Unit 22: Understand the Principles of Silviculture

Unit code: A/601/1818

QCF Level 3: BTEC National

Credit value: 5

Guided learning hours: 30

Aim and purpose

This unit aims to provide learners with an understanding of the principles of silviculture and how these can be put into practice. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or to further education and training.

Unit introduction

Silviculture refers to the growth of trees, with particular emphasis on trees growing in large groups, such as in woodlands and forests. It is a fundamental element of any forestry or arboriculture course, as it covers the numerous factors that influence tree growth, including the susceptibility of tree species to pests and diseases, the range of tolerance to differing climatic, soil and pollution conditions and the growth of different species in groups. It also includes the systems that can be used to meet various management objectives. A sound knowledge of the silviculture of several tree species is key to the successful management of forests and the production of effective management plans.

This unit focuses on the silvicultural requirements of trees in order to establish and grow successfully. It also covers the many silvicultural systems that exist to promote the growth of trees for timber products, nature conservation, recreation and other objectives. As knowledge of silviculture provides a basis for good practice in forestry and arboriculture, silviculture links with several other areas such as the planting and establishment of trees, the tending and management of trees in woodlands and forests, tree pests and diseases and harvesting of trees.

On completion of this unit, learners will have a good knowledge of the silvicultural requirements of different tree species. They will be familiar with the requirements for the successful establishment of trees and the methods available to protect newly planted trees and shrubs. Learners will understand the range of silvicultural practices and systems that exist to maximise the growth and quality of trees in forests and woodlands and their correct applications.

Learning outcomes

On completion of this unit a learner should:

1 Understand common silvicultural systems

2 Understand the requirements for the successful establishment of forests or woodland

3 Understand how to protect and improve forests and woodland

4 Understand common harvesting systems.

Unit content

1 Understand common silvicultural systems

Types of forest management: even age/uneven age; continuous/non-continuous cover; regular/irregular; coppice; underwood; high forest; wood pasture; management objectives eg timber, game, wildlife/biodiversity, recreation, amenity/landscape

Silvicultural systems: definition of a silvicultural system and its components; method of regeneration, form of crop produced and arrangement of crops over the forest area; systems; coppice with standards; clearfell; shelterwood; selection systems

2 Understand the requirements for the successful establishment of forests or woodland

Silvicultural characteristics of different species: shade tolerance; natural growth forms eg shape, height, age to maturity, longevity; reproduction, seeding years; requirements for optimal growth

Site preparation for establishment and afforestation: scarification; mounding; burning; herbicide treatments; soil improvements; health and safety

Tree nursery production: seed collection, storage; dormancy, germination, sowing; seedling manipulations eg transplanting, undercutting, sidecutting; lifting, grading; seedling storage; delivery

Artificial regeneration: planting; direct seeding; species choice; stock type (bare root, container); seedling care, storage; planting practices; spacing and stocking density; planting depth

Natural regeneration: seed source eg seed bank, surrounding trees, wind blown, animal dispersed; dormancy and germination; ground conditions; coppicing; layering; suckering; species; spacing and stocking density

3 Understand how to protect and improve forests and woodland

Protection from weeds: types of weeds (grass, herbaceous, woody); impacts of weeds on crop species; site preparation and pre-establishment weed protection; post-establishment weed protection eg tree guards, mulching, manual, mechanical, chemical; effectiveness and relative cost of different weed protection activities; environmental impacts; health and safety

Protection from pests and diseases: common tree pests and diseases (bacterial, fungal, insect, mammal); damage caused and severity; damage prevention and minimisation; pest and disease control measures; health and safety

Protection from fire: types of fire (ground, surface, crown); impacts of fire on trees and other vegetation; ignition sources; fire hazard assessment; fire behaviour; fire prevention; fire fighting; health and safety

Management improvement objectives: timber quality; rotation length; regular supply to markets; non-timber benefits eg biodiversity enhancements

Re-spacing and thinning: optimum stocking density; effects of stocking density eg competition, weed control, 'drawing-up'; effects of competition; crown closure; timing of thinning; thinning cycles; intensity of thinning; selection and marking of trees for thinning eg systematic, selective, canopy position, thinning from above, thinning from below, residual stand characteristics, position and value of individual trees; health and safety

Brashing and pruning: removal of lower dead branches; removal of live branches; high pruning; formative

pruning; knots and effects on timber quality (live knots, dead knots); benefits of brashing and pruning eg clear timber, fewer knots, visibility, access, fire prevention, improve form, force apical dominance, increase timber value; drawbacks of brashing and pruning eg financial cost, labour intensive, wounds as point of entry for diseases, poor practices; health and safety

4 Understand common harvesting systems

Harvesting considerations: physical factors – terrain classification eg slope, soil type and depth, soil moisture, access, bearing capacity, season/timing; biological factors eg durability of cut timber and resistance to degradation, consideration of sensitive or rare species of plants and animals; health and safety and protection of the general public

Harvesting systems: definition of a harvesting system; shortwood, tree length, whole tree felling methods and associated machinery eg chainsaws, timber harvesters, feller/bunchers; moving methods eg winching, skidding, forwarding, skyline/cable crane systems, helicopters

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 evaluate common silvicultural systems [IE]	**M1** recommend a silvicultural system for a given site and objectives	**D1** justify recommendations for a silvicultural system on a given site
P2 compare the requirements of artificial and natural regeneration systems	**M2** select appropriate species and regeneration method for a specified site and objectives	
P3 explain techniques and practices to protect forests and woodlands from fire	**M3** recommend suitable silvicultural practices for a woodland on a given site	**D2** justify the establishment, protection, improvement and harvesting recommendations for a given site.
P4 evaluate techniques and practices to protect forests and woodlands from pests and pathogens [IE]		
P5 evaluate techniques and practices to protect forests and woodlands from weeds [IE]		
P6 evaluate the management objectives and maintenance practices associated with individual silvicultural systems [IE]		
P7 examine harvesting activities associated with common silvicultural systems.	**M4** plan a suitable harvesting method for a specified site.	

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key			
	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

This unit provides the theoretical background for other more applied units, such as those involving the planting, protection and harvesting of trees, as well as units concerned with the planning and management of woodlands and forests. Classroom sessions are important for explaining complex subject matter such as the detailed workings of different silvicultural systems and would also be useful; to explain harvesting methods that may be difficult to observe in the field, such as those involving specialised machinery.However, considerable use can be made of independent research, including the use of textbooks and online resources, when discussing topics such as the silvicultural characteristics of different tree and shrub species or the threats posed by different pests and diseases.

In order to observe best practice in the field in a range of situations, learners should visit a variety of woodlands with differing silvicultural systems and management objectives utilising several hardwood and softwood species. In addition, learners would benefit from a visit to a commercial tree nursery to see how trees and shrubs are propagated and cared for in their early years. This will also enable them to see how different nursery products are obtained and described. A visit to a local sawmill would give learners the opportunity to see trees being converted into timber and help them appreciate the value of careful harvesting methods. It will also help learners to visualise the complete forestry cycle from establishment of trees to timber utilisation.

Care should be taken when visiting woodlands as there may be hazards from forestry machinery, lorries or falling trees and branches. In working woods, learner groups should be led by a suitable site manager who should provide a safety briefing at the beginning of the visit. Dangerous areas should be clearly pointed out or marked off. The use of fluorescent vests and hard hats is recommended.

Waterproof pads and pencils may be useful for taking notes on woodland visits held during wet weather. If working in small groups, learners will require adequate supervision.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives an **indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value**.

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduction and overview of the unit.
Assignment 1: Silvicultural Systems (P1, M1, D1) Tutor introduces the assignment.
Discussion of silvicultural characteristics of different species (including independent study).
Review of different silvicultural systems (including independent research).
Preparing a summary of different silvicultural systems and presentation.
Assignment 2: Forest Regeneration (P2, M2) Tutor introduces the assignment.

Topic and suggested assignments/activities and/assessment
Discussion of regeneration systems and comparison between artificial and natural regeneration.
Explanation of common regeneration techniques and practices (including independent research).
Visits to different sites to see a variety of regeneration methods in use.
Assignment 3: Forestry Practices (P3, P4, P5, P6, P7, M3, M4, D1, D2) Tutor introduces the assignment.
Explanation of techniques to protect forests and woodlands from weeds.
Overview of forestry and woodland protection issues and threats.
Explanation of techniques to protect forests and woodlands from fire.
Evaluation of practices to protect forests and woodlands from pests and pathogens.
Discussion of problems of pests and techniques available to control damage (including independent study).
Review of different weed species and the methods used to minimise damage to trees.
Explanation of the importance of woodland improvement and the techniques utilised to meet woodland improvement objectives.
Discussion of the methods available for the harvesting of trees and their applications.
Visits to woodlands and forests to see improvement and harvesting techniques.
Unit review.

Assessment

For P1, learners need to evaluate common silvicultural systems. Suitable evidence would be an illustrated report or a leaflet.

For P2, learners are required to compare artificial and natural regeneration systems. Tutors need to provide clear guidelines on the different attributes of the systems. Suitable evidence would be an annotated poster.

For P3, learners need to explain techniques and practices used to protect woodlands from fire. An annotated poster or oral presentation would be suitable evidence.

For P4, learners are required to evaluate techniques and practices used to protect forests and woodlands from pests and pathogens. Assessment could be linked to P3 with an illustrated leaflet or oral presentation as suitable evidence.

For P5, learners must evaluate techniques and practices used to protect forests and woodlands from weeds. This could be linked to the assessment tool for P3 and an oral presentation, illustrated leaflet or a written report could be used as suitable evidence.

For P6, learners need to evaluate the management objectives and maintenance practices associated with individual silvicultural systems. Evidence could be linked to that for P3 utilising a written report, illustrated leaflet or an oral presentation. If possible, learners should use photographs taken during visits to different forestry operations.

For P7, learners need to examine harvesting activities associated with common silvicultural systems. Suitable evidence would be an illustrated leaflet, a short report or an oral presentation. The use of learners' own photographs of harvesting operations taken during field visits would be best, but other sources can be utilised where necessary.

For M1, learners need to recommend a silvicultural system for a given site and objectives. Tutors should specify a site or agree it with learners. Assessment can be linked to P1 and a written report or annotated poster could be used as evidence.

For M2, learners are required to select appropriate species and regeneration method for a specified site and objectives. Tutors will need to specify a site or agree it with learners. Suitable evidence would be a written report, oral presentation or annotated poster.

For M3, learners must recommend suitable silvicultural practices for a woodland to meet stated management objectives. Tutors will need to specify a site or agree it with learners. Assessment could be linked to M2, and suitable evidence would be an annotated poster, an oral presentation or a written report.

For M4, learners need to plan a suitable harvesting method for a specified site. Tutors will need to specify a site or agree it with learners. This could be linked to the assessment for M3 with suitable evidence being an illustrated leaflet, oral presentation or annotated poster.

For D1, learners need to justify recommendations for a silvicultural system on a given site. Tutors will need to specify a site or agree it with learners. Assessment can be linked to M1 and suitable evidence would be a written report or oral presentation.

For D2, learners must justify the establishment, protection, improvement and harvesting recommendations for a given site. Tutors will need to specify a site or agree it with learners. Assessment for this can be linked to M2 and suitable evidence would be a written report or an oral presentation.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, M1, D1	Silvicultural Systems	As a forestry consultant, you have been asked to provide recommendations for the establishment of a silvicultural system in a woodland. As the woodland is a feature in the local landscape, consideration must be given to its amenity importance when making your recommendations.	Written report. Oral presentation with accompanying notes.
P2, M2	Forest Regeneration	In your role as a project officer for a new woodland initiative within an Area of Outstanding Natural Beauty, you will spend much time encouraging landowners to manage their woodlands and create new ones. As part of that work, you have found that most landowners do not understand the different types of young trees produced by nurseries and you need to create a document that explains these. You have been asked to produce some interpretation material for visitors to the site on the different regeneration methods that they may see.	Annotated poster. Illustrated leaflet. Video clip. Web page.
P3, P4, P5, P6, P7, M3 M4, D2	Forestry Practices	The local authority you work for owns a popular woodland site. Many of the local residents and other user groups have become upset by measures used to protect new plantings and by the harvesting of mature trees, and you have been asked to explain the different forestry practices. As a forestry consultant you have been asked to recommend suitable silvicultural methods for a local authority owned woodland site and present these to a group of local residents.	Oral presentation with accompanying notes. Annotated poster. Illustrated leaflet.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC Land-based sector suite. This unit has particular links with:

Level 2	Level 3
Ecology of Trees, Woods and Forests	TW3 Survey and report on the condition of sites for forest and woodland establishment TW4 Clear sites for tree planting TW5 Cultivate sites for tree planting TW6 Plant trees TW7 Carry out post-planting protection and maintenance TW8 Control unwanted plant growth around trees TW21 Manage coppice rotations TW35 Contribute to the management of forest and moorland firefighting
Forestry Skills	Tree Establishment and Protection
	Tree Pests and Diseases
	Ecology of Trees, Forests and Woodlands
	Forest and Woodland Management

Essential resources

Learners should have access to a range of quality texts on silvicultural systems and practices. In addition, learners should have access to internet sites for further independent study and research. Where possible, a small tree nursery at the centre's site could be a useful resource. Learners should be able to visit several forests and woodlands in the area to observe a variety of silvicultural methods and practices. In addition, links with practical work being carried out in other units, with personal and/or industrial experience, and prepared case studies or examples would be useful to learners.

A lot of learner activities in this unit are suited for group work and visual presentation. Therefore, appropriate rooms for small or large group work would be beneficial as would access to visual presentation equipment such as an overhead projector or image presentation software and hardware.

Employer engagement and vocational contexts

For this unit, centres are encouraged to make links with the Woodland Trust, local country estates, the Forestry Commission and other woodland organisations. A visit to a local commercial tree nursery is also advised. A visit to a sawmill is recommended so that learners can see the effects of silvicultural practices on the quality of timber produced from a variety of trees.

Indicative reading for learners

Textbooks

Evans J – *Silviculture of Broadleaved Woodlands* (Stationery Office Books, 1984) ISBN 9780117101548

Harmer R and Howe J – *The Silviculture and Management of Coppiced Woodlands* (Forestry Commission, 2003) ISBN 9780855385910

Hart C – *Alternative Silviculture Systems to Clear Cutting in Britain: A Review* (The Stationery Office Books, 1995) ISBN 9780117103344

Hart C – *Practical Forestry for the Agent and Surveyor, 3rd Edition* (Sutton Publishing, 1991) ISBN 9780862999629

Johnson P S and Shifley S R – *The Ecology and Silviculture of Oaks* (CABI, 2002) ISBN 9780851995700

Matthews J D – *Silvicultural Systems, 2nd Edition* (Clarendon Press, 1991) ISBN 9780198546702

Peterken G – *Woodland Conservation and Management, 2nd Edition* (Kluwer Academic Publishers, 1993) ISBN 9780412557309

Savill P S – *The Silviculture of Trees Used in British Forestry* (CABI, 1991) ISBN 9780851987392

Savill P, Evans J, Auclair D and Falck J – *Plantation Silviculture in Europe* (Oxford University Press, 1997) ISBN 9780198549086

Journals

Forestry Journal

Quarterly Journal of Forestry

Small Woods

Websites

www.forestry.gov.uk	Forestry Commission
www.rfs.org.uk	Royal Forestry Society
www.woodlandheritage.org	Woodland Heritage
www.woodland-trust.org.uk	Woodland Trust

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are ...
Independent enquirers	researching techniques and practices to protect forests and woodlands from pests, pathogens, fire and weeds obtaining information on common woodland improvement practices.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are ...
Creative thinkers	investigating silvicultural system options selecting appropriate tree and shrub species for a suitable regeneration method exploring a variety of suitable protection methods for a forest or woodland
Reflective learners	presenting information on recommended silvicultural systems and responding to feedback discussing potential regeneration methods and suitable species
Team workers	sharing resources for investigating the silvicultural characteristics of trees and shrubs
Self-managers	organising resources in preparation for field trips to forests and woodlands
Effective participators	justifying their recommendations for a silvicultural system discussing the necessity of various establishment, improvement and harvesting measures in a forest.

Functional Skills – Level 2

Skill	When learners are ...
ICT – Use ICT systems	
Manage information storage to enable efficient retrieval	storing information from various sources to complete assignment work on silvicultural practices
Follow and understand the need for safety and security practices	backing up recently acquired information on more than one device in order to prevent loss
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	carrying out research on different silvicultural practices investigating woodland improvement and harvesting techniques
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	evaluating the suitability of forestry information produced abroad for application locally
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: • text and tables • images • numbers • records	describing selected silvicultural practices and techniques that can be used to successfully establish a forest or woodland
Bring together information to suit content and purpose	recommending a suitable regeneration method for a woodland or forest giving a presentation on the selected methods for the establishment, protection, improvement and harvesting methods for a forest
Present information in ways that are fit for purpose and audience	giving a presentation on the selected methods for the establishment, protection, improvement and harvesting methods for a forest
Evaluate the selection and use of ICT tools and facilities used to present information	creating an illustrated leaflet to describe the different harvesting methods available giving a presentation on the selected methods for the establishment, protection, improvement and harvesting methods for a forest
Mathematics	
Select and apply a range of skills to find solutions	explaining how selected silvicultural systems can be used to achieve varying management objectives on different forest or woodland sites
Draw conclusions and provide mathematical justifications	explaining selected methods for the establishment, protection, improvement and harvesting methods for a forest

Skill	When learners are ...
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	recommending a suitable regeneration method for a woodland or forest giving a presentation on the selected methods for the establishment, protection, improvement and harvesting methods for a forest
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	carrying out research on different silvicultural practices investigating woodland improvement and harvesting techniques
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	writing a report on the recommendations for the establishment, protection, improvement and harvesting of a planned forest or woodland.