that a large amount of soils information is unused. Better knowledge transfer procedures are required for both new research outcomes and interpretation of existing soil information.
26. While a long-term goal is a soil equivalent to the NBN gateway, in the shorter-term the LCN will support action to promote better access to existing data held in different countries and promote knowledge transfers of soil research outcomes and dissemination of information at the UK level (e.g. through MAGIC / SSKIB).

### **Possible Soil LCN activities and outcomes**

27. There are two strands to the LCN effort to achieve better access and use of soil data. The first is to enhance access to soil information; the second is to improve its dissemination and linkages with NBN and other natural heritage datasets.

#### Securing access to datasets

28. Requirements for access to soil information have changed considerably in the past few years, moving away from paper sources to web-based and interactive media. The LCN will support efforts by the country agencies and JNCC to secure better access to soil and other environmental data for:
  - user-friendly interfaces (guidance, GIS, Web-based) which deliver an appropriate level of information aggregation for routine on-the-ground conservation activities and special functions (e.g. trends reporting);
  - auditing UK soil datasets, first to assess the quality and reliability of information, and second to assess the natural variation in the range of soil properties associated with different habitats.

#### Dissemination of information

29. The LCN does not have the capacity to undertake on its own the development of tools for soil information dissemination. A better use of our limited resources is to work in collaboration with other partners and to identify targeted information requirements for access to soil and natural heritage data. In particular, the LCN will:
  - Identify the nature conservation requirements for access to soil information at a UK level, which will enable/facilitate the comparison of spatial and temporal trends of multiple features of interest (e.g. soils, birds, vegetation, carbon). This will enable analysis for reporting on issues such as natural trends, favourable conservation status (FCS) of habitats and climate change targets. We will focus particularly on liaison with other habitat LCNs to support information gathering on soil/habitat interactions.
  - Test and further develop the tools for the assessment of soil conservation value, including broader soil functionalities.
  - Promote the concept of soil conservation value and its uptake by partners.

- Link / advise conservation agency work on the gathering and dissemination of information on the state and threat to soils in designated sites (FCS) to identify UK relevant issues (climate change / air pollution).

**Objective 2: Filling knowledge gaps on habitat/soil interactions for management and practical applications**

30. Soils research has too often focused on the delivery of single-process objectives, such as enhancing food and biomass productivity, with little consideration of the overall dynamics of soil ecosystems.
31. A considerable amount of information on the physical and chemical aspects of soil is available for specific habitats and land uses (organic farming, upland, arable, forestry) and has been used to develop and promote best practice. However, much less is known about soil biodiversity and soil properties in a wider range of natural and semi-natural habitats.
32. The NERC/BBSRC Soils Research Advisory Committee<sup>1</sup> has identified the key target for soil research as the need “***to understand soil system dynamics - develop a mechanistic and predictive understanding of how soils function, consistent with knowledge of other components of the Earth, such that we can manage them optimally in ecological, production and socio-economic terms.***”
33. The challenge for the Soils LCN is to support the development of suitable tools for better understanding soil ecosystems linked to: a) an appropriate conceptualization of soil and environmental ecosystems; and b) the better integration of soil into research and policy strategy. This will also contribute to the development of suitable tools for better management of soil ecosystems based on sound scientific evidence, including issues such as the potential thresholds, targets and trigger values of soil properties for soil type and habitat combinations.

**Possible Soil LCN activities and outcomes**

*Understanding and safeguarding the diversity and functionality of soils to ensure the provision of ecosystem goods and services to support and enhance long-term favourable condition of special features of nature conservation interest (in statutory designated sites and the wider countryside)*

34. The Soils LCN will promote integrated approaches between country agency projects on soil conservation and identify added value at a UK level, where appropriate. In particular, the LCN will:
- provide specific guidance for priority habitats (country-level activities following an LCN blueprint);
  - support the FCS process and other EU reporting;

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<sup>1</sup> <http://www.iger.bbsrc.ac.uk/SRACWorkshop/welcome.htm>.

- review information available and analyse relationships between type / range / threshold of soil properties and habitats (NVC, Corinne);
- develop and prioritise a programme of commissioned research;
- promote a wider understanding of the importance of soils.

35. Working in partnership will ensure that soil issues can be integrated into other policy areas and will support development of soil good practice codes and guidance for the benefit of people and the environment. In particular, the LCN will:

- review the possibility for landscape characteristic assessment to include soil type;
- review the role of soil in the planning process;
- compile information to support a review of the evidence base for the impact of Tier III/ HLS level activities on soil conservation.

*Understanding the impact of climate change, land use and other anthropogenic pressures on soil and land (not LCN lead)*

36. Climate change is potentially a driver of a broad range of environmental and ecological changes. Soil properties and functions will respond to the direct impacts of climate change (e.g. changes in temperature and water content which could affect biodiversity, biochemical processes, nutrient cycles and environmental functions). Indirect changes in land use and management arising from climate change may also affect soil quality (e.g. conversion of marginal land into cropping for food and biomass, changes in pest distributions and encroachment of exogenous species). Soil changes will also contribute to climate change, for instance when carbon dioxide is released through the erosion or oxidation of organic soils. In particular, the LCN will:

- promote collaborative work with other LCNs;
- support initiatives by other partners on organic soil, greenhouse gases and energy /biomass policy;
- review interactions between organic soil and habitats and their response to climate change;
- develop and promote soil mitigation and restoration strategy (LCN to lead on this).

*Promoting awareness of the role of soil in supporting and delivering sustainable management options for the natural heritage*

37. This activity should build on specific outcomes of Objective 1 and target inter-agency networks, country agencies and wider soil stakeholder communities in the development of common standards and quality control of routine conservation activities. In particular, the LCN will:

- influence UK partners policy to adopt soil nature conservation values;

- promote educational and information material promoting sustainable use of soil for benefit of habitats and people.

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