Forest Research

LOWLAND NEUTRAL GRASSLAND
Creation and management in land regeneration

Pete Harris, Alex Brearley and Kieron J. Doick

BPG

NOTE 17

Best Practice Guidance for Land Regeneration

(Photo: © Rosie Harris)

Introduction

Neutral grasslands occur throughout the UK on soils where the pH is within the range 5 to 6.5. Sometimes referred to as mesotrophic grasslands, they are characterised by vegetation dominated by grasses and herbs (Figure 1). The term 'neutral', although indicative of soil pH, is more correctly descriptive of the species assemblage being neither markedly 'calcifuge' (thriving in acid soils) nor 'calcicolous' (thriving in lime-rich soils). Most neutral grasslands occur below the level of agricultural enclosure and are thus considered 'lowlands'.[1] They include grasslands which are cut for hay and pastures where livestock raising is the main land use. Nutrient input is generally low, which helps maintain the neutral pH balance. Neutral grasslands may also be found on roadside verges, disused railway lines and golf courses, and in churchyards.

The National Vegetation Classification (NVC) describes 12 types of unimproved and semi-improved neutral grassland (MG1 to MG13; Rodwell 1992). The JNCC (2011) reports that unimproved neutral grassland habitat has declined by up to 95% in the 20th century, almost entirely due to changing agricultural practice, with less than 15 000 ha estimated to be surviving in the UK today. Where land regeneration and habitat creation are priority objectives, semi-improved neutral grassland is more commonly occurring, and is more relevant, than unimproved neutral grassland types. This guidance note reviews the essential considerations and practices for establishing neutral grasslands on reclaimed land.

Figure 1 An example of an MG6 neutral grassland *(Photo: © Rosie Harris)*

Defining features of neutral grassland

Semi-improved neutral grassland is defined as:

> *Neutral grassland that has had some agricultural improvements made to it, such as drainage or some fertilisation, but where botanical interest is maintained through a mixed sward.* (Rackham, 1986)

Neutral grassland communities have few diagnostic indicator plant species, unlike acid or calcareous grasslands. Species richness depends on whether the location is unimproved or semi-improved and with local factors such as management, underlying geology, precipitation levels and microclimate. The principal characteristics that make neutral grassland distinct from agriculturally improved grassland are the less lush sward, greater range of taller grasses and herbs and in general a Perennial Rye-grass (*Lolium perenne*)[2] cover of less than 25%. Table 1 presents some of the more commonly occurring species.

In collaboration with

agb ENVIRONMENTAL

[1] Lowland is defined as land below the level of agricultural enclosure. The altitude at which this occurs varies across the UK, typically becoming higher as one travels south.

[2] Nomenclature follows Stace (2010) throughout.

Table 1 Commonly occurring neutral grassland species.

Common name	Scientific name
Common Bent	*Agrostis capillaris*
Meadow Foxtail	*Alopecurus pratensis*
Sweet Vernal-grass	*Anthoxanthum odoratum*
Common Knapweed	*Centaurea nigra*
Crested Dog's-tail	*Cynosurus cristatus*
Cock's-foot	*Dactylis glomerata*
Lady's Bedstraw	*Galium verum*
Oxeye Daisy	*Leucanthemum vulgare*
Perennial Rye-grass	*Lolium perenne*
Common Bird's-foot-trefoil	*Lotus corniculatus*
Meadow-grasses	*Poa* spp.
Meadow Buttercup	*Ranunculus acris*
Meadow Fescue	*Schedonorus pratensis*
Red Clover	*Trifolium pratense*

Figure 2 Green-winged Orchids are a species characteristic of lowland neutral grassland *(Photo: © Natural England/Peter Wakely)*

Rare and protected vegetative species may be found, especially where the grassland is unimproved, in some cases leading to statutory protection. Examples of rare species occurring on neutral grassland are listed in Table 2. Semi-improved grasslands on former arable land often retain relatively high nutrient levels leading to dominance by rank species. Low nutrient regimes, more typical of unimproved grasslands, are associated with a more diverse and complex mix of vegetative species. Furthermore, both unimproved and semi-improved neutral grassland can support a wide range of wildlife including rare and protected species. Examples include the Brown-banded Carder Bee (*Bombus humilis*), Great Crested Newt (*Triturus cristatus*), Reed Bunting (*Emberiza schoeniclus*) and Water Vole (*Arvicola amphibious*) (Kent County Council, 2004).

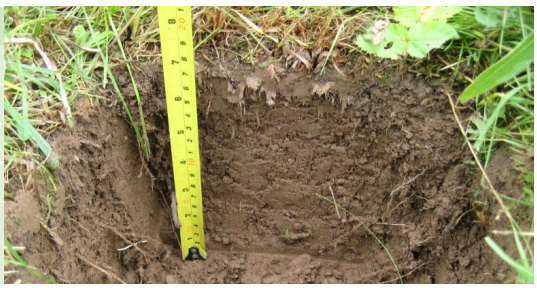
Table 2 Plant species of conservation importance occurring on neutral grassland.

Common name	Scientific name
Green-winged Orchid (Figure 2)	*Anacamptis morio*
Fritillary	*Fritillaria meleagris*
Dyer's Greenweed	*Genista tinctoria*
Adder's-tongue	*Ophioglossum vulgatum*
Yellow-rattle	*Rhinanthus minor*
Pepper-saxifrage	*Silaum silaus*

The surface soils found within existing unimproved lowland neutral grasslands are characterised by typically slow drainage rates (moisture-retentive soils), high organic matter contents and total nitrogen levels, and low levels of available phosphorus. Levels of available potassium and available magnesium are not found to have a strong influence on floral diversity of the sward. Acceptable limits are summarised in Table 3.

Table 3 Characteristics of soil suitable for neutral grassland establishment.

Parameter	Level
Topsoil depth	200–300 mm
Drainage	Slow
pH	Acid to slightly acid (pH 5.5–6.5)
Available phosphorus[a]	25 mg l^{-1} (4–12 mg l^{-1})
Organic matter[b]	4% (5–14%)
Total nitrogen[b]	0.2% (0.30–0.70%)



[a] Acceptable upper limit. A level of available phosphorus of less than 10 mg kg^{-1} is ideal to maximise floristic diversity within unimproved, semi-natural grassland communities (Marrs and Gough, 1989). While values of 11 to 25 mg kg^{-1} have potential, expect reduced floral diversity and increased risk of competition from rank and pioneer species.

[b] Acceptable lower limit. While values for upper limits are not available the values in parentheses serve as a useful guide.

Values in parentheses are primary data collected from example sites – Foster's Green Meadows, Worcester (SSSI), Long Meadow, Worcester (SSSI), and Jubilee Country Park, Kent (Site of Metropolitan Importance). Table 3 and photo kindly provided by Tim O'Hare Associates, Oxfordshire.

Site suitability

As with all reclamation projects, preliminary site investigation surveys should be conducted before selecting neutral grassland as a habitat creation option. Surveys are required to identify potential risks to human health and the environment (see BPG Notes 1 and 2 for further details) and to assess the overall suitability of the site and the planting substrate. Sites should also have a topography that allows for management by grazing or cutting.

Sites suitable for creating neutral grassland include reclaimed landfill and industrial areas where the substrate is derived from clays, loams or spoils, so long as the pH is between pH 5 and 6.5. The soil regime may be either dry, periodically inundated with water or permanently moist. Specific soil type is of low importance as grasses can be selected that can thrive under well-drained or wet conditions. However, consider also local rainfall as some neutral grassland communities thrive under wetter conditions, while others prefer a drier environment.

Where raw mineral substrates have been used in the restoration, these may require treatment to support vegetation establishment, including cultivation or the addition of organic matter. Substrate compaction will hinder vegetation establishment, and cultivation should be conducted to 0.5 m where the site survey identifies compaction; BPG Note 19 gives guidance on the need to cultivate before grassland habitat creation. Cultivation can encourage the residual seed bank to develop, and where this includes invasive plant species these will need to be controlled if they become dominant. Organic matter addition is required where the water-holding capacity of the substrate is low. Ensure that nutrient levels are not raised too high as this will favour nutrient-demanding rank grass species; paper-mill sludge and spent-mushroom compost, for example, are suitable. As a general rule, total nitrogen level should be 0.2 to 0.7% soil dry weight (Table 3), and available phosphorus and potassium less than 15 mg l^{-1} and 120 mg l^{-1}, respectively (Crofts and Jefferson, 1999).

While it is possible to adjust soil pH and fertility, you should aim to create a habitat that is most suited to the quality and conditions of the planting medium on your site. Creation of a habitat that is in keeping with the local character and landscape is likely to be a more sustainable practice.

Check whether the site is subject to and/or adjacent to any designated sites either statutory (e.g. SSSI) or non-statutory (e.g. local or county wildlife site). Such designations influence how the site should be managed. Survey also for flora and fauna protected under UK and European law and consider whether the proposed works will have a positive or negative impact. The ecological value of a neutral grassland is significantly enhanced if the grassland is part of a landscape with a mosaic of habitats including wooded areas, hedgerows and water bodies such as ponds and scrapes. Therefore, if possible create neutral grassland on a site adjacent to such habitats or where they can be included in the overall site regeneration.

Habitat creation and establishment practice

Where the site surveys demonstrate that the site and soil substrate are suitable to do so, neutral grassland can be created on reclaimed land. Substrate, desired time frame and site proximity to areas of grassland similar to the target type will dictate which establishment techniques are most appropriate. Three options are considered below.

Natural colonisation of bare substrates may be suitable where long establishment time frames are acceptable. While this option is preferable as plants establishing will be from local genetic stock adapted to soils and local conditions, it is only suitable if neutral grasslands are adjacent. Natural colonisation tends to be a very slow process as it requires the habitat to expand in from these local areas and bare ground will remain during this time that will be prone to colonisation by rank plant species. These will need to be controlled if they become dominant and limit the natural colonisation process. Natural colonisation can be accelerated through the selective introduction of grassland species via seeding or green-hay strewing.

Seeding can be undertaken using seed collected from a local donor site, subject to obtaining the permission of the landowner or tenant. Care must be taken not to deplete the donor site of seed by over-harvesting. When ripe, seeds should be collected and stored in airtight containers in a dark place at a temperature of between 2 and 5°C until required. Alternatively, a seed mix may be bought. A reputable seed house will be able to supply a mix suited to the climate and principal soil conditions of your site. Local provenance should be preferred, where available. Seed is normally sown in September/October, either by hand or using agricultural machinery such as slot seeders and seed drills, which maximise the area sown for the amount of seed used (Crofts and Jefferson, 1999). If sowing by hand, mix with damp sand to help ensure the seed is evenly distributed and lightly roll or tread the soil surface. Raking should be avoided as it can concentrate seed distribution or bury the seed too deep. If there is a prolonged dry period, the seeded area may be lightly watered. Birds and other seed predators should be kept off the land as much as possible.

Green-hay strewing can also be effective. This involves taking freshly cut hay from a local grassland which will contain seeds, and spreading this over the site to be colonised. Identify a suitable local donor site and ensure the hay is cut after flowering but while the seeds are still attached. At the donor site, keep hay turning to a minimum and collect and spread (strew) at the receptor site as soon as possible after cutting to minimise seed losses. The hay should be removed from the receptor site after a few weeks once the seed has dropped. Using a local source means that a closer match can be made between the new and existing grasslands.

Biosecurity (the objective of reducing the transmission of pests and diseases) is important and good working practice should be observed when using the green-hay strewing or seeding techniques to minimise the risk of transporting harmful organisms between sites. For example, clean and disinfect tools and boots before leaving donor and regeneration sites.

Habitat management and monitoring

To ensure long-term value, neutral grassland must be maintained. The exact maintenance requirements are site specific as they depend on whether the site is to be cut for hay or managed as pasture. Either way, without maintenance, natural succession results in a shift towards scrub and woodland. Grazing, cutting, or a mix of both prevent change to a species-poor sward dominated by coarse grasses and succession to woodland. Where grazing is selected, aim to produce a mosaic of grassland of varying lengths and small patches (no more than 25%) of scrub. For example, livestock have a random effect on the growth and distribution of plant species; different types of grazing animals are selective in the plants that they eat and can be used to create the mosaic. Cattle consume coarser herbage and trample more heavily than sheep. The trampled patches create gaps for new plants to establish. During the first 3 years, grazing should be controlled or prevented to allow the grassland to become established; that is, for seedlings to develop sufficient root systems to prevent uprooting when grazed. Once the grassland is established, light grazing can begin. Exact stocking requirements are specific to the site objectives, though a rule of thumb is to use 0.5 cattle or 2.5 sheep ha^{-1} yr^{-1} (Department of Transport, 1993). In winter and during prolonged wet conditions, livestock should be removed to prevent poaching – the compaction or physical breakdown of soil structure under the feet of heavy animals. More detailed information on management can be found in Crofts and Jefferson (1999).

Where mowing is the selected maintenance method, the emerging meadow needs to be cut in the first year in order to maintain a vegetation height of 100–150 mm, and not below 50 mm. Mowing must be timed to avoid conflict with ground-nesting birds. In the second year and thereafter, the meadow requires cutting at least once, preferably in late summer/early autumn, to a height of 50 mm after the plants have flowered. A spring cut, as necessary, will keep rank species in check; cuttings will contain seed from these plants and so should be removed.

Overly intensive management can be damaging. All-year-round grazing or mowing too often can inhibit flowering, reducing species richness of the sward. Ploughing and application of herbicides or inorganic fertilisers should be restricted. Under controlled circumstances, neutral grasslands can be treated with agricultural chemicals to improve the nutritional value of the sward as part of a defined management programme.

Even where the creation works take place in a very suitable location, evaluation of the management practices is required to get the right mix for establishment and long-term success. A site-specific long-term management plan is required. This should include a monitoring and evaluation programme that will enable the management regime to be adapted as necessary. The JNCC (2004) reports that monitoring of lowland grassland habitats should include:

- Extent of the grassland establishment: % ground cover, bald patches and presence of leaf litter.
- Sward composition: grass to herb ratio, positive indicator species, negative indicator species, species with local distinctiveness.

References

Crofts, A. and Jefferson, R.G. (eds) (1999). *The lowland grassland management handbook,* 2nd edition. English Nature/The Wildlife Trusts, Peterborough. Available from: http://publications.naturalengland.org.uk/publication/35034.

Department of Transport (1993). *The wildflower handbook.* HMSO, London.

JNCC (Joint Nature Conservation Committee) (2004). *Common standard monitoring guidance for lowland grassland habitats.* JNCC, London.

JNCC (Joint Nature Conservation Committee) (2011). Lowland meadows. In: *UK Biodiversity Action Plan – Priority Habitat descriptions.* BRIG (ed. A. Maddock) 2008 (updated 2011).

Kent County Council (2004). *Neutral grassland. Habitat factsheet.* Available from: www.kent.gov.uk/klis/resources/factsheets/habitat_fr/Neutral_Grassland.pdf.

Marrs, R.H. and Gough, M.W. (1989). Soil fertility – a potential problem for habitat restoration. In: *Biological habitat reconstruction,* ed. G.P. Buckley. Belhaven Press, London, 29–44.

Rackham, O. (1986). *The history of the countryside.* Phoenix Press, London.

Rodwell, J. (1992). *British plant communities, volume 3: grassland and montane vegetation.* Cambridge University Press, Cambridge.

Stace, C. (2010). *New flora of the British Isles,* 3rd edition. Cambridge University Press, Cambridge.

Further information and useful links

Ecoscope Applied Ecologists (2000). *Wildlife management and habitat creation on landfill sites – a best practice manual.* Ecoscope Applied Ecologists, Cambridge.

More information on biosecurity and plant health can be found at www.forestry.gov.uk/biosecurity.

Additional information may be found from the following organisations:

Bumblebee Conservation Trust
www.bumblebeeconservation.org

Butterfly Conservation
www.butterfly-conservation.org

Flora Locale
www.floralocale.org

Joint Nature Conservation Committee
www.jncc.defra.co.uk

Landlife National Wildflower Centre
www.wildflower.co.uk

Natural England
www.naturalengland.org.uk

Nature after Minerals
www.afterminerals.com

Plantlife
www.plantlife.org.uk

Royal Horticultural Society
www.rhs.org.uk

Royal Society of Wildlife Trusts
www.wildlifetrusts.org

RSPB
www.rspb.org.uk

The Grasslands Trust
www.grasslands-trust.org

The Land Regeneration and Urban Greenspace Research Group
Forest Research, Alice Holt Lodge, Farnham, Surrey GU10 4LH
Phone: +44 (0) 1420 22255 Fax: +44 (0) 1420 520180
www.forestry.gov.uk/forestresearch