This Soil Alert draws attention to the necessity of understanding the characteristics of the soils of a riparian wetland, especially their hydrology and texture, before implementing a project to restore its functionality.

Soils developed in marine alluvium, which occupy broad current or former coastal areas, are not included here, but are covered the Soil Alert for *salt affected soils*.

Riparian land (adjoining a river channel) is mainly on a floodplain. This location controls the hydrological properties of the soil, being predominantly of groundwater supplemented by intermittent, mainly seasonal, periods of flooding when river discharge exceeds the capacity of the channel and excess water spreads onto the floodplain. When surveying these wetlands, adjacent footslopes may also be included where strong groundwater discharge takes place from springs and seepages.

Figure 1 Improved pasture on the floodplain of the River Ivel in Bedfordshire

Floodplains – the clue to their natural functioning is in the name! In their undisturbed condition, floodplains perform a variety of important functions both on-site and up- and down-stream. Benefits include nature conservation, flood risk reduction and water quality regulation and improvement. However, in many areas this natural functioning has been degraded or eliminated by a variety of interventions including artificial drainage, straightening of the river channel, and the construction of flood-protection embankments to enable the cultivation and cropping of floodplain soils.

In any plans developed for the restoration of natural functioning of a floodplain, it is important to understand the distribution and properties of its soils.

Understanding the hydrology of floodplain soils is a key factor in devising appropriate management to achieve target objectives. In most cases a fluctuating groundwater table occurs, though it can remain at depth in the profile in elevated locations such as levees, even in the winter. Flooding of the ground surface from the river channel contributes surface water unless the site has been protected from inundation by the creation of flood defence embankments. Surface water can also flood the ground from tributaries entering the main

channel, or from artificial drainage ditches. See also Soil Alert for *soils affected by groundwater*.

Though the boundaries of floodplains can often be easily identified, their component soils can be many and varied. Soil texture and colour relate to the source of alluvial material from the upstream catchment. Small-scale variations in surface height (micro-relief) result from past floodplain development processes leading to abandoned channels, ox-bow lakes, backlands, point-bar ridges, and swales. The driest (brown alluvial soils) are usually found towards the river channel, sometimes associated with elevations such as levees. Backlands occupy the lowest ground, often at the back of the floodplain at some distance from the river channel. Here soils remain wettest for longest and are often peaty-topped, or even with deeper peat, supporting marsh or fen plant communities. Narrow valleys, particularly in upland catchments, may have little or no drier levee and the soils are typically gleyed throughout.

Groundwater gley soils in alluvium offer the greatest opportunity for water-quality improvement through nitrate removal by the process of denitrification. This can be particularly important where run-off from valley sides is nutrient-rich from intensive agricultural management. Nitrate in soil water is removed by conversion to nitrous oxide gas under the anoxic conditions of waterlogged soil. This nitrate-reduced groundwater may subsequently move through a gravel substratum to the river channel.

On the National Soil Map of England and Wales, floodplain soils with the greatest potential to act as riparian wetlands are where alluvial gley soils are the most common, and are found in the following soil associations:

811a Enborne, 811b Conway, 811c Hollington

812a Frome

813a Midelney, 813b Fladbury 1, 813c Fladbury 2, 813d Fladbury 3, 813e Compton,

814a Thames

Land use on these soils is frequently less agriculturally productive due to persistent wetness and the difficulties of establishing effective artificial drainage (except where pump-drained) due to a lack of fall (sloping ground) on floodplains, and the risk of frequent flooding from the river channel. Where pump-drainage with ditches has been established and flood risk is low, high value arable cropping takes place in drier eastern areas of the UK, while improved pasture for grazing and silage making predominates in the wetter west.

Much of this undrained or less intensively drained land is in permanent pasture, often rushy, and used for stock-rearing and some dairying. The benefit of these wetter soils is in terms of greater grass production during drier summer months when plant growth is limited elsewhere by seasonal droughtiness.

There is some debate about whether flooding from the river channel of naturally well drained soils (typical brown alluvial soils) or those experiencing only slight seasonal waterlogging (gleyic brown alluvial soils) from groundwater should qualify as wetland. These would be in the following soil associations:

561a Wharfe, 561b Teme, 561c Alun, 561d Lugwardine

In these cases, while most of the floodplain has better natural drainage, waterlogging is concentrated in depressions such as former channels, oxbows, swales and backlands, which can form important wetland components within drier, often more intensively managed land.

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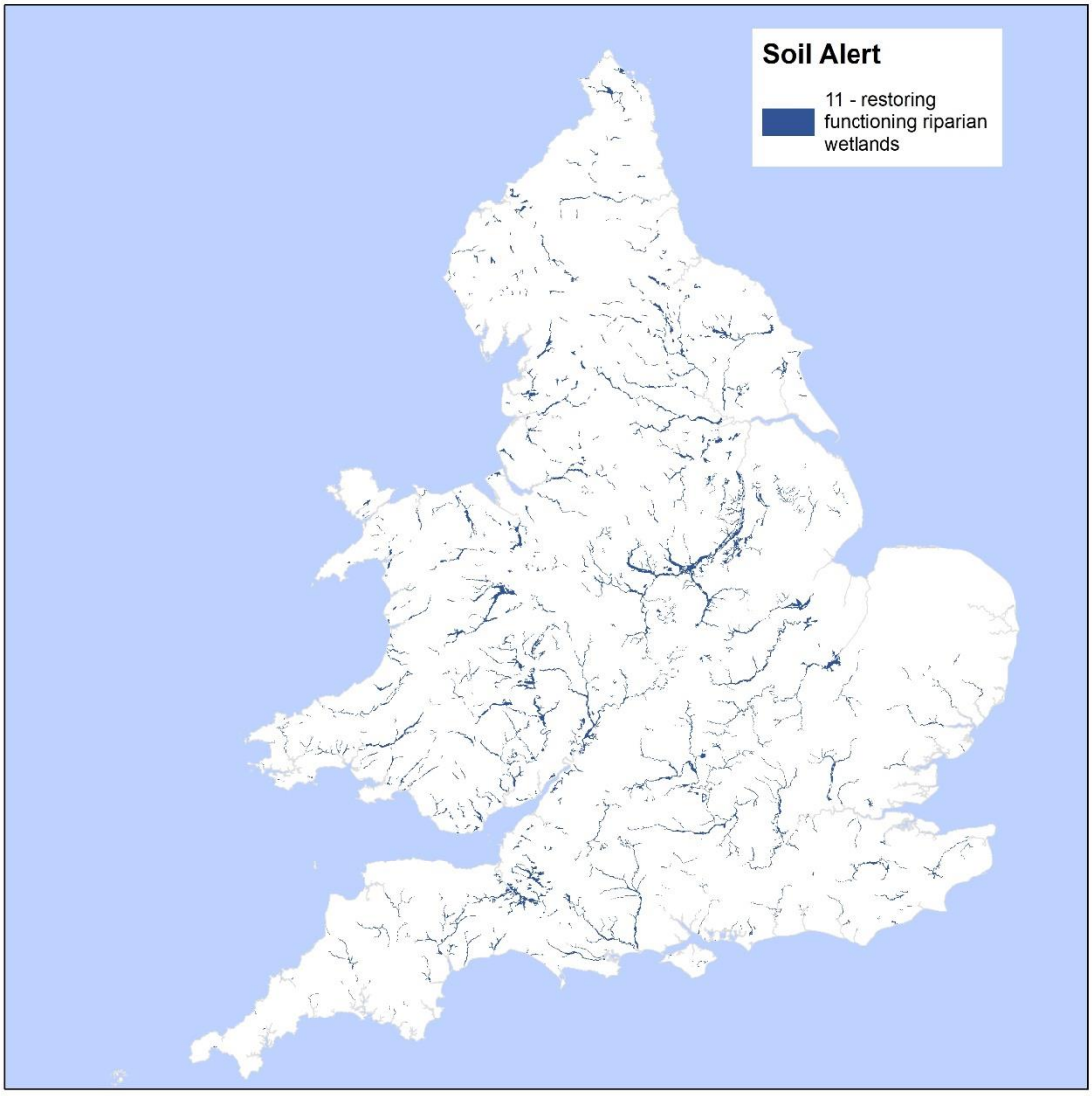

Figure 2 Distribution of riparian soils in England and Wales

Soil series affected by this alert:

5.61 ALUN
5.61 BEACH BANK
5.61 LLANDEILO
5.61 LLANGADOG
5.61 LOLHAM
5.61 LUGWARDINE
5.61 POWICK
5.61 TAVY
5.61 TEME
5.61 WALFORD
5.61 WHARFE
8.11 BLACKWATER
8.11 BLITHE
8.11 CONWAY
8.11 DOLPHENBY
8.11 ENBORNE
8.11 EVERSLEY
8.11 HOLLINGTON
8.11 KETTLEBOTTOM
8.11 RACTON
8.11 TREGARON
8.12 FROME
8.12 WITTERING
8.13 COMPTON
8.13 FLADBURY
8.13 MIDELNEY
8.13 STIXWOULD
8.14 EARITH
8.14 MAX
8.14 THAMES
8.14 WINDRUSH

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Figure 3 River Test's floodplain in Hampshire managed to maintain quality of trout stream

Ecosystem functioning of wetlands.

The framework for ecosystem services, derived under the Millenium Ecosystem Assessment (MA 2005a), indicates the wide range of benefits available for human well-being from natural ecosystems. Soils are a key component in the functioning of these systems to deliver goods and services of environmental, social, and economic benefit. These benefits are categorised broadly (2005b) as:

Provisioning (*e.g.* food, fresh water, and fibre)

Regulating (*e.g.* groundwater and surface-water interactions, removal of particles and excess nutrients, flood control)

Cultural (*e.g.* recreation and education)

Supporting (*e.g.* sediment trapping, accumulation of organic matter and nutrient cycling)

Many wetlands may seem to be little more than small patches of wet ground, often subject to piecemeal artificial drainage, though their cumulative value as wetlands may be significant, depending upon their location within a catchment, especially in headwaters where wetlands often occupy valley heads or bottomlands lacking floodplain development. However, most of these small areas are overlooked by wetland inventories. The value of small-scale wetland systems is discussed in Blackwell and Pilgrim (2011).

Management opportunities

In the restoration of floodplain functioning, there will invariably be a trade-off among the many benefits any wetland can deliver. For example, increased wetness will reduce grazing density but will aid biodiversity and nitrate removal. Target objectives should balance likely benefits and losses with appropriate planning and careful implementation.

Figure 4 Low density grazing beside the River Bure in Norfolk with a managed high watertable

Ahead of riparian wetland restoration work, it is important to determine whether more detailed soil surveys are available for consultation, or if not, to carry them out in order to map the extent and location of soil types, especially with regard to wetness categories and textures across the floodplain of interest. Restoration work may include the re-engineering (wiggling) of former channel courses, often identifiable from historic maps or current vegetation patterns, together with wetter soil profiles identified by detailed soil surveys.

The extent and distribution of soils developed in river alluvium shown on the National Soil Map are those of larger river systems; smaller scale systems are shown on more detailed published 1:25,000 maps, or may require specific project-focused soil surveys.

References

Blackwell, M.S.A. and Pilgrim, E.S. (2011). Ecosystem services delivered by small-scale wetlands. *Hydrological Sciences Journal*, 56:89 1467-1484.

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