

# Biodiverse Green Roof System

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# Welcome

to Phoenix Amenity Supplies Green Roof Information Pack. We include all the information required to create a bio-diverse green roof, including species, ecological, and technical information with additional information on maintaining a green roof.

Our Bio-diverse Green Roof Species List includes comprehensive information on each plant species with an illustration, flowering colour, height and flower period where appropriate. Our sales and technical team are there to help with any further queries you may have. Largest Specialist grower and supplier of over 300 British native wildflowers, marginal & aquatic plants and seed with over 25 years experience.







#### **Benefits**

- Creates Habitat for threatened wildlife
- Contributes towards Local Biodiversity Action Plans
- Habitat Creation (brownfield sites/wildflower habitat)
- Improved Water Retention, Harvesting & Quality
- Improves Air Quality and Reduced Carbon Emissions
- Reduces Urban Heat Island Effect
- Creates Amenity Space & Wellbeing
- Aid to Planning & Sustainability (BREEAM, CfSH)
- Financial Benefits- Reduced Building Running
  Costs

#### Terminology & Types

Green roof is the overall term for any vegetated roof system and there are a number of different types and terms used to describe these different systems. The substrate depth and type and the plant communities that can establish on these mediums define the type of green roof:

Intensive green roots are also known as roottop gardens and the vegetation is similar to ground level planting and can include anything from trees and shrubs to swimming pools and allotments. The substrate used ranges from 200mm to 400mm and has a higher organic content and a requirement for high loading capacity.

Sedum roofs are very shallow substrate, low nutrient roofs 20-60mm, the dominant plant cover is a drought tolerant species known as a stonecrop (Sedum sp). These types of roofs have been shown to support less biodiversity and often include non-native plant species imported from overseas.

Extensive or Biodiverse roofs are shallow lightweight systems that can support a diverse assemblage of native wildflowers and grasses. The diversity of vegetation and substrates will create ecological habitats for wildlife and the substrate depth varies from 80-150mm.

#### **Designing & Planning**

Involving a specialist in the early stages of the green roof design process will ensure that the right green roof system is specified to meet the objectives of the project. Whether for credits for BREEAM or CfSH assessments, to meet local biodiversity targets or provide mitigation replacement habitat for brownfield sites a specialist can design and install the roof to meet these objectives.

A structural engineer and or architect must be involved in designing a green roof to calculate weight-loading capacities of the selected green roof system. BritishFlora can provide expert horticultural and ecological advice on native species planting and maintenance.

Weights and depths of substrates can vary and a suitably qualified structural engineer will need to be consulted on weight bearing loads of different roof designs. The Table below provides a guide to weight and depth of substrates in different green roof systems.

	Intensive Roof Loadings	Extensive/ 'Biodiverse' Roof loadings
Root barrier and drainage layer	57kg/m <sup>2</sup>	11kg/m <sup>2</sup>
Depth/Type of Substrate	200-400mm	80-150mm, 10-20% organic content
Plants	26kg/m <sup>2</sup>	Wildflowers 10kg/m <sup>2</sup>
Weight of substrate (saturated)	250kg/m² (200mm depth)	96 kg/m² (80mm depth)
Maintenance	Permanent irrigation required	Periodic
Saturated Total roof loadings (Average typical roof)	333kg/m <sup>2</sup>	117kg/m²

We work with Ecologists who are Full Members of the Chartered Institute of Ecology and Environmental Management (CIEEM) and can advise on enhancing biodiversity on your green roof and attaining landscape and ecology credits for Code for Sustainable Homes (CfSH) and BREEAM. The following Information note is a brief outline of how to plan and design for a green roof system focusing on 'biodiverse' roof systems.



#### **Green Roof Layers**

Terrestrial plant communities require adequate water, nutrients, drainage and air circulating around the roots to survive and this is recreated in the green roofing engineered layering system, which follows current best practice.

The waterproofing membrane is one of the most important factors to consider prior to installation and its integrity must be confirmed prior to installation of green roof system by a specialist waterproofing contractor. The root barrier membrane is a protective layer preventing any damage to the water proofing from plant roots. A drainage board provides water storage capacity and allows excess water to drain away and the filter fleece installed above the drainage board prevents substrate from entering the drainage board.

Drainage outlets are also an important component of green roof systems and vegetation barriers composed of large pebbles will prevent vegetation growing beyond the desired areas.

- 1 Biodiversity elements- log and rock piles
- 2 Localised mounding up to 200mm depth
- **3** Wildflower planting
- 4 Extensive crushed brick substrate
- 5 Filter fleece
- 6 Drainage board
- 7 Insulation



- 8 Root barrier membrane
- 9 Waterproofing layer
- 10 Structural slab
- © Spacehub Design

#### Substrates for Biodiverse Roofs

The substrate type and depth are the most important factor when determining what vegetation can establish on the green roof. Evidence has shown that substrates designed specifically for green roofing purposes that meet industry standards (FLL Guidelines and Green Roof Code of Best Practice 2011), perform better and have the following properties:

- Fire clay based\mineral substrate
- Circumneutral pH
- Lightweight
- Good drainage characteristics
- Porous (absorbs water)
- Low nutrient (10% organic content)
- Avoids compaction (large granular)





#### **Plant Selection**

It is recommended that UK Native, UK provenance plant species are used on biodiverse roofs as they are adapted to the local environment and have evolved with our native pollinators and wildlife providing more valuable foraging resources. The vegetation that will establish well in the dry, shallow soils and low nutrient environments on an extensive green roof are those species that occur in similar dry environments in nature. These are the drought tolerant plant species (Xerophytes) of dry grasslands, brownfield sites and coastal shingle occurring in the UK, which are habitats increasingly under threat. The table at the end of this document is a recommended list of UK Native plants that are proven to establish well on extensive/biodiverse roofs.

Recommended plants for biodiverse roofs include a mixture of annual, biennial and perennial wildflowers and grasses that are drought tolerant. Plants that self-seed readily such as kidney vetch (Anthyllis vulneraria) and viper's bugloss (Echium vulgare) are effective as they allow communities to re-establish after vegetation die back following periods of prolonged drought.

Plants with long flower tubes such as red clover (*Trifolium pretense*) and viper's bugloss provide valuable nectar sources for native long-tongued bumblebee species. Bird's-foot trefoil (*Lotus corniculatus*) is a larval food plant for many butterfly species. The white flowers of campion species such as bladder and sea campion (*Silene vulgaris/uniflora*) provide good nectar sources for moths, and the seed heads of many wildflowers provide potential refuge and overwintering sites for invertebrates. Composite flowers such as ox-eye daisy (*Leucanthemum vulgare*) and yarrow (*Achillea millefolium*) and hawkbits provide good nectar sources for more generalist pollinators such as flies, butterflies and beetles.

Planting a diverse mix of species will provide nectar and pollen from spring to autumn with plants such as wild pansy (Viola tricolor) and common daisy (Bellis perennis) flowering as early as March and Lady's bedstraw (Galium verum), scabious species and knapweeds flowering well into September.

Stonecrops (Sedum species) can be a valuable addition to a biodiverse roof but should not exceed 20% cover. They will readily provide vegetation cover in more exposed areas of shallower substrate and can aid the establishment of diverse wildflowers. White stonecrop (Sedum album) is the host plant of the leaf bug Clamydatus evanescens, which is a rare invertebrate (Red Data Book 3). Native Stonecrop's are recommended on Biodiverse Roofs as non-native species will not support the same wildlife diversity. Biodiverse roofs should aim for a minimum substrate depth of 80mm that varies up to 200mm to create different microclimates where thinner areas will be less well vegetated and deeper areas will be able to hold more moisture creating structurally diverse vegetation.



#### **Establishing Vegetation**

Our experience has shown that a combination of plug planting and seeding is the most effective way to establish a biodiverse roof. However for a balanced view the pros and cons of the different planting methods are described below:

#### **Natural Colonisation**

It is not recommended to allow roofs to colonise naturally as this can take a long time, it relies on having a good seed source nearby and the bare substrate is likely to become colonised by undesirable weed species such as Buddleja.

If the green roof is located in or near to an environmentally sensitive area and local provenance seed is required, seed should be collected by a specialist contractor and grown into plugs for the green roof or seed spread directly onto the roof (See other methods below).



#### Seeding

Seeding is a cost effective method to vegetate a green roof particularly suitable for larger roofs over 1500m<sup>2</sup>. There is a wide choice of species

available from seed and the installation is relatively straightforward involving hand broadcasting or over larger areas employing hydro-seeding methods or a mechanical spreader. With seeding only, the roof can take up to 2 years before it looks established and most perennial species will not flower until the second growing season and therefore it is recommended that seeding is always used in combination with plug planting. Additionally, it is recommended that an annual mix is sown with a perennial mix to provide colour in the first season. Substrates specifically designed for seeding are available that have a smaller particle size and higher organic content and should be spread as a top dressing on the main substrate.

Autumn sowing in August/September, depending on prevailing weather conditions, is recommended to ensure that seedlings will germinate in favorable conditions and be exposed to chilling to break dormancy. BritishFlora can advise on the timing, seeding rates, substrates, and seed carrier required to sow with a seed mix to ensure even and effective establishment of your green roof.



#### Plug Planting

Plug planting is an effective way of quickly establishing a green roof and a wide range of suitable drought tolerant species for green roofing are available from BritishFlora as plug plants.

Extensive lightweight substrates between 80-150mm are suitable for wildflower plug plants, with some plants requiring deeper substrates than others (refer to plant species table at the end of the document). Ideally plug plants should be planted at the beginning or the end of the growing season (March/April, or September/October) to allow the plants to establish. BritishFlora can advise on planting densities, suitable substrates and additional growing materials that will ensure establishment of plug plant vegetation.



#### Optimum Combination for establishing biodiverse greenroof -Plug Planting and Seed

The optimum combination is to install plug plants with a seed mix to ensure successful establishment of biodiverse mix of wildflowers. Some species of wildflower are difficult to establish from seed i.e those that need vernalisation or do not withstand competition and therefore plug plants are preferable however and annuals are more successful from seed. Plug plants will help to stabilize the soil and prevent potential erosion of substrate and wildflower seed.

This combination will provide greater diversity of plants and improved short-term and long-term establishment of vegetation. It also ensures the client achieves their sustainability credits through biodiverse planting in the first year and avoids having to return to replant roofs that have failed through seeding alone.

# Sedum and wildflower blankets or pre-established systems

A pre-established sedum or wildflower turf provides an instant effect but is not recommended for biodiverse roof applications.

The plant mixes available are limited and grass species will dominate over wildflowers. In areas where a blanket is installed the substrate cannot be undulating and does not provide open areas for burrowing invertebrates or natural plant colonisation. This is also an expensive solution and daily irrigation of turf during establishment and dry spells is required to keep vegetation alive.

#### Wildlife on Biodiverse Roofs



Monitoring and research on biodiverse roofs has shown that these wildflower rich habitats can provide important wildlife stepping-stones for invertebrates and can provide foraging and nesting potential for birds and bats. They

#### should not replace habitat at ground level but in a built-up environment providing habitat at roof level can be very beneficial for biodiversity.

The habitats provide important sites for invertebrate specialists of dry environments including a number of rare species and those of principle conservation importance such as the brown-banded carder bee (Bombus humilis), which feeds on the wildflower rich habitat of biodiverse green roofs.

The insect biomass on green roofs is dominated by diptera, the principle food source for bats and therefore can attract foraging bats, particularly if a number of roofs are in the same area. In conjunction with artificial roosting sites at roof level biodiverse roofs can provide suitable habitat for bats in urban areas as wildlife stepping stones.

#### **Biodiversity Features**

A biodiverse roof should include a variety of substrate types and depths to increase the mosaic of habitat types, vegetation structure and provide different microclimates for invertebrate species. Ideally the extensive substrate depth should range between 80mm up to 200mm to allow for different plant communities to develop. For example kidney vetch will establish on the shallow substrates and taller perennials such as knapweeds will thrive on The seeds and invertebrate biomass present on the green roof (ground dwelling, flying and soil invertebrates such as earth worms and larvae) provide foraging for bird species. The old flower stems left in situ provide nesting material and nesting habitat can be provided on site at roof level through artificial nest boxes or within the building design.





#### the deeper substrates up to 200mm.

Other substrate types in addition to the extensive substrate can include sand mounds, pea gravel, shingle, pebbles, wood piles and boulders to provide damper areas and cover for ground dwelling invertebrates. Substrate features should be considered

where loading capacity allows on the building (discuss with architect/engineer). Where wind erosion is a problem heavier substrates can be used effectively to weigh down the extensive substrate and allow plants to establish by creating sheltered areas behind stone piles.

Water features can also provide an invaluable habitat and can increase insect biomass and provide bathing opportunities for birds. Insect hotels can also provide additional habitat for priority invertebrate species and can be added after initial installation.

#### Maintenance

Contrary to popular belief biodiverse roofs do require periodic maintenance throughout the lifecycle of the roof. The key maintenance period is up to 3 months after planting during the initial 'establishment period'. Irrigation is particularly important in the first 10 weeks during dry periods.

On roofs over 500m<sup>2</sup> an automated sprinkler or leaky pipe system should be considered to maintain plant health. For plug plants irrigation is required every 2-3 days to once a week during the establishment period but wildflower blankets require daily irrigation during dry spells. Green roofs are very nutrient poor environments and therefore the use of a slow release fertiliser can be beneficial to plant establishment (we can advise on fertiliser makeup and application rates). After initial establishment further fertilisation and watering should NOT be required but should be assessed by the maintenance contractor.

Ongoing maintenance on biodiverse roofs should include at least two annual visits by a suitably qualified specialist green roof maintenance contractor. The tasks required in annual maintenance can include:

- Inspection of vegetation and reporting any problems on plant establishment
- Removal of unwanted weeds such as Buddleja, Canadian fleabane, sow-thistles and docks
- Clearance of drainage pits and vegetation barriers around perimeter
- Old seeds heads should be left to overwinter to provide foraging potential for birds and overwintering sites for invertebrates.
- Cutting of wildflower turf and removal of this vegetation may be required on turfed roofs or those with more vigorous grass growth
- Invertebrate and/or wildlife surveys, which may be a requirement under BREAAM Landscape and Ecology Management Plans. This can provide invaluable information on green roof ecology and help inform future green roof design.

#### Plant & Seed Supply

BritishFlora are one of the largest suppliers of UK Native wildflowers in the U.K and are a British Provenance nursery. We grow our plug plants in a 65cc jumbo plug (84 plants per tray) in green roof substrate, which are an optimum size for shallow substrates and easy to plant.



#### **Species List**

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Scientific Plant Name Common Plant Name	Comments
Achillea milefolium - Yarrow	Medium height perennial. Substrate depth of 80-150mm. Flowering period June to August. Nectar source for generalist pollinators.
Agrimonia eupatoria - Agrimony	Tall perennial requiring deeper substrates 100-150mm. Suitable for shady areas. Flowering June to September.
Anthyllis vulneraria - Kidney Vetch	Clump-forming prolific self-seeder is quick to establish. Substrate depth of 80-150mm. Nectar sources bees and butterfly larval foodplant (small blue).
Armeria maritima spp Maritima - Thrift	Very attractive clump-forming plant suitable for exposed sites by the sea. 80-150mm substrate. Long flowering period April to October.
Bellis perennis - Common daisy	Low growing perennial suitable for substrate depth 80-150mm. Long flowering period from March to October.
Blackstonia perfoliata - Yellow-wort	Self-seeding annual. Can grow on very shallow substrates from 50-150m. Seeds provide suitable foraging for black redstarts, a species of principal importance and London BAP.
Campanula glomerata - Clustered bellflower	Substrate depth of 80-150mm. Medium height perennial. Flowering June to October.
Campanula rotundifolia - Harebell	Attractive perennial suitable for substrate depth 80-150mm. Later flowering period July to September.
Carfex flacca - Glaucous sedge	Structural semi-evergreen plant to provide cover in winter. Substrate depth 80-150mm.
Centaurea cyanus - Cornflower	Substrate depth of 50-100mm. Annual provides colour in first growing season and self-seeds thereafter. Long flowering period May to October.
Centaurea nigra - Common knapweed	100-150mm deeper substrate depth required, medium-tall perennial. Very good nectar source for bumblebees. Flowering July to September.

	Plant Name Common Plant Name	Comments
	Centaurium erythraea - Centaury	Substrate depth of 80-150mm. Birds forage on seed heads. Flowering July to August.
	Clinopodium vulgare - Wild Basil	Substrate depth of 80-150mm. Aromatic small perennial. Nectar source for moths. Flowering period July to September.
	Daucus carota - Wild Carrot	Medium height biennial, deeper substrates 100-150mm. Nectar source for generalist pollinators such as beetles. Flowering period June to August.
	Echium vulgare - Viper's Bugloss	Tall biennial, self-seeds and spreads and can grow on shallow substrates from 80mm. Good nectar resource for bumblebees. Flowering period June to September.
	Erigeron acer - Blue fleabane	Medium height self-seeding annual, can establish on very shallow substrates from 50-150mm depth. LAter flowering July to August.
	Fragaria vesca - Wild strawberry	Low growing creeping perennial suitable for shady areas. Produces small edible fruits. Flowering April-Jul.
Carly	Galium verum - Lady's Bedstraw	Substrate depth of 100-150mm, medium to tall perennial, slow-growing. Flowering July to August. Larval foodplant for moth species.
	Geranium robertianum - Herb-Robert	Substrate depth of 50mm-100mm. Suitable for shaded and exposed areas.
	Helianthemum nummularium - Rock rose	Substrate depth of 80-150mm, clump forming perennial. Very good nectar source for pollinators especially honey bees. Long flowering period May to September.
	Hypericum perforatum - Perforate St. John's-wort	Medium height perennial. Substrate depth of 80-150mm. Seed heads good foraging resource for birds species.
*	Hypochaeris radicata - Common cat's-ear	Medium height perennial. Substrate depth of 80-150mm. Good nectar source for generalist pollinators. Flowering June to September.

This list of wildflowers is recommended for biodiverse roof applications and can be supplied by BritishFlora as either plug plants and/or seed.



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	Common Plant Name	Comments
NAME OF THE OWNER	Leontodon hispidus - Rough hawkbit	Medium height perennial. Substrate depth of 80-150mm. Good nectar source for generalist pollinators. Flowering June to September.
	Leucanthemum vulgare - Ox-eye Daisy	Substrate depth 80-150mm. Medium height perennial, quickly establishes from seed. Long flowering period May to September.
「大人人」「「「	Linaria vulgaris - Yellow toadflax	Medium height perennial. Substrate depth of 80-150mm. Host plant of toadflax brocade moth, a specialist of dry environments restricted to southeast. Flowering period July to September.
	Lotus corniculatus - Common bird's-foot trefoil	Prostrate/creeping perennial. Substrate depth of 80-150mm. Good foraging for native bumblebees and larval foodplant for many butterflies. Flowering May to September
	Matricaria chamomilla - Scented mayweed	Annual or perennial herb, slightly aromatic. Can exist on very thin substrates of 20mm-150mm. Flowering periods June to July.
0 C	Origanum vulgare - Wild marjoram	Aromatic attractive perennial. Substrates 80-150mm. Nectar source for moths and bumblebees. Flowering period July to September.
	Papaver rhoeas - Common poppy	Substrate depth of 50-100mm. Annual from seed, colour in the first year and self seeds thereafter. Good nectar source for generalist pollinators such as flies.
A M	Pilosella officinarum - Mouse-ear hawkweed	Low growing perennial substrate depth 80-150mm. Nectar source for generalist pollinators. Flowering period May to August.
1.	Plantago coronopus - Buck's-horn plantain	Can grow in very shallow substrate 10-100mm. Suitable for windy and coastal sites.
	Plantago lanceolata - Ribwort plantain	Medium height perennial. Substrate depth of 80-150mm. larva; foodplant for fritillary butterflies.
19 - 19 F	Poterium sanguisorba - Sanguisorba	Medium height perennial. Substrate depth of 80-150mm.

	Scientific Plant Name Common Plant Name	Comments
Of a	Primula veris - Cowslip	Medium height perennial. Substrate depth of 100-150mm. Spring flowering April to May.
	Rumex acestosa - Common Sorrel	Medium perennial, blush red throughout the summer. Flowering May to June. Larval foodplant of orange tip butterfly. Substrate depth of 80-150mm.
	Scabiosa columbaria - Small scabious	Medium height perennial. Substrate depth of 100-150mm. Good nectar source for many pollinators. Later flowering period July to September.
	Sedum acre - Biting stonecrop	Succulent plant suitable for very dry shallow substrates.
- 110 A+	Sedum album - White stonecrop	Succulent plant suitable for very dry shallow substrates. White flowers. Flowering period June to August. Supports rare invertebrate sedum feeding bug clamydatus evanescens.
	Silene latifolia - White campion	Medium height perennial. Substrate depth of 80-150mm. Resource for foraging moths and night flying inverts and therefore attract bats.
	Silene uniflora - Sea campion	Low growing prostrate perennial on shallow substrates 50-100mm. Nectar source for moths. Flowering period June to August.
	Silene vulgaris - Bladder campion	Upright perennial on substrated 80-150mm. Nectar source for moths. Flowering period June to August.
	Thymus polytrichus - Thyme	Mat forming aromatic perennial, Good for high foot traffic areas and shallow substrates under 50mm, Good nectar source for pollinators. Flowering period May to August.
	Trifolium pratense - Red Clover	Low growing perennial, nectar source for long-tounged bumblebee species. Long flowering period May to September.
<b>```</b>	Viola tricolor - Wild pansy/ heart sease	Small annual or perennial, requires substrate depth of 50-150mm. Extended flowering period from March to October.





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