The conflicts that occur in coastal areas are on the landward side of the coastline and between different users of the inshore waters. This was the case with the coral reefs of St Lucia (see Part **2.4**). It is also illustrated in the waters of Lyme Bay on the south coast of England. Here there are at least six stakeholders or users of its waters (Figure 2.35). It is important to note that one of these stakeholders is wildlife. Again, the only solution to the conflict is to separate the different uses by allocating specific areas of water to particular users. This solution is not as simple as it might seem. It is quite difficult to mark out areas of the sea. It is also difficult to police these areas to check that they are being used as they should be.

2.7 Coastal management

Coastal management is about two things. The first is resolving the conflicts, as we saw in the previous part, between different users of the coast and between those users and the well-being of coastal ecosystems. The second is taking action to meet big changes that threaten long stretches of the coast. The changes can present risks. Two risks stand out today – the risk of coastal erosion, and the risk of coastal flooding. These two risks are related. The managers of the coast are usually employees of either local authorities or the national government.

Figure 2.36: *Retreat of the Holderness coast, England*

Coastal erosion

Coastal erosion is quite normal and natural, and in most places it is unspectacular. However, there are some stretches which are eroding at alarming speeds. For example, at Holderness on the northeast coast of England (Figure 2.36), the 20–30 metres high cliffs which are made up of soft sands, gravels and clays are currently retreating at a rate of 1 metre per year – occasionally up to 10 metres per year. Over the last 2000 years the coastline has been pushed back some 4 km.

Coastal flooding

There is a difference between the gradual retreat of a coastline by erosion and the flooding of a low-lying coastline by occasional, abnormally high sea levels. **Storm surges** are the greatest flood threat. These are caused by very low air pressure, which raises the height of the high-tide sea. Strong onshore winds then drive the 'raised' sea towards the coast and are capable of breaching coastal defences and flooding large areas. **Tsunamis** generated by earthquakes can also lead to widespread coastal flooding as was the case with the 2004 tsunami.

Storm surges and tsunamis are periodic events. However, there are some stretches of coastline where the risk of flooding is both constant and increasing. This is the case with the city of Venice at the head of the Adriatic Sea. Global warming and its associated rise in sea levels is also increasing the coastal flood risk in many parts of the world.

Over the last 150 years or so, people have taken steps to protect valued stretches of the coast from erosion and flooding. Much concrete, rock and timber have been used in the belief that these materials might help people win the endless battle against the sea. All the management strategies used so far in this battle have involved either **hard engineering** or **soft engineering**.

For more on tsunamis, see Chapter 3.2 (page 69).

Hard-engineering management

Hard engineering involves building some type of sea defence, usually from rocks or concrete. It aims to protect the coast from erosion and the risk of flooding by working against the power of waves. Figure 2.37 illustrates some of the techniques used at the foot of cliffs and on beaches. Each has its strengths and weaknesses. For example, rip rap is effective and cheaper to install than either sea walls or revetments. However, it may shift in heavy storms and be undercut by the backwash of waves.

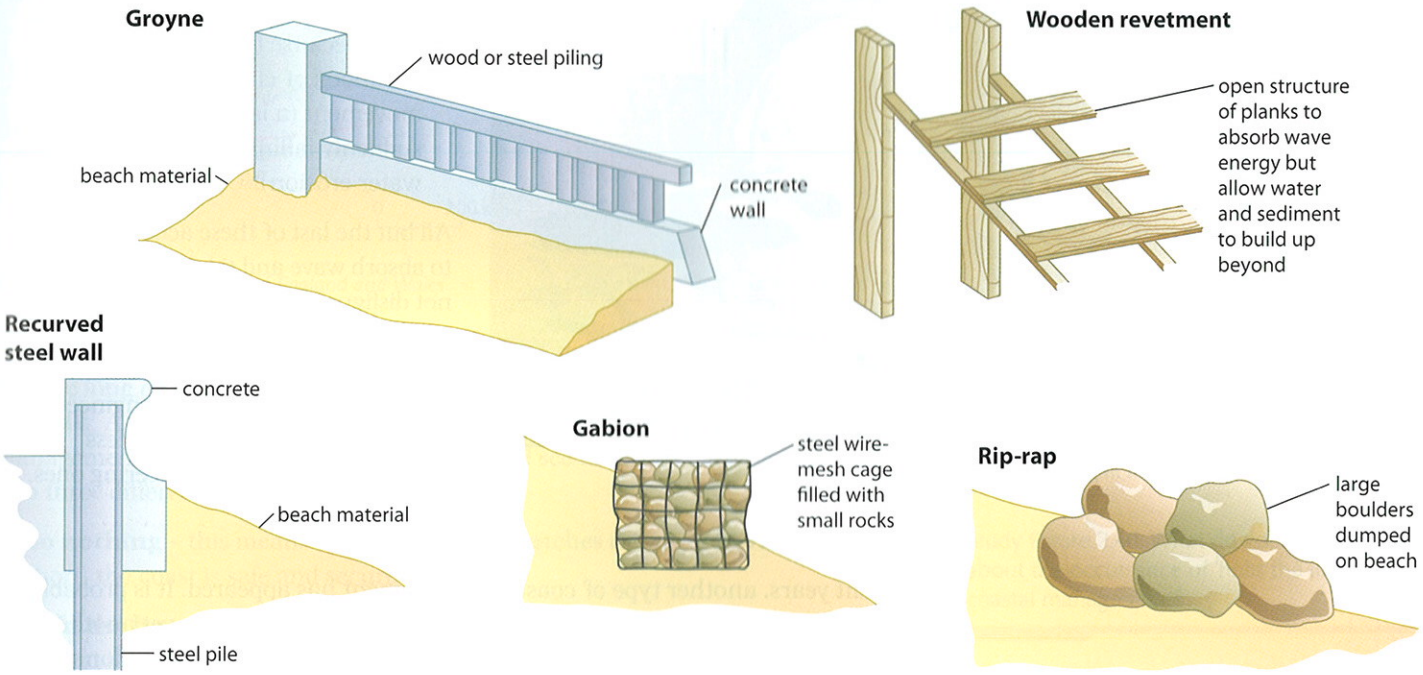

Figure 2.37: *Examples of coastal hard engineering*

Hard engineering as a whole has several disadvantages:

- most structures are expensive to build and maintain – to repair a sea wall can cost up to £3000 a metre
- effective defence in one place can have serious consequences for a nearby stretch of coastline, particularly in the direction of longshore drift. For example, groynes trap beach material that is being moved by longshore drift on their upstream side. Downstream of the groyne, the lack of beach material increases the exposure of the coast to the forces of erosion
- defence structures like sea walls, gambions and rip-rap cannot keep pace with rising sea levels
- structures can spoil the natural beauty of a coastline.

Which form of hard engineering shown in Figure 2.37 would be best for:

- reducing the effects of longshore drift
- protecting the base of a cliff from erosion?

Soft-engineering management

Soft engineering methods of coastal management try to work with natural processes. It also makes use of elements of the coastal system, such as beaches, sand dunes and salt marshes. The following are examples of soft engineering:

- **beach replenishment** – pumping or dumping sand and shingle back onto a beach to replace eroded material (Figure 2.38)
- **building bars** – underwater bars located just offshore reduce wave energy

Figure 2.38: *Beach replenishment in progress*

- **fencing, hedging and replanting vegetation** – this helps to preserve a beach or sand dune by reducing the amount of sand that is blown inland
- **cliff regrading** – the angle of a cliff is reduced so that it is not so steep because this reduces the likelihood of cliff retreat by mass movement (a large part of the cliff suddenly falling down as a result of water erosion).

All but the last of these actions are used to absorb wave and tidal energy. They do not disfigure the natural appearance of the coast. They are more environmentally-friendly than hard-engineering solutions. Soft-engineering strategies are generally much less expensive than hard-engineering ones.

Managed retreat

In recent years, another type of coastal management has appeared. It is probably a response to the rising sea levels of global warming. Some see this as yet another form of soft engineering. Others see it as a distinct form. It involves abandoning existing coastal defences and allowing the sea to flood inland until it reaches higher land or a new line of coast defence. Allowing low-lying coastal areas to flood and develop into salt marshes produces a good natural defence against storms. It also increases the amount of salt marsh – an increasingly scarce and threatened ecosystem. It is a relatively cheap method of coastal defence. The main cost is one of compensating people for the loss of 'drowned' homes and livelihoods. Because of this particular cost, managed retreat is not suitable in coastal areas where there is urban development and high quality farmland.

For more on salt marshes see Part 2.4 (page 46)

Shoreline management plans

Today in the UK and other HICs, the approach to coastal management has become much more comprehensive. It assesses all the possible risks such as the risk of flooding and cliff erosion. Those risks are then considered from the perspective of different groups of people (stakeholders) in the coastal community. Who is likely to be most threatened by a particular problem? What do they stand to lose if the particular situation takes place?

Figure 2.39: *The coastal cells of England and Wales*

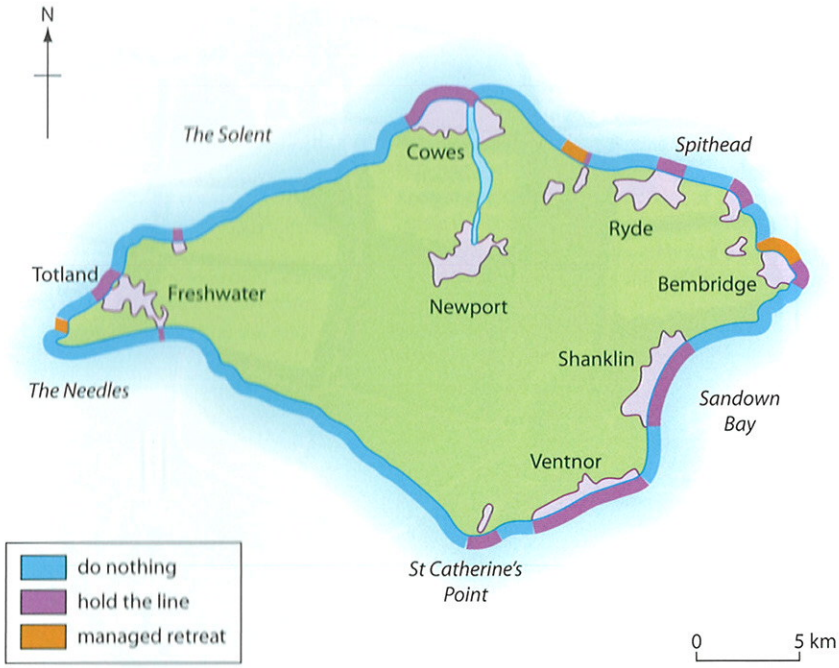

Figure 2.40: *Coastal management of the Isle of Wight*

A plan of action is then drawn up that tries to minimise the risks and costs. In the UK, the long coastline is divided up into cells (Figure 2.39) and these into smaller sub-cells. A management plan is prepared for each sub-cell. Figure 2.40 shows the management plan for the Isle of Wight. You will see that the coastline is divided up into three different types of action:

- **do nothing** – this means that along these stretches there are few if any risks. In short, the coast is safe and secure
- **hold the line** – in other words, hard engineering will be needed to continue to protect these stretches of coast because much money is invested in urban development, for example in the tourist resorts of Cowes, Shanklin and Ventnor
- **managed retreat** – three low-lying areas are recognised as being threatened by flooding. Clearly the retreat at the resort of Bembridge is going to need very careful management.

Study Figure 2.40. What do you notice about the occurrence of 'hold the line' coastal management?

Case study: Abbots Hall Farm, Essex

The east coast of England is 'sinking' into the sea at a rate of over 6 mm a year. This is beginning to threaten large areas of low-lying coast. Many kilometres of sea wall have been built over the last few centuries as protection. In Essex, about 40% of its salt marshes have been lost as a result of the rising sea level, coast erosion and land reclamation. The mudflats and salt marshes here are important feeding and nesting areas for huge numbers wading birds.

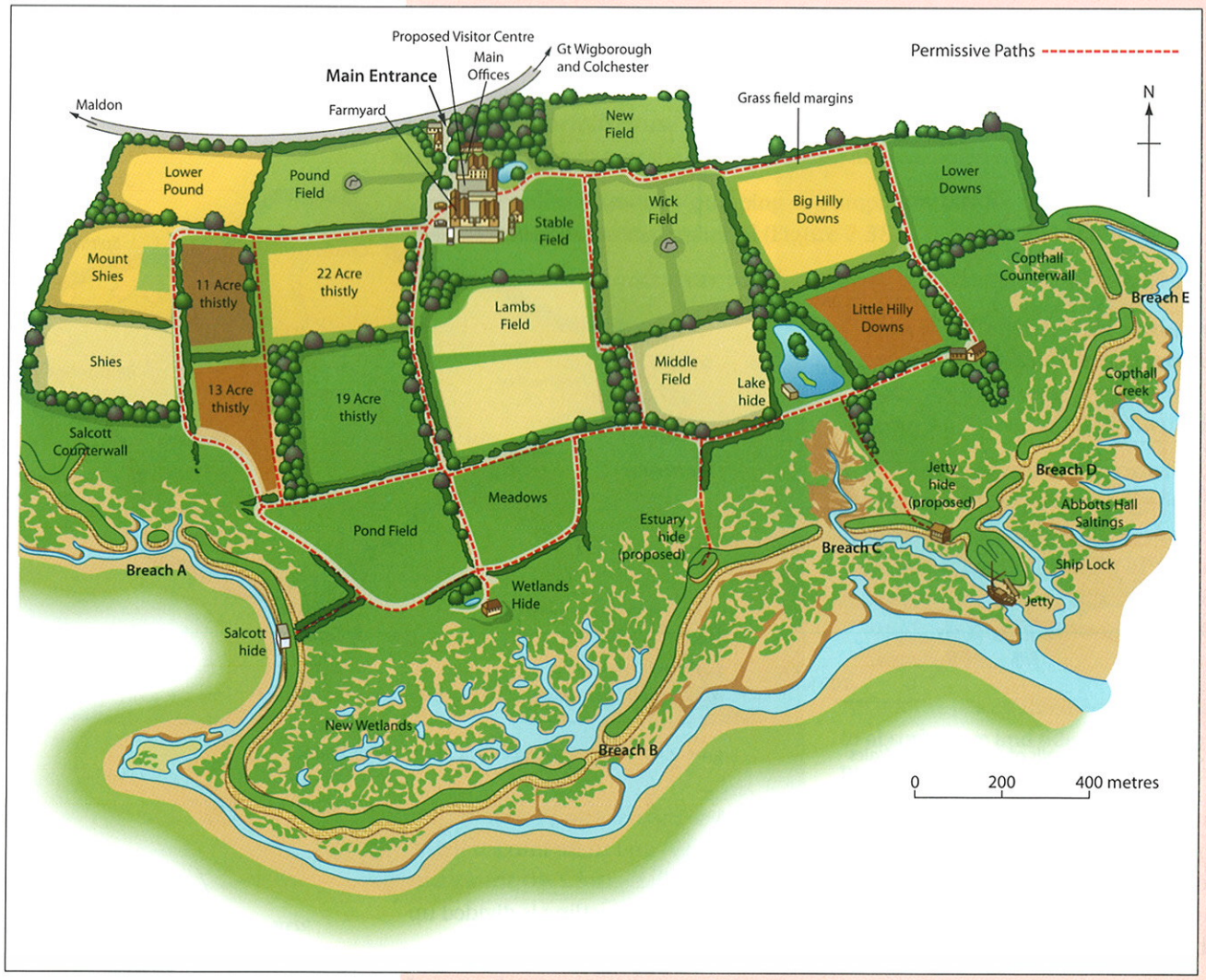

Figure 2.41: *Abbots Hall Farm managed retreat*

The Royal Society for the Protection of Birds (RSPB) owns Abbots Farm on the north side of the Blackwater estuary (Figure 2.41). In 2002 it started a programme of managed retreat. Five breaches were made in the old sea walls. This has allowed the sea to cover some 80 hectares of arable fields. The flooded land will gradually revert to what it was before it was cultivated – salt marsh.

It should be said that not everyone is a nature lover and supports this or other programmes like it. Many argue that it is a government's responsibility to protect land and people when they are being threatened by the sea. But what about the financial costs, especially in an age of global warming and rising sea levels?

Research two other examples of managed retreat, preferably outside the UK. Are there conflicting views about such management?

It will take time for people to accept that not all of the present coastline can be held against the sea in an era of rising sea levels. Managed retreat at Abbot Hall Farm was easy in that the land being lost was of no great monetary value. Now other authorities need to see that managed retreat is not just good for wildlife. Managed retreat ensures the supply of sediment that builds up the natural coastal defences of other areas of coastline, by forming marshes or beaches, shingle bars or mud flats. It is much cheaper than building sea walls and leaves the coast looking as it used to.

End of chapter checkout

Checklists

Now you have read the chapter, you should know:

- ✓ the physical processes that affect the coast
- ✓ the landforms resulting from these processes
- ✓ how these landforms are affected by geology, vegetation, sea-level changes and people
- ✓ about coastal ecosystems and their biodiversity
- ✓ the factors affecting their distribution
- ✓ why these coastal ecosystems are valuable
- ✓ how they are being threatened by tourism and other developments
- ✓ that there are conflicts along the coast, particularly between development and conservation
- ✓ the coast is changing as a result of natural processes and human activities
- ✓ the reasons for and against protecting stretches of changing coast
- ✓ the different methods used in the protection of the coast

Make sure you understand these key terms:

Arch: a coastal feature formed by the meeting of two caves cut into either side of a headland.
Bar: a ridge-like accumulation of coastal sediments exposed at low tide.
Bay: a wide, coastal inlet that is open to the sea.
Beach: an accumulation of coastal sediments, most often occurring in sheltered areas along the coast, such as bays.
Biodiversity: the number and variety of living species found in a given area or ecosystem.
Headland: an area of land jutting out into the sea.
Cave: a hollow cut by the sea into the base of a cliff.
Cliff: a steep rock slope, usually facing the sea.
Conservation: the protection of aspects of the environment for the future benefit of people.
Deposition: the dropping of material that was being carried by a moving force, such as the waves.
Development: making use of the coast for a variety of purposes, such as tourism, housing, shipping and industry.
Ecosystem: a community of plants and animals that interact with each other and their physical environment.
Erosion: the wearing away and removal of material by a moving force, such as the sea. .
Estuary: the mouth of a river as it enters the sea.
Hard engineering: protecting the coast by building such structures as sea walls and groynes.
Longshore drift: the movement of sediments along the coast by wave action.
Mass movement: the movement of weathered material down a slope or cliff due to the force of gravity.
Raised beach: a former beach now standing above sea level and some metres inland.
Soft engineering: protecting the coast by working with nature.
Spit: material deposited by the sea that grows across a bay or estuary.
Stack: a detached column of rock located just off-shore and usually caused by the collapse of an arch.
Sub-aerial: occurring on land, as opposed to underwater or underground.
Wave: a ridge of water formed by the circular movement of water near the surface of the sea.

See the Glossary in the ActiveBook for more definitions

Questions

Try testing yourself with these questions:

1 a) Name the two zones of the coast.
b) Describe the four main marine processes.
2 Why is it important to distinguish between constructive waves and destructive waves?
3 a) With the aid of a sketch diagram, describe the process of longshore drift.
b) What part does longshore drift play in the development of coastal landforms?
4 With help of Figure 2.13, suggest why the Jurassic coast is such a popular tourist location.
5 a) What is the difference between a storm beach and a berm?
b) With the help of an annotated diagram, explain how spits are formed.
6 Describe the conditions necessary for the formation of sand dunes.
7 a) What is the name given to a coastline that has experienced a rise in sea level?
b) Describe the main coastal features produced by changes in sea level.
8 Describe some of the ways in which people can affect the character of the coast.
9 a) Using Figure 2.18, describe the main features of the global distribution of coral reefs.
b) Name six physical factors controlling the growth of coral.
10 a) What is meant by the term intertidal?
b) In what ways are mangroves a very tolerant ecosystem?
11 What are the conditions favouring the growth of salt marshes?
12 How and why does the vegetation change as one moves inland across a belt of sand dunes?
13 a) What is meant by the 'goods and services' of ecosystems?
b) Give examples of goods and services that coastal ecosystems provide.
14 Why is it so important that mangroves should be protected?
15 Describe the main threats to salt marshes.
16 a) Why are sand dunes reckoned to be the least threatened of the coastal ecosystems?
b) In what ways do tourism and recreation threaten the well-being of sand dunes?
17 a) With the aid of an annotated diagram, explain what is meant by the phrase 'the coast is a natural system'?
b) What is a 'coastal cell' in the UK?
18 a) What is involved in conserving the coast?
b) Use examples from the Southampton Water case study (page 54) to illustrate the conflict between conservation and development.
19 In what ways does tourism threaten the coast?
20 a) Who are the 'coastal stakeholders'?
b) Give examples of the conflicts that can exist between coastal stakeholders.
21 a) With the help of examples, distinguish between hard and soft coastal engineering.
22 a) Explain what is meant by 'managed retreat'.
b) In what circumstances does this become the preferred coastal management option?
23 Briefly describe the steps involved in making a coastal management plan.
24 What are the coastal management options in dealing with global warming?