BRITISH STANDARD

BS 7370 :
Part 4 : 1993

Grounds maintenance

Part 4. Recommendations for maintenance of soft landscape (other than amenity turf)

Entretien des sols
Partie 4. Recommendations pour l'entretien des paysages à terrain tendre (autres que gazons décoratifs)

Landschaftspflege
Teil 4. Pflege von Vegetationsflächen (außer Freizeitrasen)

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British Waterways Board
Commonwealth War Graves Commission
Countryside Commission for Scotland
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Department of Transport
Electricity Association
Institute of Groundsmanship
Institute of Leisure and Amenity Management
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Foreword

This Part of BS 7370 has been prepared under the direction of the Environment and Pollution Standards Policy Committee.

BS 7370 has been prepared in order to provide guidance to those responsible for the upkeep of land that has recreational or amenity use, or a functional purpose that is not solely for agriculture, commercial horticulture or forestry, and includes a series of recommendations for the various aspects of such maintenance.

It has been assumed in the drafting of this British Standard that the execution of its provisions is entrusted to appropriately qualified and experienced people, for whose guidance it has been prepared.

This Part of BS 7370 categorizes soft landscape (excluding amenity turf), describes maintenance operations and sets out recommendations for seasonal maintenance programmes for each category mentioned with guidelines for monitoring the quality of maintenance. BS 7370 at present comprises the following Parts:

Part 1. Recommendations for establishing and managing grounds maintenance organizations and for design considerations related to maintenance
[1)] Part 2. Recommendations for maintenance of hard areas
Part 3. Recommendations for maintenance of amenity and functional turf (other than sports turf)
Part 4. Recommendations for maintenance of soft landscape (other than amenity turf)
[1)] Part 5. Recommendations for maintenance of water areas

Further Parts may be prepared, as necessary.

NOTE. The numbers given in square brackets throughout the text relate to bibliographic references given in **A.1**.

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[1)] In preparation.

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Section 1. General

Introduction

This Part of BS 7370 is written in four sections. The first describes the scope of the document and some of the technical terms used. The second section defines the categories of plants; both seminatural plant communities and artificial plant associations made for practical or ornamental purposes. Section 3 describes maintenance activities for soft landscape (excluding amenity turf) and section 4 sets out the seasonal maintenance programmes for the categories of soft landscape given in section 2. The recommendations given in this Part of BS 7370 are intended:

a) to assist in determining management aims and developing appropriate maintenance programmes for soft landscape;

b) to assist in monitoring the quality of management and in determining methods of setting right errors made in cultivation;

c) to define the work necessary to keep planted areas tidy, and healthy and safe, and to maintain, to a satisfactory quality, their ornamental and/or practical value. Choices of maintenance programme are indicated wherever possible.

In southern and western latitudes and in sheltered areas, the growing season may be about 8 weeks longer than in northern and exposed areas and this will influence maintenance routines (see BS 7370 : Part 1 : 1991). It is, however, not possible to express this difference numerically, as distinct from turf culture where much of the work is mechanical and measurable.

It is recognized therefore that, in some circumstances, the programmes may have to be adjusted to meet local conditions but it is recommended that the maintenance objectives and programmes described should be followed wherever possible.

1.1 Scope

This Part of BS 7370 gives recommendations for the management and maintenance of soft landscape that is intended primarily for amenity use. It is not intended to apply to areas used for the production of fruit or timber, or to specialized areas such as internal landscapes, roof gardens and ecology parks. The recommendations for maintenance given in this Part of BS 7370 apply to the growing conditions in the cool, temperate and fairly moist climate of the United Kingdom. Operations required in different seasons on various aspects of soft landscape are summarized in annex B.

Ornamental grasses and some species of grass of environmental value are covered in this Part of BS 7370, together with seminatural landscape types such as shrub and tree dominated areas, e.g. heathland, scrubland or grass and shrub dominated dune systems.

This Part of BS 7370 does not cover design aspects of landscape maintenance, nor is it intended to be a textbook on horticulture or forestry. Ecological and conservation aspects of management are given prominence where appropriate, and reference is made to suitable background reading in the text and the bibliography (see annex A).

1.2 References

1.2.1 Normative references

This Part of BS 7370 incorporates, by reference, provisions from specific editions of other publications. These normative references are cited at the appropriate points in the text and the publications are listed on the inside back cover.

Subsequent amendments to, or revision of, any of these publications apply to this Part of BS 7370 only when incorporated in it by updating or revision.

1.2.2 Informative references

This Part of BS 7370 refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are listed on the inside back cover, but reference should be made to the latest editions.

1.3 Definitions

For the purposes of this Part of BS 7370, the following definitions apply.

1.3.1 aerosol

A system of pesticide application used in horticulture, similar to a fog, in which the substance is applied in the form of minute droplets suspended in air.

1.3.2 antidesiccant

An emulsion that, when sprayed over plants, forms a temporary film which reduces water loss.

NOTE. An alternative term is antitranspirant.

1.3.3 aphides, aphids

Small sap-sucking insects.

NOTE. Common types include greenfly, blackfly and plant-lice.

1.3.4 avenue

Two or more rows of trees running parallel, or sometimes converging for special effect, to enhance a throughfare or to form a vista.

NOTE. Avenues are usually but not invariably straight.

1.3.5 bark

The outer protective tissues of woody plants.

1.3.6 beating up

Replacement of failures in a newly planted tree crop, normally carried out at yearly intervals after planting.

1.3.7 blow-out

Dune destruction through loss of stabilizing plants, allowing the sand to be blown away in large amounts by a wind of moderate velocity.

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1.3.8 brashing
Pruning away all branches from the lower trunk (normally up to 2 m or 3 m) of plantation grown trees.

1.3.9 broadleaf tree
All trees excluding conifers and palms.
NOTE. An alternative term is hardwood.

1.3.10 bulb
A modified shoot consisting of a small, more or less fleshy disc-like stem, or 'plate', bearing a more or less spherical mass of leaves above and developing adventitious roots below.
NOTE. For the purposes of this standard, the term may be considered to include corm, tuber, rhizome, tuberous root and all analogous underground perennating structures.

1.3.11 bullhead knobs
The swollen ends of tree branches resulting from severe annual pruning.

1.3.12 canker
Death of the cambium tissue in the inner bark of woody plants which gives an area where no new bark forms.

1.3.13 chimaera
A plant containing tissues of two genetically distinct plants.

1.3.14 colony plants
Plants often grown in unbroken masses of one species, especially those which are found growing naturally in this way, e.g. heathers.

1.3.15 compost
1) A mixture of growing media, with added nutrients, materials to expedite drainage, etc., often in proportions to suit special classes of plants.
2) Waste vegetable and animal matter that has been converted by biological action to compost.

1.3.16 conifer
A tree, or sometimes a shrub in the order coniferales, of the class gymnospermae.
NOTE. Conifers include pines, cedars and spruce. They are also loosely called softwoods.

1.3.17 crust
The hardened surface of clay soils and silts formed after heavy rain and subsequent drying out.

1.3.18 dead-head
To remove faded flowers or seed capsules, etc. in order to conserve the energy of the plant.

1.3.19 dot plant
Bedding plant grown on a stem or plant with imposing qualities of foliage or mass, used to punctuate seasonal bedding schemes.

1.3.20 edging plant
Plants of a low close habit used to provide a formal edging to flower beds.

1.3.21 feathered tree
A tree with a defined, reasonably straight, upright leader and a stem furnished with evenly spread and balanced lateral shoots down to near ground level.

1.3.22 field layer
The layer of herbaceous plants of the woodland floor.
NOTE. Field layer is commonly defined in forestry as ground cover.

1.3.23 fillis
A jute string, naturally brown but can be stained green; often used for tying seasonal bedding plants.

1.3.24 french drain
A trench filled up to the surface, or nearly to the surface, with hard granular material to assist drainage.

1.3.25 frilled stump
A stump that has been lacerated.

1.3.26 fungicide
Substance used to destroy or control fungal growth.

1.3.27 genus
A group of species which agree in so many characteristics that they are deemed to be descended from a common ancestor.

1.3.28 Grecian saw
A saw designed for one-handed use.
NOTE. Grecian saws have the teeth set backwards so that the cutting stroke is towards the user's body.

1.3.29 groundcover
1) Plants which by their natural habit of low, vigorous, close (usually evergreen) growth are suitable for covering the ground surface and discouraging weeds.
2) That portion of ground occupied by the perpendicular projection of the material above it.

1.3.30 groundwork
Plants that form the 'background' in bedding schemes. Examples of groundwork are bedding geraniums and wallflowers.

1.3.31 growth retardant
A chemical that temporarily restricts shoot growth and which is used to diminish maintenance of hedges, etc.

1.3.32 half-hardy plants
Plants that are usually raised in a heated structure in early spring and which are hardy enough to be unprotected during the frost-free months.

1.3.33 halving
The process of periodically severely pruning hedges to remove the accumulated twiggy growth resulting from gradual growth over a period of years.

1.3.34 herbicide
Substance used to destroy or control unwanted plant growth.

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1.3.35 humus
A substance resulting from the decay of organic matter in soil.

1.3.36 hybrid perpetual rose
Hybrids between the damask rose (*Rosa* × *damascena*) and hybrid China roses (*R. chinensis*).

1.3.37 hybrid tea rose
Hybrids between hybrid perpetual roses and tea scented roses (*R.* × *odorata*), now known as large-flowered roses.

1.3.38 insecticide
Substance used to destroy or control insects and other arthropods.

1.3.39 monoculture
Plants grown in blocks of one species, or even one clone, cultivar or variety in the case of cultivated plants.

1.3.40 natural order
A group of families naturally related to one another.

1.3.41 organic
Any kind of material which is of living origin.

NOTE. This usage differs from the strict chemical definitions of 'organic' and 'inorganic'. Urea, for example contains carbon (i.e. it is 'organic') but is considered an inorganic fertilizer.

1.3.42 paradise garden
A term devised by E. Hyams, used to denote a garden of rare and beautiful trees, shrubs and herbs disposed in an artful but artificially natural manner, to give an effect of opulent splendour (see also dictionary definitions).

1.3.43 peat
The partially decomposed plant material, found in places such as bogs, mosslands, moors, marshes or fens where mineralization has been limited by climatic factors or oxygen deficiency, which has been partially dried and otherwise processed for horticultural and landscape purposes.

NOTE. For information on the uses of peat in horticulture and landscape, see BS 4156 : 1990.

1.3.44 pendulous habit
A habit of growth, not so extreme as 'weeping', but often having individually weeping branches and an overall appearance more akin to that of a normal bushy headed tree.

1.3.45 pest
Any organism harmful to plants or to wood or to other plant products, any undesired plant, or any harmful creature.

1.3.46 pesticide
Any substance used to destroy or control unwanted insects and other arthropods, larger animals, fungi, plants, etc.

1.3.47 pH
An index figure, related to the hydrogen ion concentration, denoting the acidity or alkalinity of a solution.

NOTE 1. pH 7 is neutral; lower figures denote acidity and higher ones denote alkalinity.

NOTE 2. The above is a much simplified definition of pH and is given to assist users of this Part of BS 7370. For a detailed description of pH, reference should be made to BS 1647 : Part 1 : 1984.

1.3.48 planting
1) The act of inserting plants in the soil in order that they may grow there.

2) The completed action of planting (1), especially where this is of some size and complication.

NOTE. For the purposes of this Part of BS 7370, the word planting is to be taken to include seminatural communities of plants such as heath or seminatural woodland.

1.3.49 pleach
To train branches and twigs of adjoining plants to intertwine forming a screen, arch or ornamental shape.

1.3.50 prune
To cut away parts of a tree or shrub using a small hand tool, e.g. knife, secateurs or small saw, for one of the following purposes:

a) to control shape and size;

b) to remove dead or diseased tissues;

c) to influence flowering or fruiting;

d) to induce vigorous growth.

1.3.51 red spider
An small acarid mite having the appearance of a red or orange spider. A pest of many plants.

1.3.52 replant disease
Failures of trees or shrubs replanted in the same position as that in which a previous specimen of the same family has grown, which may be due to a number of different causes.

1.3.53 scrub
An area covered with small trees, bushes and herbs, especially when these have arisen naturally; a normal stage in the succession to climax forest.

1.3.54 secateurs
Pruning shears designed for one-handed use.

1.3.55 short shoot
A shoot on a woody plant with reduced internodes, as opposed to long shoots in vigorous vegetative growth.

NOTE. It is the short shoots which bear cones and flowers in many tree species.

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1.3.56 soft landscape

The vegetative cover, other than amenity turf, of land used for amenity purposes including trees, shrubs, herbaceous plants and grasses growing in situations as diverse as gardens, parkland, woodland, road verges, duneland and heathland.

NOTE. Such vegetation has recreational, aesthetic or functional value but agricultural or forestry productivity is not its main aim.

1.3.57 species

A group of organisms, subordinate in classification to genus, consisting of actually or potentially interbreeding natural populations that are reproductively isolated from other such groups.

1.3.58 spore

A minute reproductive cell of cryptogamous plants, fungi, etc.

1.3.59 standard

A tree, having a reasonably straight stem with temporary feathering removed flush with the stem and a well-developed, reasonably balanced head with no main branch crossing the crown, that has previously been transplanted at least once in its life.

1.3.60 subsoil

The soil, modified rock, etc. existing below that level usually reached by horticultural operations, i.e. in effect, below the topsoil which is conventionally taken to be 300 mm in depth. In natural situations it may be deeper or less deep.

1.3.61 surgery

Cutting away parts of a tree or shrub by means of a handsaw or powersaw for one or more of the following purposes:

a) to remove dead or diseased tissue;

b) to control shape and/or size;

c) to make safe unbalanced growth or damaged tissues.

1.3.62 tendril

Thread-like clinging and twining processes by which means some plants climb.

1.3.63 tine

A spike or tooth of a fork, rake, harrow or mechanical cultivator.

1.3.64 top soil

The layer of soil that is cultivated, normally about 300 mm deep.

NOTE. In natural situations, the top layer of soil may be either more or less deep. For a fuller description see BS 3882 : 1965.

1.3.65 transect

A survey line made through an area of land along which samples are taken to ascertain the character of the topography, soil, vegetation and water-table.

1.3.66 transpiration

The process by which water vapour is lost through the leaves and replaced by water drawn up through the plant from the soil.

1.3.67 transplant

A tree which has been transplanted or undercut at least once.

1.3.68 turnbuckle

A coupling with a left-hand and right-hand internal thread to allow tightening and slackening of the cable to which it is attached.

1.3.69 type

The typical formation of a plant or group of plants forming a species as described by botanical authorities.

NOTE. This is a more complicated subject than may at first appear. For further information consult *The new Royal Horticultural Society dictionary of gardening* [1].

1.3.70 whip

A tree with no head or significant feather growth that has been previously transplanted at least once in its life.

1.4 Background information

1.4.1 General

Plantings are categorized as far as possible by habit of growth and by traditional usage.

1.4.2 Environment and microclimate

Within the broad limits of the range of soils and moist climate found in the UK lie an almost infinite range of local conditions, e.g. microclimates due to differing aspects, atmospheric pollution, waterlogging, degrees of exposure or protection and soil pH value. It may be impossible, therefore, to grow a range of popular hardy plants, owing to cold winds, several hundred metres from a sheltered and favourable site where a usually tender species, such as *Acacia dealbata*, is flourishing.

Although it is possible to modify any site to make it suitable for growing a wider range of plants, this is always complicated by the difficulties imposed by soils and aspect. It will always be more practicable to plant species adapted to site conditions than to attempt extreme measures of site modification to grow a favoured species. The latter will certainly be expensive and could be futile.

1.4.3 Ecological basis of plant cultivation

Large and vigorous plants will generally suppress those smaller and less vigorous. In the UK, most land below about 300 m elevation above sea level which is left without maintenance becomes, by stages, mature woodland if there is no animal grazing (see figure 1).

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Cultivated plants are usually grown in artificial communities and only in larger seminatural areas can something approaching a climax vegetation develop. However, whatever the situation, those plants growing in conditions of environment and competition natural to the species are likeliest to be healthy and simple to maintain, e.g. a dahlia border can be highly artificial and costly to maintain, whereas a shrub border can be more natural and less expensive.

1.4.4 The wider landscape

The commons, moors, and large-scale open countryside have been modified from their aboriginal form by man, his domestic animals and his economic activities over the last few millenia. The traditional vegetational balance of woodland, scrub, low shrubs, arable and open grassland, will disappear under unbroken climax forest if economic use and management are discontinued. The management of amenity land should be primarily concerned with the retention of its aesthetic character and reconciling this character with its recreational and/or economic use. Nature conservation management of amenity land will normally be secondary to its recreational uses. There need be no conflict between conservation and beauty although there will be, on occasion, a conflict between conservation and recreation or economic use. The various factors involved in such cases should be considered, and the necessary compromises should be made.

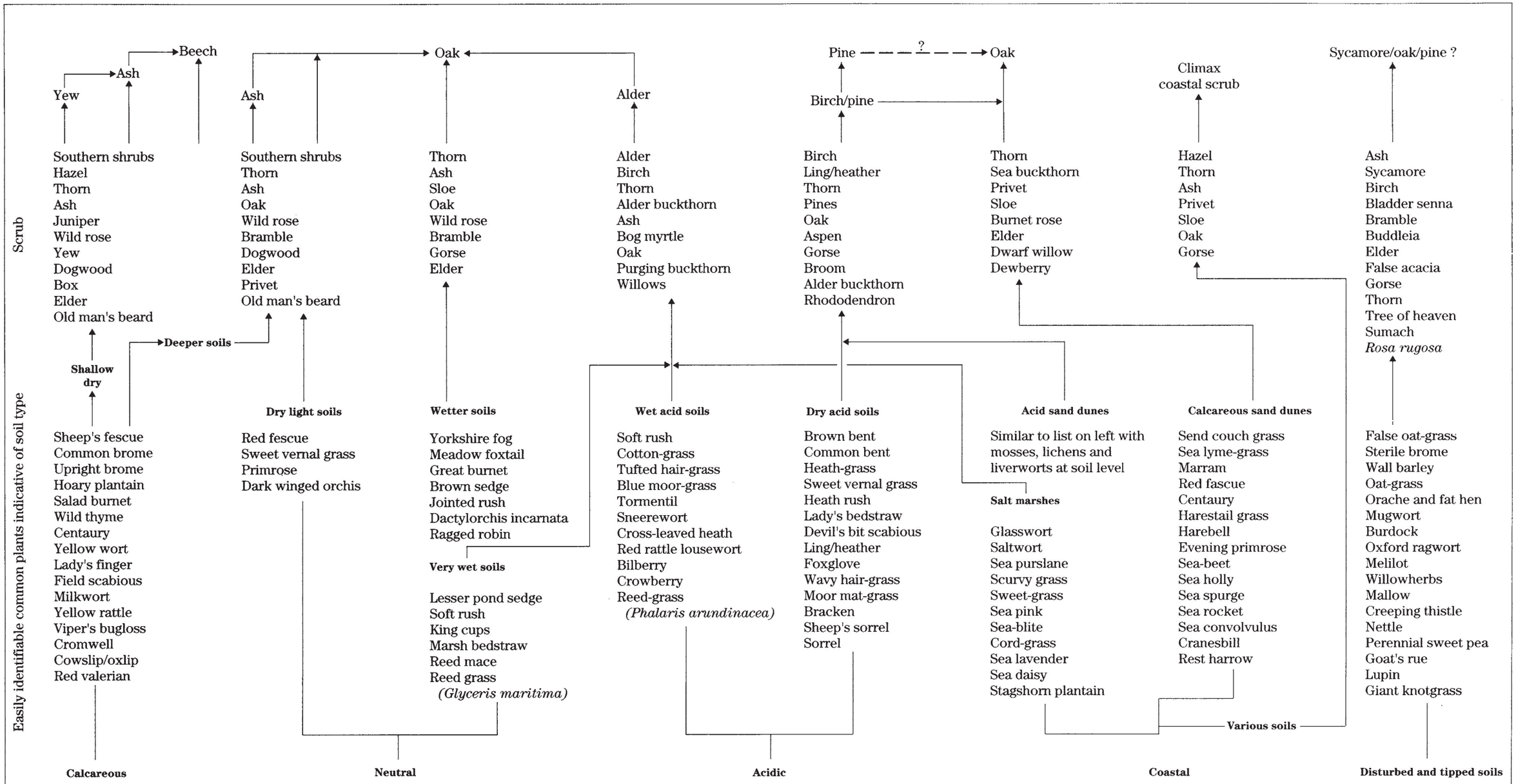
1.4.5 Nomenclature and bibliographic references

The recommendations given in this Part of BS 7370 are intended to assist those without specialist knowledge and both common and biological names for species are, therefore, quoted wherever possible. In a number of places, sources of further information are referred to in the text and these are listed in **A.1**.

NOTE. All plant names conform to *The new Royal Horticultural Society dictionary of gardening* [1].

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(Basic diagram derived from figure 6.1 in Duffey E., ed. *Grassland management and wildlife management*, Chapman & Hall, London, 1974 [2] with some amendments and additions.)

Figure 1. Succession of species from open land to closed woodland

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Section 2. Categories of soft landscape

2.1 General

This section categorizes soft landscape so that its management and maintenance may be considered rationally and recommendations made for its care. Although soil type may determine the plants able to grow, soil types are mentioned only where it seems expedient and categories are determined by the communities of plants, both seminatural and those planted for practical or ornamental purposes.

2.2 Trees

2.2.1 Trees as individuals

2.2.1.1 *General*

Trees are the most important elements in the soft landscape as, apart from their other qualities, they are the largest plants and are the longest lived, with many species outlasting three successive monumental buildings. Maintenance programmes should aim at providing healthy environmental conditions conducive to active growth and to minimizing wounding of the bark, i.e. any break-in which can admit parasitic fungi which are the main agents for the early demise of woody plants.

2.2.1.2 *Broadleaf deciduous trees*

Broadleaf deciduous trees comprise most of the common large native trees of the UK and most of the spectacular flowering trees. These trees have adapted their habit of growth to cope with latitudes where there is a well marked summer and winter. The habit of leaf shedding and dormancy in the winter period makes this a convenient time for transplanting and for major surgery, although those species susceptible to bark diseases are mostly better pruned in summer. Apart from the late winter/early spring sap flow period, pruning can usually be carried out all the year round if this is necessary.

2.2.1.3 *Broadleaf evergreen trees*

Evergreen species are always more vulnerable to inclement weather, are more difficult to transplant and, in many cases, e.g. hollies, have adapted their growth to fit within the understorey of woodland to take advantage of the shelter of the high canopy.

2.2.1.4 *Coniferous deciduous trees*

These species are a minority, little more than a handful being in cultivation in this country, i.e. larch (*Larix* spp.), swamp cypress (*Taxodium* spp.), dawn redwood (*Metasequoia glyptostroboides*), the maidenhair tree (*Ginkgo biloba*) and golden larch (*Pseudolarix amabilis*). All are ornamental and are best planted as small transplants.

2.2.1.5 *Coniferous evergreen trees*

Coniferous evergreen trees form the dominant element in the forests of the northern latitudes of the cool temperate zone.

All species are, on the whole, better planted as small transplants, although, provided that careful preparations are made, they can mostly be transplanted in large sizes also.

Many species are adapted to growing in poor soils and severe climates and may adopt rugged and picturesque irregularity of crown in such circumstances.

2.2.1.6 *Trees recently planted*

In their first years, trees require much more attention than when mature. Lack of timely maintenance may result in a ruined tree and damaged plantings. Maintenance is, of necessity, affected by the scale of the plantings. In a complex and expensive 'parks type' planting, inspections should be at least monthly and preferably weekly during the growing season. Conversely, when the areas are large and the trees are forest nursery-size transplants, inspections are usually fewer, perhaps quarterly. The scale of the planting affects all operations.

2.2.1.7 *Established trees*

The most important operation in the maintenance of mature trees is inspection for disease and tree safety, for indications as to tree longevity and to establish whether or not the reduction of the crown or other important surgical operations might extend its longevity. The relationship between tree roots and buildings and services should also be considered (see BS 5837 : 1991).

2.2.2 Trees in groups generally

Trees in groups may exhibit collective character. They modify their root patterns to radiate away from competition towards free water and nutrients in unplanted ground. The branch systems to some extent interlock to form a larger corporate canopy, especially in windswept areas. Where the group is large enough, the classical woodland structure develops (see **2.2.9.1**).

Maintenance is modified by the fact that, if a tree or minor subgroup of trees is felled, or declines and dies, this may, due to the interlocking of the system, result in 'domino train' effect windthrows and failures. Alterations to trees in groups should, therefore, be carefully thought out, and corrective and preventive measures taken where possible. Professional advice may also be necessary.

The aesthetic implications of alterations to tree groups can often be more important to the landscape than those to single trees or even, to some extent, to woodland, since copses may be essential punctuation points. Their value in nature conservation can be great owing to their relatively large fringe and their use as staging points for travelling animals.

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2.2.3 Avenues

2.2.3.1 *General*

In common with other important features in planned landscape, the original design objectives should be obtained from conserved records whenever possible before deciding on the management objectives.

2.2.3.2 *Young avenues*

The individual trees should receive the same maintenance as that given for young trees in **2.2.1.6** and items b) and c) of **4.2.1**.

2.2.4 Urban trees

Street trees are the most extreme example of the urban tree and are usually more difficult to establish, grow more slowly, and do not live as long as trees living in a less polluted and artificial environment. The number of kinds of trees generally suitable by their size at maturity, habit, etc. for thoroughfares dwindles to a few only as the dimensions of the highway are reduced. Perfect trees for narrow streets do not exist. The care of trees growing in streets should involve continuous inspection. The taking of remedial action of some kind should be routine, and a sizeable fraction of this is often abortive. Replacement of trees due to death by vandalism or other violent damage may be 5 % per annum, but may be as high as 200 % in new plantings.

2.2.5 Forest trees planted in narrow streets

Considerable effort has been devoted during recent years to attempting to replant narrow streets, usually of terraced houses without garages, with trees more appropriate to the scale of the surroundings than the London planes and limes originally planted. These experimental plantings have shown that all the proposed species suffer from problems such as failure to develop root firmness, prolific production of root suckers and damage by ubiquitous cars. Since modern cars can have rear overhangs of 1 m, street trees need to develop root firmness and a heavy base in a very short time. The London plane is highly car resistant, and will therefore probably persist in streets for the foreseeable future. It follows that annual or biennial hard pruning will remain necessary and that recommendations for tree work in this standard may not agree in all respects with BS 3998 : 1989. Further recommendations for street trees given in this standard, e.g. in **2.2.6**, also apply to trees in general growing in crowded urban situations.

2.2.6 Habit of growth of highway trees

The natural tendency of many highway trees is to lean away from the buildings into the carriageway. Trees should, therefore, be planted as far from the kerb-line as possible, and early training after planting should correct, by pruning, the tendency to lean into the roadway.

2.2.7 Parameters for permitted mature size in relation to buildings

Trees growing in the vicinity of buildings can cause various kinds of structural damage. The continued growth of stems may burst building constructions, branches can thrash roofs and walls in windy weather and crowns can cause nuisance through shading.

Trees which are an intolerable nuisance cannot be protected against covert action. Guidance on trees in relation to construction is given in BS 5837 : 1991 and further references are given in annex A.

2.2.8 Formally planted and pruned trees, e.g. pleached arbours or formal blocks

Formal landscapes, especially those of the 17th century and the first half of the 18th century, often include formally planted and pruned trees. They have since appeared in garden landscapes occasionally up to the present day. They can be extremely effective aesthetically but require skill, are labour intensive and, if of large size, will require specialized equipment such as extending ladders and platforms, and long-arm pruners of a fairly sophisticated kind.

When formally planted and pruned trees are in decline, difficulties may be experienced in establishing replacement planting, owing to replant disease, to the difficult state of the ground which may be full of ancient roots, or to overhead shading and rain shielding.

Recently planted pleached garden features will have been planted at appropriate distances from one another depending on the species and the scale of the feature. They are usually trained along a structure of vertical posts and horizontal and diagonal struts and/or wires until the branch structure is self-supporting. Branches should be pruned and tied in to the supports, but should otherwise be treated as the same species used in hedges or as young trees, requiring normally some feeding, watering, weeding and pest control.

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2.2.9 Woodland

2.2.9.1 *Mature woodland structure*

Amenity woodland of some age should show a layered structure consisting of a canopy of large forest trees with an understorey of smaller trees, a shrub layer often including climbers, and a field layer of smaller plants, mainly herbaceous.

The somewhat exaggerated diagram shown in figure 2 is included to demonstrate structure in amenity woodland and to illustrate the difference between the objectives for amenity woodland as expressed in the diagram and those shown by thinning diagrams in forestry textbooks. The most attractive amenity woodland harbours a rich variety in the density of the canopy, in the lighting of the forest floor, and consequently in the richness of the plant and animal life that thrives in its protection. Management in such cases is in the interest of an aesthetic return rather than a purely economic one. Ideally the woodland should be of an uneven age with some overmature trees, and some dead, standing and fallen timber to provide for the many life forms which subsist on wood. Trees which do not make lively woodland, such as the sycamore and other fast spreading exotics or shrubs such as *Rhododendron ponticum* (where this is overdominant), should be weeded out. Tree seedlings springing up after fires or other sudden breaks in the canopy often need very heavy thinning.

Management of an amenity woodland with a classical structure essentially amounts to manipulation of the various levels of living things in the interest of the overall aesthetic effect with due regard for nature conservation. The most radical way of effecting changes in this ecology is by manipulating shading by the tree canopy and by the understorey. An increase in light reaching the field layer can cause dramatic changes in the flora.

Thinning also reduces competition between root systems for the supplies of water and nutrients in the soil.

2.2.9.2 *Regeneration*

A natural native climax woodland regenerates itself, although not in the case of every species, by seed. In the UK, since all but a few relics of the aboriginal forest were cleared long ago, large-scale commercial forest is planted with small transplants, grows to maturity, and is then clear felled and replanted. This is not a good model for amenity woodland. Elsewhere in Europe it is more usual to practice 'selection' forestry, where the forest is rarely clear felled, and where self-sown plants are selected to grow to fill up gaps caused by selection felling or by natural causes. The system is topped up with nursery-raised transplants.

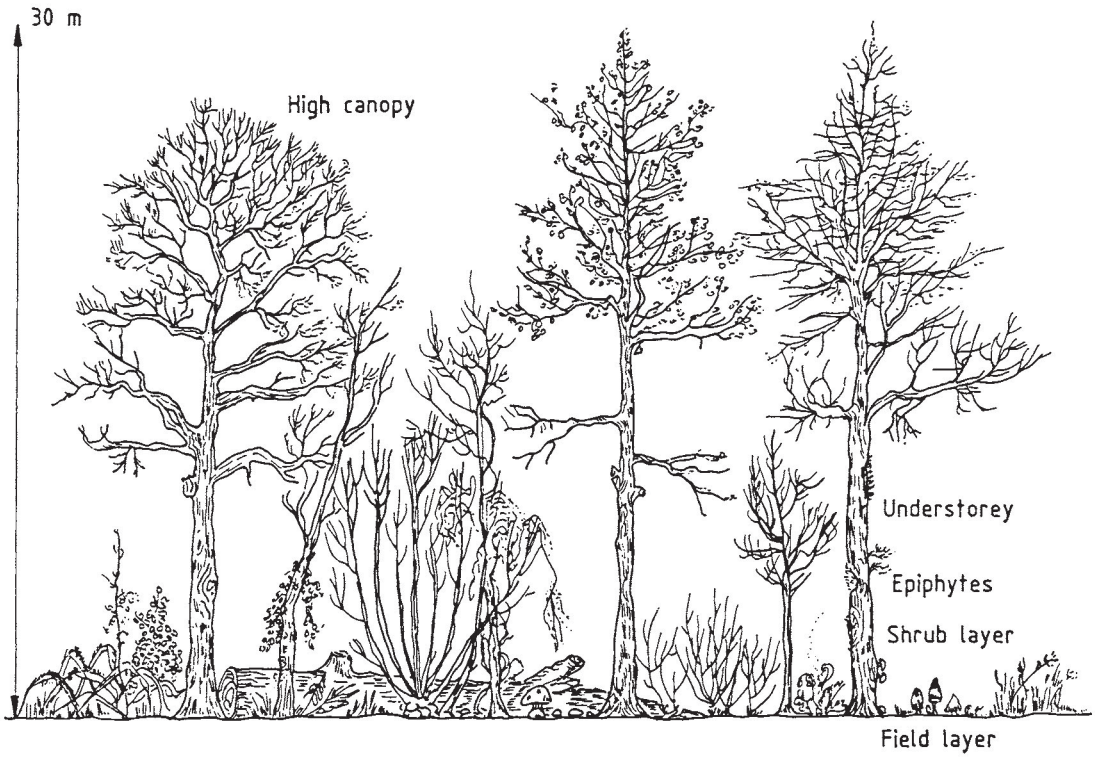


Figure 2. Mature woodland structure

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In the management of amenity woodland a more flexible approach to regeneration is required than either of these systems. Where large scale replanting (or establishment by seed in some cases) has been carried out using a formal mixture of quick-growing nurse species in order to cover the bare soil quickly, after primary establishment, gaps may be formed in order to permit variation of the forest by interplanting. When considering such options, it should be borne in mind that the original management objectives should be fulfilled.

Regeneration can be opportunistic; even in a paradise garden interesting species self-sow from time to time, and species such as redwood (*Sequoia sempervirens*) can regenerate from the stump with what amount to coppice shoots.

2.2.10 The reinstatement of woodland originally planted as commercial conifer forest and now neglected

Much amenity woodland now in some kind of public ownership was originally planted as commercial coniferous forest. If routine forest operation ceases this can lead to unfortunate situations. In a young forest, for example, such neglect can be a disaster and can result in trees at 1.5 m centres and 20 m high with stems little thicker than broom handles which pose a considerable fire risk. Assuming that coniferous forest, originally planted as commercial forest, is maintained as such for at least the first 40 years, it can be modified to become an amenity plantation. Former commercial forest is also found to be prone to disease, pests and fire owing to the use of only one or two species of conifer in large blocks (monoculture). Where it is decided to carry on with commercial forestry operations in an amenity area, systems of forestry which avoid clear felling such as the 'selection' system or systems using evergreen and deciduous species should be considered.

2.2.11 Coppice and coppice with standards

Coppice is an ancient system of woodland management where the woodland, aboriginal or planted, is cut close to the ground to stimulate a cluster of young shoots to develop which will grow on to provide a harvest of poles. The original stumps become multiple and are known as 'stools'. Since coppice is an ancient system, it is associated with its own flora and fauna and is important for nature conservation as well as for its own intrinsic attraction. A few areas are still harvested commercially at the original 5 years to 20 years rotation, depending on the tree species. It is now also harvested in some areas by trusts and voluntary groups for nature conservation.

Some coppice areas have standard oak trees spaced at about 30+ per hectare[1)], formerly left to grow for use in naval shipbuilding. In some areas the pole crops were harvested from trees cut at a sufficient height from the ground to frustrate browsing animals. These are 'pollards', the typical tree of much of Epping Forest.

For a full discussion of coppice management see Forestry Commission Leaflet No. 83 *Coppice* [3].

2.2.12 Common woodland categories

2.2.12.1 *General*

All woodlands require positive management. The type and scope of this will depend on the management objectives. These objectives and the method of implementation should be defined.

2.2.12.2 *Designed ornamental woodland with classical structure and ornamental underplanting*

The landscape may be completely artificial and may consist almost entirely of exotic species as in a London square laid out by Humphry Repton. It may more often consist of an ash or oak wood transformed into an approximation to a paradise garden. Oak or ash permit a reasonable amount of light to reach the floor of the woodland, so that underplanting can be dense and varied. Beech woods are less often transformed as the dense and shallow root system and heavy shading from the beech's close, twiggy and leafy crown inhibit underplanting. Beech woods exist mainly on chalk or limestone soils and this limits planting to those species which thrive on soils of high pH. Whilst shading is the dominant limiting factor, a factor less capable of manipulation, in spite of all the resources of modern irrigation systems, is the presence of adequate ground water at a reasonable depth. Where this is present and reliable, underplanting thrives even in fairly dense shade.

If this kind of landscape is to be kept in a flourishing state, it needs continuous and skilled management and is labour intensive. Every element in the landscape needs manipulation, e.g. thinning, replacement planting, crown lifting (see BS 3998 : 1989), making good of canopy and understorey trees, and transplanting and propagation of underplanting. It is, therefore, an expensive type of landscape to maintain although immensely rewarding both to the public and to those people involved in its care.

Where management is limited or absent and seed sources of aggressive tree and shrub species exist, such woodland will usually degenerate. As trees die, they are replaced by sycamores or other easy seeders. Long-lived shrubs, such as laurustinus (*Viburnum tinus*), may grow very large and spread. Pontic rhododendron (*Rhododendron ponticum*) and covert shrubs, such as salal (*Gaultheria shallon*) or snowberry

[1)] 1 ha = 10^4 m^2.

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(*Symphoricarpos albus*), may seed and spread by underground rhizomes, etc. to dominate the wood totally. There may be no regeneration of more desirable species, so that the canopy declines. Where the aims of management are modest, woodland can be maintained at a reasonable cost, but although requirements may be low they are not negligible. Woodland dominated by weed trees and solid evergreen weed shrubs is uninteresting and owing to its poor sight lines can be frightening to the public.

2.2.12.3 ***Informal woodland with grass groundcover***

This is a widespread type of park woodland where mature woodland, shelter belt or grazed woodland, etc. has been maintained for some years by mowing or grazing between the trunks. Where the soil is poor and mowings are removed, degradation is likely. Where the soil is fertile and the mowings are returned, the trees may well carry on in a reasonable state of health into maturity and senility. Follow-on planting is necessary if the life of the woodland is to be prolonged.

2.2.12.4 ***Seminatural native woodland with understorey and groundcover appropriate to the geology and topography***

This kind of woodland needs less maintenance and labour input than any other because so many of its elements are of a self-perpetuating kind. This is the kind of oak, ash, beech and mixed woodland, typical of many parts of the UK and often neglected in management terms for the past 200 years. Since it approximates to the natural climax vegetation it is simple to manipulate in order to modify its character. It still needs careful management so that neither the canopy, the understorey nor the shrub and field layer gain undue dominance.

2.2.12.5 ***Informal woodland maintained positively for conservation***

The management of landscape for nature conservation is usually directed towards maintaining species diversity except where special consideration has to be given to the needs of some rare species. In any locality, the greater the number of native plant species which can be persuaded or permitted to grow, the greater the number of dependent plant and animal species which are able to subsist on them. Edge ecologies, i.e. the edges of woodland, scrub, heaths, moors, water areas and hedgerows, are usually very much richer in species, especially in animal life, than unbroken large plant communities formed from only a few species. Conservation areas should, therefore, so far as is possible, be varied with a range of landscape elements to provide a multiplicity of ecological niches. Woodland with a classical structure most nearly meets the requirements of conservation in tree-covered landscape. Consequently, it is seminatural native woodland as described in **2.2.12.4** which can most easily be managed for conservation and where the variety of plant structure provides breeding spaces, fruits and other types of food for a wide variety of animal species. Exotic species which maintain few parasites and consequently fewer food resources for animal species are of less value for conservation.

The element of seminatural woodland which most often upsets the balance, where management is lacking, is the understorey and shrub layer. Where holly (*Ilex aquifolium*) or yew (*Taxus baccata*) are present, these or similar species or exotic garden escapes can become dominant and suppress other plants by shading. Where heavy thinning is necessary, this should be very carefully planned after professional advice and a full consideration of all aspects of the operation.

2.2.12.6 ***Recently planted woodland***

See **2.2.1**, especially **2.2.1.6** and **4.2** for general guidance on tree growth and maintenance.

In forest conditions, the most common limiting factors in relation to health and growth are likely to be weed competition, damage from grazing and gnawing animals and failure to beat up. Inspections to make sure plants are thriving or to take remedial action should, therefore, be as frequent as possible.

2.2.13 Shelter belts

2.2.13.1 ***General***

Shelter belts function best when the planting has been designed to permit the wind to penetrate the boscage and pass through with consequent reduction in velocity, and where the upper silhouette has fingers of branches and foliage to reduce turbulence. Walls and dense evergreen tree screens cause acceleration of the wind into turbulent gusts and eddies which can do great damage.

Maintenance, therefore, should attempt to control the permeability of the screen and to prevent holes developing in the canopy or the boscage as these can funnel the winds and accelerate them. Many shelter screens have a complex structure with both tall and short, and deciduous and evergreen elements. The management aim should be to keep all these elements in harmony by pruning, follow-on planting, etc. to prevent over-maturity and senility developing into collapse. (See **A.2** for further reading.)

2.2.13.2 ***Ornamental screens***

These are usually planted with fastigiate forms of trees, e.g. Lombardy poplar (*Populus nigra* 'Italica'), or with upright forms of conifer. They should be given a good start, deep cultivation, feeding and careful weed control for at least the first 5 years. In maturity, it is difficult to maintain uniformity, and it may be found difficult to establish replacement trees in gaps. Many need permanent corsets of green or black plastics

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covered wire netting to prevent the tips of the leading shoots drifting apart. Trees with multiple leaders suffer especially from this kind of problem; the flowering cherry 'Amanogawa', Irish yew (*Taxus baccata* 'Fastigiata') and some upright conifers are common examples.

2.2.14 Hedges

2.2.14.1 *General*

Hedges are composed of any trees or shrubs which by their habit can be controlled to form more or less impenetrable screens to provide shelter and delineate spaces. The management aim should be to promote and prolong a healthy state and foliage cover overall.

The aspect of hedge maintenance most often neglected is mulching and feeding. Many middle-aged hedges suffer from malnutrition, especially when the surrounding landscape is paved both sides.

The commonest cause of sudden death is honey fungus (*Armillariella mellea*). For further details of this plant disease and its treatment, consult Forestry Commission Arboricultural Leaflet No. 2 *Honey fungus* [4]. Alternatively, salt or weed-killer misapplication may, on occasion, be the cause.

2.2.14.2 *Formal hedges*

Formal hedges are almost invariably formed of tree species although hedges of small stature can be found of species such as hedging box (*Buxus sempervirens*) or *Cotoneaster microphylla*.

2.2.14.3 *Informal hedges*

Informal hedges are usually formed of ornamental shrubs, e.g. flowering currants (*Ribes sanguineum*, its hybrids and cultivars), *Berberis* spp. or vigorous shrub roses.

2.2.14.4 *Field hedges*

In amenity areas, field hedges are of vigorous and often spiny trees, and should be maintained, if possible, by traditional means. Cutting by mechanical long-arm flail should be avoided for growths thicker than 15 mm diameter, where possible, owing to the huge scars left by this method.

2.3 Scrub

2.3.1 General

Scrub is a necessary component of a balanced seminatural landscape. It furnishes the edge of woodland and contains attractive wildlife, as it is in the tangle of herbs, shrubs and trees of the woodland margin that many species of plant and animal find refuge and breeding space. Although an essential element, it needs control; otherwise areas of scrub coalesce into unbroken woodland, the edge effect is lost to wildlife and the open areas important for recreation and field sports disappear.

A choice exists between controlling the scrub either by cutting and poisoning the roots, or by converting the scrub to woodland. The former is the more desirable for amenity use or for nature conservation. The latter treatment will reduce maintenance costs and can be done by interplanting shade-tolerant tree species, or by permitting the natural succession of scrub to woodland to develop.

2.3.2 Seminatural shrub dominated areas

Before effective management of seminatural open space can be planned, it is essential that a full-scale ecological survey be carried out so that its plant and animal populations can be established and a policy document prepared with the advice of the successor bodies of the Nature Conservancy Council (NCC)[2].

Large areas of seminatural open space, e.g. commons, heaths and moors, are more or less covered by shrubs, in association with certain typical herbaceous plants. Heaths are mainly lowland, where the soil is poor and light, and the climate dry. Moors are mainly upland, where the soil is peaty and water retaining, and the climate is severe and wet. Some plant species are typical of both ecologies, although it is probable that different races have developed. The most conspicuous is usually ling (*Calluna vulgaris*) with several of the closely-related *Erica* spp., varying according to the climate, elevation and degree of moisture, e.g. the cross-leaved heath (*E. tetralix*) is usually found in wet places. Grasses, such as moor mat-grass (*Nardus stricta*) and purple moor-grass (*Molinia caerulea*), and sometimes tufted hair-grass (*Deschampsia caespitosa*), are also typical of wet areas. Dwarf gorse (*Ulex minor*) is found in the same situations, but its close relative, common gorse (*Ulex europaeus*), can be found in all sorts of situations, including disturbed and made-up ground.

[2]The Nature Conservancy Council for England (English Nature), Peterborough; The Countryside Council for Wales, Bangor; Scottish Natural Heritage, Edinburgh.

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Ling and the heathers tend to become senile after a number of years, so that to maintain juvenility it has been traditional to burn these areas in late winter in addition to grazing. In amenity areas, these methods are replaced or supplemented by cutting by forage harvester and removing the cut material. Gorse is maintained in a similar fashion for safety and conservation reasons.

This type of landscape is very vulnerable to degradation through invasion by unsuitable species, e.g. conifers seeding in from adjoining plantations, or garden escapes. It is also vulnerable to overuse. Enormous problems of changed character may follow cessation of traditional methods of maintaining by grazing and burning, e.g. scrub invasion. For a fuller discussion, see **3.8** and **A.2**.

2.4 Dune vegetation

NOTE. See also **3.10** and annex A.

2.4.1 General

Sand dune systems form in places on the coast where sandy beaches are exposed long enough between tides for the winds to dry out the upper layers, which can then become mobile. The wind does not usually lift the sand grains more than knee high, so grains tend to collect in the lee of, and to some extent in front of, obstructions. The stems of plants, therefore, collect a certain amount of sand around them and it is the character of the growth of these plants which determines the contour of the dunes; and the supply of sand which determines the extent and dynamic character of the system. Thus, moving from the open shore, the sand dune system comprises a succession of fore-dunes, mobile dunes, fixed dunes, dune grassland and, in some cases, dune heath and dune woodland.

The humus in the dune soil comes originally from the wrack cast up on the beach. This dries, breaks up and is blown into and amongst the dunes where it lodges at the leaf and stem bases of the dune vegetation and eventually rots down into humus.

The pH value of the dune soil is dependent on the supply of shell fragments. Since this can be copious, the pH may be 8.5 on the mobile dunes. It might be expected that blown sand from the high dunes would be spread over the fixed dunes but, except in the case of a massive blow out this occurs only to a very limited degree, as the blown sand is deposited immediately in the lee of the high dunes. They tend, however, to develop landwards very slowly and, where an abundant supply of sand is available, may also extend seawards.

2.4.2 Fore-dunes

These youngest elements in dune succession are the primary barriers against the sea. Where present, these stand only a few metres above high water mark. The dominant species may be sea lyme-grass (*Laymus* (syn. *Elymus*) *arenarius*) and/or sand couchgrass (*Agropyron pungens*), which tolerate up to 6 % (*m/m*) salt in the soil environment.

2.4.3 Main dune system

Behind the fore-dunes is the main system of mobile dunes. There will usually be a main dune ridge up to 20 m high at some distance from the fore-dunes. The seaward faces of the mobile dunes are normally partly blown out and the landward face of the ridge semi-fixed by a sparse growth of grasses and associated herbs. Between the main ridge and the fore-dunes may be a secondary system of lower dunes. These are often separated from the main ridge by a deep valley.

The dominant plant is marram (*Ammophila arenaria*). This will tolerate only 2 % (*m/m*) salt in the soil and so thrives away from high-water mark. It is the most important agent in the fixing of blown sand.

2.4.4 Fixed and semi-fixed dunes (dry)

The high dune ridge gives great protection to the areas in its lee. In the immediate lee of the ridge, a semi-fixed association develops consisting of a turf of fine grasses and herbaceous plants which only partly covers the sand surface. On the fixed dunes, further development of the turf covers the sand and can develop into dune grassland. Away from the sand supply and the well aerated substrate of the mobile dunes, the marram becomes impoverished and then suppressed.

2.4.5 Wet slacks

Wet slacks are depressions amongst the older dunes which are constantly wet. Although the floor of the slacks may be several metres above high watermark, they are wet and even in summer may be flooded.

The dominant plant is usually the creeping willow (*Salix repens*). From the wet slacks this plant may spread to colonize the dry sides of the dunes and small dunes may form around it.

These areas contain a rich supply of nutrients leached from the surrounding dunes. Humus is present, trapped at the bases of the stems of the willow. This supports a rich flora which may include orchids, grass of Parnassus (*Parnassia palustris*) and wintergreens (*Pyrola* spp.).

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2.4.6 Dune scrub

As the slacks and fixed dunes age, dune scrub appears. Where a seed source is present, sea buckthorn (*Hippophae rhamnoides*) may completely dominate the dune scrub. Elsewhere bramble or dewberry (*Rubus caesius*), burnet rose (*Rosa pimpinellifolia*), goat willow (*Salix caprea*), elder (*Sambucus nigra*) and sloe (*Prunus spinosa*) give way eventually to thorn scrub, the larger willows, grey or white poplar (*Populus* × *canescens* or *P. alba*) and birch, pine or oak. On the older fixed dunes, the sand at a distance of several hundred metres or more, and perhaps after several hundred years in time, becomes acid owing to leaching of the shell fragments, and the fescues in the turf are consequently partially replaced by bent grasses, and a heathland flora (see **2.3.2**) develops.

NOTE. The dune system described above is a classic system; any or most of these elements may be absent. In severe cases of overuse, the system may be almost obliterated and before maintenance can take place, rebuilding has to be initiated.

2.5 Parks and garden styles of planting other than trees

2.5.1 Ornamental plantings

Woody plants range from sub-shrubs and tiny shrubby thymes up to the largest trees with only arbitrary divisions. Shrubs are classified as such as a convenience for cultural and commercial reasons. Their growth and health depend on the same factors as for all woody plants. For information on tree health and growth see **3.7** and **4.2**.

The most onerous and controversial aspect of shrub culture is pruning. It is also usually the worst performed; consequently this has been given extensive cover in clause **3.6**.

2.5.2 Groundcover plants

Groundcover plants need to be carefully defined. Commercial conifer forestry is ground covering and very efficient in field layer weed suppression in any but its first few years but this is not what is popularly understood by the term groundcover. Groundcover is generally deemed to be a type of planting which is interesting, often evergreen, sometimes including herbaceous plants and sometimes plants such as the ivies, which are essentially climbing plants, treated as trailers. These may have beauties of foliage and flower, provide colour at some time of the year, suppress weeds with high efficiency, and be trouble free and cheap to maintain. Groundcover plants, by this definition, seem to function best in areas newly constructed from good quality subsoil, i.e. without a weed seed or root reservoir. With good horticultural practice, groundcover can be successful but where work measurements are made these often show that most of such plantings, although usually long lived and reasonably easily maintained, can cost more to maintain than turfed areas.

2.5.3 Climbing shrubs

Climbing shrubs may be conveniently divided into three groups.

a) *Self-clinging*. These shrubs are the simplest to grow successfully. Some species, e.g. the ivies or some *Vitis* spp., can cling to any surface, even glass, by means of adhesive roots or discs. Many may need some tying in during the early years. Tendril climbers will need wires, trellis or living plant supports. Clinging plants can damage decayed jointing and brickwork but do not normally harm well maintained structures.

b) *Twining*. These shrubs are very successful in nature. A good example is traveller's joy (*Clematis vitalba*). They will need support of some kind, artificial or living, and can become over-successful thus requiring drastic pruning.

c) *Scrambling*. These shrubs climb by shooting out long growths, sometimes provided with prickles and thorns to grasp other vegetation or objects. They are, by definition, vigorous growers and, like the rambling and climbing roses, need regular, skilled and expensive maintenance including pruning.

Ordinary shrubs or trees may be trained over supports or walls as climbing shrubs to give special effects or, in the case of tender plants, so they may have the beneficial shelter and higher temperatures provided by garden walls or buildings.

Climbing shrubs mostly require regular, skilled and expensive maintenance including pruning.

2.6 Roses

2.6.1 General

Roses, including hundreds of species, hybrids and cultivars, some of very ancient origin, exist in a vast range of forms. For authoritative advice consult the publications of the Royal National Rose Society.

2.6.2 Species, their hybrids, cultivars and similar shrub roses, used in permanent plantings

These roses are usually long lived and need less care than bedding roses although continuous flowering is more rare. When making replacements of species or shrub roses, ensure that these are not grafted plants, so avoiding the constant and expensive chore of removing root suckers.

2.6.3 Bedding roses

Bedding roses include hybrid teas (now called large-flowered), floribundas (now called cluster-flowered), and similar modern hybrid plants. They require an intensive regime of growing and pruning. Consequently, depending on the cultivar, the suitability of the soil and the severity of pruning, they become worn out and have to be replaced after a period of years.

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2.6.4 Rambling and climbing species and cultivars

Some rambling and climbing roses can be acquired on their own roots and, although they need careful maintenance and pruning, are usually long lived.

2.6.5 Soils

Some species grow well on light soils, e.g. *R. pimpinellifolia* cvs. or *R. rugosa* cvs., but most roses, and especially the bedding roses, grow best on soils with a high clay content such as the brick earths.

2.7 Herbaceous plants and ornamental grasses

2.7.1 Long-lived species capable of low maintenance landscape use

These are mostly vigorous plants which are leafy and shade the ground, therefore making good ground cover. Many of the self-maintaining species such as *Gunnera manicata* and skunk cabbage (*Lysichitum* spp.) favour damp and boggy ground and are often found at water margins.

All benefit from deep cultivation and mulching, and from generous feeding and weed control during the early years.

2.7.2 Species mainly used in more formal plantings and normally requiring routine replanting and/or propagation

This type of planting is labour intensive and requires competent maintenance. Replanning and replanting is a major operation. By replanting with self-supporting sturdy cultivars, including a high proportion of perennial plants not requiring propagation except at long intervals, maintenance costs can be reduced without distorting original design objectives. Plants such as the larger spurges, paeonies and *Crinum* spp. can be used.

2.8 Rock gardens and borders

Rock gardens and borders are probably the most labour-intensive garden features. There is little hope for mechanization and few places where weed-killers can be used. A considerable knowledge of plant species and of horticultural expertise is necessary in staff working in this area. Cultivation and supervision of rock gardens and borders has to be continuous, otherwise a site will quickly degenerate.

2.9 Bulbs

2.9.1 Long-lived species for permanent planting in low maintenance landscape

Bulbs used for landscaping should be pest-free and disease-free when planted (as indeed they should in any context) and should suit the pH value of the soil, the degree of soil moisture, fertility, and exposure to sunlight if success is to be permanent. Some bulbs may grow in one spot for years, spread and look healthy but never flower, e.g. *Sternbergia lutea* on an acid soil or such sun-loving plants as monarch of the East (*Sauromatum venosum*), *Nerine bowdenii* or *Amaryllis belladonna* in shade and lacking an autumn baking.

It is most important that the positions of these plantings are plotted and made known to all staff, otherwise they are likely to be destroyed by diggers and choppers in the dormant season or by mowers during the growing season.

Some species, formerly regarded as reliable, are, owing to the spread of virus disease in modern times, now only short-term plantings, except in cold wet northern climes where aphids, the commonest vectors of virus disease in this kind of crop, are absent. An example of this is the lily. The standard long-lived cottage garden bulbs of the late 19th century, the orange lilies (*Lilium bulbiferum* var. *croceum*), tiger lily (*L. lancifolium*), yellow lily (*L. pyrenaicum*) and madonna lily (*L. candidum*), have become considerably more difficult to cultivate.

2.9.2 Species used in more formal planting and normally requiring or receiving regular replanting or/and propagation

Bulbs used for bedding can be split into the following two categories.

a) *Bulbs used in spring bedding*. High quality bulbs for spring bedding are expensive. Economies can be made, e.g. by removing the seed pods of tulips and permitting them to complete their development in a reserve garden. The bulbs are then lifted after drying off, cleaned and graded. The retained bulbs are dipped in a pesticidal solution, dried off and stored one layer thick in a cool store, and are used in a less prominent position in the next planting season.

As spring flowering bulbs and their groundwork planting spend a long time in winter in cold wet soils, problems of disease are widespread and pest control measures should be routine.

Many managers prefer to reduce their options, and possibly their problems, and to keep labour costs low by discarding flowered stock and buying new each season.

b) *Bulbs used in summer bedding*. Many bulbs used in summer bedding are long lived and prolific. Providing that any showing signs of virus disease are discarded and destroyed, and that the stored bulbs receive a dip in an insecticidal/fungicidal solution before planting (or starting under glass) and are cleaned, dried off and dipped again at the end of the season, stocks should last for some time, e.g. *Gladiolus callianthus* (syn. *Acidanthera murielae*), *Dahlia* cvs., *Canna* cvs., *Tigridia pavonia*

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2.10 Seasonal beddings

2.10.1 General

Seasonal beddings are an expensive but highly appreciated feature of the more intimate and urban landscape. Sometimes they are economized out of existence by managers, but never by popular demand. As staff receive instant praise and appreciation from the public, it is not too difficult to achieve maximum staff identification with the success of the planting, and craftsmanship attained is often of a higher degree than with that of any other feature.

Spring bedding, planted in late October to early November, consists of a fairly limited range of hardy herbaceous plants and bulbs.

Summer bedding, planted from mid-May to early June, consists of a gallimaufry of hardy, tender and even tropical species. Standard and dot plants are often tender perennial plants which need arrangements for returning to base for overwintering care. It is prohibitively expensive to start again each year with sizeable plants of *Cordyline indivisa* or *Agave americana* 'Variegata'.

The groundwork planting consists of annuals, biennials, perennials and perennials treated as annuals which, from the management point of view, includes several classes.

2.10.2 Continuously-flowering bedding plants

Continuously-flowering bedding plants flower continuously until cut down by the early winter's frosts, e.g. fibrous rooted begonias or the modern *Impatiens* cvs.

2.10.3 Bedding plants flowering in flushes

Examples of bedding plants which flower in flushes are the *Antirrhinum majus* cvs. If these plants are overfed with nitrogen they may be out of flower more often than in flower.

2.10.4 Bedding plants used for their foliage

Bedding plants used for their foliage may flower but are used more for their leaf colour and/or form, e.g. *Pelargonium* 'Little Trot' or *Echeveria secunda* var. *glauca*. Both these plants are tender perennials and require glasshouse protection in winter. This is not invariable, for example *Perilla frutescens* var. *nankinensis* is a spectacularly purple-leaved annual. The apogee of seasonal bedding is probably subtropical bedding. This is carried out with a wide variety of plants chosen to give the impression of subtropical profusion and variety and include anything the designer thinks has the appropriate qualities, see *Subtropical bedding* [5].

2.11 Plants in containers

2.11.1 General

Plant containers are most commonly used in urban areas, where air pollution, especially traffic film from vehicles, is exacerbated by the reflection of light and heat from extensively glazed buildings, draughts, rainshadow, low humidity, and rapid fluctuations of temperature. The plants contained have to suffer small root runs, the deposition of litter and damage caused by dogs and vandals. Containers should not be set under overhangs, or near hot air or fume outlets, in deep shade, or in areas subject to wind acceleration through or between high buildings. Plants for semipermanent plantings should be chosen from lists containing species tolerant of the above, often extreme, conditions (see BS 7370 : Part 1 : 1991).

2.11.2 Containers

Containers used can be of concrete, wood, slate, etc. and should have ample strength to contain wet heavy compost for long periods. Precast concrete pots should have the reinforcement treated with a rust inhibitor before manufacture, as the pots are exposed to water containing corrosive salts, i.e. fertilizer, and this has been observed to cause, in some cases, rapid rusting, expansion of the metal and spalling of the concrete. As a precaution all containers, no matter of what material, should be lined with three coats of a reliable, damp-proofing bitumen paint, even if a liner is to be used.

Drainage should be ample. The minimum area of drainage holes to surface area of compost should be 0.25 %, and the holes should be covered with a 30 mm deep layer of pervious material, e.g. gravel rejects, crushed brick, covered with a purpose-made fines-excluding sheet of glassfibre or other equivalent material to prevent compost ingredients leaking through and staining the surrounding pavement.

The flat base of the container may form a waterproof seal if posed on a smooth pavement. The base of such a container should have a channel or channels allowing drainage water free egress; or should have a hole in the side immediately above the base. Where no channel or hole exists, a pebble underneath the base will prevent a waterproof seal. On fine pavements, balconies, windowsills, etc., special arrangements have to be made to receive drainage water, e.g. a metal channel, or at a least metal a drip-strip, to prevent water running down the face of the building.

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The minimum inside measurements of containers to be used for planting should be as follows:

a) for trees, 600 mm deep by 1 m wide by at least 1 m long;

b) for shrubs, 300 mm deep by 1 m wide by at least 1 m long;

c) for flowers and foliage plants, 200 mm deep by 200 mm wide by at least 200 mm long.

Containers should always be as large as possible and those with a removable liner should be slightly larger to allow for the liner.

2.11.3 Compost

For large tubs and boxes containing trees and shrubs, a good quality medium loam topsoil is adequate to maintain growth for the likely life span of trees and shrubs in containers. Where this is not available, a proprietary tree-planting compost should be used. For smaller sized containers, a proprietary potting compost or some near substitute can be used. Light-weight composts based on peat, vermiculite or plastics, although adequate for very sheltered situations, are not practical for large plants in draughty situations.

For window boxes and hanging baskets, the freeboard at the rim for watering should be 25 mm. For larger containers, 75 mm should be allowed.

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Section 3. Operations

3.1 Site assessment

3.1.1 General

For the purposes of this clause, it is assumed that the site to be surveyed is not a large and highly important site, and that the probability of pollution problems (e.g. former industrial, paint, gas or sewage use) can be disregarded. If these problems are likely to exist, a full professional survey should be carried out and the Environmental Health Department of the Local Authority should be involved.

Management plans, objectives and preventative maintenance and its costing are covered in BS 7370 : Part 1 : 1991. This clause outlines the equipment needed to carry out the site assessment and the features which should be examined. The number of officials to be involved in inspecting a site will depend on its size. If available, drawings of the site should be taken to the site by the inspectors and updated with relevant particulars at first hand. Modern computer logging equipment can also be used to record details at the point of observation for later transfer to permanent records in the office.

The relevant Ordnance Survey sheet of an appropriate scale should be obtained before commencement, as some of the necessary information will be found on this. The Ordnance Survey Geological Survey drift maps give details of the likely soil and subsoil. The following are useful articles to take on a site assessment:

a) pocket tape recorder, computer logging equipment and sketch pad;

b) surveying equipment appropriate to the scale of the site and the abilities of the surveyor;

c) soil auger, trowel, spade, range of polythene bags;

d) compass, British flora book, tree recognition book, camera, binoculars.

As the site will be developed already, there is no question of marking out a grid of points to take soil samples, but some can be taken at strategic points, especially at the top, middle and bottom of slopes, the lowest and highest points of the topography.

Care should be taken to ensure that the north and the scale are on any sketch plans made on site.

3.1.2 Checklist of information to be noted on an inspection

The checklist of information to be noted should include the following:

topsoil
- depth
- pH
- character

subsoil

drainage
- natural (including surface water)
- artificial

air drainage (frost hollows)

permanent water table

rainfall

exposure

altitude

prevailing wind

topography

local climate

buildings and artifacts

pollution status
- soil source
- air source

ownership legal status

constraints and problems

vegetation status
- herbaceous plants
- shrubs
- trees
- health

access points to pedestrians and vehicles

services
- water
- electricity
- gas
- telephone
- sewage

nuisances

planning constraints

natural history features

geological features

historical features

general character of surroundings

importance to landscape

area

nature conservation requirements

planning designations

access for disabled persons

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An examination of the site should be all that is normally necessary to enable a true judgement of the soil's ability to support horticultural features. Where the soil is known not to be of an extreme type, elaborate laboratory tests should not be necessary, as a good idea of the physical characteristics of a soil can be obtained by inspection, and by moulding a specimen of moist soil in the palms of the hands, feeling the texture between the finger and thumb, and identifying the trees, weeds and other vegetation on the site. Where necessary the pH value should be ascertained by the use of one of the purpose-made instruments available.

Field identification and a description of soil types are given in table 1 which is taken from table 6 of BS 5930 : 1981.

The identification given in table 1 can be qualified by site observation and identification of the plants on site. See figure 1 for some guidance on identification of soil type and drainage status. Large and healthy trees usually indicate a deep and fertile soil, flourishing nettles indicate high nitrogen and phosphorus status. For further discussion refer to the appropriate publications listed in **A.2**.

3.2 Inspections

3.2.1 *General*

There should be a hierarchy of inspections in any but the smallest maintenance organization. This clause amplifies information given in BS 7370 : Part 1 : 1991. Recommendations for the various types of inspection are given in **3.2.2** to **3.2.5**.

3.2.2 Forward-planning inspections

Forward-planning inspections should be carried out by fully qualified managerial staff at least twice a year in order to plan development, manning, follow-on planting, estimation of costs of future maintenance programmes, etc.

Forward-planning inspections should be carried out to detect early warning signs of environmental degradation, e.g. multiplication of paths, path and vegetation erosion, invasion by vehicles or domestic animals, tipping, alteration of the water-table, decline of vegetation (especially trees) and of wildlife, large alterations to the native flora, invasion by garden escapes and plants typical of disturbed ground.

3.2.3 Routine casual inspections

Routine casual inspections should be made by supervisory staff at a frequency depending on the scale of the site, the quality of the planting, and whether or not the public have access, with the object of reporting the success or otherwise of the progress of management objectives. For a large private site, the inspections should be carried out monthly but for sites open to the public or with expensive and vulnerable plantings the inspections should be carried out weekly.

3.2.4 Informal inspections

Informal inspections should be made by manual staff who should be trained to note and report, all the time they are present on site, all matters necessary for management at each routine maintenance visit, e.g. fly-tipping, vandalism and disease outbreaks.

3.2.5 Tree inspection for safety and health

Tree inspections are a specialized subject and should be carried out only by a fully qualified arborist. Inspections whether routine or otherwise should be methodical and the following scheme is recommended. Inspections should normally be made from ground level using binoculars as necessary.

a) Prepare a plan of the site, and indicate the positions of trees and their dimensions. Survey the site and note the site conditions and the local climate.

b) Identify species and methodically inspect individual trees, and follow by an auger test if necessary. It is essential that the inspection be carried out to a plan, and most arborists follow a system similar to that below.

1) Stand well back and form a general impression of the vigour and condition of the tree from its overall appearance, especially the foliage, which may show parasite attack or poor foliage due to environmental causes. If necessary, remove ivy or any other climbers and dead or loose bark to allow inspection.

2) Inspect the bark and roots at ground level. Make a small excavation to expose the condition of the roots and lower stem, and look for traces of 'bootlaces' of honey fungus (*Armillariella mellea*), or other signs of fungus attack, strangling roots, etc.

3) It is usual to work upwards from this point. Closely examining the trunk, measure the girth at 1 m above ground level and estimate age. Carry out an auger test near possible sources of decay, but avoid the use of the instrument if at all possible as auger points are often invaded by parasitic fungi. Examine for timber damage and previous surgery. It is important to try to estimate the date of any previous surgery as this gives some indication of the likely progress of any subsequent decay. Examine for cavities. Probe the depth of decayed timber, water cup, borer or fungal attack in the internal timber, decaying snags, cracks, bark loss, etc. Make a rough estimate of the tree's likely longevity.

4) Inspect the crown and crotches, ending with the condition of the fine shoots and buds, especially the thin bark on the young shoots. Estimate the amount of dead wood present and whether it is that typical of the species.

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Table 1. Field identification and description of soils

Basic soil type		Particle size mm	Visual identification	Particle nature and plasticity	Composite soil types (mixtures of basic soil types)
Very coarse soils	Boulders	> 200	Only seen complete in pits or exposures	Particle shape: Angular Subangular Subrounded Rounded Flat Elongate Texture: Rough Smooth Polished	Scale of secondary constituents with coarse soils
	Cobbles	> 60	Often difficult to recover from boreholes		Term: % of clay or silt
Coarse soils (over 65 % sand and gravel sizes)	Gravels	Coarse > 20 Medium > 6 Fine > 2	Easily visible to naked eye; particle shape can be described; grading can be described Well graded: wide range of grain sizes, well distributed. Poorly graded: not well graded. (May be uniform: size of most particles lies between narrow limits; or gap graded: an intermediate size of particle is markedly under-represented.)		slightly clayey / slightly silty — Gravel or sand — under 5 clayey / silty — Gravel or sand — 5 to 15 very clayey / very silty — Gravel or sand — 15 to 35
	Sands	Coarse > 0.6 Medium > 0.2 Fine > 0.06	Visible to naked eye; very little or no cohesion when dry; grading can be described Well graded: wide range of grain sizes, well distributed. Poorly graded: not well graded. (May be uniform: size of most particles lies between narrow limits; or gap graded: an intermediate size of particle is markedly under-represented.)		Sandy gravel / Gravelly sand — Sand or gravel and important second constituent of the coarse fraction For composite types described as: clayey: fines are plastic, cohesive silty: fines non-plastic or of low plasticity
Fine soils (over 35 % silt and clay sizes)	Silts	Coarse > 0.02 Medium > 0.006 Fine > 0.002	Only coarse silt barely visible to naked eye; exhibits little plasticity and marked dilatancy; slightly granular or silky to the touch. Disintegrates in water; lumps dry quickly; possess cohesion but can be powdered easily between fingers	Non-plastic or low plasticity	Scale of secondary, constituents with fine soils Term: % of sand or gravel sandy / gravelly — Clay or silt — 35 to 65
	Clays		Dry lumps can be broken but not powdered between the fingers; they also disintegrate under water but more slowly than silt; smooth to the touch; exhibits plasticity but no dilatancy; sticks to the fingers and dries slowly; shrinks appreciably on drying usually showing cracks. Intermediate and high plasticity clays show these properties to a moderate and high degree, respectively	Intermediate plasticity (lean clay) High plasticity (fat clay)	Clay: silt — under 35 Examples of composite types (Indicating preferred order for description) Loose, brown, subangular very sandy, fine to coarse gravel with small pockets of soft grey clay Medium dense, light brown, clayey, fine and medium sand Stiff, orange brown, fissured sandy clay Firm, brown, thinly laminated silt and clay Plastic, brown, amorphous peat
Organic soils	Organic clay, silt or sand	Varies	Contains substantial amounts of organic vegetable matter		
	Peats	Varies	Predominantly plant remains usually dark brown or black in colour, often with distinctive smell; low bulk density		

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5) Inspect the leaves, flowers and fruits.

6) Inspect the surroundings for signs of interference with the root system, e.g. underground services and leaks, recent trenching or changes in level.

7) Examine the environment in relation to the tree, air drainage and exposure, ground surface character, pavings, likely pollution, etc. Examine the soil and subsoil in which the tree is growing.

8) Investigate the treatment of the tree, its recent history of spraying, injection, feeding, pruning, weed-killing around the base, and the recent and not so recent weather in relation to the tree.

9) If the tree is sickly, discover whether the trouble is general in the area and whether the trouble is recurrent.

c) Record the visit and the work necessary and, where doubt exists regarding the safety of the upper crown, make arrangements for a visit to the site by a climber to make a report on its condition based on direct observation. File records of the inspection and work carried out. Issue notices to statutory undertakers and/or adjoining owners affected by the work, and obtain any permissions necessary for work in areas affected by planning legislation (see **3.3**) or local agreements, restrictive covenants, etc. Use the formal coding and survey markings recommended in the Tree Council's leaflet *The national tree survey* [6] in making the records.

3.3 Protected trees

Before work is carried out on trees, advice should be sought from the local planning authority as to the legality of the work. Trees may be subject to tree preservation orders, or may be in a conservation area. In addition, trees may be the subject of covenants and ownership may not be clear. Local planning authorities may be helpful but cannot necessarily be expected to have knowledge of covenants or of disputed ownerships. Careful enquiries should, therefore, be made if involvement in legal proceedings is to be avoided.

3.4 Maintenance programmes

3.4.1 General

It is usual to organize the work on planted areas to mesh with the unavoidably rigid programme of grass mowing. Although grass maintenance is not covered in this standard, a common programme is described here so that it is possible to visualize the framework of visits on which most maintenance programmes are based. This is notional only and obviously bears no relationship to programmes such as amenity forest programmes which have no framework of necessary grass mowing. For the purposes of this standard, the programme should be envisaged as starting when grass mowing starts in mid-March, as consisting of 17 growing-season visits at approximately fortnightly intervals and of four winter visits for leaf clearance and other such work.

A decision should be taken by management as to the intensity of cultivation and the quality of effect it is desirable to achieve at any site. For instance, a planted area can be an almost maintenance-free traditional oakwood or a labour-intensive paradise garden, with an infinity of variations in between. The following routines present a fairly intensive framework of maintenance tasks and leave to the user a choice based on the policy adopted by management.

3.4.2 Planning routine

Estimates, lists and plans for improvement, replacement and ordinary maintenance replanting in the case of woody plants and other permanent subjects should be made towards the end of winter and again in early autumn when it can be seen which plants have died during the season. Enough time should be left for preparatory work, receipt of quotations, etc. and for delivery before the end of the late planting season or in time for the early winter season. Rare plants may need several years for a specialist nurseryman to produce after commissioning.

Estimates, lists and plans for seasonal bedding plants should be prepared a whole year in advance, so that seeds, bulbs, herbaceous plants and standard/dot plants can be ordered. Bulbs should be specified for contract purposes by cultivar name and minimum dimensions. Herbaceous plants are less easy to describe. The approximate size of the roots and aerial parts and sometimes the size and number of buds, fully developed leaves, length and girth of stem, size, type or absence of container (usually 0.5 l or 1.0 l pots), and whether in flower or flower bud should be specified.

For permanent plantings and seasonal bedding plants, the earliest day that plants can be received on site, and the latest day which will not attract default points or deductions from contract price should be specified. It is also most important that the method of transport to site be specified, i.e. that open transport is not acceptable and that plants are not in transport for too long, and are neither transported bare root and unprotected, nor delivered to site at the weekend or during a public holiday or other time when there will be no staff on site to take in and care for the plants. It is also important that all the plants necessary to complete any particular scheme be received in one batch and in good condition, otherwise embarrassing gaps in schemes occur. Plants and bulbs should be stored until planted in a secure, cool but frost-free place and should be watered if necessary.

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Plantings should be inspected in autumn so that winter work can be estimated and organized. The work does not, in a real situation, divide itself up so neatly as in the maintenance programmes given in **3.5** to **3.10**. The work may involve brashing (in former commercial conifer plantations), thinning, transplanting, making good, replanning and replanting, scrub cutting or remedial work.

Professional advice should be sought where replantings persistently fail. The causes of this problem are various. In the case of small plants, e.g. roses, it may suffice to change the soil to a depth of 500 mm. Pressure soil sterilization has been found effective in some cases (e.g. for ornamental fruit trees).

Litter clearance should be an essential routine operation (see **3.5** and **4.1.2.2**). It is, however, difficult to make precise recommendations as it differs so widely in kind and intensity. In some situations it should be the most important routine operation.

3.5 Operations general to all types of plantings

3.5.1 General

The various activities for maintaining soft landscape are covered in **3.5.2** to **3.5.18**. It will be seen that, although turf cultivation and large-scale plant raising have become more and more mechanized, this has not been possible in amenity horticulture, most crafts remaining almost unchanged for the last 500 years.

Many of the activities are still handcrafts and are likely to continue as such for some time owing to the wide variety of species used by the plantsman in amenity landscaping. Where appropriate for conservation purposes, a restricted native flora is preferred (see **2.2.12.5**).

3.5.2 Compost

3.5.2.1 *Compost making*

Compost produced by the decay of organic residues of various kinds, resulting largely in dark brown humus, is produced by hand using an ancient traditional process. The biological action can proceed at a faster rate if it takes place within walls which retain the heat generated, if lime is added to neutralize the acids produced by the process, and if nitrogen is added to make good that absorbed by the bacteria active in the process. The traditional method of building heaps is to make them never more than 1 m wide, not more than 2 m high, but of any length. A base of soil is better than concrete or other paving, but a hard base may be necessary if removal is by machine.

The heap should be built up in 150 mm deep layers with a sprinkling of topsoil (a handful per square metre) between each layer. Alternate layers should have a sprinkling of a nitrogen-containing fertilizer, usually sulfate of ammonia (NH_4SO_4) at a rate of 30 g/m^2. Lime should be applied to the layers where nitrogen is absent at a rate of 125 g/m^2 of hydrated lime. Care should be taken to keep the sulfate of ammonia and lime separate as, if they are brought into contact, ammonia is generated, gypsum is formed and the operation is spoiled. The heap should be protected from copious rains, but should not be allowed to become dry.

Soft green leaves and shoots rapidly heat up and decay; with hard tissues the process is much slower. In order to sterilize the debris successfully, the materials have to attain a temperature of at least 70 °C. As the heat starts to fall, the heap should be turned outside to in. This regenerates the biological action and then the heat slowly falls, the heap during this process shrinks dramatically. Soft plant tissue will complete the process in as little as 6 weeks; harder tissues will take as long as 18 months. Heaps composed largely of wood chips may take 2 years or even 3 years before being rendered into usable humus.

3.5.2.2 *Large-scale shredding and composting*

Tree prunings, hard debris and plant stems, etc. accumulate in enormous quantities in large maintenance concerns and disposal is becoming more and more of a problem.

One solution, pioneered in North America, is to pass all landscape maintenance rubbish through a mechanical shredder which beats grass into tiny flinders and tears hard tissues into fragments. The resultant material is then passed through a rolling screen which separates compostable fragments from hard debris and deposits them through a chute into a vehicle which carries the material off for composting.

Tree prunings, which have been chipped before delivery to the site, may be added to the compost heaps. The mixed shredded materials and chips are distributed into long windrows. The material is treated as far as possible in the same way as a conventional compost heap with the addition of nitrogen and lime; a piped water supply is essential. The layers cannot be as thin as in the conventional heap. All forming and turning is carried out by machinery.

Such compost is sometimes available commercially.

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3.5.3 Conservation of tender perennials used in seasonal bedding

Propagation and overwintering care of plants removed to the greenhouse are not covered by this standard. The following recommendations refer solely to the conservation of perennial plants before they leave the site at the end of the growing season and to some extent the overview necessary for the manager.

Almost all groundwork plants are now raised from seed and are sometimes sown as early as January. This means that only plants that cannot be more economically raised from seed are carried over winter. Only those plants which are required as standard dot plants, e.g. *Pelargonium zonale* 'Mrs Hill', or coloured-leaf cultivars or edging kinds, e.g. *P.* 'Little Trot' or *P.* 'Harry Hieover', are now available. Special arrangements will have to be made, sometimes 12 months in advance, if specialist dot plant or edging are required. Examples of plants to be returned to the nursery intact with their root systems and soil for conservation are as follows.

a) ***Woody plants***

Abutilon pictum 'Thompsonii'

A. megapotamicum 'Variegatum'

Bougainvillea cvs.

Cordyline spp.

Datura spp.

Dracaena cvs.

Fuchsia cvs.

Calocephalus brownii

Plumbago auriculata (syn. *capensis*)

b) ***Herbaceous plants***

Arundo donax var. *versicolor*

Begonia semperflorens culturum hybrids (syn. × *ascotiensis*)

Canna spp.

Chlorophytum spp.

Pelargonium coloured-leaf cultivars
edging cultivars
ivy leaf cultivars

Phormium tenax cvs.

Yucca spp.

c) ***Succulents***

Agave spp.

Crassula spp.

Echeveria spp.

Pachyphytum spp.

3.5.4 Cultivations

3.5.4.1 *Digging*

For a fuller description, see *The new Royal Horticultural Society dictionary of gardening* [1]. Digging should usually be preparatory to planting. The soil should be broken up to a depth of a spade blade (conventionally a 'spit' of 250 mm) in single digging, or two spade depths (conventionally two 'spits' amounting to 500 mm) in double digging. A spade should normally be used, but a digging fork may be used where the soil is an intractable clay, and where the site is large and free of obstructions a mechanical rotary cultivator may be used. Most machines of this type break up the soil into a finely divided state, but only to a depth of about 150 mm. There are larger machines which can cultivate to a depth of 250 mm. The frequent use of mechanical cultivators may result in the formation of a layer of hardened soil just beneath the reach of the tines (hard pan or plough sole). The finish after mechanical cultivation is usually of fine crumb to the full depth, suitable for planting or seed sowing after firming and fine levelling. A spade or fork achieves a finish which may be suitable for planting, but which needs further cultivation by fork or rake to break down the soil into fine crumb before seed sowing.

If manure, fertilizer, lime, etc. are to be used, they should either be spread out on the surface of the soil before digging commences and turned in; or they should be buried in the soil during the course of digging. If a spade is to be used, the finish may be rough-dug where lumps are left as they fall from the spade, or fine-dug where lumps are chopped with the spade, achieving a more finely divided and level surface. Rough digging should mainly be carried out in the autumn so that the winter frosts can act on the clay fraction and reduce the lumps into fine crumb. Efficient digging depends at least as much on the quality of the tool as on the skill of the operator. A good spade or fork should have an overall length compatible with the height and strength of the operator. The blade should be attached to the handle by a swan neck at a noticeable angle as shown in figures 3a) to d), and should be formed from a steel sandwich, with a leaf of hard steel between two outer leaves of softer steel so that the blade sharpens whilst in use. Stainless steel blades are more efficient but are very much more expensive.

3.5.4.2 *Forking*

Forks range in size from two-tine specimens, with tines only about 75 mm long, used in weeding and pricking up rockeries to six-tine manure forks, excellent for shifting large tufts of strawy horse manure or dry protective material.

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