Unit 13: Measure Trees and Carry Out Woodland Sampling

Unit code: D/601/1813

QCF Level 3: BTEC National

Credit value: 10

Guided learning hours: 60

Aim and purpose

This unit aims to provide learners with an understanding of measuring trees and woodlands 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

Effective management of trees in forestry or arboriculture relies on the acquisition and interpretation of quantitative data on trees and their growth. The majority of this data comes from field measurements of individual trees and stands of trees and the use of geographic information technologies. This acquired data is analysed to provide information for a number of management purposes, including estimating the volume of single trees and timber in a woodland, and calculating the cost of operations.

This unit introduces learners to the theory and practice associated with the quantitative description of trees and woodlands. Learners have the opportunity to develop the practical skills needed to carry out mensuration and mapping tasks accurately. The unit also allows learners to select appropriate methods and understand the limitations of the available methods.

Learners will discover mensuration conventions commonly employed in UK forestry and measure key parameters of individual trees and stands of trees and how to measure the volume of felled and standing trees on a range of sites and for a variety of purposes. They will study the principles of sampling and apply this understanding to sampling stands of trees and woodlands.

Learning outcomes

On completion of this unit a learner should:

1 Be able to measure trees

2 Be able to measure volume of felled timber and standing trees

3 Be able to sample woodlands.

Unit content

1 Be able to measure trees

Conventions: units of measurement, solid volume, cubic metres, height, weight, diameter and basal area; overbark and underbark measurements; accuracy and precision; leaning trees; trees on slopes; record keeping; diameter at breast height; diameter classes, diameter limits; rounding down; forked trees; deformed trees; coppiced stools

Individual tree parameters: stem diameter (diameter at breast height (DBH), top diameter, mid-diameter); basal area; height (total height, form height and timber height); yield class

Individual stand parameters: stocking density; stand basal area; top height; yield class

2 Be able to measure volume of felled timber and standing trees

Log volume: Huber's formula; Hoppus system, timber stacks; methods advantages, disadvantages; volume to weight ratio; felled timber measurements, conventions, length, rounding down, diameter, recording methods; top diameter measurements for sawlogs and methods for small roundwood

Volume of individual standing trees: volume by sectional measurement; single tree tariff charts

Volume of stands of trees: tariff system; abbreviated tariff; advantages and disadvantages, costs in relation to timber value

3 Be able to sample woodlands

Sampling: sampling methods eg simple random, stratified random and systematic sampling; sources of bias; sampling units (point, transect and plot); plot size; plot shape; plot intensity; plots on boundaries; influence of stocking density on sampling schemes; canopy classes; appropriate trees for a crown thinning and a stem thinning

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 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 explain why trees are measured		**D1** justify the methods and conventions used to assess volume of individual trees, stands and felled timber for a given site or scenario
P2 explain mensuration conventions [IE]		
P3 measure individual tree parameters [IE, TW]		
P4 measure stand parameters [TW]		
P5 measure volume of felled timber [TW]	**M1** select appropriate methods of determining volume for felled timber, individual trees and forest stands	
P6 measure volume of individual trees [TW]		
P7 measure volume of forest stands [TW]		
P8 evaluate sampling methods and units [IE, RL]	**M2** select appropriate sampling methods for a given site to identify the appropriate intensity of marking trees for felling to meet stated objectives.	**D2** justify the choice of sampling and marking intensity of trees on a given site and the methods of mapping and surveying used to establish net and gross areas.
P9 evaluate the influence of woodland structure on sampling schemes [IE RL]		
P10 produce a sampling scheme [IE]		
P11 carry out woodland sampling [TW]		
P12 select and mark trees for felling. [SM, EP]		

PLTS: This summary references where applicable in the pass criteria, in the square brackets, the elements of the personal, learning and thinking skills. 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

Delivery of this unit will involve practical and written assessments, visits to suitable collections and will link to work experience placements.

Tutors delivering this unit should use a wide range of techniques. Lectures, discussions, seminar presentations, site visits, supervised fieldwork, internet and/or library-based research of personal and/or industrial experience would all be suitable. Delivery should stimulate, motivate, educate and enthuse learners.

Learners should have the opportunity to measure trees and undertake tariffing operations as well as measure individual trees on a range of sites. Classroom sessions would be useful for establishing basic mensuration techniques and conventions and for processing and analysing data. It is important that learners carry out as much tree measurement, surveying and mapping as possible.

Due to the variability of woodland sites, learners should be given the opportunity, initially, to measure single species and contiguous stands of trees before moving on to mixed and uneven aged stands. Visiting expert speakers could add to the relevance of the subject for learners. For example, a forest harvesting contractor or forest manager, a forestry consultant, forest surveyor or an arboricultural officer or consultant could talk about their work, the situations they deal with and the methods they use.

Health and safety issues relating to measuring trees, undertaking tariffing operations, or any practical work with any items of equipment, must be stressed and reinforced regularly, and risk assessments must be undertaken before any practical activities. Adequate personal protective equipment (PPE) must be provided and used following the production of suitable risk assessments.

Tutors should consider integrating the delivery, private study and assessment for this unit with other relevant units and assessment instruments learners are taking as part of their programme of study.

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.
Introduction of mensuration conventions and units. Discussion on the uses of mensuration in the management of trees and woodlands.
Assignment 1: Measurements of Single Trees and Stands (P1, P2, P3, P4) Tutor introduces assignment.
Practical work on measurement of individual trees and stand parameters including discussion and independent research into use of conventions and reasons.
Processing and analysing data from practical work exercises.

Topic and suggested assignments/activities and/assessment
Assignment 2: Measurement and Volume Calculation of Felled Timber, Individual Trees and Stands (P5, P6, P7, M1) Tutor introduces assignment and field work.
Fieldwork on sampling and stand volume assessment together with felled and stacked volume.
Classroom work.
Assignment 3: Tariffing (P8, P9, P10, P11, P12, M2) Tutor introduces assignment.
Tariffing work in the field.
Data analysis.
Assignment 4: Mensuration Systems Management (D1, D2) Tutor introduces assignment.
Field work.
Self-study and research.
Individual support.
Unit review.

Assessment

For P1, learners need to explain why trees are measured. This could be assessed alongside P2 and evidenced as part of a report.

For P2, learners have to explain the conventions used in mensuration. This is best evidenced as part of a report or it could be assessed during practical work with suitable methods of evidence recording.

For P3, learners are required to measure the parameters of an individual tree, including stem diameter (DBH), top diameter, mid-diameter height and yield class. Tutors should provide a number of suitable trees to measure and learners need to record data on a suitable form.

For P4, learners need to measure stand parameters, to include stocking stand density, basal area, top height and yield class, and to record answers on a suitable form or with a report. Tutors should provide access to suitable areas for measurement and to any necessary supporting material.

For P5, learners are required to measure the volume of felled timber, to include timber lengths, stacked volume sawlogs and small roundwood. This could be evidenced using a record sheet or through a report.

For P6, learners are required to measure the volume of individual trees by the use of sectional measurement and single tree tariff charts. This is best completed as part of a report.

For P7, learners must measure the volume of forest stands. This should include the use of the tariff system and abbreviated tariff and is best presented as a field work report.

For P8, learners need to evaluate sampling methods and units. This should involves assessing appropriate sampling methods for given sites and is best evidenced within a report.

For P9, learners are required to evaluate the influence of woodland structure on the choice of sampling schemes. This is best evidenced in a report evaluating practical work sites.

For P10, learners are required to produce a suitable sampling scheme for a given area of woodland. This is best evidenced in a report along with mensuration data.

For P11, learners are required to carry out woodland sampling. This is best assessed through learners choosing and applying an appropriate sampling scheme for a given site and producing a written report.

For P12, learners need to select and mark trees, and should include marking trees for removal in a crown thinning and a stem or low thinning. Marking should be carried out using removable tape, rather than permanent paint or axe marks.

For M1, learners are required to select appropriate methods of determining the volume of felled timber and individual trees and stands. This can be evidenced over a period of time through practical work and recorded appropriately or through learners identifying appropriate methods for a given site and type of felled timber.

For M2, learners must select appropriate sampling methods for a given site and identify the appropriate intensity of marking trees for removal to meet stated objectives. This is best evidenced through learners applying appropriate techniques on a selected site and explaining these in a report.

For D1, learners need to justify methods and conventions applied to assess the volume of individual trees, stands and felled timber for a given site or scenario. Evidence could be provided by learners assessing an appropriate site and producing a report.

For D2, learners are required to justify the choice of sampling scheme used and the intensity of marking on a given site and the methods of establishing gross and net areas via mapping and survey work. This is best evidenced through a practical site analysis and a written report on the findings, including maps and drawings as appropriate.

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, P2, P3, P4	Measurements of Single Trees and Stands	As a forester or arborist you are required to measure the parameters of individual trees and stands and to work out, from fieldwork, the data to give accurate parameters. You must explain why mensuration conventions are applied to tree measurement.	Practical fieldwork. Written report. Data analysis.
P5, P6, P7, M1	Measurement and Volume Calculation of Felled Timber Individual Trees and Stands	You are required to measure and work out the volume of felled timber. This should be timber length measurement as well as stacked measure or sawlogs, using appropriate conventions. You are also required to measure and provide estimated volume for individual trees and stands.	Practical field exercises. Written report.
P8, P9, P10, P11, P12, M2	Tariffing	A forest manager's role involves working out appropriate sampling schemes and tariffing for given sites. You are required to use the appropriate techniques to apply a suitable sampling scheme for a given site and to mark trees for removal to meet stated objectives (for example, thinning to meet a target volume to be removed).	Field data and a report.

Criteria covered	Assignment title	Scenario	Assessment method
D1, D2	Mensuration Systems Management	This assignment may be combined with the above assignment. This can be determined by the tutor. As a manager you are required to work out the appropriate mensurational techniques and survey methods for a given area to meet stated objectives and to justify these techniques in terms of accuracy and cost effectiveness.	Written report.

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
Introduction to Practical Forestry Skills	Understanding Woodland Management
Undertaking Ecological Surveys and Techniques	Understand the Principles of Silviculture
	Undertake Tree Surveys and Inspections and Analyse the Data
	T9 Select, mark and measure trees

Essential resources

Learners will need access to a range of mensuration resources including DBH tapes, linear tape measures, drag tapes, logging tapes, surveyor's chains, measuring wheels, callipers, compasses, scale rulers, planimeters, clinometers, hypsometers and relascopes. Learners should have the opportunity to study a range of individual trees and different woodlands, as well as different species in a range of surroundings.

Access to the internet and a library with multiple copies of specialist texts is also essential.

Employer engagement and vocational contexts

This unit would be enhanced by visits to operational sites where tariff work is ongoing and/or has been completed, to meet with organisations that use these methods of timber measurement, such as the Forestry Commission, management and harvesting companies, and larger private estates.

Visits to see felled timber sites and opportunities to measure different species would also be beneficial, as would visits from speakers from timber buying companies and sawmills if possible.

Indicative reading for learners

Textbooks

Avery T and Burkhart H – *Forest Measurements* (McGraw-Hill Publishing, 2001) ISBN 9780071130059

Hamilton G – *Forest Mensuration Handbook, 4th Edition* (The Stationery Office Books, 1996) ISBN 9780117100237

Hibberd B – *Forestry Practice* (The Stationery Office Books, 1991) ISBN 978011710281 1

Lillesand T, Kiefer R and Chipman J – *Remote Sensing and Image Interpretation* (John Wiley & Sons, 2003) ISBN 9780471451525

Philip M – *Measuring Trees and Forests, 2nd Edition* (CABI Publishing, 1994) ISBN 9780851988832

Rollinson T – *Thinning Control, 3rd Edition* (Stationery Office Books, 1988) ISBN 9780117102569

West P – *Tree and Forest Measurement* (Springer Verlag, 2003) ISBN 9783540403906

Journals

Forestry

Forestry and British Timber

Quarterly Journal of Forestry

Website

www.forestry.gov.uk Forestry Commission

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	analysing appropriate mensuration systems for given sites
Creative thinkers	applying appropriate techniques to given situations
Reflective learners	improving their learning through reflective practice in the application of fieldwork
Team workers	gathering mensuration data and carrying out survey work
Self-managers	organising reports and managing their time
Effective participators	working as part of a team gathering field data.

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 ...
Independent enquirers	applying appropriate systems and mensuration equipment
Creative thinkers	reviewing various mensuration systems and their application
Reflective learners	reflecting on practical work and the application of sampling schemes appropriate to a given site
Team workers	participating in effective teamwork and communications when applying mensuration systems
Self-managers	organising and applying mensuration systems and techniques effectively
Effective participators	working to capture reliable data on site and in teamwork.

Functional Skills – Level 2

Skill	When learners are ...
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	using spreadsheets to work out mensuration data
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	evaluating the use of spreadsheets within mensuration data management
Manage information storage to enable efficient retrieval	storing information for assessment
Follow and understand the need for safety and security practices	safely storing and retrieving information
Troubleshoot	
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	researching mensuration systems
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	producing data tables and mensuration information
Present information in ways that are fit for purpose and audience	presenting mensuration data
Evaluate the selection and use of ICT tools and facilities used to present information	using spreadsheets
Select and use ICT to communicate and exchange information safely, responsibly and effectively including storage of messages and contact lists	carrying out internet research using spreadsheets in mensuration calculations and data storage
Mathematics	
Understand routine and non- routine problems in a wide range of familiar and unfamiliar contexts and situations	analysing mensuration data gathering site data and measurements of tree parameters
Identify the situation or problem and the mathematical methods needed to tackle it	analysing mensuration data
Select and apply a range of skills to find solutions	analysing mensuration data
Use appropriate checking procedures and evaluate their effectiveness at each stage	analysing mensuration data

Skill	When learners are ...
Interpret and communicate solutions to practical problems in familiar and unfamiliar routine contexts and situations	analysing mensuration data
Draw conclusions and provide mathematical justifications	analysing mensuration data
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	contributing to teamwork and fieldwork
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	producing a mensuration handbook
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	producing reports.