APPENDIX IV

Plantlife

# Managing grassland road verges

A best practice guide

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Plantlife 2019

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**There are nearly 313,500 miles of rural road verge in the UK – equivalent in area to our remaining lowland species-rich grassland**

**700 species of wild flower grow on road verges – nearly 45% of our total flora – but there has been a 20% drop in floral diversity due to poor management and nutrient pollution**

**For 23 million commuters, road verges can be their only daily contact with nature**


**Water and flood risk management**

**Access to services**

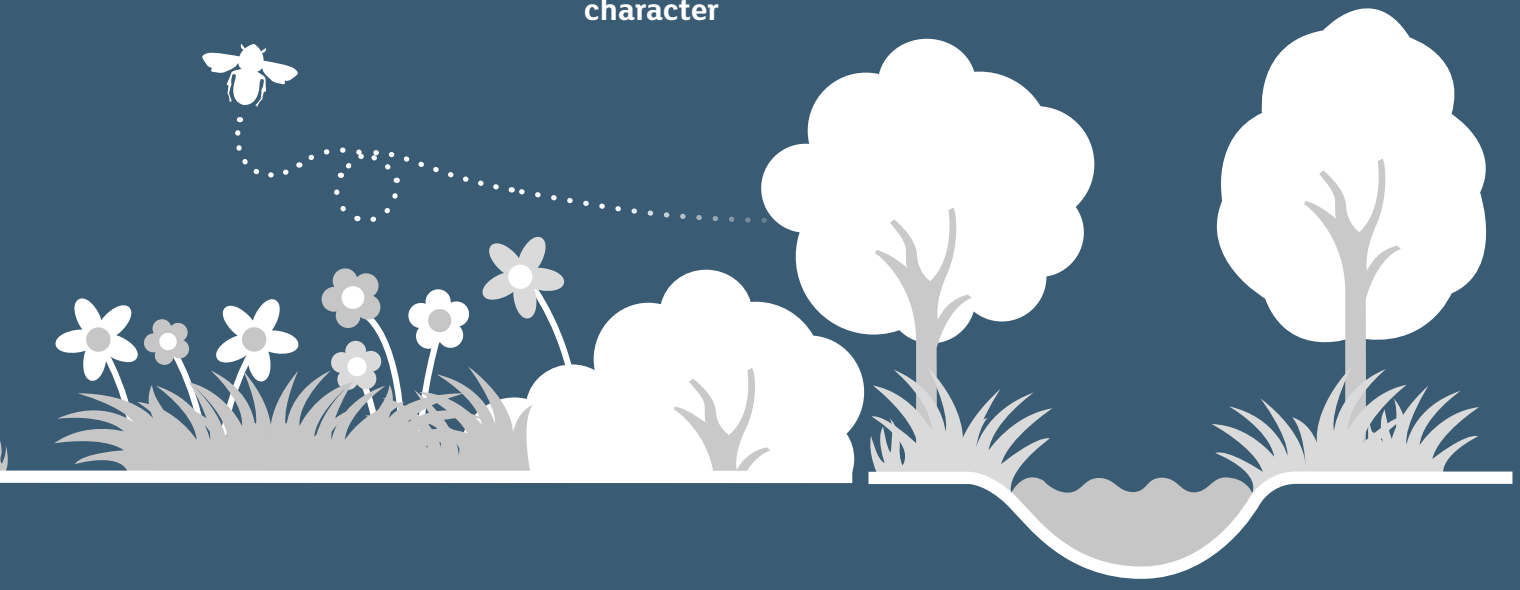
**Enhanced bank stability**

**With thanks to the UK Green Infrastructure Partnership**

**These guidelines fulfil a recommendation in the Government's National Pollinator Strategy. Proper management of all verges would create a pollinator habitat the size of London, Birmingham, Manchester, Cardiff and Edinburgh combined**

**With over 97% of meadows destroyed since the 1930s, road verges are a vital refuge for pollinators and other wildlife**

- Noise and air pollution buffer
- Pollinator corridors
- Enhanced biodiversity
- Carbon sequestration
- Visual screening
- Enhanced local character
- Improved air quality
- Tourism gateway



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# Executive summary

**There are nearly 313,500 miles of rural road in the UK. With verges running most of their length, it is the equivalent in area to our remaining lowland species rich grassland and represents a nationally significant resource of increasing importance to UK wildlife.**

Establishing ecological networks to support the recovery of nature is a priority for government. When managed well, road verges, whether rural or urban and whether on major or minor roads, can sustain an astonishing amount of wildlife: more pollinators are found on well-managed verges than in the neighbouring countryside and nearly 45% of our total flora is found on verges.

Today, the majority of the UK's grass road verges are either cut too frequently and at the wrong time, or abandoned to scrub. Cuttings are left to lie creating a thick thatch, inhibiting growth and increasing soil nutrient levels, which further stimulates vigorous grasses and other nutrient-loving plants. This cycle increases on-going management costs and negatively impacts on the safe functioning of the highway. These unintended consequences are largely due to inappropriate management contracts, focused on safety considerations with little or no consideration of potential wider benefits.

**We need to manage our road verges as a nationally significant response to the decline of our wildlife, raising the management bar across the whole grassland estate not just on a few hundred miles of roadside nature reserve.** Such transformative action is what is necessary to create 'more, bigger, better and joined up' habitats and 'Making Space for Nature' in keeping with government recommendations.

This guide advocates a different management approach. One that reduces cutting frequency, reduces vegetation growth and the resulting management burden, improves the natural capital value – in particular the number and diversity of flowering plants – and ordinarily results in sustainable operational costs long term and a reduced carbon footprint.

It is a practical guide for highways managers, road engineers, operations managers, landscape architects and all those engaged with verge management and creation. It covers those aspects previously described in the Design Manual for Roads and Bridges wildflower handbook and focuses on the management of lowland and upland grassland verges.

It supports:

- Government and statutory agencies deliver their statutory duties and biodiversity net gain obligations
- Industry's corporate social responsibilities to reduce environmental impacts
- The road network to fully contribute towards environmental, social and economic objectives

**This publication complements safety considerations and focuses on those areas where there are no safety constraints restricting management. Its aim is to shift the balance so that species-rich habitat becomes the predominant asset across the network, so doubling the area of the UK's species-rich grassland.**

# Introduction

To only consider road verges in respect of the adjacent highway is to miss a nationally significant opportunity. Government, asset managers, businesses and the public are increasingly recognising the potential of this green infrastructure.

The sterile neat-and-tidy ideal of the verge as manicured lawn is slowly but surely being challenged, particularly on our motorways, rural verges, and some urban highways. Species-rich verges enhance the local character and the visual interest of the highway for the road user and help the road blend into the wider landscape, reducing visual impacts. The daily commute is often the only regular contact a road user has with the natural landscape, supporting health and wellbeing as well as attracting inward investment and promoting civic pride.

**Creating and managing species-rich grassland is a brilliant way to improve the biodiversity value of road verges and reduce long-term management costs.** Verges rich in native wild flowers support more wildlife, are more resilient to environmental change, enhance ecological connectivity and provide better ecosystem services such as pollination. When maintained through a cyclical management regime, grassland verges provide a cost-effective management option and represent an important opportunity for highway authorities to realise the benefits of enhanced 'Natural Capital'.

All highways authorities have statutory biodiversity duties. These legal duties support conservation being a natural and integral part of the highway authority's policy and decision-making. Following these management guidelines will support highway authorities to discharge their duties and ensure that the soft estate under their management contributes towards local, national and international biodiversity obligations. When managed well, the network of road verges is ideally placed to deliver what is necessary to make 'more, bigger, better and joined up' habitats and fully contribute towards the conservation of the UK's biodiversity.

Better investment in our natural capital is crucial. Such investment reaps dividends and is deemed a priority by government and wider society who understand that business culture needs to change. Highway authorities and industry increasingly recognise this as they shift towards becoming 'biodiversity net gain' businesses.

> A Natural England case study on the A590 in Cumbria demonstrated how management could deliver a 123% increase in 'biodiversity units' as well as delivering an uplift in wider ecosystem services such as air quality, pollination and water management.

Adoption of this good-practice management by highway authorities – thereby ensuring their service providers adopt better management – ensures efficiencies, brings benefits to highway performance and enables the sustainable development of our road network.

Results are best sustained when there is effective partnership between highway authority, industry and the third sector.

> A landscape-scale partnership between Cumbria Wildlife Trust, Natural England and Highways England was conceived to enhance 12km of existing verges of the A590 in rural South Cumbria within the Morecambe Bay Nature Improvement Area. Between 2015-2016, 73 soft estate plots were identified for enhancement works and management continues until 2020. This partnership meets targets set in the Highways England Biodiversity Plan, engages the community and partners, enables knowledge transfer and brings people together to carry out practical conservation work.

This guide sets out the general, broad management principles for grass verge management. Given the different nuances and contexts of verge habitats, we recommend engaging with an ecologist or NGO with knowledge of local grasslands when creating management plans. The case studies highlighted throughout this document provide examples of the variety of approaches that can be taken, and are available in full on Plantlife's website.

Adoption of this management guidance will also ensure road verges contribute towards national targets to improve ecological connectivity and improve resilience to climate change impacts. In England, this equates to a potential contribution of 111,225miles of verge habitat, in Scotland 35,046miles and in Wales 29,018miles.

# Managing grassland road verges

The Strategic Road Network (SRN) – motorways and major A roads – is managed by Highways England, Welsh Government, Transport Scotland, Northern Ireland's Department for Infrastructure, and Transport for London. Outside the SRN, County and Metropolitan District Councils are normally the highway authorities for their area, although some C roads and unclassified roads are delegated to the local District, Parish or Community Councils. In order to maximise the biodiversity and environmental potential of any verge, there are three steps to consider:

- **Assessment – understanding what you've got**
- **Management specifications**
- **Monitoring – performance management**

# Assessing the current wildlife value of your grassland road verges

Assessing the existing biodiversity value of the verges under your management is an important first step. It will help identify the broad habitat types so that appropriate and cost effective management can then be detailed in management contracts, so maximising return on investment.

Such information can be incorporated into GIS-based systems as part of the highway authority's general asset management, allowing updates to be easily made to inform annual maintenance in much the same way as hard infrastructure assets are recorded and managed.

> Fermanagh and Omagh Council, with Ulster Wildlife and Transport NI, assessed their rural road verges and incorporated the resulting data into the council's GIS system to ensure appropriate management.
>
> In Lincolnshire, the Wildlife Trust co-ordinated over 250 volunteers to survey road verges. Over 160 new roadside Local Wildlife Sites were designated along about 250km and the data is now in a GIS system. This not only shows designations but can report species lists for over a third of the county's road network. By flagging biodiversity risks and opportunities, this data now guides advice to Lincolnshire County Council, maintenance contractors and utilities companies, as well as planning officers.

The *Design Manual for Roads and Bridges* identifies three main classifications of grassland verge:

- **Amenity grassland and grassland with bulbs** (DMRB Landscape Element 1.1 & LE1.2). This is the main type of grassland in **urban/suburban** areas, settlement entry points in rural areas and at rest areas and laybys on the SRN. The intensive management of such amenity grasslands is typically set to maintain a short, even sward, containing a maximum of 10% herb species and no scrub. Changing the management regime can improve the biodiversity and visual amenity of such grasslands and deliver significant cost savings.

- **Open (aesthetic) grassland** (DMRB type LE1.6). This is the predominant type of grassland found across the road network and is either naturally occurring or created by grass-dominated seed mixes. Open aesthetic grassland is defined as those areas with less than nine species/m2 (including grasses but excluding lower plants and shrubs). Such grassland areas have typically more than 30% grasses with low cover of wild flowers such as creeping buttercup *(Ranunculus repens)* and white clover (*Trifolium repens)*. Such grassland provides significant potential for enhancement.

- **Species-rich grassland** (DMRB type LE1.3). This occurs in discrete areas and is made up of naturally occurring or introduced grasses and wild flowers. Species-rich grasslands can be broadly defined as those areas with **nine or more species/m2** (including grasses but excluding lower plants and shrubs), or areas of grassland in poor condition that could be rehabilitated to become species-rich grassland. Such areas are important for the maintenance and expansion of biodiversity across the road verge network.

Grasslands are also defined according to soil type. Classifying your verges against published UK and national priority grassland habitat types will support reporting against corporate, national and local biodiversity targets, as well as enabling natural capital accounting and broader 'Corporate Social Reporting'.

Neutral, calcareous and acid grassland can all occur within the categories described on page 11. Species-rich calcareous or neutral grasslands typically support 12 or more species/$m^2$, although acid grasslands typically support fewer species with a lower threshold of six species/$m^2$. Acid grassland may also be present as part of a mosaic with heathland and moorland (DMRB type LE 1.5). Where this occurs, the habitat should be managed to maintain the structural diversity, including the maintenance of dwarf shrubs, which require different management prescriptions but are outside the scope of this guide.

## Assessment methods

Classifying different grassland types and enhancement opportunities can be done by **remote assessment** using readily available information:

- Desktop surveys – reviewing aerial photography or historical records to identify floristically diverse or rich areas and areas of good potential. This can be done at regional and local scales.
- Areas already identified and managed for nature conservation – such as statutory protected sites, Local Wildlife Sites or Road Verge Nature Reserves.
- Areas where rare or notable species have been recorded.
- Data is available from local biological record centres, the National Biodiversity Network (www.NBN.org.uk) and local wildlife groups – for example, your local Wildlife Trust.
- Information from members of the public and community groups.

Ideally, areas of species-rich grassland should be confirmed on the ground to ensure cost-effective management planning. This might include:

- **Drive-by surveys** in spring/early summer by an experienced surveyor is often sufficient to identify grassland of interest. Such drive-by assessments can also be used to identify other factors influencing management, such as gradients, access and the wider landscape context, helping identify opportunities for creating 'more, bigger, better and joined up' areas. Drive-by surveys are considerably cheaper than full botanical surveys, are suitable for high-speed roads where pedestrian access is restricted, and allow for long stretches of verge to be surveyed. Repeated drive-by surveys at different times of the year can also help prioritise areas for more detailed assessment.
- A **Phase 1 Habitat Survey** Joint Nature Conservation Committee (JNCC) allows for detailed management planning as it captures broad habitat types (for example, calcareous grassland) and other information such as plot size and existing management.
- A full **botanical survey** by an experienced botanist, which is ideal for discrete areas of species-rich grassland to establish baseline data and identify notable, rare and protected species.

# Management specifications

## General principles to improve wildflower diversity on all grassland verges

### Regular management is essential

An annual or cyclical programme is ideal and helps manage problem and competitive species. Grasses often outcompete wild flowers as they typically have extensive root systems, can be vigorous and can cope with a wider range of conditions. Without regular management, rank tussock-forming grasses can quickly dominate, reducing species diversity.

Rolling management programmes are cost effective, minimise operational impacts, improve safety and maximise the Natural Capital Value of the asset in keeping with highway authority statutory duties. Conversely, where this proactive cycle does not occur, long-term management costs tend to increase, business performance is reduced while risks increase and the Natural Capital and biodiversity value of the road verge is diminished as they quickly develop into bramble thickets and scrub.

### Timing is everything

It is vital that wild flowers are able to complete their full lifecycle – i.e. grow, flower and set seed. This replenishes the seed bank and allows populations to be maintained cost-free and indefinitely. Cutting too early and too frequently swiftly eliminates many species, reducing diversity and the value of the road verge. Cutting after flowers have set seed in late summer allows visually striking displays of wild flowers and a rich source of pollen and nectar for pollinators. Wild flowers take roughly six to eight weeks from flowering to setting seed.

A **two-cut management approach is ideal** for suppressing coarse grasses and encouraging wild flowers, so reducing management burden over time.

| Management option | | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **One cut** | | | | | | | | | full cut | | | | |
| **Two cuts** | Summer and autumn cutting | | | | | | | | partial cut | | full cut | | |
| | Late winter and autumn cutting | | full cut | | | | | | | full cut | | | |
| | Dry verges (short vegetation) | regular cuts | | | | | | | | regular cuts | | | |
| | Species-rich verges with mown edge | | 1m strip | | | | | | | full cut | | | |

### If only one cut is possible:

- Cut the verge once a year between August and September and remove the cuttings. This allows plants to flower and, importantly, gives time for seed to be shed.
- Management should create areas of bare earth to allow good contact between the seed and the soil, and provide habitat for invertebrates.
- Areas identified as open grassland should be cut on a cyclical management regime.

## If more cuts can be undertaken, choose one of the following:

**Summer and autumn cutting**

- Cut the majority of the verge between mid-July and September to mimic the pattern of hay meadow management. Randomly leave some areas (10-20% of the area) uncut to leave some flowering plants for pollinating invertebrates – for example, specifying leaving at least one working width at the back of the verge every 100 metres.
- Cut the entire area again from October to December to remove late season growth. This is increasingly important as winters are likely to become milder and the growing season lengthens.

**Late winter and autumn cutting**

- Cut the verge during February and March. This is before most verge plants flower and it will not disturb ground-nesting birds. Raising the cutter bar on the back cut will lower the risk to amphibians, reptiles and small mammals.
- Cut the verge again during September and October. This slightly later cutting date allows plants that were cut earlier in the year time to grow and set seed. This cutting regime is particularly suited to areas with late-flowering species, such as devil's-bit scabious (*Succisa pratensis*), which may not flower and set seed until September. It is also suited to areas with early flowering plants, such as cowslips (*Primula veris)*, as it removes any shading vegetation prior to flowering.

**Dry soils and coastal situations**

- On verges with dry/sandy soils and in coastal situations where the natural vegetation growth is short (ankle height), frequent cutting can take place up until April and restart in September (i.e. avoiding the main flowering period from mid-May through to the end of August). This will help develop a flower-rich turf with clovers (*Trifolium* sp.), trefoils (*Lotus* sp.), vetches (*Vicia* sp.), self-heal (*Prunella vulgaris)* and other small species, providing a long continuity of flowers, valuable for bees and other invertebrates.

## If it is not practical to cut the whole width of a species-rich verge:

- On species-rich verges, cut a 1-metre strip at the edge of the verge as early as possible (February-March) to allow grass at the back of the verge to grow longer, providing structural diversity that is especially important for invertebrates. Cut the full width during September-October.
- On narrow verges of less than 1 metre, leave some sections uncut to provide the same structural diversity – for example, 50 metres of uncut sections every 200 metres.

## Cut-and-collect

In all circumstances, achieving low soil fertility is key to enhancing wildlife value and reducing management burdens. Most wild flowers are associated with lower fertility soils. Conversely, soils with high fertility containing high levels of nitrates and phosphate, for example, support more vigorous grasses and competitive species such as nettles and cow parsley. Removing the arisings at the point of cutting takes biomass and the nutrients they contain away from the verge. This reduces the layer of dead grass or thatch and opens up the soil surface to allow seed germination. Repeated over a number of years, it has demonstrable impact on soil fertility, encouraging slower growing and more diverse species that require less management, so delivering direct cost savings. Increasing numbers of highway authorities (and their managing agents) are adopting cut-and-collect as the simplest way to reduce the management costs and win efficiencies. Reduced cutting also reduces operational impacts such as traffic management, ensures drainage courses remain open, aids litter collection and delivers wider benefits such as supporting increased numbers of pollinators.

Ideally remove all cuttings for alternative use (for example, anaerobic digestion or compost production) or leave to rot down in dedicated and sacrificial areas within the soft estate. Where cut-and-collect or biomass harvesting is being employed, some verges identified as being species-poor with vigorous growth can be cut in May for a period of time until fertility drops.

Low cost, common sense solutions are increasingly being adopted to dispose of grass cuttings. Disposing of arisings as close as possible to where they are cut minimises haulage and, when kept within the soft estate, avoids waste regulations. Small composting heaps rot down quickly or can be utilised as mulch around trees or among shrub-planted areas.

> Kent Wildlife Trust gather their cuttings into habitat piles, which can provide good resting habitat for reptiles and insects. For larger volumes, create drive-through disposal points in tree/shrub areas away from full public view to discourage fly tipping.

Cuttings are now recognised as a viable biomass resource which can be utilised to produce a range of products including biomethane-based compressed natural gas (CNG), electricity and heat. This offers significant opportunity to offset operational costs with novel revenue streams.

> Road verge biomass harvesting with a tractor-powered suction flail has been trialled on Lincolnshire's minor rural roads in partnership with Lincolnshire Wildlife Trust. Herbaceous biomass from road verges is also being trialled as a feedstock for on-farm combined heat and power (CHP) anaerobic digesters.

## Managing public perceptions

Flower-rich verges are increasingly popular with local communities and are an effective way of encouraging wildlife into the heart of the built environment. However, they can be seen as untidy and neglected by some residents and road users. Cutting narrow strips around the verge, so framing the verges inside, is a simple but effective way to give the perception of tidiness and help offset potential negative feedback on a perceived lack of management. Raising awareness of the importance of road verges and engaging local communities in their active management will also help to mitigate this negative perception.

> In 2016 and 2017, a mowing trial was conducted on 17 urban roads in Sheffield by the Sheffield Living Highways Partnership (The University of Sheffield, Amey, Sheffield City Council and The Sheffield and Rotherham Wildlife Trust). On one side of each road, mowing proceeded as normal (every three to four weeks) but was reduced by half on the other side during the entire mowing season. The trial was communicated to the public through press, signs on lamp posts and leaflets delivered to each house on the trial roads. Research on public perception found that although local residents did not always appreciate the appearance of the unmown grass, there was appreciation that it was better for wildlife.

Collecting cuttings will help with public perception. Not only does the verge look less neglected, litter collection is aided and, slowly, soil fertility is reduced so helping wild flowers to thrive at the expense of fast-growing nutrient-loving grasses. When cutting is first reduced, there can be attractive localised displays of spring flowers but visual appeal and diversity reduces during the summer because of high fertility, resulting in a greater chance of complaints.

## Power of community buy-in

There is tremendous scope in harnessing the energy and commitment of local groups.

> In South Shropshire, the Edgton Village Verge Volunteer Group won funding from the Shropshire Hills Area of Outstanding Natural Beauty (AONB) Conservation Fund and went on to assess all the verges in the village. This baseline evidence showed that Edgton has some of the best verges in the county and cutting regimes were agreed with South Shropshire Highways following public consultation. Ongoing discussions ensure the project is maintained and further partnerships have been established with the National Trust, Shropshire Hills AONB Partnership and Shropshire Wildlife Trust. In Warwickshire, a partnership between Warwickshire County Council Highways and volunteers from Stour Valley Wildlife Action Group and Butterfly Conservation carry out valuable scrub clearance after the annual cut on a 1.25km cutting on what is now one of the best calcareous grassland sites in the county.

## A Enhancing amenity grassland verges

Most amenity road verges have little biodiversity value but they can offer significant potential. Some tightly mown verges often have a good diversity of wild flowers, albeit suppressed. Reducing the frequency of cuts will allow species such as yarrow (*Achillea millefolium)*, self-heal *(Prunella vulgaris)*, clovers (*Trifolium* sp.), trefoils (*Lotus* sp.) and vetches (*Vicia* sp.) to flower and better support other wildlife.

Cut-and-collect early spring and autumn to deliver the twin objectives of keeping the verges neat and attractive, but also of creating conditions that will allow more wild flowers to thrive from late spring to late summer. Over time, this management will reduce soil fertility, so fewer cuts will be needed and more wild flowers will be able to thrive.

> Adoption of cut-and-collect by Dorset Council on some of their urban verges has reduced cutting frequency by 30%, is providing five-year management savings of £36,000 and £11,000/yr staff savings, and is covering the cost of the new cut-and-collect machinery. Whereas conventional flail cutting produced no cost recovery, decreased wildlife value and resulted in ever-increasing amounts of grass to cut.

Plug plants can be used to introduce greater diversity, helping to kick-start colonisation and spread. Plug plants are easy to use and can be either grown from locally collected seed or purchased from local suppliers. Management contracts should account for care whilst the plugs' roots establish, including clearing tussocks to avoid excessive competition or shading. Transplanting plug plants can be time-consuming, requiring hand tools and follow-up management, but may reduce costs associated with ground preparation prior to introducing seed. In some situations, volunteers in managed work parties have planted plugs on their local verges. Plant out at a rate of 6-10 plugs/m² (according to species); planting in autumn is much more successful as it avoids spring droughts that can desiccate the small plugs. Plug plants can be vulnerable to heavy predation by rabbits.

## B Restoring open grassland verges

Plan restoration management of open grassland verges in phases, as most of the estate is likely to have suffered from either excessive cutting at the wrong time of year or, conversely, under-management/abandonment resulting in an overall loss of biodiversity, as well as significant losses of grassland habitat to bramble thicket/scrub.

Initially focusing restoration on areas adjacent to species-rich grassland has the dual benefit of creating larger areas that are more cost-effective to manage, and which are more resilient to environmental pressures such as climate change.

In areas where there has been no management and where a short period of intensive management is required to reinstate a grassland area, it is important to first reduce soil fertility in order for fine grasses and wild flowers to thrive. Initial costs can be recouped over the medium term (three to five years) after which time ongoing management costs are reduced and benefits continually improve.

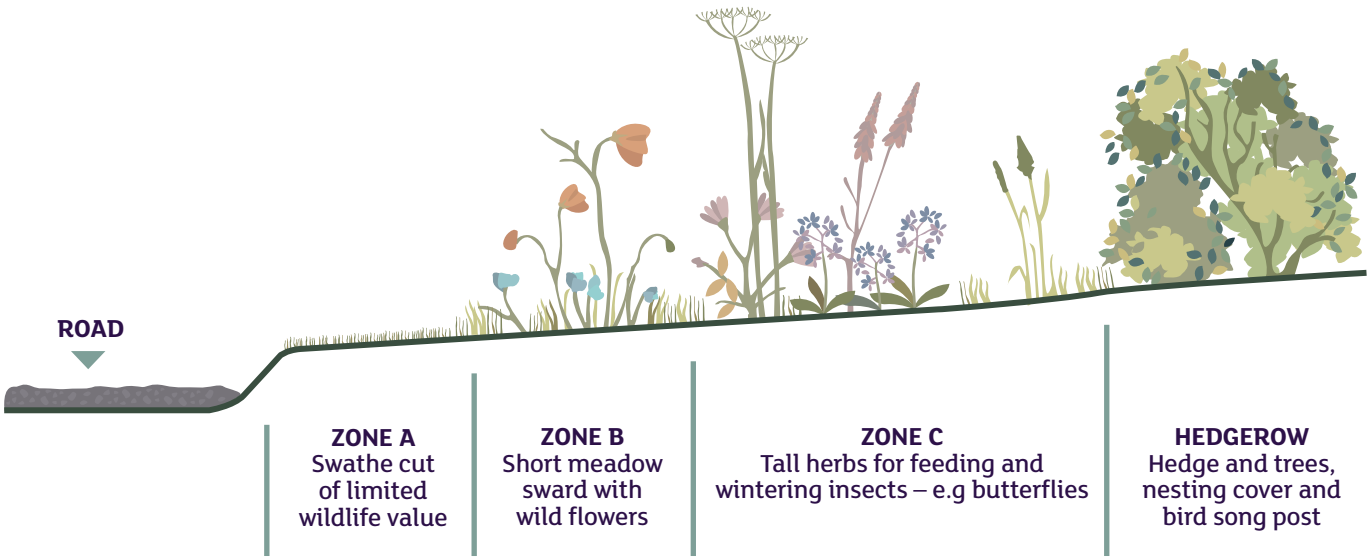
Wild flowers, finer-leaved grasses, sedges and rushes have a tendency to remain at low densities in areas dominated by coarser grasses and other competitive species. Targeting areas which have low densities of **positive indicator species** can result in the re-emergence of dormant or latent wild flowers – i.e. plants that are present but don't get the chance to flower because of repeated cutting, or which come into flower following scrub removal. Common examples include spotted and marsh orchids (*Dactylorhiza* sp.), primroses (*Primula vulgaris)* or cowslips (*Primula veris)*.

Species diversity can be restored by opening the sward and introducing restoration management prescriptions described above. Equally, adjacent species-rich areas can spread and colonise cleared verges through natural seed dispersal if the correct conditions are created.

## Variety is key

Structural diversity benefits both flora and fauna. Ideally, a gradient of vegetation height should be applied with shorter vegetation closer to the road and longer grass left at the back merging into hedges, banks or woodland. On wider verges, this can be readily achieved by the standard swathe (safety) cut, retaining short vegetation adjacent to the tarmac with a reduced cutting regime for the central areas and a longer three to five year cutting cycle for the back to stop scrub and woodland encroachment. This creates verges with the structural diversity of open grassland, so supporting the greatest number of species throughout the year.

Regular operational management can also provide structural diversity. For example, maintaining sight lines, visually inspecting structures or providing safe access to roadside equipment can create a diverse sward with areas of short vegetation, occasional bare earth and longer vegetation that is ideal for supporting biodiversity.




Idealised management zones across the width of a roadside verge

## Yellow rattle *(Rhinanthus minor)*

Introducing semi-parasitic yellow rattle (*Rhinanthus minor)* can bring many benefits. Not only can it reduce the quantity of grass growth by 60-80% – so reducing the frequency of cuts and the quantity of cuttings to remove – it creates space for other wild flowers to grow, directly increasing diversity of the verge.

Being an annual, it is critical that it is allowed to set seed after flowering to sustain populations. Seeds must be sown fresh (preferably collected from a local source) and before November to allow sufficient cold-stratification/development over winter. Seeds need to come into contact with the soil surface to germinate, hence sowing seed immediately after a cut-and-collect improves exposure of bare earth and improves germination. Further scarification can also increase germination. Yellow rattle is best introduced onto moderate or low-fertility soils after reinstating favourable management. Once yellow rattle has established and is reducing grass growth, seeds of other wild flowers can be introduced if none have appeared naturally from the soil seed bank.

## Incorporating scrub

Scrub also provides structural diversity and, by providing early pollen, nectar, fruit and shelter for invertebrates, reptiles, birds and mammals, can be part of grassland verges managed under rotation. However, if left unchecked, it will affect the operational performance of the highway and the verge's biodiversity value.

The best scrub for wildlife is often thin and patchy with lots of flower-rich edge habitat. Scrub comprised of a few woody species, of even age, height and density with little understorey ground flora is less valuable.

Scrub develops when the management of grassland verges has become less frequent, or abandoned altogether, especially if adjacent to mature scrub or woodland. Within large areas of grassland (more than 1 hectare), about 5% scrub can be advantageous when managed on cyclic rotation. Scrubbed-up areas should periodically be reverted back to bare mineral or subsoils to maintain a mosaic grassland habitat with these discrete cleared areas allowed to regenerate naturally back to grassland without incurring further management costs.

The amount of open scrub should be specified during the management planning process. Areas of scrub would ideally be rotated across the wider road verge network and should be maintained between 5-10% scrub cover.

Scrub should be cut as close to the ground as possible. Herbicide or repeat cutting in future years may be required to prevent regrowth. Use of machinery may depend on access restrictions and hand tools will be more appropriate for smaller areas, with chainsaws and brush-cutters required for denser patches. Tractor-mounted flails and specialist remote-controlled machinery can be used for dense scrub.

Clearance of scrub should be undertaken outside the bird-breeding season between February and September, and a licence might be required if other protected species are likely to be present, such as hazel dormouse or slow worm.

## Importance of bare ground

Some bare ground is important for a wide range of wildlife, especially invertebrates. Raking, or localised scarification or scalping with machinery during cutting, allows seeds to germinate and supports natural succession. This benefits early successional species such as bird's-foot-trefoil (*Lotus corniculatus)*, oxeye daisy (*Leucanthemum vulgare)* and kidney vetch (*Anthyllis vulneraria)*, as well as rarer species that require sparse swards for establishment, including bee orchid (*Ophrys apifera*), pyramidal orchid (*Anacamptis pyramidalis)* and common-spotted orchid *(Dactylorhiza fuchsii)*. Creating small areas of bare ground, and leaving small exposures of natural geology such as sandstone faces untouched during construction, also benefits invertebrates such as bees and wasps and other pollinators, and provides sunny open areas for reptiles to bask.

## Sowing seed into small scrapes

An alternative method to increase the diversity of the vegetation is to create small (3-5m$^2$) scrapes or inoculation plots where the top layer of vegetation is removed, exposing bare ground or even the subsoil. This can be achieved using a spade or preferably a mechanical turf stripper. This removes the top layer of topsoil – including weed seed bank and roots/rhizomes of competitive grasses – to desiccate and deplete the existing rank vegetation. Bare areas can be sown with an 80/20% by weight meadow mix of suitable grass/wild flowers. The seeds should be pressed onto the surface of the soil and left uncovered. In areas with tussocky grasses, larger scrapes prevent the surrounding vegetation from shading the developing seedlings. Seeds can be collected by hand or with a brush-harvester from surrounding species-rich grassland, and they should be suited to the type of soil and geographic location of the grassland road verge. Recording the location of scrapes using GPS will support future monitoring.

Creating small scrapes can take time and may incur additional contractor costs. However, it is a particularly good method in areas with tricky terrain where other methods of diversifying the sward may not be as easy to achieve. Follow-up management for species-rich grassland will be required to maintain the diversity of the vegetation.

## C Maintaining existing species-rich grassland verges

Species-rich verges offer the maximum biodiversity value, supporting more wildlife, being more resilient to environmental change and providing better ecosystem services such as pollination.

Maintaining species-rich grassland is often less costly than managing either open (aesthetic) grasslands or amenity grassland as they require fewer cuts, despite the need to remove cuttings. Management prescriptions should be detailed in the specification for works, with the areas clearly identified and mapped on a GIS (geographic information system) to allow future monitoring.

Species-rich grassland is maintained on an annual cycle, using cut-and-collect operations wherever possible. Cutting is timed to late summer or early autumn to enable wild flowers to set seed, whilst the removal of cuttings/arisings is important to maintain low soil fertility and reduce management costs.

Some species-rich road verges may be afforded special protection. Statutory sites such as Sites of Special Scientific Interest (SSSI), or Areas of Special Scientific Interest in Northern Ireland, are legally protected and activity, including planned management, requires the formal permission of the relevant statutory nature conservation organisation. Other non-statutory sites also occur on road verges, such as Local Wildlife Sites (or Site of Local Conservation Importance in Northern Ireland, Local Nature Conservation Site in Scotland or Site of Importance for Nature Conservation in Wales). These sites are locally important and should be afforded protection through local policies adopted by the local highway authority. In some areas, these may be referred to as Roadside Nature Reserves or Conservation Verges. In such circumstances, advice should be sought from the local authority ecologist or Local Wildlife Sites Partnership.

In protected areas, such as National Parks and Areas of Outstanding Natural Beauty, advice should be sought to ensure that road verge management contributes towards their statutory purpose to ‘conserve and enhance the natural beauty, wildlife and cultural heritage’ of the area.

Road verges can also support protected species and, where these are known to occur, specialist advice should be sought. Adoption of these management prescriptions will ensure that grassland verges support a broad range of wildlife: the provision of structural variation, including bare earth and variable sward height, shelter from occasional scrub and the transition between different habitat types, will provide a mosaic habitat along the road network. This will support the conservation of priority species including statutorily protected species such as dormice, smooth snake and great crested newts.

## D Restoring species-rich grassland verges

Species-rich grassland verges that are not actively managed quickly lose their value. However, such areas 'lost' through neglect and/or inappropriate management can often be restored by reintroducing appropriate management techniques as described and encouraging the natural recolonisation of wild flowers. This approach is both practical and cost effective.

Ensuring appropriate management is in place or reinstating appropriate management is the priority for such areas.

> In collaboration with Durham Wildlife Trust, Sir Robert McAlpine is working to restore 40 hectares of road verge to species-rich grassland on the A19 in Durham. The road cuts through much of the magnesian limestone escarpment and many SSSIs and Local Wildlife Sites either border the A19 network infrastructure or are within 200 metres. By cutting annually in September, removing the arisings and undertaking scrub removal, the company hopes to restore the species-rich grassland interest.

When considering restoring verges, it is crucial to understand the wild flowers that still occur in the sward (as well as those that might have been lost) so management prescriptions can be applied appropriately. If the area has deteriorated significantly, it might be necessary to expose some bare earth to support better germination, especially if the area is dominated by coarse grasses. In some circumstances, it may be necessary to reintroduce wildflower seed.

On open grassland that either has some wild flowers, or has lost them within the last five years, rehabilitation management should be adopted and can result in rich and diverse flowering verges without any other intervention.

## E Managing competitive or problem species

One of the most common factors preventing roadside verges reaching their full potential is the presence of competitive or problem species (see Appendix 2 on page 33). In favourable conditions, some native species can become dominant. Reinstating regular cutting will effectively control these competitive species and should be considered as part of restoration or enhancement management.

Typical native species that can dominate grassland verges include:

- indicators of high soil fertility such as nettles, cow parsley, hogweed and hemlock that can reduce visibility
- woody vegetation, such as gorse and bramble
- ruderal species, such as rosebay willowherb, which are first to colonise disturbed land, particularly where management such as scrub control has resulted in bare ground
- species with extensive (rhizomatous) root systems, such as bracken and tor grass
- problem species, such as creeping and spear thistle and broadleaved and curled dock, which can also develop following active management on fertile verges where diffuse pollution from neighbouring agricultural land creates the conditions for their growth.

It should be recognised, however, that these species have wildlife benefits as a food source, habitat or cover: their management is about balance not eradication.

## Controlling competitive grasses

Competitive grasses such as rye grasses (*Lolium* sp.), tufted grasses such as cock's-foot (*Dactylis glomerata*), false oat-grass (*Arrhenatherum elatius*) and Yorkshire fog (*Holcus lanatus*) are perhaps the main competitors of wild flowers on road verges. Finer grass species, such as common bent (*Agrostis capillaris*), timothy (*Phleum pratense*), crested dog's-tail (*Cynosurus cristatus*) and sheep's fescue (*Festuca ovina*) are more likely to co-exist with wild flowers rather than taking over. Appropriate mowing can reduce tussock-forming grasses but may encourage others to spread. Removing grass thatch by raking, and reducing the soil nutrients by collecting the cuttings, reduces the dominance of tufted grasses when maintained over a number of years.

Verges that were originally established using grass-only seed mixes, or where wild flowers have been lost with little prospect of re-establishing from the seed bank, may need new plants introduced. Such introductions should be considered under a two-stage approach: initially establishing the right conditions to support wild flowers by reducing competitive grasses and creating bare earth to support future wild flower germination and secondly, by introducing wild flowers either by seed or as plug plants.

## Bracken management

Bracken (*Pteridium aquilinum*) is a common fern with extensive rhizomes and can spread quickly and dominate areas of grassland. Bracken can be important for some species, such as rare fritillary butterflies that feed on violets (*Viola* sp.) growing under bracken, but most bracken on roadside verges is dense and can encroach harmfully on the grassland.

Dense bracken should be cut at least twice in the first few years, in May/June and July/August, and the cuttings removed. This will immediately start to weaken the rhizomes that will bleed out without being able to replenish their energy through photosynthesis. Following this management, a single cut should be undertaken in June/July to continue to weaken the rhizomes.

Bracken control through cutting requires long-term management. Annual cutting may take an estimated five to 10 or more years to reduce dense bracken stands, while cutting twice a year may reduce dense bracken to less than 10% of its former cover within 10 years. However, bracken can quickly recover to 80% of its former density within four to six years following the cessation of cutting.

Chemical control can be effective in reducing the cover of dense stands within two to four years. However, bracken quickly recovers if no follow-up management is undertaken. Seek further advice prior to using chemicals.

## Problem species

Problem species are those considered under the Weeds Act 1959 and include creeping and spear thistle (*Cirsium arvense* and *C. vulgare*), and broadleaved and curled dock (*Rumex obtusifolius* and *R. crispus*). Using subsoils and avoiding importing in topsoils reduces the likelihood of these species becoming problematic. Before any control is undertaken, it is worth understanding why they might have become problems. For example, fertiliser run-off or spread from neighbouring fields may result in higher soil nutrients leading to an abundance of creeping thistle. Perhaps scalping during mowing is leading to excess bare ground and the growth of spear thistle, or machinery is compacting the soil and encouraging the growth of docks *Rumex* sp. If these underlying causes are not tackled, the problem can persist even with treatment.

The three main methods of control are cutting, herbicide and hand pulling. Wherever possible, eliminate the general non-targeted use of herbicides, limiting them to spot treatment when this is prescribed for the problem species. Special care should be taken if applying spot treatments to problem species on species-rich verges.

**Thistles:** Mechanically cut thistles when the plant is in bud and the flower heads start to turn purple. This weakens the rhizome and the plants cannot recover without leaves to photosynthesise. Spear thistle can be pulled but this method is not effective for creeping thistle and may encourage spreading. Careful spot spraying with a targeted or broad-spectrum herbicide can quickly reduce thistles within one to two years, but thistles can recover following the cessation of spraying. Indiscriminate sprayings affect non-target species, especially 'daisy' family plants such as oxeye daisy (*Leucanthemum vulgare*). All arisings should ideally be removed to prevent nutrients returning to the soil but otherwise compost in a nominated sacrificial area.

**Docks:** Mechanically cutting docks should be done well before the plant sets seed. Pulling or digging out docks is not recommended as the long root can splinter, resulting in many new plants. Docks can be targeted by spot-spraying which can be effective within two to four years of application. The use of broad-spectrum herbicides will also affect non-target species. All arisings should ideally be removed to prevent nutrients returning to the soil but otherwise composted in a nominated sacrificial area.

**Common ragwort:** The Ragwort Control Acts seek to prevent common ragwort spreading where there is threat to the health and welfare of animals. Although road verges can have high cover of ragwort the risk to grazing animals is normally slim. For more information on assessing the risk level posed by ragwort and appropriate control methods, see the Defra Code of Practice For Preventing The Spread Of Ragwort. The native plant is biennial, forming a rosette in the first year and flowering during the second year. Although identified as an injurious weed species, it also supports a wide range of invertebrates, such as cinnabar moth, and it is an exceptional provider of nectar and pollen late in the season.

In those instances where control is necessary, it is essential to act before seed heads are mature to prevent the spread of fresh seed. Only removing the flower heads and allowing the cinnabar moth to feed on the remaining vegetation has proved to be highly successful but otherwise pulling and digging plants in spring and early summer is effective but can be difficult on verges and typically leaves large areas of bare earth that can be recolonised from the seed bed. Cut and pulled plants can be piled up on sacrificial areas of the verge, but in the unlikely event that livestock have access to the verge, all plant remains must be removed. Mechanical cutting can be undertaken but may stimulate the growth of side shoots the following year. Herbicides can be used to control ragwort and spot treatment at the rosette stage with a selective herbicide is recommended to prevent other broadleaved species from being killed.

**Gorse:** Where acid grassland and heathland are being established on sands or gravels, gorse often becomes a problem after five years, eventually smothering the dwarf shrubs and acid-loving plants. Annual mowing or strimming of gorse from the first year for up to 10 years will prevent it from becoming a long-standing problem. Once fully established, gorse is difficult to remove without substantial investment.

**Buddleia and cotoneaster:** Buddleia and cotoneaster (usually small-leaved cotoneaster) establish quite commonly on bare chalk or limestone substrates and if left unchecked, will spread to dominate the vegetation to the exclusion of more desirable native grassland vegetation. When small, buddleia and cotoneaster can be pulled by hand. Once established, they usually require herbicide treatment to remove them.

## F Creating new species-rich grassland verges

Creating species-rich grassland on new verges/following earthworks is recommended as a cost-effective and sustainable use of the soft estate. When properly considered from the outset, it can provide significant savings to the overall capital costs by, for example, eliminating the need to import topsoil onto the site. Adopting the detailed methods described below will ensure high-quality species-rich grassland with lower ongoing maintenance costs and biodiversity gain.

The most obvious justification for the creation of species-rich grass verges is their attractive natural appearance and the interest they provide for road users; it might be the only daily contact they have with the natural landscape. Wild flowers also help new roads blend with the landscape, they provide corridors of nature conservation value, and they demonstrate from the planning stage a concern to minimise the environmental impacts of new routes. Furthermore, if the right principles are applied, the ongoing management of the species-rich road verge can be considerably less than ongoing management for open grassland, periodic scrub, tree management and amenity grassland.

In a rural setting, species-rich verges should be established everywhere as the default grassland type and managed accordingly. There is an urgent need to re-establish wildlife corridors and suitable habitat in the countryside that has been lost to agricultural improvement in the past 70 years. The potential for achieving this on the Strategic Road Network (SRN) is substantial.

In an urban setting, opportunities for creating species-rich verges will be context specific, but the default should be to specify them over standard amenity grassland unless there are overriding justifications.

Species-rich grassland growing on subsoil, bare mineral or low-fertility topsoil should also be considered for grassland areas where safety benefits are a priority, such as on visibility splays and approaches to junctions and roundabouts. The vegetation on these types of soils require much less frequent management than if fertile topsoil is used, leading to a lower cost to maintain necessary sward heights. More wild flowers will thrive in the lower fertility conditions and subsoil usually has fewer problem weeds and grass seeds.

Similar low-fertility substrates with sparse species-rich grassland can be considered as an improvement for accident-prone sites where visibility along the verge is a contributory factor. As well as increasing visibility, there is an ongoing benefit of cost savings with the reduced management.

> In 2018, one of the approaches to the Waddock Cross Junction in Dorset – a notorious accident blackspot due to poor visibility – was modified. The grass verge was removed to a depth of 600 mm below the carriageway and in-filled with crushed chalk to bring it back to road level. Kidney vetch and bird's-foot trefoil were sown on the bare mineral. These minor capital investments cost c. £5000 and are expected to reduce mowing costs by 90% each year. The improved visibility has provided immediate collision-reduction benefits alongside a net gain for biodiversity.

Locations available for the creation of species-rich grassland on low-fertility earthworks includes:

- Most rural verges
- Cutting and screening mounds
- Embankments
- Junctions, interchanges and roundabouts
- Areas of land set aside to accommodate material from roads set in cuttings and tunnel spoil

## How to create species-rich grassland verges

The guiding principle for creating species-rich road verges is to avoid the use of fertile topsoil. High soil fertility encourages excessive growth of non-desirable species and reduces the success of wild flower establishment. Newly created grassland must instead be finished with clean subsoil or bare mineral substrate.

There may be a reluctance to finish verges with subsoil or bare mineral, on the expectation that the landscaping will look incomplete and nothing will grow quickly. This is not the case and there are several common and showy species that quickly establish in profusion on bare ground, such as kidney vetch (*Anthyllis vulneraria*) on chalk and limestone-based soils and oxeye daisy (*Leucanthemum vulgare*) on neutral soils. Bare mineral may contrast strongly with the surrounding landscape when first exposed, but it weathers quickly and revegetates. Chalk is bright white at first but changes to a mottled grey within months. The combination of weathered mineral and abundant wild flowers provides an appealing and naturalistic landscape.

> As part of the mitigation package included in the construction of the Weymouth Relief Road, topsoil from semi-improved calcareous grassland along the route was saved separately and scattered thinly over about 7 hectares of cutting slopes to a depth of no more than 10-15mm. The remainder of the slopes received no topsoil at all. All cutting slopes were sown with a grassland wildflower mix of 25 species suitable for chalk and limestone habitat. In 2019, eight years after after the road opened, a survey was undertaken by Dorset Environmental Records Centre, which showed that there were 140 flower species thriving on the slopes, including bee and pyramidal orchids. Monitoring by Butterfly Conservation has shown that these slopes support 30 species of butterfly, including Chalkhill Blue and Dingy Skipper. Since the road opened in 2011, there has been minimal requirement for management because the soil is so impoverished and grazing is only needed every four years or so. While the wildflower seed cost £24,000, there is an estimated net capital cost saving of £270,000 due to not using topsoil, and annual maintenance costs are negligible.

When heavy earth-moving machinery is used to remove topsoils and during slope formation, the subsoil material can become heavily compacted and left with a glassy finish that is liable to plate and form an impenetrable surface for seed germination. This is particularly common for clays and alluvial silts and, in such circumstances, it may be necessary for some surface preparation – for example, the surface to be ripped or rotovated, to create a tilth to encourage seed germination. Close liaison with the design and construction teams will ensure that slope stability is not affected by this surface treatment, and that the finishing operations be carried out along the contour of the slope to avoid deep erosion by surface run-off.

**Natural colonisation:** this is the most cost-effective method of achieving a species-rich verge where soil fertility is low but can only be achieved if the verge is adjacent to species-rich habitat. The process may take considerable time, especially if there is limited transfer of seeds (which would usually be transferred on livestock or machinery). Bare ground, skeletal soils and sparse vegetation are an important habitat for many species of plants and invertebrate, so there is not always a need to create a dense sward.

**Natural seeding:** in some cases, verges and the surrounding countryside are so depleted of wild flowers that natural colonisation is unlikely to take place. In such cases, natural seeding methods can be used to introduce wild flowers by transferring green hay or brush-harvested seed collected from a local species-rich verge or meadow (the donor site) to the verge being created (the recipient site). This ensures species will be naturally present and better adapted to local conditions. In this way, the local character and genetic diversity of our verges is preserved and more species will become established more quickly than by using a generic, non-specialist seed mixture, which invariably contains fewer (sometimes inappropriate and non-native) species and often includes more grass seed than wildflower seed. Natural seeding methods also have the potential benefit of engaging local communities, who can become involved in collecting seed from nearby nature reserves and farms, and with sowing seed or growing plug plants.

> In 2015, the North and Mid Wales Trunk Road Agent started a project to enhance and restore the Conwy Portal site as part of the Welsh Government "Road Verges for Wildflowers Initiative". The existing area of infrequently maintained rank grassland was cut in late summer and the cuttings were collected to reduce fertility. Following cut-and-collect, the ground was scarified using a grass harrow to open up the turf and create areas of bare earth to aid seed establishment. Green hay was harvested from local SSSI meadow Caeau Tan y Bwlch and was spread over the scarified verge on the the same day. Follow-up surveys of the site have revealed an increase in the number and frequency of positive indicator species including yellow rattle, bird's foot trefoil, meadow vetchling and red clover.

**Bought seed mixes:** sowing of generic seed mixes from non-specialist suppliers can be costly and may result in the vegetation bearing little resemblance to naturally-occurring species-rich communities in the locality. However, purchasing a seed mixture may be the only option in some locations where other methods are not available. Wildflower seed should be of British origin, locally-sourced, and should be an appropriate species mix for the subsoil (or mineral) and locality. Seek advice from the authority ecologists or Local Biological Record Centre to help create a bespoke seed mix suited to the area, and avoid species that might dominate and out-compete other wild flowers. Avoid using generic pollinator and wildflower mixes as they often contain species that are not present in local grasslands and will result in the homogenisation of grasslands across the UK. Using mixes without (or very low percentages of) grass seed helps wild flowers establish without competition from grasses.

**Species-rich turf:** this is a relatively recent innovation with suppliers growing turf with a range of wild grasses and flowers. This method of creating species-rich grass verges is probably the costliest option as the entire area for creation would need to be covered by ready-grown turf. However, it does work and with appropriate management gives instant results and is suitable for difficult ground conditions where other methods may prove impractical.

**Use of saved topsoil:** the only occasion where topsoil should be used to finish areas for wild flowers is where it can be saved from existing species-rich areas that will be destroyed as part of the development. This topsoil will contain a valuable seed bank of wild flowers and grasses and must be stored separately from other topsoil prior to re-use. Topsoil should be stored such that as much of the soil fauna survives when it moves to its new location.

## Prescriptions for creating flower-rich grasslands along new roads

There are different methods for establishing species-rich grassland depending on the technique being used.

If **natural colonisation** is being used, there is no need to do anything further once the verge has been created, apart from making sure that the surface of the soil has a fine tilth to facilitate seed germination.

The use of **saved topsoil** should be undertaken by spreading the topsoil thinly onto the bare ground of the new verge, around 15mm or deeper if site conditions allow or necessitate, as some wildflower species, such as Meadow Cranesbill, may require deeper infertile soil for successful establishment. Wild flower and grass seeds germinate from the soil surface, usually no more than 1cm depth (½in), and deeper spreading of the soil will bury seed, restricting germination.

The use of **natural seeding** methods needs slightly more planning. The donor seed source (a local flower-rich meadow or verge) should be identified before works begin:

- If green hay is being used, the seed source ideally needs to be within an hour's drive of the recipient road verge, and certainly within half a day's journey time. The transfer needs to be undertaken quickly to prevent the green hay from heating up and cooking the seeds. Green hay is cut in late July or August to maximise the diversity of flowers with set seed and collected using a forage harvester or flail mower. The hay is taken immediately to the prepared road verge where the soil should already have been prepared to a fine tilth. The green hay can be spread by hand or mechanically with a muck-spreader and any clumps can be separated using hand pitchforks. If the green hay is transferred as bales, these can be put through a straw strewer to spread the material, separating any clumps with pitchforks. Following the hay spreading, a roller should be used to ensure the seed has good contact with the soil.
- If brush-harvested seed is being used, a contractor with a brush-harvester will be able to harvest the seed from the donor site. Seed can be used fresh – for example, by loading it into a trailer or muck-spreader and transferring it within half a day to the receptor road verge as described, or it can be sieved and dried to be spread at a later date. Brush-harvested seed is best used within a few months of collection, particularly if yellow rattle (*Rhinanthus minor*) is present (this annual requires a period of cold to trigger germination). Brush-harvested seed is best spread between August and November, and should be strewn across bare ground that has been prepared to a fine tilth. Seed should be sown on or just under (within 1cm of) the soil surface. Sowing can be done by hand or machine if the chaff (stalks and leaves that are also picked up by a brush-harvester) has been removed, enabling the seed to pass through a hopper. Once the seed has been spread, the ground should be rolled to push the seed onto the soil surface, creating good contact.

If using a **generic non-local seed mixture**, this should be bought from a reputable specialist supplier of UK native wildflower seed. Generally, it's best to get a mixture with a higher proportion of wild flowers – for example, 80:20 or 100% wildflower seed. The seed can be sown by hand onto a prepared soil surface with a fine tilth in either autumn or spring, or can be passed through a hopper towed behind a tractor. Seed should be sown on or just under (within 1cm of) the soil surface. The ground should then be rolled to press the seed onto the soil. Depending on the contractor, it might be possible to attach a roller behind the hopper, thereby making a single pass over the new verge and reducing compaction. Alternatively, hydro-seeding can be used spraying a mixture of water, seed and binding agent onto the prepared verge.

**Species-rich turf:** The verge needs to be prepared with a fine tilth with all large stones removed or buried. The species-rich turf should be rolled out and lightly pressed down onto the soil surface before watering. Watering may be required until the turf has established, which may take as long as three months, particularly in extremely dry weather.

## Prescriptions for creating flower-rich grasslands along existing road verges

There are occasions where species-rich grass verges could be **created on existing species-poor verges**. Before work is undertaken, test for soil fertility, particularly the amount of phosphate (P). A P index of 0-1 is ideal for most wild flowers and grasses. A P index of 2 suggests that competitive species may take over and a seed mixture with species that are able to survive in these more fertile conditions is recommended. If the P index is 3+, it is unlikely that a species-rich grassland will develop as competitive species, particularly tussock-forming grasses, are likely to take over.

**Soil nutrients can be reduced over time**, and there are various methods to achieve this:

- Soil stripping removes the top layer of nutrient-rich topsoil and is effective in reducing soil nutrients. The depth of soil removal needs to be carefully calculated with a plan of depositing the excess topsoil or selling it for subsequent use by others. This may be restricted if, for example, the road verge is in a floodplain.
- Cutting and removing vegetation several times a year limits the nutrients that are otherwise recycled in the soil. This can take several years and, with soils of low permeability (for example, clay soils), a low P index may never be achieved. If this is the case, gaps in the sward could be opened using yellow rattle and a species mix with wild flowers that are more tolerant of fertile conditions could be trialled.
- Capping, which is overlaying existing soils with suitable substrate/subsoil, possibly as part of using saved topsoil, is generally discouraged as it can be nutrient-rich. All the vegetation due to be covered with the new soil should be removed – either by scraping off or spraying with herbicide – to prevent it growing through the new soil. Scrapings can be placed in a pile at the back of the verge if it is wide enough, or removed from site if the verge is too narrow. There have been occasions where this management has been undertaken and, over time, nutrients have leached upwards into the new soil, encouraging more competitive species with the result that the works did not create a species-rich grassland in the long term. The impact of raising or lowering soil levels needs to be considered, for example on drainage and profiles.
- Soil inversion is where a deep plough of earth-moving machinery buries the richer topsoil beneath a layer of subsoil. There are similar issues with nutrients leaching upwards as described under capping above and it requires specialised machinery which may not be readily available. It has the potential to be quite costly.

Buried archaeology should be considered prior to soil stripping or inversion being undertaken.

If the soil conditions are suitable, the next stage is to open up bare ground to receive a seed source. At least 50% bare ground should be created, with 80-90% ideal for the germination of seeds. This can look drastic but experience has shown that the harder you hit a site to begin with, the more successful the result. Creating bare ground should ideally be done mechanically, though there may be occasions where spot treatment of herbicide is more effective, such as on slopes to eradicate wall cotoneaster, or where mechanical means are not practicable:

- Harrowing – to create bare ground, a power-harrow or a combination of a flail mower and tine harrows can be used. Small horticultural rotary cultivators may also be suitable where access for larger machinery is restricted. The vegetation may need to be cut short before harrowing to enable patches of bare ground to be created and to remove large grass tussocks.
- Herbicide – advice from a qualified contractor should be sought about the types of herbicide that can be used, and application, as well as any risk of unintended consequences, such as run-off and diffuse pollution.

A seed bed should be created by rotovating or harrowing to make a fine tilth, once bare ground has been established, and prior to spreading seed. When herbicide has been used, it is advisable not to cultivate the soil as this is likely to expose weed seeds; instead, just surface sow then follow with rolling.

Species-rich grassland can be established using the methods outlined under the section on creating species-rich grassland along new roads (see page 26).

## Management of newly created species-rich grasslands

Cut-and-collect mowing is a key way of maintaining the biodiversity of grass verges but not the only one. Consideration during scheme design should also be given to the opportunity for establishing grazing units for cattle or sheep, especially where verges are wide for forward visibility, and on embankment and cutting. Stock-proof fencing, set back from the road edge, will be an additional requirement to be specified, together with a water trough and supply.

Flower-rich grasslands established on subsoil or bare mineral are unlikely to require ongoing annual management, and grazing every three to five years for a few weeks in that year may be all that is needed.

# Monitoring grassland road verges

Monitoring the effectiveness of management is crucial to measuring contract performance and informing future management measures. There are various attributes or performance measures that can be usefully monitored and should be reflected in management contracts.

| Attribute | Frequency | Comments |
|---|---|---|
| **Habitat extent** – area of habitat type (species-rich grassland) within the soft estate | 5 yearly | Aerial photography/site inspection |
| **Vegetation composition** – species frequency/ abundance present | Annually/biannually | This might be undertaken as a community assessment or using indicator species |
| **Positive indicator species** – presence/absence/ population numbers | Annually/biannually | e.g. indicator or notable species |
| **Negative indicator species** – negative/invasive species | Annually/biannually | e.g. indicator or notable species |
| **Biometrics** – area, habitat type and condition | Annually/biannually | e.g. Government biodiversity metric 2.0 |
| **Area under favourable management** – amount of road verge following these guidelines | Annually | Incrementally increasing target |

Monitoring should be prioritised for those areas afforded statutory or non-statutory protection and other species-rich areas, or where restoration and enhancement management is in place.

There are numerous established monitoring methods available, including ground vegetation surveys (Common Standards Monitoring, Rapid Assessment, the National Vegetation Classification or Phase 1 surveys) or remote monitoring (for example, aerial photography and LIDAR). These should be integrated into the GIS-based asset management system to support and inform management contracts. Support and assistance could be sought from local community groups and Local Sites Partnerships.

# Further guidance and reading

Highways England agrees with the good practice principles stated within this guidance; however, all contractual requirements should be based upon standards for highways, for example the Design Manual for Roads and Bridges

*Design Manual for Road and Bridges (DMRB*)
Highways England, Transport Scotland, Welsh Government and
Northern Ireland Department for Infrastructure (2018)
www.standardsforhighways.co.uk

*Making Space for Nature: A review of England's Wildlife Sites and Ecological Network* (2010)
Chaired by Professor Sir John Lawton CBE FR

*Keeping the Wild in Wildflower*
www.plantlife.org.uk

Department of Environment Food & Rural Affairs:

- *Local Sites - Guidance on their Identification, Selection and Management*
- *Construction Code of Practice for the Sustainable Use of Soils on Construction Sites*
- *Defra Guidance for Successful Reclamation of Mineral and Waste Sites*
- *Good practice guide for handling soils*

*The Biodiversity Metric 2.0*
Natural England

Case studies from around the UK showcasing the practical implementation
of these guidelines can be found in full online at:
https://plantlife.love-wildflowers.org.uk/roadvergecampaign/management-guidelines

# Glossary

**Access management** Grass is regularly cut to maintain access around structures or other critical infrastructure. This management is usually undertaken using hand tools, often during the growing season. Cuttings are usually not collected.

**Amenity grassland** is grassland that is often intensively managed with cuts several times a year, resulting in a relatively short sward. In very intensive systems, amenity grassland may be cut up to eight times per year. The reason for the intensity of management is generally linked to its location – for example, grassland situated on roadsides in villages or town centres. Works are undertaken using a wide variety of equipment, from hand mowers through to larger ride-on mowers. Collection of the cuttings is more common on amenity grassland, and there is a wider range of equipment available to do this as generally the sites are level and flat, and the road speed is reduced making it safer for operatives to carry out work.

**Herb** Herbaceous or non-woody plant.

**Propagule** Any structure capable of being propagated or acting as an agent of reproduction, or a plant part, such as a bud, that becomes detached from the rest of the plant and grows into a new plant. This includes seeds, stolons or rhizomes.

**Swathe (safety) cut** Undertaken several times a year with the aim of keeping the first 1-2 metres of grassland from the road short to maintain sight lines. The swathe cut is applied to the majority of road verges and is especially important on the strategic road network and other major routes. This cut is usually undertaken using a tractor-mounted flail and cuttings are not removed. It ensures a short sward that deters invertebrates and small mammals away from the road. On minor roads it may not be necessary to undertake a swathe cut where there are no hazards.

### Additional criteria

**Diversity or biodiversity:** This is a combination of species richness (the number of species present in a given area) and their abundance. It is closely related to habitat size and structural diversity, as well as the inherent species composition of the type of grassland habitat in question. For example, some habitats are inherently more diverse than others, and secondary habitats may be quite rich in this respect. Conversely, many ancient semi-natural habitats (in particular heathlands that are not considered in this management guidance) may be inherently species-poor, but of considerable importance in that they often support rare plants and animals. Where good examples of supporting habitat are identified through new surveys, conservation priorities should be re-evaluated to ensure that the grassland is being managed appropriately.

**Position in an ecological unit** refers to the relative ecological isolation of a grassland road verge. In the context of this assessment, stands of grassland roadside habitat of moderate quality would be raised in value if they are adjacent to large stands of semi-natural habitat outside highway boundary. In such instances, it should be assumed that the verge habitat would support species that would be more typically associated with adjacent semi-natural habitat. Equally, a species-rich grassland road verge would assume rather lower value if the nearest similar habitat were several kilometres away

**Rarity:** in this context refers to species of plant, animal and type of habitat whose populations or extent are considered to be under threat. The premise is based upon the principal that very small, in particular ecologically isolated populations and habitats, are more likely to be lost as a result of harmful changes in management, direct destruction or even as a result of some random destructive event (such as fire or drought). Rarity is generally assessed at local, regional and national levels and assessment is assisted by reference to texts, such as Red Data Books and legislation, including the Natural Environment and Rural Communities Act 2006, and Wildlife and Countryside Act 1981.

**Size** is closely related to diversity and rarity, particularly when considering the extent of a habitat type. Larger areas of habitat enable there to be greater structural diversity on grassland verges, providing increased species richness and larger, and therefore more stable, populations of plants and animals. It is of particular importance in the event of disturbance, such as a severe drought, fire or flood, as larger populations of vulnerable species are more likely to survive these random events. Where the event leads to the loss of part of a population, there is an opportunity for recolonisation.

**Typicalness** refers to whether the habitat in question is considered a good example of a particular type and is of most use when assessing long-established plant communities. The National Vegetation Classification can assist assessment in this context, as it attempts to provide 'snapshots' of typical plant communities across the UK that have developed under a range of environmental conditions and management regimes.

# **Appendix 1:** Equipment used to manage grassland verges

**Hand-held tools** are used for more intricate work such as clearing around road signs and Armco crash barriers, steep slopes and less accessible places. They are universal across all road types and the most common are strimmer, brush-cutter and walk-behind mowers.

**Ride-on mowers** make cutting moderately large areas of grass, such as road verges in an urban area, much quicker and more efficient than hand-held tools and cause minimal soil compaction, improving water retention. They can be used in areas where a fine finish is required, such as at motorway service stations, and are usually highly manoeuvrable and able to cut close to street furniture such as lamp columns and road signs.

**Tractor-mounted flails** can cope with tussocky and dense grass swards or light scrub which is mown once or twice a year. Most flails are driven by the power take-off (PTO) from the tractor and attached to the three-point hitch at the rear of the tractor. Some tractors also have front-mounted flails. Commonly the flail is attached to a hydraulic side-arm (the side-arm flail) and this provides a versatile mowing head able to cope with vertical and horizontal alignments, and all angles of slope in between. The reach of the flail is limited by the length of the side arm. The standard 1-2 metre swathe cut immediately next to the road edge is one width of the flail head. Care should be taken to avoid soil compaction on wet ground.

**Remote-controlled cutting:** remote-controlled mowers are becoming increasingly common, especially on steep slopes where operator safety on conventional driven machinery is a particular concern. Track laying mowers can cut embankments up to 55 degrees. Several different interchangeable heads are available, including a standard flail head for grass and light scrub to forestry mulcher heads that will tackle substantial scrub and small trees. As the operator is remote from the machinery, problems associated with Hand Arm Vibration Syndrome are avoided.

**Cut-and-collect:** machinery that removes the cut grass at the same time as the cutting is known as cut-and-collect, or cut-and-lift technology. It is commonly used across large areas of grass where leaving cuttings is deemed unsightly or unacceptable, such as on golf courses. Although frequently employed in continental Europe, it is not often used on UK road verges, yet would transform the way that verges are managed, and in most cases would lead to cost savings and increased biodiversity as Dorset and Lincolnshire councils have experienced.

**Small-scale cut-and-collect mowers for urban use:** Dorset Council is moving to replace all their ride-on mowers with cut-and-collect machinery, so that they are dual purpose. They still have mostly standard ride-on front deck flail mowers (less often front deck rotary mowers) but by the end of the 2018/19 year, will have four or five cut-and-collect. They currently have two in operation daily:

- Amazone 4WD Profihopper. http://www.amazone.co.uk/2376.asp
- Grillo Front Deck rotary mower. http://www.grilloagrigarden.co.uk/fd450

**Large-scale flail collectors for some urban but mainly rural use:** Large-scale flail collectors – where grasslands are flat and wide enough for the tractor, flail and hopper to operate – can be used. They are operated on some road verges, public open spaces, nature reserves and school grounds. The flail collectors also cope with cutting heather and light scrub.

- Ryetec flail collector http://www.ryetec.net/product.php?id_product=20
- Amazone flail collector http://www.amazone.co.uk/285.asp

# **Appendix 2:** Reference list of indicator plant species that could be used when monitoring

| **Lowland meadow species** | | **Comment** |
|---|---|---|
| Betony | *Betonica officinalis* | Common in more acid soils |
| Bulbous buttercup | *Ranunculus bulbosus* | Common in most drier lowland meadows |
| Common bird's-foot trefoil | *Lotus corniculatus* | |
| Common/black knapweed | *Centaurea nigra* | |
| Crested dog's-tail | *Cynosurus cristatus* | |
| Devil's-bit scabious | *Succisa pratensis* | Common in more acid soils |
| Field scabious | *Knautia arvensis* | |
| Hawkbits | *Leontodon* sp. | Includes autumn hawkbit (*Leontodon autumnalis*) and rough hawkbit (*L. hispidus*) |
| Lady's bedstraw | *Galium verum* | Common in more calcareous lowland soils |
| Meadow buttercup | *Ranunuculus acris* | Common in most damper lowland meadows |
| Meadow vetchling | *Lathyrus pratensis* | |
| Oxeye daisy | *Leucanthemum vulgare* | |
| Quaking-grass | *Briza media* | Common in more calcareous soils |
| Salad burnet | *Poterium sanguisorba* | Common in more calcareous soils |
| Self-heal | *Prunella vulgaris* | |
| Sweet vernal grass | *Anthoxanthum odoratum* | |
| Tufted vetch | *Vicia cracca* | |
| Yellow oat-grass | *Trisetum flavescens* | Common in more calcareous lowland soils |
| Yellow rattle | *Rhinanthus minor* | |

| Upland hay meadow species | | Comment |
|---|---|---|
| Bulbous buttercup | *Ranunulus bulbosus* | |
| Cat's-ear | *Hypochaeris radicata* | |
| Common bird's-foot trefoil | *Lotus corniculatus* | |
| Common/black knapweed | *Centaurea nigra* | Can be common in some upland hay meadows but might not be present or at low levels |
| Crested dog's-tail | *Cynosurus cristatus* | |
| Great burnet | *Sanguisorba officinalis* | |
| Hawkbits | *Leontodon* sp. | Includes autumn hawkbit (*Leontodon autumnalis*) and rough hawkbit (*L. hispidus*) |
| Ladies'-mantle | *Alchemilla* sp. | |
| Meadow buttercup | *Ranunuculus acris* | |
| Meadow vetchling | *Lathyrus pratensis* | Common in most upland hay meadows |
| Oxeye daisy | *Leucanthemum vulgare* | Might not be present or at low levels |
| Pignut | *Conopodium majus* | |
| Red clover | *Trifolium pratense* | |
| Self-heal | *Prunella vulgaris* | Might not be present or at low levels |
| Sweet vernal grass | *Anthoxanthum odoratum* | |
| Wood crane's-bill | *Geranium sylvaticum* | |
| Yellow rattle | *Rhinanthus minor* | |

| Floodplain meadow species | | Comment |
|---|---|---|
| Common bird's-foot trefoil | *Lotus corniculatus* | Might not be present or at low levels |
| Common/black knapweed | *Centaurea nigra* | |
| Common sorrel | *Rumex acetosa* | |
| Crested dog's-tail | *Cynosurus cristatus* | |
| Cuckoo-flower / Ladies'-smock | *Cardamine pratensis* | Might not be present or at low levels |
| Great burnet | *Sanguisorba officinalis* | |
| Hawkbits | *Leontodon* sp. | Includes autumn hawkbit (*Leontodon autumnalis*) and rough hawkbit (*L. hispidus*) |
| Meadow buttercup | *Ranunuculus acris* | |
| Meadow foxtail | *Alopecurus pratensis* | Might not be present or at low levels |
| Meadowsweet | *Filipendula ulmaria* | |
| Meadow vetchling | *Lathyrus pratensis* | |
| Oxeye daisy | *Leucanthemum vulgare* | Might not be present or at low levels |
| Pepper-saxifrage | *Silaum silaus* | Might not be present or at low levels |
| Ragged-robin | *Lychnis flos-cuculi* | |
| Red clover | *Trifolium pratense* | |
| Self-heal | *Prunella vulgaris* | Might not be present or at low levels |

| | | |
|---|---|---|
| Sweet vernal grass | *Anthoxanthum odoratum* | |
| Yellow rattle | *Rhinanthus minor* | Might not be present or at low levels |

| **Sedge pasture species** | | **Comment** |
|---|---|---|
| Carnation sedge | *Carex panicea* | |
| Common bird's-foot trefoil | *Lotus corniculatus* | Might not be present or at low levels |
| Common/black knapweed | *Centaurea nigra* | Might not be present or at low levels |
| Crested dog's-tail | *Cynosurus cristatus* | |
| Cuckoo-flower/ Ladies'-smock | *Cardamine pratensis* | |
| Devil's-bit scabious | *Succisa pratensis* | Might not be present or at low levels |
| Eyebright | *Euphrasia officinalis agg.* | Might not be present or at low levels |
| Great burnet | *Sanguisorba officinalis* | Might not be present or at low levels |
| Hawkbits | *Leontodon* sp. | Might not be present or at low levels. Includes autumn hawkbit (*Leontodon autumnalis*) and rough hawkbit (*L. hispidus*) |
| Lesser spearwort | *Ranunculus flammula* | Might not be present or at low levels |
| Marsh marigold/Kingcup | *Caltha palustris* | Might not be present or at low levels |
| Meadow buttercup | *Ranunuculus acris* | |
| Meadow foxtail | *Alopecurus pratensis* | Might not be present or at low levels |
| Meadow vetchling | *Lathyrus pratensis* | Might not be present or at low levels |
| Meadowsweet | *Filipendula ulmaria* | Can be a sign of lack of grazing |
| Ragged-robin | *Lychnis flos-cuculi* | Might not be present or at low levels |
| Red clover | *Trifolium pratense* | |
| Self-heal | *Prunella vulgaris* | Might not be present or at low levels |
| Sharp-flowered rush | *Juncus acutiflorus* | Might not be present or at low levels |
| Sweet vernal grass | *Anthoxanthum odoratum* | |
| Yellow rattle | *Rhinanthus minor* | Might not be present, or at low levels, or in patches |

| Calcareous grassland species | | Comment |
|---|---|---|
| Bee orchid | *Ophrys apifera* | Might not be present or at low levels |
| Betony | *Betonica officinalis* | Might not be present or at low levels |
| Bulbous buttercup | *Ranunulus bulbosus* | |
| Carnation sedge | *Carex panicea* | |
| Cat's-ear | *Hypochaeris radicata* | Might not be present or at low levels |
| Common bird's-foot trefoil | *Lotus corniculatus* | Might not be present or at low levels depending on sward height |
| Common/black knapweed | *Centaurea nigra* | |
| Common/black sedge | *Carex nigra* | |
| Common milkwort | *Polygala vulgaris* | Might not be present or at low levels |
| Common restharrow | *Ononis repens* | Might not be present or at low levels |
| Common rockrose | *Helianthemum nummularium* | Might not be present or at low levels depending on sward height |
| Common-spotted orchid | *Dactylorhiza fuchsii* | Might not be present or at low levels |
| Crested dog's-tail | *Cynosurus cristatus* | |
| Crosswort | *Cruciata laevipes* | Might not be present or at low levels |
| Devil's-bit scabious | *Succisa pratensis* | Might not be present or at low levels |
| Dropwort | *Filipendula vulgaris* | Might not be present or at low levels |
| Eyebright | *Euphrasia officinalis agg.* | |
| Fairy-flax | *Linium catharticum* | |
| Field scabious | *Knautia arvensis* | Might not be present or at low levels |
| Glaucous sedge | *Carex flacca* | |
| Greater knapweed | *Centaurea scabiosa* | Might not be present or at low levels |
| Greater yellow rattle | *Rhinanthus serotinus* | Might not be present or at low levels |
| Harebell | *Campanula rotundifolia* | |
| Hawkbits | *Leontodon sp.* | Includes rough hawkbit (*Leontodon hispidus*) and lesser hawkbit (*Leontodon saxatilis*) |
| Hoary plantain | *Plantago media* | |
| Horseshoe vetch | *Hippocrepis comosa* | Might not be present or at low levels |
| Kidney vetch | *Anthyllis vulneraria* | Might not be present or at low levels |
| Lady's bedstraw | *Galium verum* | |
| Oxeye daisy | *Leucanthemum vulgare* | Might not be present or at low levels |
| Pyramidal orchid | *Anacamptis pyramidalis* | Might not be present or at low levels |
| Quaking-grass | *Briza media* | |
| Sainfoin | *Onobrychis viciifolia* | Might not be present or at low levels |
| Salad burnet | *Poterium sanguisorba* | |
| Self-heal | *Prunella vulgaris* | Might not be present or at low levels |
| Small scabious | *Knautia columbaria* | Might not be present or at low levels |
| Sweet vernal grass | *Anthoxanthum odoratum* | |
| Upright brome | *Bromus erectus* | Can be a sign of lack of grazing |
| Wild basil | *Clinopodium vulgare* | Might not be present or at low levels |

| | | |
|---|---|---|
| Wild carrot | *Daucus carota* | Might not be present or at low levels |
| Wild marjoram | *Origanum vulgare* | Might not be present or at low levels |
| Wild thyme | *Thymus praecox* | Might not be present or at low levels depending on sward height |
| Yellow oat-grass | *Trisetum flavescens* | |
| Yellow-wort | *Blackstonia perfoliata* | Might not be present or at low levels |

| **Purple-moor grass and rush pasture species** | | **Comment** |
|---|---|---|
| Carnation sedge | *Carex panicea* | |
| Common lousewort | *Pedicularis sylvatica* | Might not be present or at low levels |
| Common sorrel | *Rumex acetosa* | |
| Cross-leaved heath | *Erica tetralix* | Might not be present or at low levels |
| Cuckoo-flower/ Ladies'-smock | *Cardamine pratensis* | |
| Devil's-bit scabious | *Succisa pratensis* | Might not be present or at low levels |
| Greater bird's-foot trefoil | *Lotus uliginosus* | |
| Heather/ling | *Calluna vulgaris* | Might not be present or at low levels |
| Lesser skullcap | *Scutellaria minor* | Might not be present or at low levels |
| Lesser spearwort | *Ranunculus flammula* | |
| Marsh bedstraw | *Galium palustre* | |
| Meadow buttercup | *Ranunuculus acris* | |
| Meadowsweet | *Filipendula ulmaria* | Might not be present or at low levels |
| Purple-moor grass | *Molinia caerula* | |
| Ragged-Robin | *Lychnis flos-cuculi* | Might not be present or at low levels |
| Saw-wort | *Serratula tinctoria* | Might not be present or at low levels |
| Self-heal | *Prunella vulgaris* | Might not be present or at low levels |
| Sharp-flowered rush | *Juncus acutiflorus* | |
| Sneezewort | *Achillea ptarmica* | Might not be present or at low levels |
| Sweet vernal grass | *Anthoxanthum odoratum* | |
| Tormentil | *Potentilla erecta* | |
| Water mint | *Mentha aquatic* | |
| Western gorse | *Ulex gallii* | Might not be present or at low levels |
| Whorled caraway | *Carum verticillatum* | Might not be present or at low levels |

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ISBN: 978-1-910212-87-5
Front cover photograph Catharine Shellswell/Plantlife
Designed by evansgraphic.co.uk
Printed by Acanthus Press, Wellington, Somerset

**Plantlife would like to record grateful thanks to HRH The Prince of Wales's Charitable Fund and the Trustees of Rees Jeffreys Road Fund for their grants in support of this publication and our national campaign for better management of road verges.**