



Research Information Note 216

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PHYSICAL SITE EVALUATION FOR COMMUNITY WOODLAND ESTABLISHMENT, by A. J. Moffat and N. A. D. Bending

Abstract

Before decisions on species selection and site amelioration can be made, planning for tree planting should take account of site factors such as climate, topography, and soil quality and quantity. The amount of information required is larger if sites have been disturbed by mining or industrial activity. Important site parameters are identified, and minimum standards for tree planting schemes are proposed.

Introduction

1. The Forestry Commission's policy of encouraging new woodlands close to areas of population is being promoted through initiatives such as community forests and grant incentives including the Community Woodland Supplement. The locations of these woodlands encompass a wide range of site types, from agricultural land to land disturbed by man through mining or other industrial activities. Disturbed land may be restored to various standards, or remain derelict. Some disturbed land may be contaminated, and other land may be underlain by imported wastes of industrial or domestic origin.
2. Woodland design should begin with the appraisal of the major influences at work in the existing landscape. These include the regional landscape context, the physical conditions, existing areas of ecological importance, and roads and access routes. This Note focuses on the physical nature of the landscape, and provides guidelines on the assessment of land for its potential to support a woodland cover. The other aspects of site evaluation are dealt with fully in the *Community woodland design guidelines* (Forestry Commission, 1991).

Basic information for all sites

3. Assessment of climatic conditions is fundamental to achieving satisfactory woodland establishment. Particularly important are exposure (windiness) and extremes of temperature, especially unseasonable frosts. Although late spring and summer droughts are harmful to tree growth, variation in annual rainfall throughout Britain is a relatively unimportant factor except on man-made sites. Silviculture textbooks list species tolerant of different climatic conditions.
4. Air pollution may be of possible local importance in some community forests. Careful species choice may help mitigate any adverse effects. However, research on ambient air pollution levels has shown very small effects and few differences between species, and it is premature to make recommendations.
5. Assessment of topography should be done on all sites. Topography primarily affects the ability to perform cultivation operations necessary for tree establishment, though it will also affect the harvesting of the crop, siting and design of footpaths, open spaces, etc. Slope angle and form will help indicate where poor drainage or frost pockets can be expected.

Information on soil and substrate

Land under agriculture

6. The degree and kind of information required on soil and substrate will depend upon previous land use. In general, knowledge of soil type will provide the best means of deciding tree species for undisturbed land previously under agriculture (Hibberd, 1988). This can be obtained from soil maps of scales of 1:63 360 or smaller, if they exist for the area in question, and by pit inspection on site. Good guidance on soil observation and identification is given by Burnham (1980). Information on soil type can be supplemented with measurements of soil pH and calcium carbonate content, and by observations on soil colour which can indicate drainage characteristics. This set of information has been used by Evans (1984) to derive guidance on broadleaved species selection for lowland Britain, and is directly applicable to community forest areas on undisturbed sites.
7. Assessment of soil physical conditions, particularly soil depth, and whether a plough pan is present, will help in deciding the need for, type of and extent of cultivation required.

Disturbed land

8. Disturbed land being considered for community woodlands commonly suffers from a shortage, or even absence, of soil materials suitable for tree growth. The quantity of soil reserves must first be

evaluated before a specification for tree planting is determined. Disturbed land can be subdivided into two broad categories: (a) land which has undergone mineral extraction, and (b) land which may have been affected physically or chemically by industrial activity, or the importation of wastes and other materials. Much of the land in this category may be derelict.

Mineral workings

9. All stages of restoration may occur on sites affected by mineral workings, from an unrestored quarry to a site with all soil materials replaced. It is important that a full soil resource survey is undertaken on all of these sites types. Such a survey should aim to assess: (a) characteristics of soils including the volume (or depth if replaced) of topsoil and subsoil materials, their pH, texture, stoniness and physical state, and (b) the same characteristics of overburden materials on site which may substitute as 'soil forming materials' if soils are in short supply. A survey of overburden materials should also include information on intrinsic fertility including macronutrient content and soluble salt content (electrical conductivity). In areas of coal mining, the iron pyrite content of the overburden is another important property to evaluate, as its presence can lead to acute acidity problems and tree failure (Jobling and Stevens, 1980).

Other disturbed land

10. A soil resource survey is also important in the evaluation of derelict or infilled land; in addition, surveys must consider the possibility that part or all of the site may suffer from chemical contamination. Types of contamination will depend on the nature of previous mining or industrial activity. They may include toxic metals such as copper, nickel and zinc, combustible substances such as coal and coke dust, inflammable gases such as methane from domestic landfill, substances such as sulphates, chlorides and acids, or oily and tarry materials and other complex organic compounds (ICRCL, 1987). Methods for assessing potentially contaminated land are given in ICRCL (1987) and BSI (1988). Identification of contamination is usually a combination of documentary evidence, visual observation and laboratory analysis of soil or spoil samples. The pattern of vegetation cover can often reveal much about the soil's ability to support tree growth, and its evaluation is useful in deciding where soil sampling should take place. Soil gas sampling should be performed if putrescible materials have been buried beneath a soil cover.
11. Depending on the level of soil resource survey required, and expertise available, it may be appropriate to employ consultants to carry out the mapping, sampling and analysis of soil materials.

Minimum soil standards for woodland establishment on disturbed land

12. Table 1 sets out soil standards for woodland establishment on disturbed land, taking account of the needs the tree crop will have over a full rotation length. If a site falls below these standards, it is unlikely that trees will achieve the level of growth expected on an undisturbed site. Soil amendment will be required to raise the potential of the site, or the objectives of tree planting will need to be reconsidered.

Table 1 Minimum soil standards for tree establishment on disturbed land

1.	Depth	Not less than 1 m of rootable soil material [†]
2.	Bulk density	<1.5 g cm ⁻³ to at least 50 cm depth <1.7 g cm ⁻³ to 1 m depth
3.	Aeration status*	Soil oxygen >5% during the growing season
4.	Stoniness	<40% by volume. Few stones greater than 100 mm in size
5.	pH	3.5-8.5
6.	Electrical conductivity	<2000 μS/cm (1:1 soil: water suspension)
7.	Iron pyrite content	<0.5%
8.	Heavy metal content	Not excessively over ICRCL threshold trigger concentrations (ICRCL, 1987)
9.	Organic contaminants	Not exceeding ICRCL action trigger concentrations (ICRCL, 1987)

[†] 2 m of soil cover recommended on modern landfill sites where a cap forms part of the pollution control measures.

* particularly relevant to landfill sites.

13. An adequate soil thickness is vital for trees to grow to maturity. If soil depth is limited, soil materials should be moved to meet the minimum standards on parts of the site, and planting restricted to these areas. Alternatively, deficiency can be made up with imported materials, which themselves meet the standards set in Table 1. Ripping and other forms of cultivation must be used to relieve compaction where it is identified, and landforming will help to reduce waterlogging and improve aeration status. Details of these operations are contained in Wilson (1985). Very stony materials (>40% stones), or those containing a large amount of building waste, should be considered unsuitable for tree establishment because of their inherent droughtiness and the difficulty of planting into them.
14. Alkaline soils with very high pH (>8.5) are virtually impossible to ameliorate to acceptable pH levels, and should be rejected for woodlands. It is, at the moment, unrealistic to attempt to treat soil materials that fall outside conductivity and pyrite recommendations. Very acid soils (pH <3.5) are usually caused by the oxidation of iron pyrite. These can be limed to raise pH to acceptable levels, though the cost of liming can be prohibitively expensive. Professional judgement must be employed in the interpretation of soil heavy metal contents: trees are relatively tolerant of elevated levels of many heavy metals, but in community woodlands where public access is encouraged, it is advisable to employ the 'threshold' trigger concentrations relevant to those for "parks, playing fields and open space" (ICRCL, 1987). If levels of organic contaminations exceed 'action' trigger concentrations, remedial action is essential. This may require removal of contaminated materials or their burial by, and isolation from, uncontaminated soil.
15. Community forestry planting schemes should aim to establish tree stands with an expectation of health and acceptable growth over a normal life span. The purpose of a site survey is to identify areas where this aim can be met. If the survey reveals a shortfall in soil quality or quantity, it is vital that tree planting is restricted only to those parts of the site where healthy and prolonged growth can be expected.

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- * Obtainable as a leaflet from Richmond Publishing Co. Ltd., P.O. Box 963, Slough SL2 3RS (Tel: 0753 643104). Price £2.95 including postage.
- † Obtainable from Department of the Environment, Publications Sales Unit, Building 1, Victoria Road, South Ruislip, Middlesex HA4 0NZ (Tel: 081 841 3425). Price £2.25 including postage.

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