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SERIES C		

Krajinné trávníky
Landschaftsrasen

This standard is intended for the restoration and establishment of grasslands performing primarily non-production functions. The standard defines methods of regrassing leading to an improvement of the ecological properties of landscapes with regard to the functionality of the vegetation while respecting their species diversity.

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Act No. 219/2003 Coll. on the Marketing of Seed and Planting Material of Cultivated Plants, amending certain laws (Act on the Marketing of Seed and Planting Material), as amended
Act No. 254/2001 Coll. on Waters and Amendments to Certain Acts (The Water Act), as amended
Act No. 266/1994 Coll. on Railways, as amended
Act No. 326/2004 Coll. on Phytosanitary Care and Amendments to Certain Acts, as amended
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Basic documents for the standard are available in the Nature Conservation Agency (NCA) library.

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1 . Standard purpose and contents

The standard defines methods of grassing leading to an improvement of the ecological properties of landscapes with regard to the functionality of the vegetation while respecting their species diversity.

It is intended for the restoration and establishment of grasslands performing primarily non-production functions, the primary purpose of establishment or restoration not being biomass production.

The standard is intended for all entities whose activity relates to grasslands in the landscape (land managers, applicants for support from subsidy schemes, designers, suppliers, contractors, employees of public administration and local governments, non-governmental organisations, farmers, investors, land owners and tenants, etc.).

Determining the method of grassing is a highly specialised activity requiring sufficient and comprehensive knowledge. The method of grassing has to be consulted with nature protection authorities and other professional entities already in the preparation stage.

The standard respects and follows up on other Nature and Landscape Management Standards, notably:

SPPK D02 001 Restoration of grasslands using regional seed mixtures.

SPPK D02 004 Mowing of grasslands.

Updates to the standard are expected due to technological advancements, new knowledge of the issues and climate change.

1.1 Legal framework

Act No. 114/1992 Coll. on Nature and Landscape Protection – Section 5, Paras. 4 and 5; Section 16, Para. 1, Item (f); Section 26, Para. 1, Item (d); Section 29, Item (e); and Section 34, Para. 1, Item (d) regulate deliberate dissemination of introduced plant species and crossbreeds in the landscape, and deliberate dissemination of introduced plant species in protected areas (national parks, protected landscape areas, national nature reserves, nature reserves), and additionally defines the general protection of wild plants, protection of protected plant species and restrictions relating to the collection of seeds and entry to certain source areas.

Act No. 326/2004 Coll. on Phytosanitary Care – Section 3 defines requirements for natural persons and legal entities with respect to the identification and restriction of spreading harmful organisms, including weeds; the Act also defines jurisdictions of authorities in this sector.

Act No. 219/2003 Coll. on Marketing of Seed and Plant Propagating Material of Cultivated Plants, amending certain acts (Act on Marketing of Seed and Plant Propagating Material) and Decree No. 129/2012 Coll. on Details of Marketing of Seed and Plant Propagating Material of Cultivated Plants define requirements and procedures for marketing of seed mixtures intended for the preservation of the natural environment as well as licensing of seed mixtures intended for the preservation of the natural environment.

Act No. 408/2000 Coll. on Plant Variety Rights Protection and Amendment to Act No. 92/1996 Coll. on Varieties, Seed and Planting Material of Cultivated Plants (Act on Plant Variety Rights Protection) defines rights and obligations with respect to plant varieties,

competences of authorities in the field of variety rights protection, the process of granting plant variety rights and inspection of the maintenance of varieties.

2. Terminology

2.1 General terminology

2.1.1 **Grassland** – an artificially (deliberately) defined category of long-lived grass or grass-herb communities with primarily non-production functions and a varying degree of stability, which always provides protection of the soil from erosion processes. Some grass areas **do not comply** with the definition of the categories of parterre lawns, park lawns or sports ground lawns pursuant to ČSN 83 9031 (Landscape vegetation modification techniques – Lawns and their establishment):

Lawn *- plant cover comprising grasses, including the vegetation layer with their roots and shoots, which is typically not used for agricultural purposes; it may contain leguminous and other herbs depending on the purpose of use.*

2.1.2 **Vegetation** – a set of plants (plant community or phytocenosis) growing on the soil surface, in a land plot or area.

2.1.3 **Target ecosystem** – an ecosystem that should be attained at a specific disturbed site, having a natural species composition and providing ecological functions.

2.2 Methods (techniques) of subsequent grassland use

2.2.1 **Meadow** – a grassland maintained by mowing typically once or twice a year, only occasionally grazed if necessary (occasional meadow grazing instead of second mowing). This notion of the term meadow is classified in the category of extensively managed grasslands.

2.2.2 **Pasture** – a grassland maintained by grazing animals kept as farm livestock with subsequent possible mowing of grazing leftovers. This notion of the term pasture is classified in the category of extensively managed grasslands.

2.2.3 **Intensively used grassland** – a grassland maintained by frequent mowing, more than three times a year. This is a marginal matter in the case of grasslands.

2.2.4 **Technical grassland** – a specific type of grassland not complying with the requirements of any of the above categories.

2.3 Seed and planting material

2.3.1 **Variety** – a set of plants belonging to the lowest level of botanical classification, definable by showing traits resulting from a certain genotype or combination of genotypes, discernible from any other set of plants by showing at least one of these traits and considered a unit that can be propagated without change (see Section 2 of Act No. 219/2003 Coll.).

2.3.2 **Seed** – seeds for the propagation or cultivation of plants (see Section 2 of Act No. 219/2003 Coll.); a special category is **regional seed**, where the seeds are obtained, propagated and used within a specified area of origin without any breeding processes.

2.3.3 **Variety maintenance breeding** – a procedure following generally recognised practice assuring the maintenance of variety uniformity and stability (see Section 2 of Act No. 219/2003 Coll.).

2.3.4 **State Variety Book**– an official national list of plant varieties registered in the Czech Republic for certification and marketing (see Section 2 of Act No. 219/2003 Coll.); for the current list of varieties, see http://eagri.cz/public/web/ukzuz/portal/odrudy/informace-o-odrudach/odrudy-registrovane-v-cr/seznam-odrud/.

2.3.5 **Registered variety** – a variety listed in the State Variety Book (see Section 2 of Act No. 219/2003 Coll.).

2.3.6 **Conservation variety** – a regional (local) variety or a variety naturally adapted to local conditions and threatened by genetic erosion, registered with respect to its importance for the preservation of plant genetic resources (see Section 2 of Act No. 219/2003 Coll.).

2.3.7 **Landrace** – a set of populations or clones of a plant species naturally adapted to the environmental conditions in their area (see Section 2 of Act No. 219/2003 Coll.).

2.3.8 **Seed mixture for use in agricultural production** – a mixture which may only contain seed of agricultural species and vegetable species listed in the List of species, with the exception of beet seed and varieties of grasses not intended for use as fodder crops (see Section 12 of Act No. 219/2003 Coll.). This category includes grass and legume-grass fodder crop mixtures for permanent meadow or pasture or for short-term vegetation on arable land; their name may specify them by the harvest/grazing time (early, midseason, late), by on the prevailing component (e.g., cocksfoot mixture), or by site conditions (e.g., for dry conditions, for light soils) or by the livestock category for which they are designed (for dairy cows, for horses, etc.).

2.3.9 **Seed mixture for use outside agricultural production** – a mixture that may contain seed of fodder plants as well as other plant species, including species not included on the List of species (see Section 12 of Act no. 219/2003 Coll.). This category includes a wide range of grass mixtures, sometimes named after the purpose of use (e.g. grasslands, decorative lawns, park, recreational or sports ground lawns, technical grasslands). They are mostly grass mixtures containing seed of lawn varieties of only a few grass species (*Poaceae*). Some grasslands require a more diverse species composition; such **species-enriched seed mixtures** contain seed of varieties of more grass species and is enriched with varieties of species of other families, mostly legumes (*Fabaceae*). The seed origin is not regional, but the composition of the mixture respects the ecology and domestic origin of species and varieties. The category for use outside agricultural production also includes very species-rich grass-herb mixtures for decorative horticulture, containing grasses, legumes and dicotyledonous herbs of other families (sometimes even annuals). The components of these mixtures are not obtained, propagated and used in the area of origin.

2.3.10 **Seed mixture intended for protection of the natural environment** (preservation mixture) – a mixture which may contain seed of fodder plants and other plant species, including species not included in the List of species and which is marketed for the purpose of protection of the natural environment in connection with the conservation of plant genetic resources (see Section 2 of Act No. 219/2003 Coll.); it can only be marketed in the area of origin of the seed mixture (see Section 12a of the Act).

2.3.11 **Directly harvested mixture** – a seed mixture intended for protection of the natural environment obtained by seed collection at the collection site (see Section 2 of Act No. 219/2003 Coll.); species-rich material containing seeds obtained by harvesting or green hay or dry hay, by combine harvesting of vegetation areas, harvesting of vegetation areas using brush or vacuum harvesters, sweeping hay flower, etc.

2.3.12 **Mixture from separately grown components** (crop-grown mixture) – a seed mixture

intended for protection of the natural environment obtained by mixing the seed from individual components propagated separately from the collection site from seed collected at the collection site; the mixture contains genera, species and subspecies typical of the site within the collection area (see Section 2 of Act No. 219/2003 Coll.); this category corresponds to the term **regional seed mixture** used in nature conservation.

2.3.13 **Area of origin** – the area of traditional cultivation of the conservation variety to which the variety is naturally adapted or an area with which the seed mixture intended for protection of the natural environment is naturally associated (see Section 2 of Act No. 219/2003 Coll.).

2.3.14 **Source area** – a Site of Community Importance or a protected area (see Section 2 of Act No. 219/2003 Coll.).

2.3.15 **Collection site** – the part of a source area in which seeds were collected for the seed mixture intended for protection of the natural environment (see Section 2 of Act No. 219/2003 Coll.); also known as **source site** or **donor site**.

2.3.16 **Protected variety** – a variety having been assigned protection rights pursuant to the Act (see Section 2 of Act No. 408/2000 Coll.).

2.3.17 **Protection rights** – rights and obligations related to plant varieties arising from a valid decision by the Central Institute for Supervising and Testing in Agriculture (see Section 2 of Act No. 408/2000 Coll.).

2.3.18 **List of species** – the list of species of cultivated plants specified in the Annex to Decree No. 378/2010 Coll., integrating applicable European Union regulations. Registration is only possible for varieties of species included in the List of species and varieties of decorative plants (see Section 28, Para. 2 of Act No. 219/2003 Coll.). Some of the species included in the List of species are not indigenous to the CR (the grasses *Bromus catharticus*, *B. sitchensis* and *Phalaris aquatica*, the legumes *Galega orientalis*, *Trifolium alexandrinum*, *Trigonella foenum-graecum*) and their varieties are not suitable for use in grasslands (see Annexes 1 and 2).

3. Types of grasslands by priority use

With respect to their use, the standard identifies functions of grasslands with their priority use. The priority use is a starting point for grassland typology and determines the establishment and subsequent management techniques.

The method of grassing, including selection of seed material and composition of grassland mixtures, is governed by natural conditions, subsequent uses and objectives, for the realisation of which one of the following priorities (cultivation objectives) is chosen:

- **Priority use 1B (*biodiversity*) – Increasing biodiversity (plants and animals)**

  Grasslands established for the purpose of increasing species diversity while respecting the type of community corresponding to the site conditions.

- **Priority use 2T (*technical*) – Grassing of a technical type (along roads, erosion-prone areas, flood prevention measures, grassy paths, etc.)**

  Grasslands established for the purpose of strengthening the physical properties of a site and its resistance to erosion and/or mechanical stress. In many cases, this priority overlaps with 1B (biodiversity).

- **Priority use 3KN (*fodder, nectar*) – Producing fodder and nectar (for small game, bees)**

  Grasslands established for the purpose of strengthening the carrying capacity of hunting grounds (increased or improved natural biomass production) or increasing the proportion of nectar and pollen-producing plants in a grass-herb community.

The different types of grassland according to the above priorities are specified in Chapter 9.

4. Rules for establishing grasslands

4.1 Basic rules

4.1.1 Use only Central European plant species and respect their ecological requirements.

4.1.2 Section 5, Para. 4 and 5; Section 16, Para. 1, Item (f); Section 26, Para 1, Item (d); Section 29, Item (e); and Section 34, Para. 1, Item (d) of Act No. 114/1992 Coll., prohibit deliberate dissemination of introduced plant species and crossbreeds in the landscape, and deliberate dissemination of introduced plant species in protected natural areas (national parks, protected landscape areas, national nature reserves, nature reserves).

4.1.3 Use varieties of Czech origin and prefer varieties grown in the Czech Republic. Use of varieties of interspecific (*Lolium* ×*hybridum*, *Trifolium pratense* × *Trifolium medium*) and intergeneric crossbreeds (×*Festulolium*) and varieties produced by polyploidisation (i.e. tetraploid varieties of the genus *Lolium* and the species *Trifolium hybridum* and *Trifolium pratense*) is prohibited; see Annex 1 (Suitable and unsuitable grass species and varieties) and Annex 2 (Suitable and unsuitable legume species and varieties); in addition, sowing tall fescue (*Festuca arundinacea*) in grasslands is prohibited except for grassing of a technical type (airfields, dog-training grounds) and, in justified cases, in areas of its natural growth.

4.1.4 When selecting species for mixtures, respect differences in ecological conditions of a site, particularly in relation to the acidity/alkalinity of the environment, altitude and, during maintenance, differences in weather between years.

4.1.5 It is not recommended to include protected plant species in grassland mixtures, only in exceptional cases and with consent of nature conservation authorities.

4.1.6 Sowing a grass-herb mixture cannot immediately produce a fully-fledged plant community: the species composition of the mixture only sets the outline of the vegetation, which is then subject to developmental changes as part of spontaneous succession.

4.1.7 In selected cases, consider the suitability of allowing spontaneous succession. At sites up to 1 ha in area in the vicinity of original semi-natural grassland vegetation, prefer spontaneous grassing.

4.1.8 In justified cases (primarily in technical grasslands), successful formation of turf should use auxiliary, permanent or temporary material, such as geosynthetic materials with an erosion protection function used for preventing or reducing movements of the top soil layer due to erosion activity. The selection and use of an appropriate auxiliary material (see Annex 7) has to be described and justified in the project documentation.

4.1.9 A layer of mulch material for grasslands has to be capable of producing a microclimate promoting the growth of the sown plants while suppressing the growth of invasive species, particularly herbs. It should have the capacity to retain and release water and must not contain any components which would damage plants. Mulch material used particularly in combination with geosynthetics made of natural fibres may temporarily protect the soil surface from mechanical effects, e.g. torrential rain, wind and hail.

4.1.10 Bonding agents, i.e. materials used for surface stabilisation and/or connection of materials applied, must not contain any soluble substances harmful to plants or the environment, nor produce such substances by decomposition. A professionally determined

dosage must not permanently inhibit plant germination.

4.1.11 The designer is responsible for the selection of a mixture of suitable composition for the respective soil and climate conditions.

4.1.12 The seed producer is responsible for supplying a mixture of the exact composition based on the composition specified in the technical report. A mixing report must be supplied together with the mixture.

4.1.13 The work contractor along with the design or technical supervisor is responsible for the correct grassland establishment according to the work procedure specified in the project documentation.

4.1.14 If a grassland takes longer to develop, i.e., the success of the grassing cannot be evaluated at the moment of work handover (see 7.1, 7.3 and 7.2.2), management of the grassland should be financed by the work contractor along with the design or technical supervisor until the final inspection (i.e. for 1–2 years). Under these conditions, the implementing contractor along with the design or technical supervisor is responsible for the condition of the vegetation (grassing success).

4.2 Seed for ecological restoration

4.2.1 Regional seed or plant material mixtures

4.2.1.1 Donor (source) sites for seed, mulch and hay always have to be selected for the specific site to be restored (grassed) in cooperation and with consent of the NCA CR or National Park Administration, possible already in the project design stage (the consent must define collection requirements, including inspection of donor sites). The land owner and tenant have to agree with the use of a site as a seed source.

4.2.1.2 Source sites for the restoration of species-rich meadows or pastures may include any natural or semi-natural grasslands, particularly communities of the *Arrhenatherion*, *Bromion*, *Molinion* and *Deschampsion* associations. To a lesser extent, it may be necessary to restore other communities, such as vegetation of the *Polygono-Trisetion*, *Violion*, *Nardo-Agrostion*, *Cynosurion* and *Bromo-Festucion pallentis* associations.

4.2.1.3 There is currently no database of donor sites in the CR.

4.2.1.4 Harvesting methods for directly harvested mixtures

see SPPK D02 001 Restoration of grasslands using regional seed mixtures (Chapter 4.2).

4.2.1.5 Mixtures from separately grown components

see SPPK D02 001 Restoration of grasslands using regional seed mixtures (Chapters 4.3 and 4.4).

4.2.2 Species-enriched seed mixtures

4.2.2.1 These mixtures are a compromise between ordinary grass or legume-grass mixtures with a simple species composition and regional mixtures, in cases when no regional seed mixture is available on the market.

4.2.2.2 These are grass-herb seed mixtures not obtained, propagated and used in the area of origin; marketing of the mixtures is permitted within the CR.

4.2.2.3 They contain rather large numbers of domestic plant species of the *Poaceae* and

Fabaceae families, corresponding to the ecological conditions of the site and the intended target community, and Czech varieties, selectively bred from domestic sources using, if possible, traditional methods (selection, intraspecific crossbreeding).

4.2.2.4 The seed is not of regional origin but the composition of the mixture respects the ecological perspective, i.e. suitability of the mixture for various natural conditions.

4.2.2.5 A suitably chosen mixture composition and amount of seed and a correct establishment technique of grass and legume vegetation enable subsequent colonisation of grassland plant species from the surrounding landscape. The success of vegetation enrichment with herbs depends on the distance from source areas.

4.2.2.6 When composing species-enriched mixtures, the functional properties of the different grass and legume species and varieties and the subsequent use of the grassland (mowing or grazing) have to be taken into account.

4.2.2.7 If a certain percentage of a highly competitive species in the mixture is exceeded, such a species may significantly suppress more slowly developing plant species with lower competitive power in the grassland (so-called critical sowing quantity).

4.2.2.8 Detailed specifications for the different types of grassland are given in Chapter 9.

4.3 Use of geosynthetics to promote grassing

4.3.1 Grasslands cannot be established on slopes with a gradient steeper than the natural ground slope, even if supported by anti-erosion geosynthetics on the surface; they have to be structurally (geotechnically) reinforced first.

4.3.2 Slopes or banks have to be protected from the effects (energy) of flowing surface water by using suitable geosynthetics, selected according to the stability requirements for the slope or bank fortification (tangential stress or non-eroding velocity). In the case of long-term use of geosynthetics, long-term UV stability of the material is required. On the other hand, in case geosynthetics with a temporary function (e.g. made of natural fibres) are used, UV stability is undesirable.

4.3.3 The use of auxiliary anti-erosion (geosynthetic) material on a slope is a means of achieving sound, continuous turf.

4.3.4 Grassing of visible areas of earth mounds made of reinforced earth with a slope gradient steeper than the natural ground slope is handled case by case using geotechnical methods.

4.3.5 The limit slope for manual sowing with the use of anti-erosion geotextiles is generally 1:1 (45°). Steeper slopes require seed application by means of hydroseeding (see 6.4.4).

4.3.6 Rock outcrops are not covered with geotextile; they are only exposed and cleared down to a “sound” substrate.

4.3.7 The use of appropriate anchoring elements and the method of attaching the anti-erosion geotextile on the slope depend on the subgrade and the planned mowing method or mowing frequency, or the mower type.

4.3.8 Basic auxiliary anti-erosion materials are specified in Annex 7.

5. Zoology

5.1 When composing mixtures for grasslands, it is necessary to consider creation of living conditions for animals, particularly if only a species-enriched mixture is used instead of regionally sourced seed.

5.2 The main factors affecting species composition, species diversity and abundance of animals in grasslands include:

- species composition and species diversity of the plant component (vegetation),
- spatial structure of the vegetation,
- type and frequency of management (mowing, grazing, burning, etc.),
- age (time of existence) of the grassland area,
- integration of the grassland in the landscape, e.g., distance from other grassland habitats of similar type, which may serve as sources of colonisation.

5.3 If the main purpose, or at least one of the purposes, of establishment of a new grassland is biodiversity support, the chosen grassing method should take into account all the above aspects and of course the local situation.

5.4 Creating a habitat type which has never occurred in the landscape naturally or attempting to adjust it ('tailor' it) to animal species missing in the surrounding landscape and thus not able to colonise the new habitat, are pointless.

5.5 In many cases, spontaneous or controlled succession is the optimum method of establishing a grassland area, particularly at sites resulting from mining of mineral resources (quarries, slag heaps, sand pits, gravel pits, clay pits, etc.). Early stages of succession in the areas very often serve as surrogate habitats for numerous endangered insect and arachnid species. Technical reclamation of such sites, typically performed by covering them with a layer of earth and sowing inappropriate grass mixtures or planting woody plants, usually ruins the potential of such sites for biodiversity conservation. Controlled succession can also be used in roadsides, vineyards, on abandoned arable land, etc.

5.6 In cases of grassing by means of sowing, promotion of animal biodiversity requires preference of species-rich mixtures of local grasses and herbs in compositions corresponding to the morphological, soil and moisture conditions of the site.

5.7 The composition of a mixture can be adjusted, e.g. for diurnal butterflies, by adding food plants for caterpillars and nectar-producing species for adults (see Annex 3). To increase the attractiveness of a site for butterflies, it is also important to diversify it using solitary or little groups of domestic woody plant species, which provide butterflies not only with nectar but also shelter from weather conditions and, in road cuts, from wind flow from tunnels.

5.8 Species-poor non-production grass mixtures including legumes may support at least some ordinary pollinator species (e.g. particular bumblebees) as long as they are enriched with additional nectar- and pollen-producing dicotyledonous plants flowering later in the season (e.g. cornflowers and mallows) in order to maintain the food supply until late summer.

6. Establishing a grassland

6.1 Plot preparation and weeding

6.1.1 Establishment of a long-functioning vegetation has to be preceded by careful preparation in the form of an analysis of site conditions in relation to the desired vegetation composition and method of maintenance management.

6.1.2 When establishing grasslands, enrichment with garden substrate or spreading of topsoil is undesirable. The above does not apply to humus addition to exposed slopes as part of construction work prescribed in project documentation.

6.1.3 In case the site has an extremely high proportion of persistent weeds or invasive plant species, it is advisable to weed out the soil for successful establishment and development of a quality plant community. Presence of annual weeds is normal and not considered a problem.

6.1.4 Mechanical weeding is preferred to application of plant protection products. Annual weeds are destroyed mechanically by repeated harrowing. The success of mechanical removal of persistent weeds or elimination of older turf depends on the power of the available machinery and developmental stage of the weed. It is often necessary to carry out several soil treatment operations in a row (ploughing, cutting). The vegetation layer retains a high proportion of undecomposed green biomass, which can subsequently cause depressions in the grassland due to its gradual decay. If fast turf removal is necessary, it has to be peeled off.

6.1.5 If application of a total herbicide is necessary, it should be done before the sowing, ideally twice on the green leaf surface of the weeds and other plants. Weeding is done using a registered total herbicide which affects the weed's root system. It is always applied to the leaf surface and the product effect period is 14–18 days depending on the temperature. If the spraying has to be repeated, it is better to use a selective herbicide (always take into account water protection zones), which often works better on dicotyledonous persistent weeds than a total herbicide.

6.1.6 In case the plot intended for restoration is used for growing a perennial fodder crop, the recommended period between elimination of the original vegetation and sowing of a grassland for priority use 1B (biodiversity) is at least one year. In the transition period, the plot can be used for growing a short-term crop without application of any fertiliser in order to reduce the nutrient contents in the soil.

6.1.7 When eliminating a (semi-)natural permanent vegetation, including potential secondary growth during the transition period, mechanical measures have to be preferred to chemical ones (also for animal protection).

6.1.8 Varied relief is an advantage for subsequent colonisation of the grassed site by animals.

6.1.9 For grasslands with priority use 2T (technical), after soil preparation for sowing (levelling, harrowing, raking, rotary tilling, rolling), the ground (surface of load-bearing vegetation layer) must not contain objects larger than 5 cm (plant remains, stones, etc.).

6.1.10 The soil of a plot prepared for sowing has to be sufficiently aerated, with a fine lumpy soil structure and an even surface, which facilitates not only germination but also subsequent vegetation management, particularly mowing.

6.1.11 Soils with a high nutrient content in the topsoil are left without fertilising for 1–2 years before restoration and ploughed using deep (24–30 cm) to very deep (over 30 cm) tillage to

make the lower, nutrient-poor layer come to the surface. Before sowing a species-rich mixture, it is recommended to sow the plot temporarily (for 1–2 years) with a short-term crop (oat, barley, Italian ryegrass, etc.) and mow the vegetation, removing the aboveground biomass from the plot to reduce the nutrient content in the soil.

6.1.12 The soil surface is levelled with a land leveller.

6.1.13 Large stones are removed as needed (collected and piled outside the restored area or loaded on a vehicle and transported away).

6.1.14 Finally, the soil surface is compacted by rolling.

6.1.15 Points 6.1.11 to 6.1.14 do not apply to grasslands established in water channels and on embankments or cut slopes in transport infrastructure with a slope gradient steeper than 1:2 (approx. 12°) and in areas where biotechnical structures are implemented (e.g. gravel lawns, planted quarry stone assemblies, etc.).

6.2 Fertilisation

6.2.1 Sites for grasslands with priority use 1B (biodiversity) are not fertilised.

6.2.2 The soil nutrient supply should be optimised at sites for grasslands with priority use 2T (technical). A suitable form is a combined multi-component fertiliser containing at least 5 $g.m^{-2}$ of pure nitrogen (N) in addition to basic nutrients and trace elements. Fertilisation is skipped or reduced where the vegetation layer has a high nutrient supply. Farm fertilisers are not used. For more frequently mown grasslands with priority use 2T (technical), adding fertiliser in the year of establishment is advisable to support closed vegetation and reduce weeds.

6.2.3 In exceptional cases, the nutrient supply in the soil (phosphorus, calcium) can be optimised at sites for grasslands with priority use 2T (technical) and 3KN (fodder and nectar).

6.3 Time of establishment

6.3.1 Sowing time affects the germination of different plant species, species composition of the resulting vegetation and its cover. Sufficient moisture plays a significant role, too.

6.3.2 Seed mixtures can be sown throughout the year; approved times are from March to mid-May and from September to October. Under certain circumstances, it is better to sow mixtures just before the first frost to make the seeds germinate only the next spring and help the plants make good use of the soil moisture.

6.3.3 When sowing outside the appropriate times, the establishment technique needs to be adjusted to the conditions.

6.4 Method of establishment

6.4.1 Spontaneous succession

6.4.1.1 This is spontaneous development of an ecosystem (species composition and soil above all) without any direct human interventions in disturbed areas. In some cases, spontaneous succession may become the basis of controlled succession, which is deliberately affected by people in order to achieve a desired target ecosystem.

6.4.1.2 After harvesting the agricultural crop, the field can be left without intervention

immediately; it is desirable to level the ground with a land leveller if ploughed up.

6.4.1.3 The neighbouring diaspore source area should be mown at times which allow seeds of the required plant species to mature.

6.4.1.4 From the 3rd to the 5th year, the succession area should be mown periodically using ordinary mowers (once to twice a year) and the biomass should be raked up and removed from the site.

6.4.2 Sowing

6.4.2.1 The basic method of establishing a grassland, depending on the size and accessibility of the area, is manual sowing, using sowing machines, possibly also using centrifugal spreaders or hydroseeding.

6.4.2.2 Ground slopes up to 30% are suitable for sowing. Steeper slopes have to be grassed using other techniques (hydroseeding 6.4.4, turfing 6.4.9, laying pre-grown grass and grass-herb mats 6.4.10).

6.4.2.3 Depending on mixture type and cultivation purpose, the sowing quantity for grasslands is in the range of 2 $g.m^{-2}$ (priority use 1B –biodiversity) to 30 $g.m^{-2}$ (priority use 2T – technical). Most suppliers of these mixtures specify the recommended sowing quantities for each mixtures type.

6.4.2.4 Preconditions for successful sowing are good seed quality and appropriate seed mixture composition.

6.4.2.5 When handling any seed mixture, always take into consideration ‘self-sorting’, i.e. separation of seeds of different physical properties (shape, size, weight) and due to awns or hooks on seed surfaces, etc. To eliminate this, the seed mixture needs to be agitated continuously to maintain an even distribution of the seeds.

6.4.2.6 Sowing success is also affected by sowing time, soil preparation before sowing, seed quantity used, weather and the human factor.

6.4.2.7 In cases when subsequent maintenance of the vegetation is not assumed (e.g. biocorridors, baulks, game overpasses, etc.), it is sufficient to sow grass mixtures only or mixtures with lower proportions of herbs.

6.4.2.8 When sowing rocky sites and other areas difficult to access on steep slopes, where soil erosion has to be prevented, the seed mixture has to contain grass and herb species producing less aboveground biomass with respect to the site conditions.

6.4.3 Sowing into a cover crop

6.4.3.1 A cover crop, or more accurately ‘cover culture’, refers to a crop underneath which grass-herb mixtures are sown. This technique is particularly suitable as part of erosion control on slopes. It is used when sowing mixtures with a slow development and low seed quantities, which would not hold the top layer of the vegetation substrate with their root systems and would close very slowly.

6.4.3.2 This is ideally achieved using the diploid Westerwold ryegrass (*Lolium multiflorum* var. *westerwoldicum*), which gradually recedes from the vegetation area after it has performed its erosion control function by fast covering of slopes and partial shading of slow-germinating species.

6.4.3.3 Permanent continuance of the cover culture at the site is not desirable, because its

origin and properties (such as habitus, resistance to drought, competitiveness) do not match the intentions and other requirements made on the grass-herb community being established.

6.4.3.4 The use of a cover crop when sowing on slopes is particularly desirable in the case of very late sowing dates or periods with a risk of torrential rain.

6.4.4 Hydroseeding

6.4.4.1 This is a type of sowing using specialised equipment (hydroseeder) which makes it possible to vegetate areas difficult to access, areas with basic soil of lower quality, and slopes up to 60° steep.

6.4.4.2 A mixture of the required material is applied to the intended area in a single operation under high pressure from a tank. The spraying is carried out using a hose or a tower sprayer unit with various types of spray nozzles.

6.4.4.3 The mixture in the tank is designed in accordance with the needs of the area to be sown; it always contains seed, water, anti-erosion components and mulch material, which ensures a higher germination capacity, better rooting and moisture retention. In justified cases, the mixture can be enriched with a fertiliser, organic material and auxiliary soil substances to promote plant germination and growth. The materials used have to be environmentally sound.

6.4.4.4 Mulch and seed retention at the spraying location is achieved using a fixative, which facilitates passage of the mixture through the hydroseeding equipment, and supports germination.

6.4.4.5 The mixture of components applied to the site helps to keep soil and seed in the desired place until this work is taken over by the vegetation itself.

6.4.4.6 There are special types of hydroseeding. They include a technique for establishing grassland without any vegetation layer directly on a rock outcrop, which can at the same time include cuttings of local succulents (the spraying then requires a mechanism that does not damage the cuttings).

6.4.5 Additional sowing into existing vegetation

6.4.5.1 Before additional sowing, the existing vegetation has to be mown low and the mown material has to be removed.

6.4.5.2 The additional sowing is performed into disturbed turf typically using special sowing machines. Before the additional sowing, the original turf has to be harrowed or wheel-cut thoroughly so as to produce about 40–50% of free space for successful germination of the added seed. The higher the proportion of slow-germinating species in the added seed mixture, the thinner the original vegetation has to be. The additional sowing time has to be chosen with respect to specific site conditions (periodic droughts and waterlogging).

6.4.5.3 The additional sowing may use a pure herb mixture or herbs mixed with grasses; herbs should make up at least 10% (weight) of the mixture and comprise appropriate plant species with relatively fast development and high competitiveness.

6.4.6 Planting of pre-grown plants or vegetative parts

6.4.6.1 This establishment method is particularly convenient for species in which development from seed is very lengthy and competitiveness very low. Planting is thus the most efficient method of achieving their presence in the vegetation.

6.4.6.2 Selected plant species can be propagated using their vegetative organs (bulbs, tubers,

rhizomes and tufts of grass, stonecrop cuttings). Planting is performed manually or using specialised planting machines.

6.4.7 Combination of sowing and planting of grasses and herbs

6.4.7.1 In specific cases, it is convenient to combine the advantages of sowing and planting to achieve the growth of target plant species as soon as possible.

6.4.7.2 The cases are particularly the following:

- seed of diagnostic plant community species is difficult to obtain or very expensive,
- insufficient guarantee of fast seed germination,
- spontaneous dissemination of unsown but desirable meadow plant species is problematic (long distance from donor site, etc.).

6.4.7.3 Also various vegetative plant parts (cuttings, tufts, etc.) can be planted, significantly reducing the costs of planting material.

6.4.8 Use of green hay

6.4.8.1 Rules for the use of green hay, biomass rich in seeds, are defined in Standard SPPK D02 001 Restoration of grasslands using regional seed mixtures (Chapter 5.2.3).

6.4.8.2 Harvested green hay is removed from the donor site immediately after the mowing and spread evenly and loosely on the prepared site, where it is left to dry.

6.4.8.3 Green hay is spread manually over smaller sites.

6.4.8.4 At larger sites, the material is spread using a loader wagon, hay tedder or manure spreader.

6.4.8.5 Finer material has to be spread in thin layers (prevents rotting); coarse material can be left in a thicker layer.

6.4.8.6 The quantity of material applied is 1–2 $kg.m^{-2}$ (i.e. mulch 5–10 cm thick) at sites prone to erosion or desiccation, 0.5–1 $kg.m^{-2}$ (i.e. mulch 3–5 cm thick) at sites which are flat or not prone to erosion.

6.4.8.7 The size ratio between donor site and renewal site is in the range of 1:2 (for vegetation with high biomass production and high seed content) to 8:1 (for low dry grassland vegetation), depending on the type of source vegetation and seed-containing biomass production at a particular harvest time.

6.4.9 Turfing

6.4.9.1 Turfing refers to reinforcement of slopes (banks of water channels or dykes) with grass turf or mats (ČSN 75 0120).

6.4.9.2 Turfing is only used in exceptional cases (transfer of existing vegetation for conservation purposes, erosion-control measures, etc.).

6.4.9.3 Turfing can be performed in several ways:

- full cover,
- in a chessboard or strips, with the rest of the area strewn with suitable earth (substrate) and sown with a grass mixture in justified cases,
- frontal (fortifying with vegetation used in watercourse adjustments), in which turf

blocks 20–50 cm wide are placed on top of each other (not side by side).

6.4.10 Laying pre-grown grass and grass-herb mats

6.4.10.1 This method is used in exceptional cases of a requirement for fast grassing (grasslands with priority use 2T – technical).

6.4.10.2 Suitable particularly at relatively small sites or at extreme sites.

6.4.10.3 Pre-grown mats can consist of grasses or grasses and herbs. Their species and variety composition has to comply with the rules specified in Chapter 4.

6.4.10.4 Grass mats are made by specialised companies for various fineness compositions of the vegetation layer soil at the location. The growing time of a grass mat is at least 12 months. Pre-growing of grass-herb mats requires more time than the pre-growing of grass mats.

6.4.10.5 Depending on the restoration needs and objectives, a species composition suitable for a specific site can be prepared in advance. When pre-growing grass-herb mats, the herb species in the mixture should preferably be shallow-rooting species, which adapt more successfully when laid on the ground and do not have the risk of root system damage.

6.4.10.6 The laying has to be performed without delay, no more than 48 hours after cutting, and is carried out in a binding with overlaps of at least 10–20 cm, so that there are no longitudinal or transverse gaps between the mats.

6.4.10.7 The technique is conditioned on sufficient moisture after grass mat laying. If irrigation is possible, it is important to provide proper subsequent watering for at least 3 weeks.

6.4.10.8 In the case of laying mats on slopes, fastening of the grass mats to the substrate is necessary (pegs, hooks, etc.).

7. Post-establishment management (finishing and development management)

The success rate of grassing in the landscape is conditioned on correct techniques of subsequent management. Pursuant to ČSN 839051, vegetation management after grassing consists of finalising, development and maintenance management (see Chapter 8), with procedures differing according to priority use of a grassland, including acceptance requirements.

7.1 Grasslands with priority use 1B (increasing biodiversity)

7.1.1 Annual weeds always appear in the vegetation after establishment and are removed only as part of 'weed mowing'; under certain conditions, they may in fact perform the desirable role of cover crops (cultures).

7.1.2 Weed mowing is always the first and sometimes also the second mowing after vegetation establishment. In the case of a vegetation height of around 30 cm it is typically performed as 'tall mowing' – about 10 cm above the ground to avoid damage to seedlings of slow-germinating plants.

7.1.3 Vegetation development and closing typically take 2–3 years, depending on mixture composition and the weather in the first years after sowing. In the following years, support of the herb cover requires early mowing at the turn of May and June, at the time of forage ripeness of grasses.

7.1.4 Due to the long vegetation development and closing time, sown sites are typically handed over immediately after the sowing. The success of the grassing cannot be seen at that moment, so it is advisable to make an inspection 1–2 years after the handover (warranty claim). Therefore, documentation can be requested on the handover of sown sites for grasslands with priority use 1B (biodiversity; see 7.4) but the state of the vegetation cannot be assessed.

7.1.5 At manually sown or mechanically sown flat sites, it has to be checked that the seed is sown evenly, worked in shallowly and pressed to the soil surface. In justified cases, where uneven sowing can be an advantage for additional colonisation by species from the surroundings, a sowing evenness check is not absolutely necessary. A precondition for this exemption is presence of source sites within sufficient distance from the sowing site.

7.1.6 At hydroseeded sites, it has to be checked visually that the seed is sown evenly using an auxiliary pigment in the mixture. In addition, it is checked if the layer of auxiliary material is sufficient. Entering a hydroseeded area must be prohibited to prevent damage to the anti-erosion and growing layers.

7.1.7 Detailed work acceptance requirements are always specified in the project documentation, section Technical Report.

7.2 Grasslands with priority use 2T (technical utilisation)

Due to their different vegetation development, grasslands composed purely of grasses and grass-herb vegetation should be distinguished.

7.2.1 Grass vegetation

7.2.1.1 Annual weeds always appear in the vegetation after establishment and are removed only as part of ‘weed mowing’. Under certain conditions, they may in fact perform the desirable role of cover crops (cultures). In exceptional cases (hydroseeding), weeds can locally be removed using selective herbicides. If persistent weeds occur excessively and permanently (e.g. thistles, docks), herbicide application is necessary.

7.2.1.2 Weed mowing is always the first and sometimes also the second mowing after vegetation establishment. It is typically performed at a vegetation height around 30 cm as ‘tall mowing’ – about 10 cm above the ground to avoid damage to seedlings of slow-germinating plants.

7.2.1.3 Vegetation development and closing typically take 3–6 months, depending on mixture composition and the weather in the first years after sowing the grass mixture.

7.2.1.4 Early and more frequent mowing of the grass vegetation in the first years accelerates its closing.

7.2.1.5 Fertiliser may be added to the grass vegetation in justified cases.

7.2.1.6 A state ready for acceptance is achieved when the sowing has produced a more or less even vegetation which covers 75% of the area with grass species from the seed mixture. The last mowing can be performed no later than two weeks before acceptance. Other grass and herb species which are not a problem at the site can be tolerated.

7.2.1.7 Detailed work acceptance requirements are specified in the project documentation, section Technical Report.

7.2.2 Grass-herb vegetation

7.2.2.1 Annual weeds always appear in the vegetation after establishment and are removed only as part of ‘weed mowing’. Under certain conditions, they may in fact perform the desirable role of cover crops (cultures).

7.2.2.2 Weed mowing is always the first and sometimes also the second mowing after vegetation establishment. It is typically performed at a vegetation height around 30 cm as ‘tall mowing’ – about 10 cm above the ground to avoid damage to seedlings of slow-germinating plants.

7.2.2.3 Vegetation development and closing typically take 2–3 years, depending on mixture composition and the weather in the first years after sowing. In the following years, support of the herb cover requires early mowing at the turn of May and June, at the time of forage ripeness of grasses.

7.2.2.4 Due to the long vegetation development time, sites are typically handed over immediately after the sowing. The success of the grassing cannot be seen at that moment, so it is advisable to make an inspection 1–2 years after the handover (warranty claim).

7.2.2.5 At manually or mechanically sown flat sites, it has to be checked upon work handover that the seed is sown evenly, worked in shallowly and pressed to the soil surface.

7.2.2.6 At hydroseeded sites, it has to be checked visually at work handover that the seed is sown evenly using auxiliary pigment in the mixture. In addition, it is checked if the layer of auxiliary material is sufficient. Entering a hydroseeded area must be prohibited to prevent damage to the anti-erosion and growing layers.

7.2.2.7 For grasslands sown with special objectives, at extreme sites (rocky cuts, extreme slopes over 1:1) or in the case of a choice of special species, the cultivation measures in

relation to evenness and soil cover can be conditioned by other provisions.

7.2.2.8 Detailed work acceptance requirements are always specified in the project documentation, section Technical Report.

7.3 Grasslands with priority use 3KN (providing fodder and nectar)

7.3.1 Annual weeds always appear in the vegetation after establishment and are removed only as part of 'weed mowing'. Under certain conditions, they may in fact perform the desirable role of cover crops (cultures).

7.3.2 Weed mowing is always the first and sometimes also the second mowing after the establishment of a grassland for fodder use. It is typically performed at a vegetation height of around 30 cm as 'tall mowing' – about 10 cm above the ground to avoid damage to seedlings of slow-germinating plants.

7.3.3 Weed mowing is not carried out in grasslands for nectar use unless absolutely necessary due to a high level of weed infestation. The first mowing in the year of sowing is performed after the herbs providing bee forage have flowered.

7.3.4 Vegetation development and closing typically take 0.5–2 years, depending on mixture composition and the weather in the first years after sowing.

7.3.5 The success of the grassing cannot be seen immediately after work handover, so it is advisable to make an inspection 1–2 years after the handover (warranty claim). Therefore, documentation can be requested on handover of sites sown for grasslands with priority use 3KN (fodder and nectar; see 7.4), but the state of the vegetation cannot be assessed.

7.3.6 At manually sown or mechanically sown flat sites, it has to be checked at work handover that the seed is sown evenly, worked in shallowly and pressed to the soil surface.

7.3.7 Detailed work acceptance requirements are always specified in the project documentation, section Technical Report.

7.4 Work acceptance documentation

7.4.1 A report on the handover of a site intended for grassing is made before the contractor starts work.

7.4.2 At work handover, the client receives a mixing report for the seed used, a material safety data sheet for any plant protection products, fertilisers and auxiliary soil substances if used, and declarations of conformity for any other components used.

7.4.3 The seed quality is declared in the mixing report. The sowing of the required mixture can be verified by checking the batch number on the tag of each mixture package. The quantity of seed sown can be verified by checking the number and weight of the mixture packages.

7.4.4 When establishing a grassland using hydroseeding, a hydroseeding formulation is submitted, including dosage of each component.

7.4.5 When using sowing material from collection direct at donor sites (green hay, hay, etc.), consent of nature protection authorities is added.

7.4.6 Documentation is not required for sites established by means of spontaneous succession.

8. Maintenance management

Maintenance management follows up on development management and is used for the maintenance of full functional effectiveness of the grassland.

8.1 Grasslands with priority uses 1B (increasing biodiversity) and 3KN (providing fodder and nectar)

8.1.1 Mowing

8.1.1.1 Regular mowing is the most appropriate grassland management method. Unmown sites lead to an accumulation of old hay, which prevents growth of seedlings and thus reduces species diversity of the grassland, to a spread of undesirable weed species (docks, thistles, nettles, *Calamagrostis epigejos*, etc.), and to encroachment with self-seeding woody plants, most commonly *Crataegus* spp., *Prunus spinosa*, *Robinia pseudoacacia*, *Betula pendula*, *Populus tremula* and sometimes also pines (*Pinus* spp.).

8.1.1.2 The first mowing is typically performed at a vegetation height of 20–30 cm, leaving 8–10 cm of vegetation. The primary objective of the first mowing is to suppress annual weeds in the grassland and to improve light conditions for slower developing species.

8.1.1.3 The most appropriate mowing equipment for the first mowing (most considerate to young plants) is a sickle bar mower or, at small sites, a hand scythe. Alternatively, a rotary mower or brush cutter can be used, but always with a well-sharpened blade or wheel. A blunt blade and a trimming string are inappropriate for the first mowing, as they pull young plants out of the soil.

8.1.1.4 In the following years, one cut is performed in June and sometimes another one in mid-August or later (known as ‘aftermath’).

8.1.1.5 The cut material must be removed. Under certain conditions, it can be left at the site for 2–5 days to allow shedding of ripe seeds and is then removed.

8.1.1.6 To promote invertebrate diversity, it is essential that the management is not carried out over the whole site at once but, if possible, in parts with several weeks between.

8.1.1.7 The number of cuts during the growing season depends on the ecological conditions of the site, particularly moisture availability, soil nutrient contents and altitude.

8.1.1.8 In terms of mowing frequency, grasslands can be divided into occasionally mown, once-mown, twice-mown and multiple-mown. For details, see SPPK D02 004 Mowing of grasslands (Chapter 3.2).

8.1.1.9 Various types of mowing (full cover, mosaic, phased, leaving unmown patches) are detailed in SPPK D02 004 Mowing of grasslands (Chapter 3.3).

8.1.2 Mulching

8.1.2.1 Mulching of grasslands is inappropriate. For details, see SPPK D02 004 Mowing of grasslands (Chapter 4.3.2).

8.1.3 Fertilisation

8.1.3.1 Fertilisation of grasslands with priority uses 1B and 3KN is inappropriate.

8.1.4 Rolling

8.1.4.1 In addition to rolling after sowing, it is in some cases advisable to roll oung vegetation after germination, e.g. in the case of autumn sowing in spring, when young seedlings have risen due to soil freezing in winter.

8.1.4.2 Rolling always has to be carried out in dry weather to prevent soil from sticking to the roller surface.

8.1.5 Harrowing

8.1.5.1 Performed in older vegetation as needed in order to disturb the turf and thus support competition of weaker herbs in spring, before the growing season starts.

8.1.5.2 Meadow harrows and bar harrows are suitable for this purpose, at small sites also ordinary garden rakes.

8.1.6 Levelling

8.1.6.1 Levelling pastures and molehills in meadows and pastures is recommended in spring in years following the grassland establishment.

8.1.7 Liming

8.1.7.1 In the case of a low soil pH, liming can be exceptionally performed to support legumes and herbs in the vegetation.

8.1.8 Irrigation

8.1.8.1 Grasslands are mostly designed for conditions and sites where artificial irrigation is not expected.

8.1.9 Removal of undesirable plant species

8.1.9.1 When managing extensively used grasslands, it is advisable to monitor the occurrence of undesirable weed species and adjust the mowing times and frequency to their presence and growing stages so as to prevent their dissemination.

8.1.9.2 Weed species can also be removed mechanically, e.g. individual cutting or pulling out plants with roots, or chemically by locally applying an appropriate herbicide.

8.1.10 Use of hemiparasitic plants

8.1.10.1 Dominance of *Calamagrostis epigejos* or other grasses at restored grassland sites can be suppressed by appropriate sowing of hemiparasitic species of the *Rhinanthus* genus Desirable meadow species can then develop in the opened spots.

8.1.10.2 Before sowing in autumn, it is necessary to mow the vegetation, rake out old hay and sow the *Rhinanthus* seeds by the end of November at the latest to break their dormancy.

8.1.10.3 The seeds are sown by simple sprinkling; the seeds can be pressed gently into the topsoil using rakes.

8.1.10.4 When sowing *Rhinanthus alectorolophus*, make sure to prevent its spreading into field cultures.

8.2 Grasslands with priority use 2T (technical utilisation)

Due to the great variability of maintenance management of the different types of technical grasslands, the specific management aspects are described for each type separately (see 9.2).

9. Main grassland types

9.1 Grasslands with priority use 1B (increasing biodiversity)

9.1.1 Extensive meadows and pastures include grass-herb vegetation without or with scattered woody plants.

9.1.2 Grass-herb undergrowth in forested biocorridors and hedgerows includes vegetation consisting of sciophytic species. Shading has effect on the composition of suitable herb and grass species depending whether the site conditions are dry or moist. Shading is negligible in newly established forested biocorridors and hedgerows.

9.1.3 Grasslands for the grassing of alluvial plains are grass-herb vegetation for the lowest parts of valleys. The vegetation has to show good resistance to the kinetic energy of torrential rain and erosion.

9.1.4 Grasslands for floodplains and polders are grass-herb vegetation for frequently dry sites which are subject to irregular longterm inundation after long-lasting and intensive precipitation.

9.1.5 Grasslands along watercourses, berms[1] and wetlands comprise grass-herb vegetation on variously sloping sites exposed to water erosion due to the effects of water flow energy, kinetic energy of precipitation and changing water levels.

9.1.6 Grasslands in newly established extensive orchards comprise grass-herb vegetation in dry conditions, commonly with a low sward at sites with high insolation.

9.1.7 Grasslands in stabilised extensive orchards comprise grass-herb vegetation in dry conditions, commonly with a low sward, at sites with partial shading.

9.2 Grasslands with priority use 2T (technical utilisation)

9.2.1 Grasslands on banks of streams, dams of lakes and water reservoirs

9.2.1.1 In this case, priorities 2T (technical) and 1B (biodiversity) almost always overlap.

9.2.1.2 The purpose of grass (grass-herb) vegetation along watercourses is to absorb part of concentrated surface runoff from the surroundings and to intercept part of the debris and chemicals (pesticides, fertilisers, etc.) flowing from the surroundings. The purpose of grass (grass-herb) vegetation along riverbeds is reinforcement of the bed based on requirements for the stability of slope or bank fortification (tangential stress or non-eroding velocity). Grass (grass-herb) vegetation along watercourses and in riverbeds, abd on banks and dams of water

[1] A berm is a longitudinal strip of the bottom of a water channel inundated only under higher water level conditions.

reservoirs is made up of or complement riparian vegetation.

9.2.2 Grasslands on road and railway slopes and embankments

9.2.2.1 The purpose of these grasslands is to prevent wind and water erosion on cutting and embankment slopes, stabilise and reinforce the topsoil with grass roots, produce a continuous turf and thus prevent sliding of topsoil or solifluction, but not landslides.

9.2.2.2 Grass (grass-herb) vegetation on cutting and embankment slopes has only a limited capacity to drain torrential rain and are able to secure surface runoff from rainfall and torrential rain, usually from the cutting or embankment slope, not the surface or concentrated runoff of water flowing down from high-lying areas.

9.2.2.3 Mowing at least once a year is recommended to prevent growth of inappropriate woody plants.

9.2.2.4 The choice of appropriate species should take into account the requirement for low vegetation and effects of road salt in winter.

9.2.2.5 Beyond mowing and possible removal of cut material, the management of this vegetation type consists only in mending damaged grassland, rehabilitation and renovation after traffic accidents.

9.2.3 Grasslands on ski slopes

9.2.3.1 The purpose of these grass (grass-herb) areas is to prevent all kinds of damage to vegetation by erosion and use for sports.

9.2.3.2 In the growing season, these areas can be used for grazing or haymaking.

9.2.4 Grasslands on landfills, mine waste dumps, fly ash deposits, etc.

9.2.4.1 The purpose of grass-herb areas on landfills and fly ash deposits is to prevent slope surface erosion, aesthetic improvement of the facility, reinforcement and improvement of the vegetation layer with a root system to prevent exposure of foil covering landfills or fly ash deposits and any fly ash drift from the deposits.

9.2.4.2 In addition to grasses, the seed mixtures should include herbs and legumes with a soil improvement effect.

9.2.5 Gravel turfs and paths

9.2.5.1 A gravel turf (*Schoterrasen* in German) is a traversing grassland on a gravel layer 20–30 thick with spaces filled with earth and rooted by grasses. Gravel turfs increase the water absorption capacity of the landscape while providing burdening space.

9.2.5.2 Materials of the load-bearing structure (gravel) make up 80% of the volume, while the auxiliary materials (compost, earth) form 20% of the vegetation layer volume. The two layers have to be separated with geotextile to avoid a risk of gradual loss of earth from the topmost layer. If no geotextile is used, earth has to be added to all layers of a gravel turf. Materials of the load-bearing structure (gravel, recycled construction debris) then make up 80% of the volume, while the auxiliary materials (compost, earth) form 20% of the volume of each layer of the gravel turf.

9.2.5.3 Depending on intensity of use (see Annexes 4 and 5), gravel turfs are established with one load-bearing vegetation layer 15–30 cm thick or with two layers, the deeper one being a drainage layer 20–25 cm thick made of coarser material and the top layer is 10–15 cm thick

and contains a finer gravel fraction mixed with earth or compost.

9.2.5.4 Gravel turfs are established at sites with slopes up to 5%.

9.2.5.5 In justified cases, the vegetation layer of a gravel turf may include auxiliary soil substances based on hydroabsorbents and silicate colloids.

9.2.5.6 Depending on the planned burdening, mixtures for gravel grassland can be composed purely of grasses or may be complemented with herbs. Grass-herb communities are suitable for gravel turfs if lower strain is expected.

9.2.5.7 After the first mowing, a gravel turf not containing any herbs (except *Achillea millefolium*) has to be fertilised using a nitrogen fertiliser at a rate of 5 $g.m^{-2}$. Regular nutrition promotes recovery and closing of gravel turfs exposed to heavy loads.

9.2.5.8 Gravel turfs with dicotyledonous herbs (except *Achillea millefolium*) should not be fertilised regularly, as this decreases the species diversity.

9.2.5.9 Extensive gravel turfs are mown periodically (once or twice a year, more often if needed) to a height of 4–6 cm.

9.2.5.10 Winter maintenance must not disturb the gravel grassland surface with ploughshares.

9.2.5.11 Inadequate burdening of gravel turfs may lead (if overloaded, if cars brake too often, etc.) to shifting of the gravel layers, formation of ruts and as a result creation of puddles.

9.2.5.12 The carrying capacity of an existing gravel turf can be increased primarily by draining the plot, additional compaction, additional replenishment of the missing gravel fraction, and increasing the thickness of the load-bearing vegetation layer.

9.3 Grasslands with priority use 3KN (providing fodder and nectar)

The mixtures should comprise grasses, legumes and herbs which not only match the ecological conditions but can also meet the needs of livestock. In this respect, not only the nutrient content but also palatability of the different species is important. The mixtures should contain plants of the *Poaceae* and *Fabaceae* families which are indigenous in this country (see Annexes 1 and 2).

9.3.1 Grasslands for pollinators and butterflies

9.3.1.1 All grasslands with priority use 1B (biodiversity) are suitable for pollinators and butterflies.

9.3.1.2 Presence of individual host plant species mentioned in Annex 3 in the mixture will enable development of butterflies at a site.

9.3.1.3 Nectar-producing biostrips in the Czech Republic are subsidised as part of agri-environmental climate protection measures based on an application submitted to the State Agricultural Intervention Fund.

9.3.2 Grasslands aimed at increasing the natural value of field hunting grounds

9.3.2.1 The composition of mixtures aimed at increasing the natural value of field hunting grounds depends on the focus of the hunting ground on a single species (game preserves) or more game species simultaneously.

9.3.2.2 Each game category has its specific requirements, but game health is always better with a more diverse diet.

9.3.2.3 Game birds require sufficient fragmentation of hiding spots in the landscape. Vegetation providing the shelter should also offer food, which is not only the seed of herbs in a mixture (such as legumes) but, most importantly, insects and their larvae, the presence and development of which are bound to the presence of specific plant species in the vegetation.

9.3.2.4 Deer prefer vegetation consisting of grasses and perennial legumes.

9.3.2.5 As for herbs in the mixture, not only dietetically suitable species, such as *Plantago* spp. and *Achillea* spp. are important, but also *Cichorium intybus*, for example, used by roe deer for cleaning their antlers.

9.3.2.6 The mixture must not contain species which are poisonous, thorny, invasive or with a tendency to dominate in the grassland.

9.3.2.7 Gamekeeper fields are intended for small ungulates. The mixture for these fields should match the requirements of the game and the fields should be managed in a way that some crops are available to game throughout the year.

Annex 1 Overview of suitable and unsuitable bred grass species (*Poaceae*) and varieties bred in the CR (according to ÚKZÚZ as of 31 May 2017 or business sources).

Grass species and varieties bred in the CR, suitable for grasslands

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Species		**Czech varieties** (registered, protected)
Phleum nodosum L.	suitable	Zubr
Phleum pratense L.	suitable	Bobr, Cavalet, Oderský, Sobol
Phalaris arundinacea L.	in specific conditions	Chrastava
Lolium multiflorum Lam. var. *westerwoldicum* Wittm.	suitable (diploid varieties only) only for cover crop (culture) technique	**diploid** varieties: Prokop, Rožnovský (tetraploid varieties unsuitable, not shown)
Lolium perenne L.	suitable (diploid varieties only)	**diploid** varieties Ahoj, Bača, Doton, Filip, Hamlet, Handicap, Hannibal, Helada, Hele, Jakub, Jonas, Jozífek, Olaf, Patrik, Proly, Pronum, Propan, Propoz, Sadek, Slávek, Talon, Tremolo, Vojta, Zamini, Zekol, Zelot, Zifer, Zirkon (tetraploid varieties unsuitable, not shown)
Festuca rubra L.	suitable	Andulka, Aranka, Barborka, Ferota, Fidelio, Jitka, Makyta, Mirka, Petruna, Protenza, Táborská, Tagera, Tamburina, Tangenta, Terka, Termika, Tokata, Tradice, Vendula, Viktorka, Zorina, Zulu (= Valaška)
Festuca brevipila Tracey, syn. *Festuca trachyphylla* (Hackel) Krajina	suitable	Dorotka, Štěpánka
Festuca pratensis Huds.	suitable	Kolumbus, Otava, Pastorela, Pronela, Proxana, Rožnovská
Festuca ovina L.	suitable	Lucka
Poa palustris L.	in specific conditions	Rožnovská
Poa nemoralis L.	in specific conditions	Dekora, Tanemo

Poa pratensis L.	suitable	Bradley, Harmonie, Hekate, Hetera, Hifi, Slezanka, Zuzka
Poa trivialis L.	in specific conditions	no Czech varieties
Poa compressa L.	in specific conditions	Razula
Holcus lanatus L	suitable	Hola
Deschampsia cespitosa (L.) P. Beauv	suitable	Kometa
Arrhenatherum elatius (L.) P. Beauv. ex J. Presl et C. Presl	suitable	Rožnovský (Median - awnless, unsuitable)
Cynosurus cristatus L.	suitable	Rožnovská
Alopecurus pratensis L.	suitable	Talope, Vulpina, Zuberská
Agrostis capillaris L.	suitable	Golf, Kuzma, Polana, Venca, Vítek
Agrostis canina L.	suitable	no Czech varieties
Agrostis gigantea Roth	suitable	Janek, Rožnovský, Václav
Agrostis stolonifera L.	suitable	Horus, Trylek
Koeleria macrantha (Ledeb.) Schult.	suitable	Enif
Dactylis glomerata L.	suitable	Dana, Niva, Vega (syn. Lyra), Toscali (Tosca was Slender orchardgrass until 2007, *D. polygama* Horv.), Zora
Bromus inermis Leyss.	suitable	Brozde, Dassa, Pella, Radmill
Anthoxanthum odoratum L.	suitable	Jitka
Trisetum flavescens (L.) P. Beauv.	suitable	Polom, Rožnovský, Větrovský

Note: The underlined variety names are varieties bred purely from domestic sources for which the breeder specifies this information.

Grass species and varieties bred in the CR, unsuitable for grasslands

Species		**Czech varieties** (registered, protected)
x *Festulolium* Asch. et Graebn.	prohibited, intergeneric hybrid	(varieties not shown)
Lolium x *boucheanum* Kunth	prohibited, interspecific hybrid	(varieties not shown)
Lolium multiflorum Lam. subsp. *italicum* (A. Br.) Volkart	unsuitable	(varieties not shown)
Festuca arundinacea Schreb.	unsuitable; only for technical grasslands and in areas of natural occurrence	Kora, Promona, Prosteva, Provenia
Poa annua L.	unsuitable, annual species	no Czech varieties
Bromus sitchensis Trin.	unsuitable, introduced species	(varieties not shown)

Annex 2 Overview of suitable and unsuitable bred legume species (*Fabaceae*) and varieties bred in the CR (according to ÚKZÚZ as of 31 May 2017 or business sources).

Legume species and varieties bred in the CR suitable for grasslands

Species		**Czech varieties** (registered, protected)
Trifolium alpestre L.	suitable; use only within boundaries of current distribution	Alpin
Trifolium ochroleucum Huds.	suitable; use only within boundaries of current distribution	Helian
Trifolium rubens L	suitable; use only within boundaries of current distribution	(Rudolf - plant variety rights applied for).
Trifolium montanum L.	suitable	Guru
Trifolium campestre Schreb.	suitable	Macik
Trifolium pratense L.	suitable (diploid varieties only)	**diploid varieties**: Agil, Bonus, Brisk, Callisto, Cyllene, Elara, Feng, Ganymed, Garant, Helike, Himalia, Chlumecký, Kalyke, Radan, Respect, Slavín, Slavoj, Spurt, Start, Suez, Tábor, Trubadur, Van, Vendelín, Vltavín, Zefyr (tetraploid varieties unsuitable, not shown)
Trifolium pannonicum Jacq.	suitable; use only within boundaries of current distribution	Panon
Trifolium repens L.	suitable	Bak, Bobr, Borek, Hájek, Jura, Klement, Král, Kron, Luke, Nivel, Vysočan
Trifolium arvense L.	suitable (annual species) in specific conditions	Rolan
Trifolium hybridum L.	suitable (diploid varieties only)	**diploid varieties**: Táborský, Pooderský (tetraploid varieties unsuitable, not shown)
Melilotus albus Medik.	suitable (annual or biennial species)	Běla, Meba
Astragalus cicer L.	suitable	Astra (variety bred as grain legume)

Lotus uliginosus Schkuhr	suitable	Trajekt
Lotus corniculatus L.	suitable	Lotar, Maleják, Taborak, Tenor
Medicago lupulina L.	suitable	Ekola
Anthyllis vulneraria L.	suitable	Antyl, Ivan, Pamir
Onobrychis viciifolia Scop.	suitable	Višňovský
Medicago sativa L. subsp. *falcata* (L.) Arcang.	suitable	Manon
Securigera varia (L.) Lassen	suitable	Eroza

Legume species and varieties bred in the CR, unsuitable for grasslands

Species		**suitable Czech varieties** (registered, protected)
Galega orientalis Lam.	unsuitable, introduced species	(varieties not shown)
Trifolium nigrescens Viv.	unsuitable, introduced species	(varieties not shown)
Trifolium pratense L. x *Trifolium medium* L.)	prohibited, intergeneric hybrid	(varieties not shown)
Trifolium alexandrinum L.	unsuitable, introduced annual species	(varieties not shown)
Trifolium fragiferum L.	unsuitable	(varieties not shown)
Trifolium ambiguum M. Bieb.	unsuitable, introduced species	(varieties not shown)
Trifolium incarnatum L.	unsuitable, introduced annual or biennial species	(varieties not shown)
Trifolium medium L.	unsuitable	(varieties not shown)
Trifolium vesiculosum Savi	unsuitable, introduced species	(varieties not shown)
Trifolium resupinatum L.	unsuitable, introduced annual or biennial species	(varieties not shown)
Trigonella foenum-graecum L.	unsuitable, introduced species	(varieties not shown)
Lotus ornithopodioides L.	unsuitable, introduced species	(varieties not shown)

Medicago sativa L.	unsuitable	(varieties not shown)

Annex 3 Examples of plant species supporting diurnal butterflies

a) Caterpillar host plants

Plant species	Example butterfly species	Remark
Lotus corniculatus	*Leptidea sinapis* *Colias hyale* *Callophrys rubi* *Cupido argiades* *Cupido decoloratus* *Plebejus argus* *Polyommatus icarus* *Erynnis tages* *Zygaena carniolica* *Zygaena loti* *Zygaena viciae* *Zygaena angelicae* *Zygaena filipendulae* *Zygaena lonicerae*	
Anthyllis vulneraria	*Cupido minimus* *Polyommatus dorylas*	
Securigera varia	*Leptidea sinapis* *Colias alfacariensis* *Colias hyale* *Cupido alcetas* *Glaucopsyche alexis* *Plebejus argus* *P. argyrognomon* *Polyommatus icarus* *P. coridon* *P. bellargus* *P. daphnis* *Erynnis tages* *Zygaena loti* *Z. ephialtes* *Zygaena filipendulae*	

Trifolium pratense *T. medium* *T. montanum* *T. alpestre*	*Colias hyale* *Cupido argiades* *Cupido decoloratus* *Cyaniris semiargus* *Polyommatus icarus* *Zygaena viciae* *Zygaena lonicerae*	
Medicago spp.	*Colias hyale* *Callophrys rubi* *Cupido decoloratus* *Polyommatus icarus*	
Vicia spp.	*Leptidea sinapis* *Colias hyale* *Cupido decoloratus* *Cupido alcetas* *Glaucopsyche alexis* *Polyommatus amandus* *Zygaena viciae*	
Onobrychis viciifolia *Onobrychis arenaria*	*Callophrys rubi* *Glaucopsyche alexis* *Polyommatus thersites* *Zygaena carniolica* *Zygaena loti* *Zygaena viciae*	
Potentilla spp.	*Pyrgus malvae* *Pyrgus serratulae* *Pyrgus carthami*	
Fragaria spp.	*Pyrgus malvae*	
Malva spp.	*Carcharodus alceae*	
Rumex acetosella *Rumex acetosa*	*Lycaena phlaeas* *Lycaena tityrus* L*ycaena virgaureae* *Lycaena alciphron* *Lycaena hippothoe* *Adscita statices*	
Festuca ovina, F. rubra, etc.	*Melanargia galathea* *Hipparchia semele* *Brintesia circe* *Erebia medusa* *Maniola jurtina* *Aphantopus hyperanthus* *Coenonympha pamphilus* *Lasiommata megera* *Hesperia comma*	

Holcus lanatus	*Coenonympha arcania* *Lasiommata megera* *L. maera* *Thymelicus sylvestris*	
Plantago lanceolata *T. medium*	*Melitaea athalia* *M. cinxia* *M. aurelia*	
Centaurea spp.	*Jordanita globulariae*	
Thymus spp.	*Pseudophilotes vicrama* *Zygaena purpuralis*	dry sites
Genista spp.	*Glaucopsyche alexis*	dry sites
Ononis spinosa	*Polyommatus icarus*	
Eryngium campestre	*Zygaena laeta* *Z. punctum*	dry sites
Helianthemum spp.	*Callophrys rubi* *Aricia agestis* *Pyrgus alveus* *Adscita geryon*	dry sites
Sanguisorba minor	*Spialia sertorius* *Pyrgus malvae*	dry sites
Sanguisorba officinalis	*Phengaris nausithous* *P. telejus* *Brenthis ino*	wet sites
Geranium pratense	*Aricia eumedon*	wet sites
Filipendula ulmaria	*Brenthis ino* *Pyrgus malvae*	wet sites
Aristolochia clematitis	*Zerynthia polyxena*	wet sites in South and Southeast Moravia

b) Examples of nectar-producing plants frequently visited by adult diurnal butterflies

Carduus spp.
Cirsium spp.
Centaurea s.l. spp.
Dianthus carthusianorum, D. deltoides
Eupatorium cannabinum
Sambucus ebulus
Calluna vulgaris

Annex 4 Gravel turf loading classes (FLL, 2000)

Loading level	Vehicle type	Utilisation time	Traversing frequency	Parking time
1	Cars up to 3.5 t	year-round	1–2 a week	half a day
2	Cars up to 3.5 t	periodically	1 a day	all day
	Lorries up to 11.5 t		occasionally	
3	Cars up to 3.5 t	half-year	2–3 a day	all day
	Lorries up to 11.5 t		occasionally	
4	Lorries up to 11.5 t	all-year use		

Annex 5 Thickness of gravel turf load-bearing layer depending on loading level (FLL, 2008)

Loading level	Construction method	Recommended thickness of load-bearing vegetation layer
1	1 layer	15–20 cm
2	1 layer	20–25 cm
3	1 layer	25–30 cm
4	2 layers	10–15 cm top vegetation layer 20–25 cm bottom vegetation layer

Annex 6 General recommendations for the use of natural geotextiles

The design process has to take into account the geotextile lifespan with respect to the prospects of grassland development and turf formation. The following approximate lifespans has been determined experimentally:

- geotextile made of natural jute fibre: 3 years (2 winters),
- geotextile made of natural coconut fibre: max. 9 years (usually 5 years in the CR).

Another approximate classification for the use of natural geotextiles is by the slope gradient to be reinforced and is based on designers' experience[2]:

- geotextile made of natural jute fibre, weight 250 g/m^2, up to 1:2, i.e. approx. 27° (in extreme cases up to 1:1.5, i.e. approx. 34°), always in combination with another erosion control measure (mulch, hydroseeding, green hay, unwoven natural fibre geotextile, etc.),
- geotextile made of natural jute fibre, weight 500 g/m^2, up to 1:2, i.e. approx. 27° (in extreme cases up to 1:1.5, i.e. approx. 34°); can be used on its own,
- geotextile made of natural coconut fibre, weight 400 g/m^2, up to 1:1.5, i.e. approx. 34° (in extreme cases up to 1:1, i.e. approx. 45°), separately in partly shaded places or in combination with another erosion control measure (mulch, hydroseeding, green hay, unwoven natural fibre geotextile, etc.),
- geotextile made of natural coconut fibre, weight 700 g/m^2,up to 1:1, i.e approx. 45° (steeper in extreme cases) – always separately, in sunny places.

Basic rules for laying natural geotextiles[3]:

1) The soil profile has to be worked to a depth of 75 mm, with all waste removed as well as large stones if the slope is to be smooth. If not, large stones or gravel spots (without a humic soil layer) can be left out and do not have to be covered with mesh.
2) Loosen the surface and slope it, add fertiliser in justified cases.
3) Sow the slope with grass seed of the prescribed quantity (as an alternative, use green hay, hayloft sweepings, etc.).
4) Lay the geotextile on the sown slope. Mulching and hydroseeding is recommended only for some geotextile types and is pointless for mats.
5) Unroll mesh strips downhill or along the foot of the slope. Strips have to overlap 100–200 mm and laid so that water cannot get under them (like roofing tiles), i.e., start from the lowest strip if laying along the foot of the slope.
6) Spread the mesh loosely and evenly, without stretching it. In the first calendar year after

[2] "In extreme cases" refers to very short slopes or in combination with hydroseeding, etc.

[3] Source: Zlatuška K. (2003): Ochrana břehů vodního toku zatravněním zejména za podpory geotextílií. Monografie. Folia Universitatis agriculturae at silviculturae Mendelianae Brunensis. Brno, 45 pp, ISBN 8071576913, 9788071576914.

the laying, the mesh will stretch and expand due to alternating climate conditions. The mesh will be pressed into the soil in the first winter, biodegrading processes (rotting) will start and lengthwise and planar changes will stop.

7) The ends and corners of the topmost strip have to be embedded in a trench 150 mm deep and secured with pegs (about 3 pegs per metre). Using a wooden pole fastened with wooden pegs and embedded in the trench has not proven useful in practice.
8) The bottom ends or corners have to be folded down (doubled) over a length of at least 150 mm and secured with 3 pegs per metre. The bottom end of a strip can also be secured with stones (stone riprap), a lattice fence or a patch fence, or by inserting a net on the backside of the building object to which the reinforced slope is connected (retaining wall, bridge abutment, etc.).
9) Longitudinal joints between strips should overlap 100–200 mm and should be anchored every 0.5–1 metre. An additional line of pegs is placed in the middle of each strip (chessboard), again 0.5–1 metre apart as according to need.
10) If mesh strips are laid downhill, the strips have to overlap 500 mm.
11) The anchors are wooden pegs made of spruce timber, wooden pegs of living willow or alder branches (pole saplings), wire hook nails made of spring wire, steel pegs made of ribbed construction steel, or rock nails. The choice of anchoring method and peg length depends on the subgrade. Use wooden pegs or wire hook nails for earth and sand, wooden or steel pegs for gravel, and living wood pegs extending beyond the slip surface for waterlogged or sliding areas. The typical dimensions of the anchoring elements are 30 × 30 × 300 mm.

Annex 7 Auxiliary materials

Geosynthetic (GSY) – a generic term describing a product where at least one component is made of a synthetic or natural polymer in the shape of a sheet, strap or three-dimensional structure, used in contact with earth and/or other materials in geotechnology and construction engineering.

Geotextile (GTX) – a planar, permeable, polymer (synthetic or natural) textile material which may be unwoven, knitted or woven, used in contact with earth and/or other materials in geotechnology and construction engineering.

Geogrill (GGR) – a planar polymer structure consisting of a regular open grill or firmly joined tensile elements which can be linked by extrusion, binding or weaving or knitting, and where the holes are larger than the elements.

Geonet (GNT) – a geosynthetic consisting of parallel systems of ribs laid across each other and firmly connected with similar systems at various angles.

Geomat (GMA) – a three-dimensional permeable structure made of polymer monofilaments and/or other elements (synthetic or natural), mechanically and/or thermally and/or chemically and/or otherwise jointed.

Geocell (GCE) – a three-dimensional permeable polymer (synthetic or natural) structure in the form of a honeycomb or similar cellular structure, made by jointing geosynthetic straps.

Geocomposite (GCO) – an industrially manufactured composite material containing at least one geosynthetic product among its components.

Grassing mat – a mat with degradable load-bearing fabric with seed inserted. Not suitable for grasslands.

Slope grill – a system laid or embedded on slopes or embankments, supported from below or anchored, jointed two-dimensionally.

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