

# Unit 36: Undertake Site Surveying, Levelling and Setting Out

<b>Unit code:</b>	<b>Y/600/9882</b>
<b>QCF Level 3:</b>	<b>BTEC National</b>
<b>Credit value:</b>	<b>10</b>
<b>Guided learning hours:</b>	<b>60</b>

## ● Aim and purpose

This unit aims to provide learners with an understanding of how to undertake site surveying, levelling and setting out and how these can be applied in practice. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or further education and training.

## ● Unit introduction

Surveying is a useful skill for all horticulturists who are likely to be involved in the development of sites, whether relating to garden design, sports or nurseries. It is relevant to those who produce site maintenance and development programmes, and garden design plans, as many sites do not have accurate plans that show detail other than boundaries.

Learners will develop the skills needed to carry out accurate linear and level surveys using equipment that is commonly available within the industry. They will look at the presentation of survey and site appraisal data. The survey of a site is enhanced by the process of site appraisal which identifies the presence and quality of all existing features on site. In addition, the current and proposed use of the site is analysed, helping learners to identify potential design and maintenance solutions while taking relevant constraints into account.

Finally, they will consider issues of setting out a site from a plan. This includes two-dimensional areas and three-dimensional setting out and covers the setting out of gradients for, for example, surfaces, foundations, irrigation and drainage.

## ● Learning outcomes

**On completion of this unit a learner should:**

- 1 Be able to measure site dimensions and levels
- 2 Understand site survey equipment and techniques
- 3 Understand the presentation of survey data
- 4 Be able to set out on the ground from plans, including shapes and levels.

# Unit content

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## 1 Be able to measure site dimensions and levels

*Linear survey:* stations; base line; offsets; recording methods; equipment (chain or tape base line); triangulation of base lines for large sites and features to be recorded eg boundaries, paths, trees, permanent features

*Scale drawing:* equipment required; use of scales in producing drawings; process of interpreting survey data; tracing plan to produce base plan

*Possible errors:* poor base line; inaccurate offsets; poor recording; inaccurate equipment

*Aids to accuracy:* use of check lines in linear survey

## 2 Understand site survey equipment and techniques

*Level survey:* permanent benchmark; temporary benchmark; spot heights; grid survey, cross-section; method of recording (rise and fall or height of collimation)

*Heights:* correct labelling of plan

*Correct methods:* correct recording; use of numeracy in surveys

*Aids to accuracy:* arithmetic checks; closing of survey

*Surveying equipment:* appropriate equipment eg measuring devices, compass, levels, global positioning systems (GPS), optical or laser levels equipment

## 3 Understand the presentation of survey data

*Inventory:* listing all features on site; features (boundaries, buildings, hard landscape items, services, planted areas, specimen plants and trees, access points); characteristics (topography, soil types, climate, microclimate, slope, aspect, views in and out of the site, function, circulation); quality eg construction and maintenance of built features, health and structure of plants; constraints eg planning conditions, Tree Preservation Orders (TPO) 2006, client requirements

*Presentation:* purpose and application of different survey types, metric scales, units of measurement, grid references and bearings; process of laying out, plotting and draughting survey drawings; use of GPS, Geographical Information Systems (GIS) and computer aided draughting systems

## 4 Be able to set out on the ground from plans, including shapes and levels

*Geometric features:* rectangle; arc; circle; hexagon; ellipse

*Site:* drainage, irrigation; 3D features including gradients, changes of level, steps

*Plan:* reading and interpretation of plan data – linear and levels

*Setting out:* evaluation of data set out to fulfil the proposed plan

*Levels:* working from a benchmark; transfer and setting of levels; data from plan to ground

## 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:
<p><b>P1</b> measure site dimensions and levels using a range of survey equipment safely [IE, TW, SM, RL, EP]</p>	<p><b>M1</b> carry out accurate surveying to meet given objectives with minimal assistance</p>	<p><b>D1</b> evaluate selected horticultural scale drawings and make recommendations for improvement</p>
<p><b>P2</b> record and collate site readings [IE, SM, RL]</p>		
<p><b>P3</b> present survey data in an appropriate format [IE, TW, SM, EP, RL]</p>		
<p><b>P4</b> explain the safe use and maintenance of surveying equipment, including poles, tapes, optical and laser levels and theodolites, electronic and global positioning system (GPS) measuring devices</p>	<p><b>M2</b> explain in detail each stage of surveying carried out</p>	
<p><b>P5</b> explain the principles and processes of surveying techniques, including triangulation, bearings and offsets, sloping ground, GPS and total stations including dealing with site problems, sources of error and degrees of accuracy</p>		

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:
<b>P6</b> explain the purpose and application of different survey types, metric scales, units of measurement, grid references and bearings	<b>M3</b> explain in detail given surveys	
<b>P7</b> describe the process of laying out, plotting and draughting survey drawings from field data		
<b>P8</b> review the use of GPS, GIS and computer-aided draughting systems of plotting surveys		
<b>P9</b> mark out sites from plans of different scales, including features, structures and plants	<b>M4</b> set out a 3D feature on a selected horticultural site to meet given objectives.	<b>D2</b> evaluate geometric and 3D features on a selected horticultural site to meet given objectives and make recommendations for improvement.
<b>P10</b> set out rectangles, circles, hexagons, ellipses and irregular shapes		
<b>P11</b> set out levels and falls accurately and in compliance with site safety requirements.		

**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.

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

# Essential guidance for tutors

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## Delivery

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

Tutors delivering this unit have opportunities to use as wide a range of techniques as possible. Lectures, discussions, seminar presentations, site visits, supervised surveying and setting out practicals, research using the internet and/or library resources and the use of personal and/or industrial experience would all be suitable. Delivery should stimulate, motivate, educate and enthuse learners.

Work placements should be monitored regularly in order to ensure the quality of the learning experience. It would be beneficial if learners and supervisors were made aware of the requirements of this unit before any work-related activities are undertaken, so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to carry out a site survey and they should ask for observation records and/or witness statements to be provided as evidence of this. Guidance on the use of observation records and witness statements is provided on the Edexcel website.

Visiting expert speakers could also add to the relevance of the subject for learners. For example, garden designers, contractors or estate managers could talk about their work, the situations they face and the benefits of accurate surveys.

Whichever delivery methods are used, it is essential that tutors stress the importance of good site management and the need to manage the resource using legal methods.

Health and safety issues relating, for example, to the use of hand tools and trip hazards must be stressed and reinforced regularly, and risk assessments must be undertaken before 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 which learners are taking as part of their programme of study.

Learning outcome 1 is likely to be delivered through formal lectures, discussion, site visits, practicals and independent learner research. On completion, learners will be aware of the various techniques used in linear surveying and in transferring the information to a scaled plan. There should be progression from surveying a small site from one base line to surveying a large site, using offsets and triangulation to establish the site boundaries and existing features, for example surveying in a tree or structure. The need for accuracy must be stressed, since inaccurate recording will affect the implementation of, or any changes to, a plan and may incur an eventual cost penalty.

Learning outcome 2 covers the equipment and techniques used in taking a level survey. It develops the knowledge and skills gained in learning outcome 1 and takes the plans produced further. Delivery techniques will be similar to those used for learning outcome 1. Learners must be given the opportunity to carry out level surveys, collect data and then produce plans using the collected data. Learners will transfer this data in the form of spot heights or contour lines which will help to identify any changes in the topography affecting possible changes in the design or management of the site. It is vital that accuracy is an intrinsic part of calculating levels, especially where water is involved.

Learning outcome 3 covers the process of site appraisal which helps to identify the character of the site in question. Learning outcomes 1 and 2 define the physical appearance but learning outcome 3 puts a value on existing features and identifies scope for change. It is expected that formal lectures and discussions, to introduce ideas, and site visits should form part of the delivery of this learning outcome. Practical sessions in a drawing office will allow learners to develop their drawing skills so that the ideas can be presented graphically.

Learning outcome 4 looks at the methods used to set out features and sites. It is expected that formal lectures, demonstrations and practicals should form part of the delivery of this learning outcome.

## 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.
<b>Assignment 1: Carry out a Survey</b> (P1, P4, P5, P6, P7, M1, D1)
Tutor introduces the assignment.
Theory session: surveying. Tutor to demonstrate the basic techniques for measuring and recording information gathered on a linear survey, ie taking linear measurements, triangulation and offsets. Define the need to develop an accurate record of any given site. The tutor may demonstrate the topic by showing a selection of survey plans.
Practical surveying: introduce the exercise, review the equipment, correct usage and measuring techniques. Learners to develop the ability to practise and demonstrate basic skills and techniques in gathering and recording survey data.
Practical session: recording of information can be written as notes on the site plan and supported by photographs to which text can be added.
<b>Assignment 2: Carry out a Site Appraisal</b> (P2, M3)
Tutor introduces the assignment.
Theory session: site appraisal. Tutor to introduce the topic, explore what learners should be looking for and its role in developing an accurate analysis of a given site.
Theory session: tutor to discuss the importance of recognising any issues as part of the appraisal eg hazardous structures, poor construction – steps too deep, large cracks in walls and how this should form part of the site appraisal and will also inform health and safety measures.
Practical site appraisal 1 Learners to develop the ability to observe, analyse and record the demographic features of a site, both hard and soft landscaping. Recording of information can be written and supported by photographs.
Practical session: learners to develop their observation skills by looking at and analysing a selection of site plans with appraisal notes.
Practical site appraisal 2 Learners to develop the ability to observe, analyse and record the demographic features of another site, which is very different in nature to the previous site, both hard and soft landscaping. Recording of information can be written and supported by photographs.
Practical session: learners to develop their skills in adding analysis data to photographs as an alternative method of presenting site appraisal information.

## Topic and suggested assignments/activities and/assessment

Practical drawing: introduce the topic and its role in providing an accurate, scaled, plan drawing with site analysis of a given site. Introduce the equipment used, for example scale rulers, compass, set square, correct usage and demonstrate the drawing techniques used to produce a scaled, plan drawing.

Learners to develop the ability to interpret the information gathered from the survey and the drawing skills to draw up a scaled, plan drawing of the same site.

Practical session: simple drawing to scale exercises.

Learners to develop the ability to use the equipment and skills required to produce a scaled plan.

### **Assignment 3: Carry out a Levels Survey and Record the Data.** (P8, M2, D2)

Tutor introduces the assignment.

Theory session -practical levels surveying: introduce the topic and its role in developing an accurate survey, changes in level record of a sloping site.

Theory session: demonstrate how changes of level will inform and influence the design of the site eg a sloping site will require steps or ramps for safe use.

Theory session: demonstrate the safe design and construction for steps and ramps.

Practical levels survey session: introduce the equipment, correct usage and techniques.

Learners to develop the ability to demonstrate basic skills and techniques in gathering and recording levels survey information.

Theory session: introduce the methods used to calculate the changes in level.

Demonstrate the accepted methods for accurate plotting of the same on the plan eg reduced levels shown as figures where recording is taken.

Learners to develop the ability to use the required mathematical methods to calculate the changes in level.

Theory session: introduce and demonstrate the role of a 'cross-section' in showing both existing and proposed changes of level.

Tutor can use existing 'cross-section' drawings to demonstrate.

Theory session: using a selection of horticultural cross section drawings learners are to develop skills in evaluating the plans and recording a number of recommendations for improvement of the site.

Theory and practical session: demonstrate the method of producing a 'cross-section' drawing from existing levels data on a scaled levels plan.

Learners to develop the ability to produce a 'cross-section' from the levels data recorded on their site plan.

Practical drawing: learners to develop a series of drawings showing existing and proposed levels as cross-section drawings.

Practical drawing: introduce the topic and its role in providing an accurate analysis, scaled levels plan drawing of a given sloping site.

Learners to develop the ability to interpret the information gathered from the levels survey and to develop the skills to draw up a scaled levels plan drawing of the same site.

### **Assignment 4: Setting Out.**(P3, P9, P10, P11, M4)

Tutor introduces the assignment.

Theory session: tutor to introduce the topic; demonstrate a setting out plan and methods of setting out a design on a site.

Practical session: setting out a design. Explain the exercise.

Learners to develop skills in reading a design plan and setting it out on site to meet the objectives of the proposed design.

## Topic and suggested assignments/activities and/assessment

Practical session: setting out a 3D feature. Explain the exercise.

Learners to develop skills in reading the design plan, setting out a 3D feature on site to meet the objectives of the proposed design.

Evaluate the work and make recommendations for improvement.

Unit review.

## Assessment

For P1, learners must carry out a linear survey with one base line to meet given objectives and produce a scale drawing. Tutors should identify the objectives or agree them through discussion with learners. Where possible, to ensure assessment is fair the size and complexity of the tasks should be the same for all learners. Learners are expected to produce a scale drawing to meet the objectives and to show evidence that they have completed the survey and recorded the data.

P1 could be assessed directly by the tutor during practical activities. If this format is used then suitable evidence from guided activities would be observation records completed by learners and the tutor and accompanied by appropriate worklogs or other relevant learner notes. If assessed during a placement, witness statements should be provided by a suitable representative and verified by the tutor. This could be linked to evidence for other assessment and grading criteria.

For P2, learners must carry out an inventory of a selected horticultural site, identifying site features. Tutors should identify the site or agree it through discussion with learners. The site may be the same as that used to provide evidence for other assessment and grading criteria. Where possible, to ensure assessment is fair the size and complexity of the tasks should be the same for all learners. Evidence could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector), an annotated poster or a written assignment.

P3 requires learners to set out geometric features on a selected horticultural site to meet given objectives. Tutors should identify the site or agree it through discussion with learners. The site may be the same as that used to provide evidence for other assessment and grading criteria. Where possible, to ensure assessment is fair the size and complexity of the tasks should be the same for all learners. Learners are expected to provide evidence for all geometric features listed in the unit content. Evidence can be in the same form as for P1.

For P4, P5, P6, P7 and P8, learners could produce a report on surveying, levelling and setting out.

P9, P10 and P11 could be assessed directly by the tutor during practical activities. If this format is used then suitable evidence from guided activities could be observation records completed by learners and the tutor and accompanied by appropriate worklogs or other relevant learner notes. If assessed during a placement, witness statements could be provided by a suitable representative and verified by the tutor.

For M1, learners must carry out accurate surveying to meet given objectives with minimal assistance. Tutors should identify the objectives or agree them through discussion with learners. Where possible, to ensure assessment is fair the size and complexity of the tasks should be the same for all learners. Learners are expected to produce a scale drawing to meet the objectives and to show evidence that they have completed the survey and recorded the data. Evidence may be in the same form as for P1.

For M2, learners must explain in detail each stage of surveying carried out. This might be evidenced through a report linking to P4, or through practical activities and oral questioning.

M3 requires learners to explain in detail given surveys. Tutors should identify the survey or agree it through discussion with learners. The survey may be the same as that used to provide evidence for other grading criteria. Where possible, to ensure assessment is fair the size and complexity of the tasks should be the same



for all learners.

For M4, learners must set out a 3D feature on a selected horticultural site to meet given objectives. Tutors should identify the site and objectives or agree them through discussion with learners. The site may be the same as that used to provide evidence for other grading criteria. Where possible, to ensure assessment is fair the size and complexity of the tasks should be the same for all learners. This requires a two-stage process, firstly setting out the site and then using appropriate equipment to show the height and depth of the constituent parts of the site or feature. The techniques of linear and level surveying can be used to produce an accurate site layout. Evidence could be in the same format as for P1.

For D1, learners must evaluate selected horticultural scale drawings and make recommendations for improvement. Tutors should identify the drawings or agree them through discussion with learners. The drawings may be the same as those used to provide evidence for other grading criteria. Where possible, to ensure assessment is fair the size and complexity of the tasks should be the same for all learners. Learners are expected to provide evidence for three different scale drawings. Recommendations for improvement must be realistic and appropriate. Evidence could be in the same form as for P2.

D2 requires learners to evaluate geometric and 3D features on a selected horticultural site to meet given objectives and make recommendations for improvement. Tutors should identify the site or agree it through discussion with learners. The site may be the same as that used to provide evidence for other grading criteria. Where possible, to ensure fairness of assessment the size and complexity of the tasks should be the same for all learners. Recommendations for improvement must be realistic and appropriate. Evidence could be in the same form as for P3.

### 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, P4, P5, P6, P7, M1, D1	Carry out a Survey	You are to carry out a survey, on a site chosen by your tutor. You are to use a range of equipment and methods and demonstrate skills in and understanding of the process you are carrying out.	Practical observation and assessment. Drawn plan to scale.
P2, M3	Carry out a Site Appraisal	You are to carry out a site appraisal and record the information using a variety of methods.  Demonstrate how existing site features will influence your design proposals.	Practical observation and assessment.  Site appraisal information presented on the survey plan and/or as photographs with supporting text.  Evaluation of existing site and design proposals.

Criteria covered	Assignment title	Scenario	Assessment method
P8, M2, D2	Carry out a Levels Survey and Record the Data	You are to carry out a levels survey, use a variety of methods to record and calculate the data and produce a fully scaled, levels plan with cross- sections.  Demonstrate how existing site features will influence your design proposals.	Practical observation and assessment.  Levels plan, drawn to scale, showing reduced levels on the plan and cross sections.  Evaluation of existing levels and their influence on design proposals.
P3, P9, P10, P11, M4	Setting Out	You are to demonstrate your plan reading and interpretation skills by setting out a selection of shapes within a design with a 3D element.	Practical observation and assessment.  Written evaluation with recommendations.

## 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
Setting Out from a Plan	L19 Create grassed and planted areas CU91 Assess the characteristics of sites
	Understand the Principles and Practices of Landscape and Garden Design
	Establish and Manage Exterior Plant Displays
	Establish and Manage Interior Plant Displays
	Construct and establish Sports and Amenity Turf Areas
	Manage Winter and Summer Sports Turf Surfaces
	Prepare Landscape and Garden Design Briefs

## Essential resources

Learners will need access to 30 m tape measures, optical auto levels and an appropriate number of poles, canes or pegs to mark the position of base lines. It is possible to use laser levels but they should be used in conjunction with a staff for measuring rises and falls. Drawing boards and associated equipment and materials are required to enable learners to produce drawings to A2 or A1 size.

Access to horticultural sites with a wide range of features and associated buildings is required to give learners a realistic site for surveying and appraisal.

## Employer engagement and vocational contexts

This unit focuses on the practical aspects of site survey, both linear and levels, and site appraisal, the associated skills being acquired through a series of practical exercises. The recorded data is then collated and, through practical drawing sessions, interpreted as fully scaled and annotated plans of the given site, which are used as a basis for the final stage of on site setting out. Tutors are encouraged to create a diverse range of exercises within which learners have plenty of opportunity to put theory into practice. Learners could develop and apply their knowledge by also undertaking an independent site survey as well as centre-based exercises.

## Indicative reading for learners

### Textbooks

Bannister A, Raymond S and Baker R – *Surveying, 7th Edition* (Longman, 1999) ISBN 978-0582302495

Clancy J – *Site Surveying and Levelling, 2nd Edition* (Architectural Press, 1991) ISBN 978-0340505472

Whyte W and Paul R – *Basic Surveying, 4th Edition* (Architectural Press, 1997) ISBN 978-0750617710

### Websites

[www.defra.gov.uk](http://www.defra.gov.uk)

Department for Environment, Food and Rural Affairs

[www.environment-agency.gov.uk](http://www.environment-agency.gov.uk)

Environment Agency

[www.hse.gov.uk](http://www.hse.gov.uk)

Health and Safety Executive

[www.lantra.co.uk](http://www.lantra.co.uk)

Lantra Sector Skills Council

## 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 ...
<b>Independent enquirers</b>	carrying out a level survey to meet given objectives and recording spot heights on a plan
<b>Creative thinkers</b>	considering the site appraisal information and how this will influence the design proposals
<b>Reflective learners</b>	evaluating and applying their learning to practical exercises making recommendations based on the evaluation of information collected
<b>Team workers</b>	carrying out practical survey and analysis exercises participating in group discussions
<b>Self-managers</b>	planning and organising their work in order to meet deadlines
<b>Effective participators</b>	working and contributing to a group exercise/discussion

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 ...
<b>Independent enquirers</b>	acting independently with regard to researching the given subject matter
<b>Creative thinkers</b>	finding solutions to problems
<b>Reflective learners</b>	reflecting and drawing on previous information and learning experiences in order to consolidate their learning
<b>Team workers</b>	interacting and communicating with members of a team to achieve and fulfil a given task
<b>Self-managers</b>	demonstrating an ability to organise/manage themselves and any required tasks, using a planned structured approach
<b>Effective participators</b>	demonstrating that they can successfully participate in any required task