

2 Sustainable construction

For thousands of years, humans have exploited the natural resources of the world, for example, coal, oil, gas, metals, gypsum and aggregate. All of these resources are consumed in the production of construction materials. The burning of fossil fuels has contributed to an annual increase in the Earth's temperature, known as global warming. Many measures – such as legislation to increase sustainable construction, and tighter building regulations – have been put into place to reduce the factors that contribute to global warming.

Many measures have been implemented to protect the natural environment, for example, designating certain areas as National Parks, protecting green belts of land, efficient use of recycling techniques that reduce the need to mine or develop new resources. The government's recent initiative to redevelop brownfield sites (areas of land with existing buildings on them that have exceeded their life span) has reduced the need to develop greenfield sites.

The current emphasis is on the sustainable use of construction materials and processes so homes can be made that have low carbon emissions and are more energy efficient, therefore reducing the reliance on oil-based resources. Sometimes this can be as simple as buying materials manufactured locally, which saves transport costs.

Learning outcomes

After completing this unit you should:

- 1 know the important features of the natural environment that need to be protected
- 2 understand how the activities of the construction and built environment sector impact on the natural environment
- 3 understand how the natural environment can be protected against the activities of the construction and built environment sector
- 4 understand sustainable construction techniques that are fit for purpose.

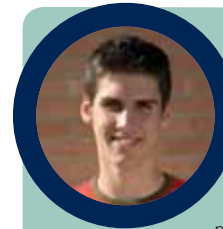
Assessment and grading criteria

This table shows you what you must do in order to achieve a pass, merit or distinction grade, and where you can find activities in this book to help you.

To achieve a pass grade the evidence must show that you are able to:	To achieve a merit grade the evidence must show that, in addition to the pass criteria, you are able to:	To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, you are able to:
P1 describe six different features of the natural environment that must be considered at the planning stage of a construction project	M1 assess the potential environmental impact of a proposed construction project on the local natural environment	D1 assess the importance of addressing environmental issues for the mutual benefit of the community and individual construction firms
P2 explain four different forms of global pollution arising from construction projects		
P3 explain how four different forms of local pollution arising from construction projects may harm the local environment		
P4 explain four key methods used to protect the natural environment from the impact of the construction and built environment sector	M2 compare the four key methods used to protect the natural environment in terms of cost, effectiveness and public perception	
P5 explain three different, fit-for purpose sustainable construction techniques.	M3 compare sustainable construction techniques in terms of relative cost and performance.	D2 justify the use of appropriate sustainable construction techniques for a specified construction project.

How you will be assessed

The evidence requirements for pass, merit and distinction grades are shown in the grading criteria grid. Evidence for this unit may be gathered from a variety of sources, including well-planned investigative assignments, practical work or reports of practical assignments. You will be given written assessments briefs to complete for the assessment. These will contain a number of assessment criteria from pass, merit and distinction



Student voice: Carter

Before I studied this unit I'd never considered things like protecting our resources for the future. I did not realise that oil and gas cannot be replaced and are fast running out. This is a very serious issue.

I now realise why saving energy and resources is important for the Earth and why we should do everything possible to protect our natural environment.

This unit has made me aware of the factors that have a major influence on the built environment both globally and at a local level and what can be done to prevent any further damage, preserving the future for our children.

Over to you

- What does the phrase 'sustainable construction' mean to you?
- What do you already know about importance of sustainable construction?
- What are you looking forward to learning about in this unit?

1 Know the important features of the natural environment that need to be protected



Warm up

Starter stimulus: The environment

The environment is rapidly changing. Flash floods are becoming much more common. In groups, think about the following questions.

- How is environment is changing as a result of human actions?
- What can be done to reduce the impact that humans are having on the Earth's climate?
- How can you make more people aware of what is happening?

Features

Air quality

Good air quality is vital for life and is an essential part of a healthy environment. Large factories tend to be situated away from population centres in order to prevent pollution entering the breathable atmosphere over towns and cities; indeed, large chimneys push the pollution further up into the atmosphere avoiding any fallout to local inhabitants.

This was not always the case. During the Industrial Revolution, coal replaced water as the main source of fuel used to power the pulleys and belts that drove industrial machinery. There was no control over the use of this new technique, and pollution became a serious problem as smog developed over the large industrial cities of the UK. Smog brought with it poor visibility as well as breathing difficulties for the cities' inhabitants – smog depleted oxygen levels. Deaths from asthma, bronchitis and other lung diseases became common.

The development of the petrol engine led to another rise in pollution, this time caused by lead-based petrol emissions. The government at the time passed acts to control waste emissions into the atmosphere. The Clean Air Act of 1956 was one example, and smog over large population centres was quickly reduced as a result of this legislation.

Today, the level of carbon dioxide (CO₂) emissions are strictly controlled so the effects of global warming are not increased. Tree and landscape planting improves the quality of air and is considered to be a sustainable part of any housing development.

Air quality obviously differs with geographical location. The centre of London or will have a vastly poorer quality of air than sparsely populated areas of Scotland. Generally, the more population and industry in an area, the poorer the air quality.

Ozone quality

Ozone is a gas that occurs naturally in the Earth's upper atmosphere. It shields the Earth from harmful ultraviolet (UV) radiation. Without the ozone layer, there would be no life on Earth.

Chemicals such as chlorofluorocarbons (CFCs) were used as propellants in aerosols, as well as cooling gases in fridges and freezers when they were first developed. However, in the 1980s, scientists made a link between the use of these CFCs, and the hole opening up in the ozone layer above the Antarctic. Since 1987, many of the world's governments have signed up to the Montreal Protocol on Substances that Deplete the Ozone Layer. As a result, CFCs have been replaced with less harmful chemicals. Scientists now believe that the hole in the ozone layer is getting smaller.

Soil quality and natural drainage

The benchmark for soil quality is hard to define. No two soils are the same and therefore there is no British Standard for a soil to be compared against. However, two environmental committees have formulated up to 67 measured variables for soil quality. The **Soil Association** grades soils against a certain standard for the organic growing of fruit and vegetables. Below are just a few of the categories against which soils may be measured:

- drainage properties
- texture
- acidity
- **pH** balance (see Figure 2.1) – ideally a good soil should have a pH of between 6 and 7.
- use
- level of contamination
- fertility
- mineral content
- organic content
- structural properties.

Extremely acid	4.3 or over
Highly acid	4.3 – 4.8
Moderately acid	4.8 – 5.5
Mildly acid	5.5 – 7.0
Mildly alkaline	7.0 – 7.7
Moderately alkaline	7.7 – 8.5
Highly alkaline	8.5 or higher

Figure 2.1 pH range of soil

Key term

Soil Association organisation promoting healthy soils via a certification scheme that enables a producer to use the term 'organic' produce.

pH the measure of acidity or alkalinity of a substance.

A quality soil is one that will sustain life. Soil is used in construction to provide attractive and environmentally landscaped areas for the community to interact with. New housing schemes must include these areas as part of the government's sustainability policy.

The drainage of soils is a vital environmental consideration. Tree roots bind soil together. In areas that have been deforested (as has been the case in many parts of the UK, and in many developing countries) the soil is left unbound. Therefore, when

these areas are exposed to high levels of moisture, i.e. when it rains, the water runs off and sits on the surface. In small amounts this does not cause a problem, but if the rainfall is very heavy, it can result in flash flooding. Recent government planning policy which has allowed developments within flood plains, has added to this problem. Overburden on a river's **levees** causes them to break and localised flooding to occur.

Soil drainage depends greatly on the structure of the soil, that is, how many pores or open voids are contained within it. The voids allow water to penetrate through the soil, eventually ending up within an **aquifer** below ground. Clay soils tend to resist the passage of moisture, whereas limestone rock allows the percolation of water through it. Therefore, geography and location play an important part in soil quality and drainage, along with the substrata of the rocks below the surface soils.

Key terms

Levees natural banks of silt deposits which are left after a river floods. These are shaped into higher banks to control flood waters. In 2005, some of the levees protecting New Orleans in the USA broke and flooded the city.

Aquifer an underground storage area created naturally within the Earth's rock strata.

Landscape

During the Ice Age, millions of tons of ice were pushed southwards down half of Britain. This action moulded and shaped the landscape beneath it, often leaving behind boulder clay and rocks, and this provided the basis for the natural landscape that is familiar to us today. However, the UK has undergone many changes since the ice melted away.

There are many varied and diverse areas of natural beauty within easy reach of major towns and cities that are protected, for example the highlands of Scotland, the Cotswolds, Cornwall, the Lake District and the Pennines. Local natural landscapes comprise forests, rivers, streams, hills, topography and the unspoilt countryside.

The landscape is a valuable resource. Tourists travel to the UK to see pieces of history, and the unique landscape. An attractive view with open spaces allows the use of the landscape for recreation purposes such as horse riding, fishing and hill walking.

The coastal landscape is continually changing, as erosion from the action of the waves, moves parts of the coastline steadily inward. The different coastal rocks produce different landscapes, for example, the clay boulder slopes of the Yorkshire coastline are dramatically different from the chalk-white cliffs of Dover.

Urban landscapes carry a unique signature, for example, in the Lake District, most houses are built of slate, whereas sandstone is the predominant building material in Edinburgh. A lot of inner cities have a vertical landscape; London is becoming a rival to the buildings of New York with many multi-storey constructions such as the Swiss Re Gherkin. Leeds city centre is also developing vertically.

Natural amenities

The facilities and services afforded by the natural environment cover a wide range of activities:

- Rivers – used for a variety of water-based sports such as fishing, angling and canoeing. Fishing is regulated under licence by the Waterways Environment Agency.
- Lakes – the Lake District, for example, is enjoyed by boating enthusiasts; a ferry service and pleasure craft attract a healthy tourist industry.
- Fenlands – the naturally occurring seasonal flooding areas of the fenlands and the Norfolk Broads produce large areas for migrating birds to feed upon during their annual migration from other climates. This enables the development of protected areas for wildlife conservation and the hobby of bird watching to flourish.
- Moors – the natural moors of the Yorkshire and Pennine regions are unique, although it may be said that humans have developed this environment by burning large areas for the promotion of grouse shooting as a sport. Large areas of the moors tend to be managed estates.
- Mountains – the Scottish and Welsh mountain areas offer hill walking and mountain climbing. Scotland also offers skiing facilities in winter.
- Natural forests – used to cover most of Britain during the Middle Ages, but they have been gradually cut down and used for fuel and ship building. There are small areas of natural woodland that are now protected from felling. Natural woodlands provide a landscape that can be used for mountain biking, dog walking and exercise.

- The sea and beaches – Britain's coastal areas are unique and diverse. From the pebble beaches of the south coast to the sandy beaches of Norfolk and the rugged granite cliffs of parts of Cornwall and Scotland, beaches attract tourists during the summer months. Many are protected under an SSSI (site of special scientific interest). The sea is a valuable source of food, although stocks of fish are protected by European Union quotas.

Land use

The use of the land has been defined over hundreds of years and has been largely governed by the local population and the resources that are available at a given time. As villages developed into towns and then major cities; expansion took place into the surrounding land. In order to feed the population, farming and agriculture developed in the fields surrounding the villages.

During the Industrial Revolution, resources such as coal, oil, water and wood were increasingly used, and the industrial use of plots of land was born. The waterway network developed with a canal system that was later superseded by the railway network.

More recently, planning control has given the community more say in the choice of land use and has limited development where it is considered inappropriate. For example, the expansion of out-of-town shopping developments has been reversed through government policy on strategic planning.

Land use can therefore be broadly categorised into:

- agricultural
- heavy industrial
- housing
- commercial
- natural landscape.

Green belts

Green belts are the areas of green land that surround communities and provide open parkland for the community to enjoy, away from the industrial use of the land. Green belt land is protected; no development is permitted on it. Green belts provide an attractive and aesthetic area that breaks up the large conurbations; they also provide a buffer zone between different land uses and help to maintain a clean, fresh and natural land that all of the community can experience and enjoy.

Thinking point



In 2006, over 300 applications were made to develop on areas of green belt. The Office of the Deputy Prime Minister (now Communities and Local Government) approved 150 of these!

Agriculture

Land that is used to produce food is known as agricultural land. It can be classified into two broad areas:

- Arable – the growing of crops.
- Livestock – the raising of animals.

Arable farming in the UK includes cereal crops, such as wheat and barley, and horticulture, which is the growing of fruit and vegetables. There has recently been a drive for organically grown crops, i.e. crops produced without the use of chemicals. Livestock includes the production of meat from cattle, sheep and pigs, and the use of cattle for producing milk.

Agriculture plays a significant part in developing the fertile regions of the landscape by ploughing the land and adding fertilisers to grow crops. This alters the natural landscape from its raw state into a condition that can be used for food production. Large areas each side of a major river are the most fertile for this use, as the river floods depositing minerals and materials that feed nutrients into the soils.

Forestry

The use of land for forestry can be divided into:

- naturally occurring, established woodlands that are hundreds of years old and are carefully managed

PLTS



By exploring the environmental issues from different perspectives, you could develop your skills as an **independent enquirer**.

- plantations – areas of land that have been deliberately planted to grow and harvest timber resources.

In Britain, natural woodlands are limited to small pockets. There is a national forest at Nottingham, but a lot of woodland was cleared for industrial development, ship building and to use as fuel. Forests also provide an opportunity for recreation, offering an ideal environment for walking, bird watching, horse riding and biking.

The UK government's Forestry Commission looks after many of the forests and protects them as well as developing and expanding the use of timber as a resource. Timber, unlike oil, gas and coal, is a renewable resource that is not finite.

Countryside

The British countryside is not developed in strong concentrations. Small villages and settlements, such as farms, are surrounded by green areas of farming or natural landscape which is known as the countryside. In the UK, these areas are green due to high concentrations of rainfall; in hotter climates they would be brown.

There are very distinctive areas of countryside, for example the Wolds of Lincolnshire, the Lowlands of Scotland and the South Downs of Dorset.

Assessment activity 2.1



A large plot of land has come on to the market and a developer has obtained outline planning consent for a housing development with 50 homes upon it. You live in a local village adjacent to this land. The local community is outraged at the decision to allow the development in principle, on this piece of unspoilt, green landscape.

In order to help fight an objection to full planning consent, identify and describe the features of the natural environment that must be considered at the

planning stage, which could be used to contest the development.

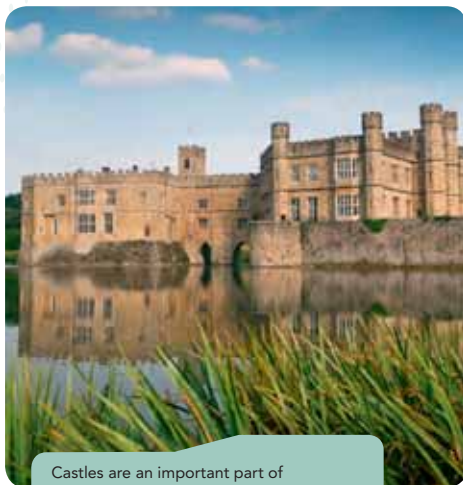
List six features of the natural environment with descriptions against each. **P1**

Grading tips

For **P1** place yourself on the land and list six features that will want protection from development.

Remember!

The countryside is an area of green scenery that is clean, attractive and unique within easy reach of major living areas.



Castles are an important part of British heritage

Heritage

Britain has been inhabited by humans for thousands of years. Over this period, we have developed a unique and enviable heritage that is now protected. Heritage encompasses not just the land but the structures created upon it and could include the following:

- battlefields
- ancient monuments and icons
- castles
- manor houses
- streets
- archaeological sites
- bridges
- parks and gardens.

It is vital that these are taken care of for future generations to enjoy. They are part of the culture of the UK and stand out as distinctive structures. A prime example is the stone circle of Stonehenge. A system of **listing** important buildings has protected many of them, as has the National Trust which owns and runs some of the historic locations in the UK.

Key term

Listed building a building of special architectural or historic interest in the UK. Alterations to these buildings must be carefully considered before they are made.

Theory into practice

Find out more about listed buildings in England at English Heritage's website, www.english-heritage.org.uk; for information on listing in Scotland, see Historic Scotland's website, historic-scotland.gov.uk.

Remember!

English heritage attracts a substantial tourist industry, especially from the USA, Japan and other countries, which substantially adds to the economic well-being of the UK. It is vital that it is protected.



Water resources

Over the past 100 years, the use of water as a resource has increased. It is used not just for drinking but also for washing, flushing toilets, cleaning and bathing. A dishwasher and washing machine are now considered essential items in many homes. Indeed, the growth in hot tubs now puts even more strain on the distribution systems that supply the water.

Water resources include the extraction of water above and below ground. Above ground, water is captured in reservoirs or by damming a river supply, extracting from rivers, or in hot climates by desalination plants from seawater. Below ground, boreholes are sunk within permeable rocks to extract the water by pumping. Water is a valuable commodity – a licence is needed to extract it and it must be protected from contamination through pollution leaking into the soils and rocks.

Remember!

The Earth has the same body of water as the day it was created; nothing has been taken away or added. The water cycle describes how water evaporates from the sea into the atmosphere, moves as clouds, then falls as rain water, and runs into rivers, and back to the sea.



Water quality

Water for human consumption is extracted from reservoirs, rivers and boreholes. It then has to be treated to enable it to be classified as drinking water. Water is distributed around the UK using a system of pipework, which is then rated or metered as the consumer uses it.

Water cannot contain any harmful elements such as bacteria, as this would affect people's health. Pure, fresh and clean water can be extracted at source and bottled as a mineral water. Non-drinking water supplies tend to be used in European countries where water is in short supply; we, for example, use drinking water to flush toilets in the UK.

Water quality is often determined by the material through which it percolates during its journey to the aquifer, which is an underground storage area created naturally within the Earth's rock strata, for example limestone.

Marine environment

The marine environment covers many aspects, including:

- harbours
- the sea
- estuaries
- marshes
- beaches
- cliffs.

The marine environment differs from the river environment in that it is salt-water based and not fresh water, but it is worth noting that several rivers are tidal. The tides are a gravitational effect caused by the moon's influence on the Earth. Along the coast there will be high-tide and low-tide marks. Global warming has been blamed for leading to the steady rise in sea levels as a result of the melting of polar ice. This rise could threaten many cities throughout the world, for example, London and Venice would be in danger if the sea levels rise much more. Hurricanes and the storm surges that arrive with rising sea levels are a great threat too, as the flooding and devastation of New Orleans in 2005 shows.

Marine wildlife is extensive in its range and biodiversity. The surface of the Earth is covered with a great deal of salt water, much of which has not been explored, so there is still a great deal to discover about this environment. Britain's coastline differs depending

on the surrounding rock structures that meet the sea – soft rocks and clays are easily washed away by the action of the waves, whereas igneous rocks take longer to be broken down into fine sands.

Theory into practice

Look up 'biodiversity' using an Internet search engine. Write your own definition in no more than 20 words.



Wildlife

Wildlife is the native life that exists within a geographical location. Native wildlife tends to be unique to its area, for example the colonies of birds that congregate in certain areas, like the Dartford warbler, or ospreys in Scotland. However, some species migrate with the seasons, for example, the swallows of North Africa visit Britain each year.

Wildlife, as the name suggests, refers to life that is truly wild, i.e. not animals that have been tamed by human interference, for example, horses, pigs and sheep. There is a wide range of wildlife in Britain, for example, birds, seals, whales, fish, snakes, otters, which are all left alone to develop and establish themselves within the landscape.

It is important to remember that the agriculture industry have an effect on wildlife. The crops that are grown and the land that is cleared for cattle have an impact on the diversity and location of wildlife. Humans have to be very careful to avoid disturbing wildlife or this may tragically mean extinction for some species.

Biodiversity

Biodiversity is a term used to describe the amount of living matter and range of biological species present in a particular environment (or geographic area). It covers everything from microorganisms to wildlife such as ducks and swans. Biodiversity is essential to ensure the continued success of an ecosystem; if an imbalance develops, then one species can take over; this can be seen most obviously with rat or mice infestations.

Any activity humans undertake has an effect on biodiversity. For example, if a building is constructed on a plot of land in a green belt, an area the size of the footprint of the building has been lost, and all the biodiversity contained within it. However, the loss can be compensated by external landscaping to encourage more wildlife in the area.

Remember!



Biodiversity evolves; there are many species and microorganisms that have yet to be discovered.

in the countryside. These areas have not been interfered with by humans. Humans have had a considerable impact on British natural habitats, which now require more protection than ever, so those that remain can be enjoyed in the future. Even grazing sheep on land destroys the natural habitat.

Nearly half of the ancient woodlands, and almost three-quarters of the ponds in the UK have been lost. This has had a detrimental effect on biodiversity; some species are already extinct. Environmentalists have responded to the loss of so much of the natural habitat by attempting to restore many of the natural habitats in Britain.

Natural habitat

Natural habitat refers to the place where any living thing naturally lives. Most of the British Isles was originally covered in woodlands, but a large proportion of this has been removed for the construction of buildings and to be used as a fuel source.

Natural habitats include the heaths, meadows, limestone pavements and moorlands that can be found

Assessment activity 1.1



A small area of green belt land has unexpectedly come on to the market and is expected to be granted outline planning permission with the sale. Many members of the local community have voiced their opposition to the development.

You work for the developer. To help defend the development, undertake an assessment of the potential environmental impact a proposed construction project will have on such a piece of land and on the local natural environment. **M1**

Make an assessment of the important environmental issues and how they will be addressed for the mutual benefit of the community and the construction developer of the land. **D1**

Grading tip

For **M1** you will need to look at what impact a development would have, what potential harm could occur and how the development could minimise this impact

D1 requires that you assess the environmental issues in terms of importance for the community and balance this against the company developing the environment

WorkSpace

Sue White

Environment Research and Development



Sue works for the Government within the environment department. Her role is to research and develop new methods of constructing buildings that reduce our reliance on the use of fossil fuels. This is an important role as the Government has signed up to an international agreement on the zero carbon emissions home. This means that the carbon locked up in the home is equal to the amount of carbon it has taken to construct which therefore is neutral.

Sue obtained her job through a Graduate Recruitment Program. She had attended college and completed a National Diploma and then went onto take a degree at university in Sustainability and the Built Environment.

Sue interacts with many national house builders, which gives her access to construction sites where she can research and develop ideas. Sue also has control of a budget which is used to build and test homes using research materials. The project she is currently working on involves using straw blocks – a waste product from the harvesting of food stuffs – as a building material to construct homes.

Sue loves the experimentation involved in trying out different materials for research projects to see what results can be obtained in energy efficiency. There are several new ideas on the market, for example, ground-source heat pumps, small-scale wind farms, methane gas fuels, and waterless toilets.

Sue works with a dedicated team who have all come from construction and design backgrounds, either through a-levels or Diplomas and a University education. She has been rewarded with the amount of effort that she put into her studies to succeed in a job she really loves doing.

The test results she has produced are now being considered by the Government and may be introduced into the Building Regulations when they are next revised to become law.

Think about it!

- What ideas could you research on energy efficiency in homes?
- What would be your ideal job in this field?
- Would you enjoy working in a team?