Fieldwork sites at the Derwent Gorge, near Castleside, County Durham

- **Geography**
  Soils and vegetation in the Derwent Gorge

Geography

ORGANISATIONAL DETAILS

Aim of fieldwork

To investigate the relationship between soils, vegetation and slope in the Derwent Gorge and consider the reasons for the area's designation as a National Nature Reserve.

Target Group

Key Stage 4 geography.

Location

Derwent Gorge, County Durham

Practical Details

- Parking – Coaches must park at Mosswood (GR: NZ 067506). Minibuses can park at the junction to the northeast of Crooked Oak (GR: NZ 057501). Please ensure that no agricultural access is blocked.
- Useful map – Ordnance Survey 1:25 000 Explorer Map 307 Consett and Derwent Reservoir.
- Natural England should be contacted before any fieldwork at this site is undertaken. The contact details are as follows:

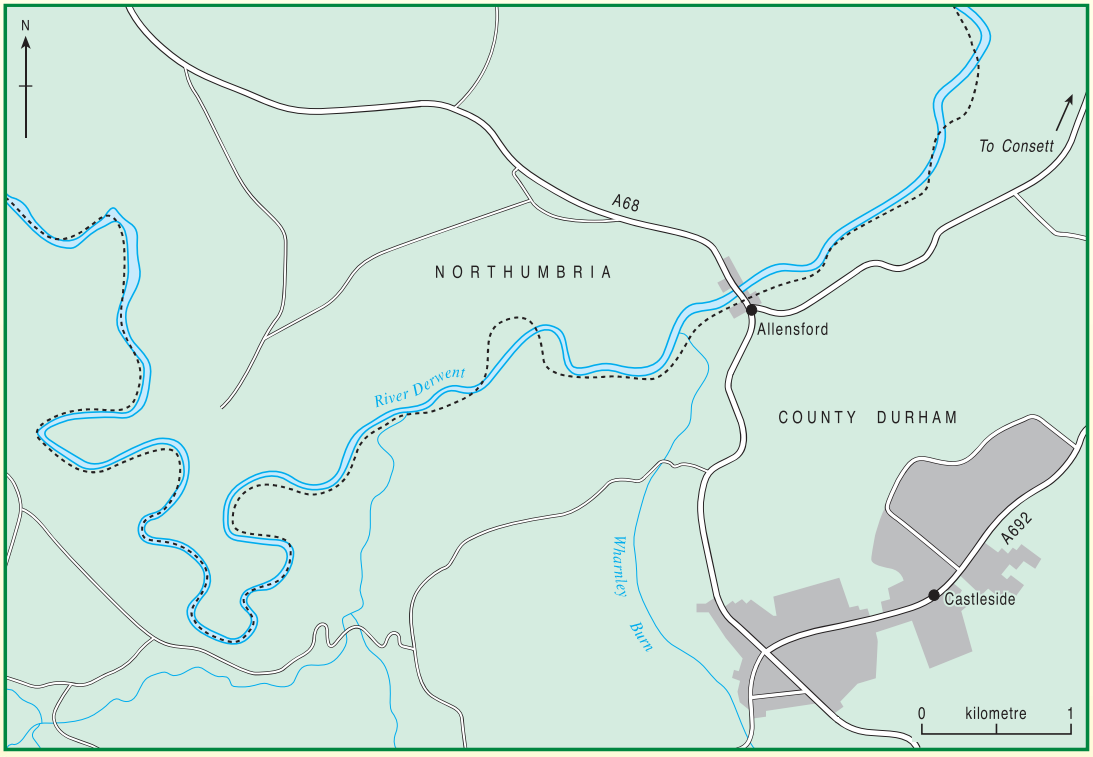
  Site Manager,
  Derwent Gorge and Muggleswick Woods
  National Nature Reserve, Widdybank Farm,
  Forest-in-Teesdale,
  Barnard Castle,
  Co. Durham,
  DL12 0HW.
  Telephone: 01833 622374.

Safety Issues

- Special care should be taken getting on and off the coach or minibus.
- The access from Mosswood is along a minor road. Although a quiet road it is used by heavy agricultural traffic.
- Care should be taken within the Derwent Gorge as there are very steep slopes, river cliffs and fenced-off mine shafts.
- Refer to the Hazard Identification Sheet.

Soils and Vegetation in the Derwent Gorge

Fieldwork Outline - Teacher Resource Sheet



HAZARDS IDENTIFICATION SHEET

The following notes will help teachers conduct their own risk assessments. This is not a risk assessment and teachers should follow guidelines from the Department of Children, Schools and Families.

Hazard Identified	Risk and to whom	Control measures
Getting on and off the coach or minibus	Caution needed when getting off the coach or minibus. All students and staff.	Supervise students getting off the coach or minibus and gather in a safe place.
Narrow minor road	The road to the Derwent Gorge is narrow and although quiet is used by heavy farm vehicles and machinery. All students and staff.	Warn about conditions. Walk in single file and have a leader and back marker to warn about approaching vehicles.
Uneven paths	Paths are uneven and may be slippery in wet weather. Students may slip and fall. All students and staff.	Warn about conditions.
Unfenced sections of river	The river is unfenced in certain sections. All students and staff.	Warn about conditions. Close supervision needed along the unfenced river sections.
Steep slopes and river cliffs	There are unfenced steep slopes and river cliffs in the Derwent Gorge. All students and staff.	Warn about conditions. Keep students and staff away from areas where they could fall.
Mine shafts	There are fenced-off mine shafts in some areas. All students and staff.	Warn about conditions. Do not enter mine shafts.

INTRODUCING THE FIELDWORK

Purpose and aims of the visit

The main purpose of the fieldwork is to look at the relationship between soils, vegetation and slope in the Derwent Gorge and to look at the reasons for the area's designation as a National Nature Reserve.

The aims of the fieldwork are:

- To look at the geological and geomorphological features of the Derwent Gorge
- To consider how people have used the area in the past
- To investigate the relation between soils, vegetation and slope along a transect in the Derwent Gorge and
- To look at the reasons for the area's designation as a National Nature Reserve

Background information

The Derwent Gorge is a deeply incised gorge created by the River Derwent cutting into the Carboniferous rocks of the area. The rocks were formed 350 – 290 million years ago during the Carboniferous Period in a shallow, tropical sea. The river cliffs of the Derwent Gorge show exposures of sandstone and shale. The River Derwent has cut into the these rocks, probably at end of the last glacial period, due to melt water and the possible rise of the land relative to sea level as the weight of the ice was removed. The Derwent Gorge and Muggleswick Woods were declared a National Nature Reserve in 1992 as they contain some of the finest ancient oak woodlands in northeast England.

- General introduction - Introduce the area using the O.S. map extract, comparing the Derwent Gorge with the area around it.
- Soil and vegetation relationships – use Student Information Sheet 1 to introduce vegetation and soil relationships.

Having introduced the aims of the fieldwork and ideas relating to soils and vegetation set up hypotheses based around the following:

- Does the dominant tree cover vary across the slope?
- Does the vegetation of the herb and shrub layer vary across the slope from the top of the gorge to the bottom?
- Does the depth of soil vary across the slope?
- Does the PH of the soil vary?
- Does the angle of slope vary?

Add your hypotheses to Student Resource Sheet 2.

Introducing Fieldwork Methods

1. Introduction to the Derwent Gorge

This will involve a walk and information for each site is provided in the 'Undertaking fieldwork' section and information can be recorded on Student Resource Sheet 1.

2. Soils and vegetation survey

Introduce the fieldwork methods needed to test the hypotheses. Use student Information Sheet 2 to introduce the methods and record the results on Student Resource Sheet 2.

UNDERTAKING THE FIELDWORK

1. Introduction to the Derwent Gorge

If arriving by coach, park at Mosswood (GR: NZ 067506). It is just over 1 km to Crooked Oak from here. Minibuses can park at the junction before Crooked Oak. From Crooked Oak walk along the footpath into the Derwent Gorge.

The table below provides information about each stop on the walk and students can record the information on Student Resource Sheet 1.

Location and grid reference	Background information
1. National Nature Reserve sign (GR: NZ 055495)	This point is the entrance to the Derwent Gorge and Muggleswick Woods National Nature Reserve. It was declared a National Nature Reserve in 1992 as it has some of the finest ancient oak woodland in northeast England. The steep-sided valleys carved by the River Derwent and its tributaries, the Horsleyhope and Hisehope Burns, has limited the human influence on the woodland. The woodland displays a range of shrubs and herbs below the canopy as well as ferns and fungi and over 60 species of lichen. Breeding birds of the Reserve include redstart, pied flyctacher and wood warbler. Kingfisher, dipper, grey wagtail and goosander are found along the river. Mammals in the wood include red squirrel, roe deer and badger. Complete activity 1 on Student Resource Sheet 1. Continue along the footpath for another 400m until you see a track to the left that goes down to the River Derwent. Follow the track to the field at the bottom and then cross the field to obtain a view of the river cliff.
2. Combfield House river cliff (GR: NZ 057493)	The river cliff on the opposite side of the river exposes the rocks of this area of the North Pennines. The rocks are from the Carboniferous Period, 350 – 290 million years ago (Ma). The cliff face shows beds of sandstone that vary in thickness and layers of shale. These rocks have been cut into by the River Derwent. This probably happened at the end of the last glacial period when the discharge of the river was increased due to large volumes of melt water. The river may also have incised as a result of the land rising relative to the sea level as the weight of the ice was removed from the land. Complete Activity 2, Student Resource Sheet 1.
3. Silvertongue Mine (GR: NZ 057493)	Cross the field back towards the track. In the northern corner of the field there is a fence and stile. Cross the stile and follow the footpath for about 30 metres and you will see various piles of stone – these are the remains of the workings of the Silvertongue Mine. The Silvertongue Mine was a lead mine. The only record of output is 138 tons of galena in 1848; the silver content is stated to have been 30 oz per ton of lead.
4. Bottom of the track (GR: NZ 056492)	Return to the bottom of the track. If you look closely at some of the trees here you can see that lots of branches sprout from the base of the tree. This indicates that the tree has been coppiced. Coppicing is the cutting down of stands of trees in rotation. In the 19th century stands of trees in the Derwent Gorge were coppiced with the wood being used to make charcoal. The charcoal was used in lime kilns. Lime kilns burnt limestone to produce quicklime which could be powdered and put on the fields to improve the soil. Looking across the field you can see that the field is on the inside of a meander. This is the only land within the Derwent Gorge that can be used for farming as it is not so steep. This field is a hay meadow. The hay from it will be used to feed animals over the winter. Use the information from stop 3 and 4 to complete Activity 3 on Student Resource Sheet 1.

2. Soils and vegetation survey

The soils and vegetation survey will be carried out along a transect that runs from the woodland just to the northwest of the main footpath (GR: NZ 055490) to the River Derwent (GR: NZ 057493). Recap the hypotheses recorded on Student Resource Sheet 2 and the methods using Student Information Sheet 2. Divide the class into groups of 3 – 4. Carry out the survey every 50m along the transect, recording the results on Student Resource Sheet 2. Tree canopy information can be recorded as a class.

Fieldwork equipment

The following equipment will be required:

- 100m tape
- Soil auger
- Metre rule
- Gun clinometer
- 2 x ranging poles
- 0.5m2 quadrat
- Soil testing kit or pH probe
- Tree identification guide
- Flower identification guide

FOLLOWING UP THE FIELDWORK

1. Introduction to the Derwent Gorge

Using the information you have gathered write a paragraph about the Derwent Gorge. Include information on the following:

- The location of the area using the O.S. map and aerial photograph
- The geology and geomorphology of the gorge
- The wildlife habitats of the gorge
- The human use of the gorge
- Why it was designated a National Nature Reserve

2. Soils and vegetation survey

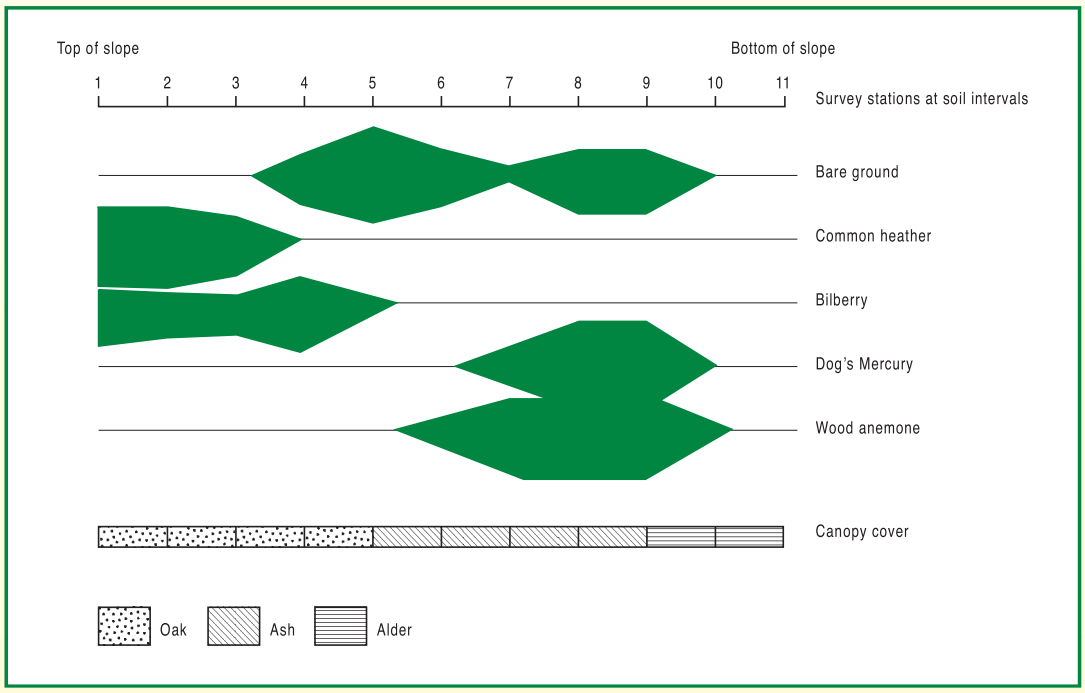
a. On graph paper or on the computer draw graphs to show the following:

- Distance along the transect against slope angle
- Distance along the transect against soil depth
- Distance along the transect against soil acidity (pH)

b. Draw 2 scatter diagrams. The first graph should have slope angle on the x-axis and pH on the y-axis. The second graph should have slope angle on the x-axis and soil depth on the y-axis. Draw a best-fit line through your results.

c. Describe what your graphs show. Suggest why your graphs show the relationships they do.

d. For your quadrat data draw a kite diagram. Draw a kite diagram for each species you have recorded as a percentage cover, including the bare ground data. The diagram below shows a kite diagram. If at site 1 common heather formed 46% of the cover, an area representing 23% is shaded each side of the horizontal axis. This repeated for each plant species at each site and the kites made by joining the results for each site together and shading the area. This type of

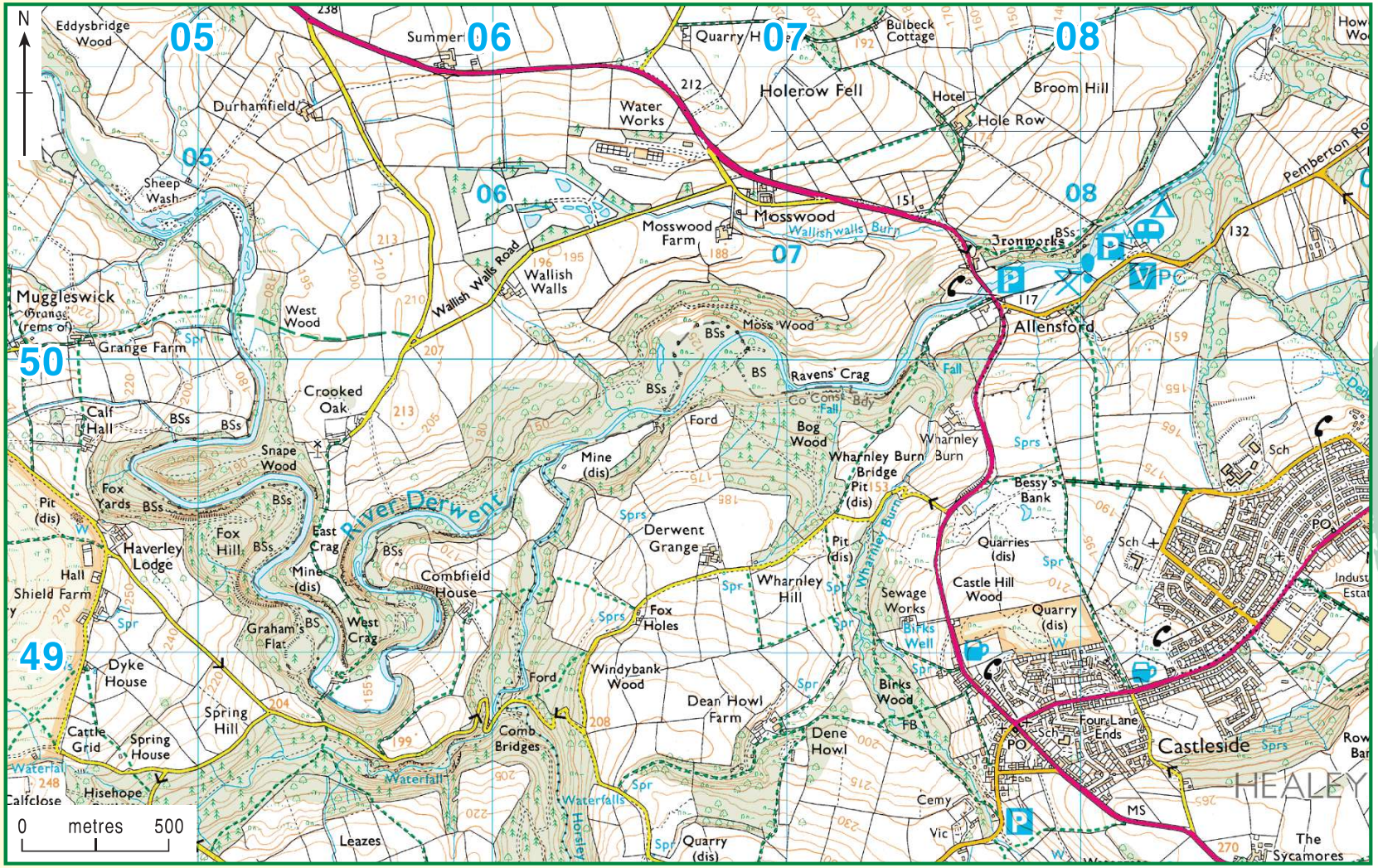


graph shows relationships over the transect very clearly and can be compared with the slope and soil data.

e. For each site decide what dominant tree species makes up the canopy of the woodland. Assign a colour to each dominant species and above or below your kite diagram colour the site in with the correct colour.

f. Describe the vegetation pattern across the transect for both the herb and shrub layers and the dominant canopy trees.

g. Describe and explain any relationships you can identify between the soil characteristics, soil depth and the vegetation cover.



O.S. Map of Derwent Gorge



Ordnance Survey Map Symbols

ROADS AND PATHS

M1 or A6 (M) — Motorway

A35 — Dual carriageway

A30 — Main road

B3074 — Secondary road

Narrow road with passing places

Road under construction

Road generally more than 4m wide

Road generally less than 4m wide

Other road, drive or track, fenced and unfenced

Path

RAILWAYS

Multiple track

Single track

PUBLIC RIGHTS OF WAY

Footpath

Bridleway

BOUNDARIES

National

County (England)

Civil Parish (CP)

National Park boundary

SELECTED TOURIST AND LEISURE INFORMATION

P — Parking

Information centre

PC — Public convenience

Telephone

Campsite / caravan site

Golf course or links

Public house

Walks

Viewpoint

Picnic site

Country park

GENERAL FEATURES

\+ — Place of worship

Building

Bus or coach station

Triangulation pillar

Windmill

BP/BS — Boundary post / stone

CH — Clubhouse

FB — Footbridge

Mon — Monument

PO — Post Office

Pol Sta — Police station

Sch — School

TH — Town hall

Soils and Vegetation in the Derwent Gorge

Student Information Sheet 1

AN INTRODUCTION TO SOILS AND VEGETATION

Soils

Soils form a thin layer on the surface of the earth's crust and provide the basis for plant life on land. A number of factors affect how soils are formed (see Figure 1) and hence the characteristics of the soil. These characteristics, in turn, influence the plants that grow in the soil.

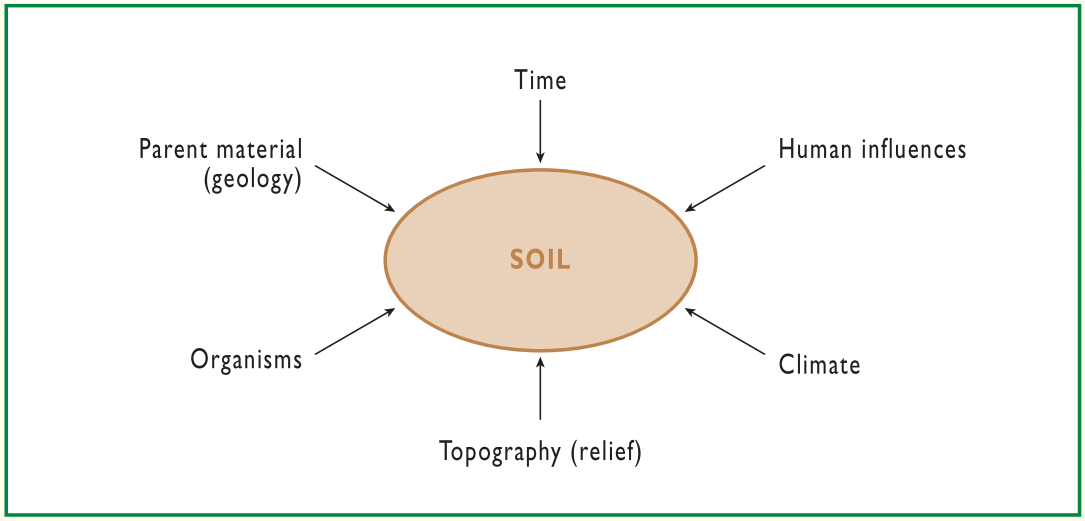


Figure 1: Factors affecting soil formation

Within the Derwent Gorge the main factor to vary across the transect of the hillside from the top of the gorge to the bottom will be the topography, and in particular the slope angle. Soil types are related to the topography of the hillside and the sequence of soil types down a slope is called a **CATENA**.

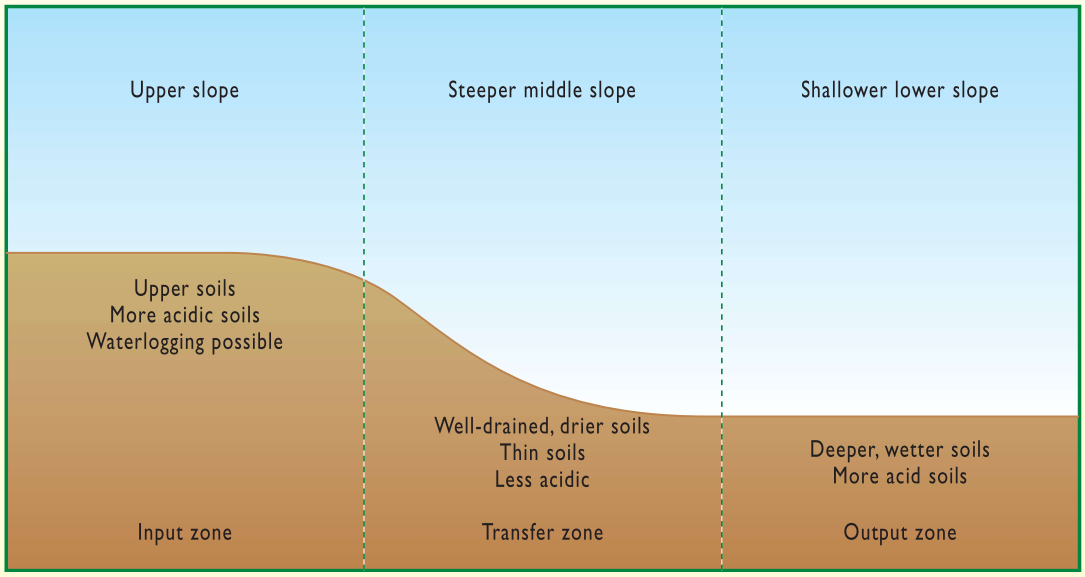


Figure 2: A typical catena

Slope angle affects the drainage of the soil, the soil depth and the pH of the soil. On steep slopes there is a greater flow of water through the soil and the effect of gravity increases the risk of soil erosion. As a result soils on a steep slope are likely to be thin, poorly developed, dry and higher in pH (less acidic). On gentler slopes there will be a slower rate of water movement through the soil and at the top of the slope this will increase the likelihood of water-logging and make the soils more acidic. At the foot of the slope there will be little soil erosion but increased weathering due to the higher water levels in the soil and material will be received from downslope movement so that the soils will be deeper. Figure 2 describes a typical catena.

The purpose of the transect from the top of the Derwent Gorge to the bottom is to see if the soil depth and pH vary across the hillslope in the way described.

Vegetation

Woodlands have a structure that is made of different layers (see Figure 3). The transect of the Derwent Gorge will look at the canopy and the herb and shrub layers.

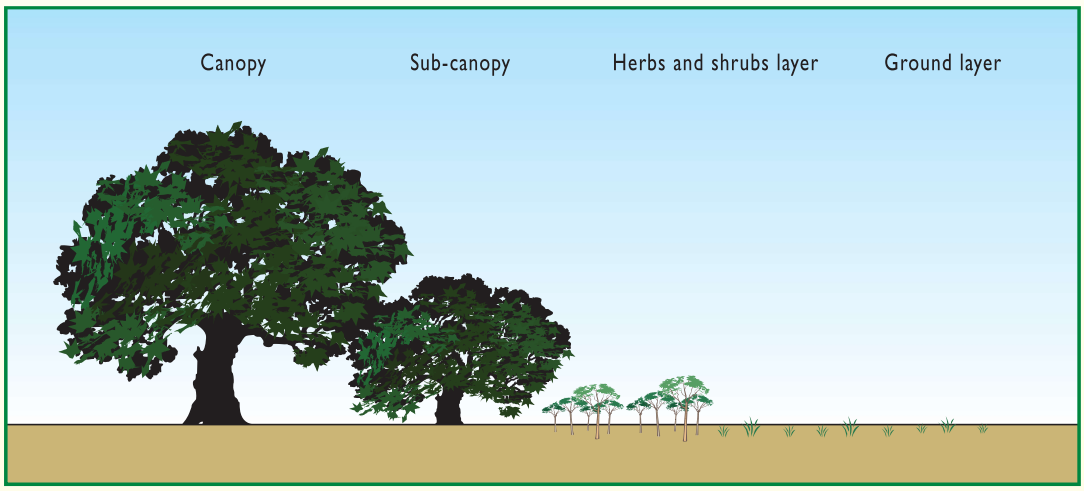


Figure 3: Vegetation structure of a woodland

The dominant vegetation in the Derwent Gorge is deciduous woodland. The tree species which make up the woodland vary with the soil type and hence the position on the hillside. On the more acidic soils of the upper slopes you would expect oak to dominate the canopy with heather and bilberry in the herb and shrub layer. On the steeper slopes with well-drained, less acidic soils you would expect the canopy to be dominated by ash, with herbs such as dog's mercury and wood anemone in the herb and shrub layer. On the lower slopes where it is less well drained you would expect alder to dominate the canopy and an array of ferns in the shrub and herb layer.

Parts of the Derwent Gorge have also been managed as traditional hay meadows. These areas will display a range of flowers in the summer including devil's bit scabious, knapweed and betony as well as many grass species.

Soils and Vegetation in the Derwent Gorge

Student Information Sheet 2

SOILS AND VEGETATION METHODS SHEET

A transect is a transverse section across an area – a line along which a survey can be carried out. In the Derwent Gorge you are going to carry out a transect from the top of the gorge (GR: NZ 055490) to the River Derwent at the bottom (GR: NZ 057493). This transect will be about 500m long and a survey of soils and vegetation will be carried out every 50m along the transect. The gradient of the slope needs to be recorded every 10m. The transect follows a track in places and the survey should be carried out through the left hand fence. This will minimise the disturbance to wildlife in this National Nature Reserve. Lay out a 100m tape to work along to record the gradient and then complete the rest of the survey at 50m intervals. At each survey point the following methods will be used by each group to investigate the soils, the vegetation and the gradient of the slope:

• Gradient of the slope

Every 10m along the transect the gradient of the slope needs to be recorded. This can be done using a gun clinometer and ranging poles. Two students stand 10m apart along the transect. The student at the top of the slope holds the gun clinometer to the ranging pole. The student at the bottom of the slope holds the other ranging pole and places their hand at the same height on the ranging pole as the top student has the gun clinometer on the top pole. The student at the top of the slope sights along the gun clinometer to the height of the student's hand at the bottom of the slope. The trigger is released so that the dial on the clinometer can swing. When it has stopped swinging the trigger is let back to stop the dial from moving again. The slope angle can then be read off the clinometer in degrees.

• Soil depth

The soil depth is measured using a soil auger. The auger is wound into the soil until it touches the bedrock and cannot go any further. The auger is then pulled out and the depth of the soil can measured off the auger using a meter rule.

• Soil pH

The ph is a measure of the concentration of hydrogen ions – the greater the concentration, the more acid the soil. The pH is measured on a scale of 1 – 14; pH 7 is neutral and values below 7 are acidic and values above 7 alkaline. The pH of the soil can be measured using a standard soil testing kit or soil pH probe. Figure 1 shows how to measure the pH of soil but each soil testing kit will have its own instructions. Use a sample of soil from the upper part of your soil auger for your test.

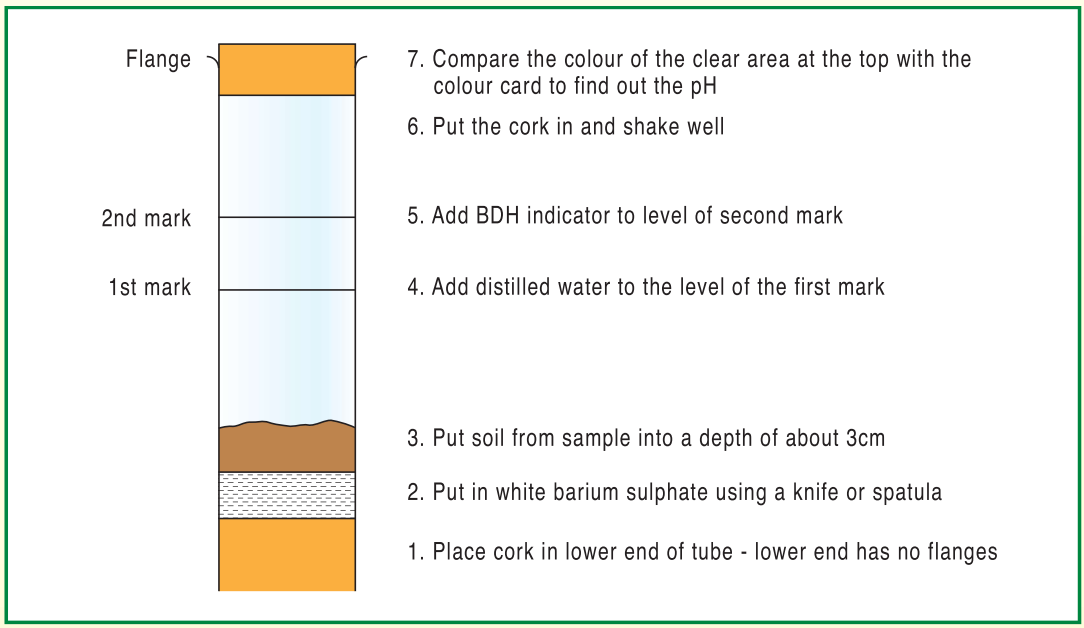


Figure 1: Testing the pH of soil.

Vegetation Survey - herb and shrub layer

At each survey site place a 0.5m x 0.5m quadrat on the ground and record the percentage cover of each plant identified. A quadrat is a frame, usually a square, of a known area. The quadrat may be divided with string so there are 25 smaller units to make estimating the percentage cover easier. The percentage cover of each species is estimated by eye. It may be more than 100% if you have more than one layer of vegetation. The percentage cover of bare ground should also be estimated.

You will need a plant identification book to help with naming the plants you find.

Vegetation Survey - canopy layer

This part of the survey can be undertaken as a class at each survey site. At each survey site measure out 10m (5m either side of your exact survey site) using a tape measure and record the tree species that you can see immediately in front of you.

This would normally be carried out with 10m x 10m quadrat but as this wood is fenced in places it is not possible to do so.

You will need a tree identification book to help you name the trees that you see.

Soils and Vegetation in the Derwent Gorge

Student Resource Sheet 1

AN INTRODUCTION TO THE DERWENT GORGE

Activity 1

a. Using the aerial photograph below put a X to show where you are currently standing.

b. Use the aerial photograph and the information given to describe the characteristics of the Derwent Gorge and Muggleswick Woods National Nature Reserve.

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Activity 2

a. Draw a field sketch (in the box overleaf) of the river cliff in front of you. Add the following labels:

Thickly-bedded sandstone **Thinly-bedded sandstone** **Shale**

River Derwent **Inside of meander** **Outside of meander** **Vegetation**

b. Describe how the River Derwent has cut such a deep gorge.

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Activity 3

a. Describe how people have used the Derwent Gorge.

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b. Explain how the woodland has survived in the Derwent Gorge and why the area is a National Nature Reserve.

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Soils and Vegetation in the Derwent Gorge

Student Resource Sheet 2

SOILS AND VEGETATION RECORDING SHEET

Activity 1

Record your hypothesis below:

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2 .....

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3 .....

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4 .....

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5 .....

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Soil slope measurements

Distance along transects (m)	Slope angle	Distance along transects (m)	Slope angle
0-10		150-160	
10-20		160-170	
20-30		170-180	
30-40		180-190	
40-50		190-200	
50-60		200-210	
60-70		210-220	
70-80		220-230	
80-90		230-240	
90-100		240-250	
100-110		250-260	
110-120		260-270	
120-130		270-280	
130-140		280-290	
140-150		290-300	

Site Number	Distance along transect (m)	Soil depth (m)	Soil pH	Percentage cover of species in the shrub and and field layers	Tree species recorded and number