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A Comparison of Coastal Management Schemes

The world's coastlines are among the most important and intensively used areas on the planet. They are under great pressure from activities such as tourism and settlement, and also processes like erosion, climate change and sea level change.

Coastal management tries to accomplish two things. First, it tries to resolve conflicts between different groups of users, and between those groups and the well-being of the coastal environment. Secondly, it takes action to minimise threats to the coastline. There are two main threats today: coastal erosion and flooding.

All of the UK's coastline is divided, for management purposes, into cells, and these into smaller sub-cells. A shoreline management plan (SMP) is drawn up for each sub-cell. These plans try to minimise risk and also expenditure. For each sub-cell one of four main management approaches is adopted (Figure 1). These plans outline how the coastline is to be managed and what strategies are to be used. They are developed and implemented by local authorities and government bodies like the Environment Agency. These plans are agreed after discussions with interested organisations and local communities.

- **No active intervention** – there is no planned investment in defending against flooding or erosion, whether or not an artificial defence has existed previously.
- **Hold the (existing defence) line** – an aspiration to build or maintain artificial defences so that the position of the shoreline remains. Sometimes, the type or method of defence may change to achieve this result.
- **Managed realignment** – allowing the shoreline to move naturally, but managing the process to direct it in certain areas. This is usually done in low-lying areas, but may occasionally apply to cliffs.
- **Advance the line** – new defences are built on the seaward side.

Figure 1: Shoreline management plan approaches

Coastal management strategies can be put into two broad categories:

- Hard engineering approaches, involving the construction of artificial structures like groynes and sea walls. They tend to be more expensive, shorter-term and often have a greater impact on the environment. They can be seen as being less sustainable.
- Soft engineering options are less expensive. They are generally longer-term and, as they work with nature rather than against it, can be seen as more sustainable.

We are going to look at two areas of the British coastline to see how complex coastal management can be; often it is a juggling act, as managers try to get a balance between the many considerations. Lyme Regis will illustrate a hard engineering approach, while in Pevensey Bay largely soft engineering strategies have been used in recent years.

Lyme Regis

Lyme Regis is a small resort on the Dorset coast (Figure 2). The town is famed for its fossils from the nearby cliffs and beaches, which are part of the World Heritage Jurassic Coast. Lyme Regis is located on an exposed part of the shore. There is no natural harbour, and man-made structures have been necessary to provide a safe mooring for boats and defence against storms. The Cobb is the town's jetty, dating from about the 13th century. It has been destroyed and rebuilt several times, and without it there would not be a town.

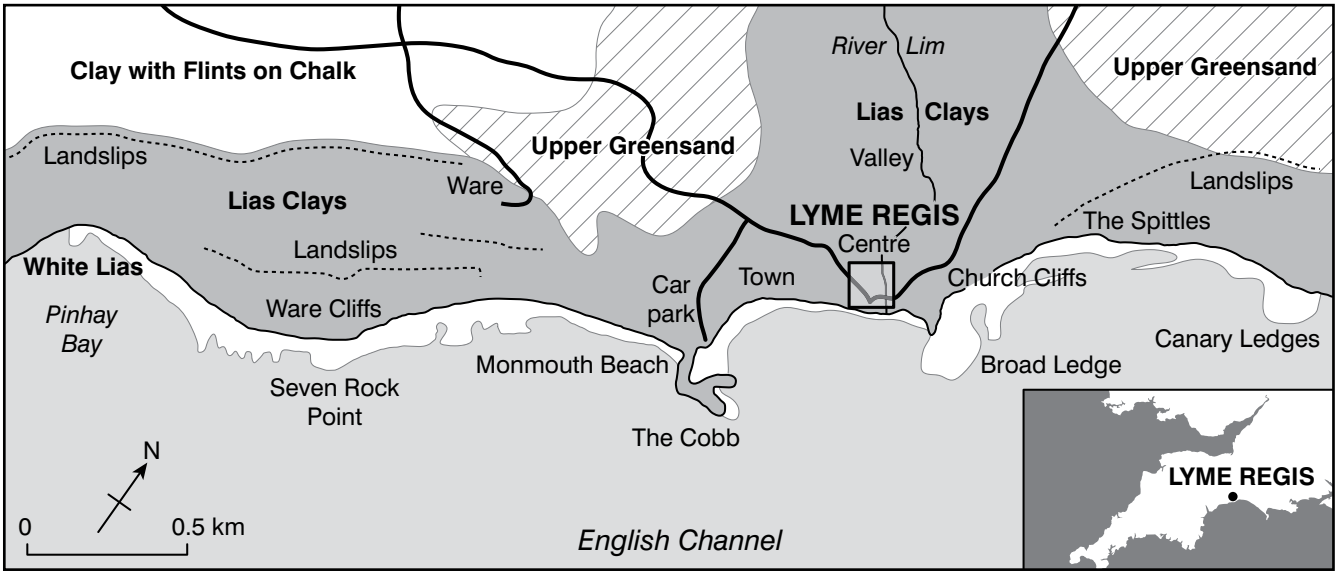

Figure 2: Location of Lyme Regis

The coastline is composed of soft rocks and faces serious challenges from landslides and coastal erosion. This has become worse in the last 100 years. In 2012 a tragedy occurred in which a young woman was killed when a sudden collapse of a cliff buried her under 40 tonnes of rock. Lyme Regis is built on a steep and actively eroding hillside. The geology consists of a base of limestone above which there are layers of clay overlain with sandstone and sandy soil. The combination of sand over clay makes the cliffs inherently unstable. Throughout the existence of the town there has been damage to coastal defences, including the sea walls, and many properties have been lost to the sea. This is a stretch of coastline today where there are roads and both residential and commercial properties near the shore.

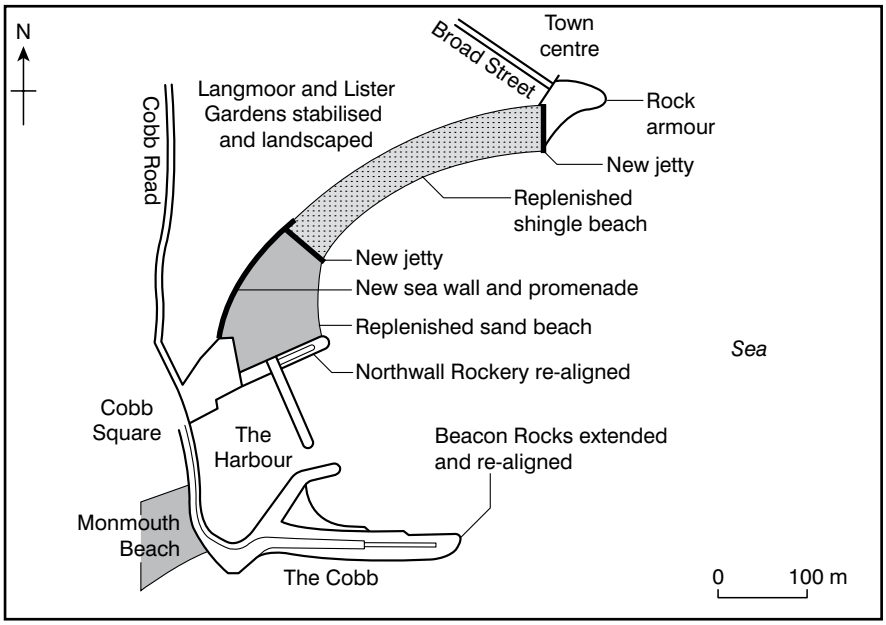

Figure 3: The main features of the coastal management plan at Lyme Regis

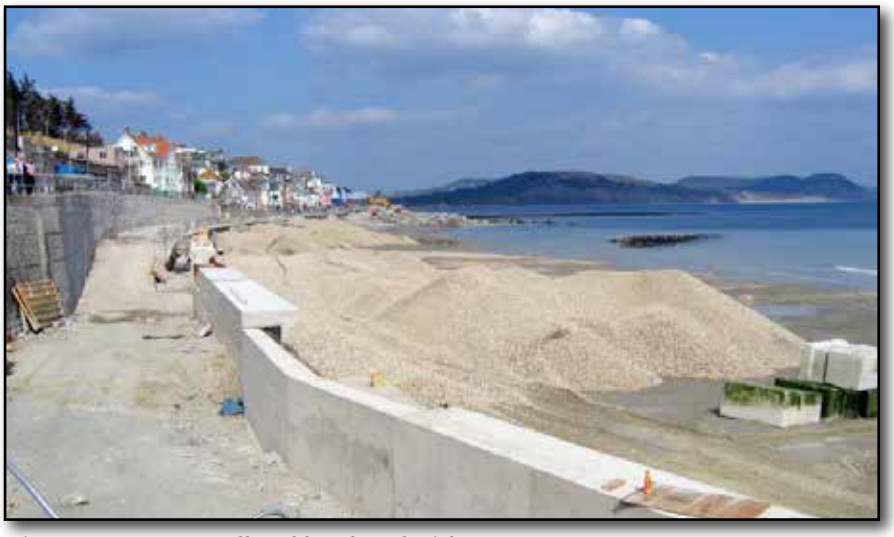

Figure 4: New sea wall and beach replenishment at Lyme

Source: http://geophotos.webs.com/MEtherington

The SMP approach is mixed. In the vicinity of Lyme Regis the approach is to 'hold the line' (even over one small stretch to 'advance the line'). This is being carried out with an extensive programme of new sea defences. Away from the town there is a mix of 'holding the line' and 'do nothing'.

The Lyme Regis Coastal Protection Scheme was developed by West Dorset District Council in the early 1990s. Its aim is to provide long-term protection for Lyme Regis and to reduce the threat of landslides. This was to be accomplished by a long-term phased programme of engineering works: (Figure 3).

Phase 1 (1994 and 1995)
This involved the construction of a new sea wall with rock armour revetment and a new promenade at the eastern end of the town. It also dealt with the dilapidated sewerage system.

Phase 2 (completed in 2007)
This scheme is to protect the area from Cobb Gate to the harbour in Lyme from landslides. It involved slope stabilisation and drainage works in Langmoor and Lister Gardens.

Access to the sea front has been improved. Cobb Road was slipping down the hill. This has been stabilised, strengthened and widened. The land behind the beach has been stabilised to prevent landslides, with over 1,000 deep-bored pins fixing it to the firmer rocks below. New drainage systems have been put into the reshaped parkland.

A new sea wall was also constructed. This was in front of the old sea wall and represents a short stretch where the line has technically been advanced. There was some old rock armour called Beacon Rocks at the end of the Cobb. A new rock armour revetment was put in place using huge boulders (each weighing 18 tonnes) of a resistant igneous rock brought all the way from Norway. Beach replenishment was also used and new masonry jetties built to keep beach material in place. The beach will take energy out of storm waves as they approach the sea front (Figures 4 and 5).

Phase 3
This focused on the area between Monmouth Beach and Ware Cliffs, a less developed part of the coast. It was considered that there was no economic justification for coastal works in this area, so the overall management approach was to 'do nothing'. Some ongoing maintenance to stabilise slopes was to be carried out as a public service.

Phase 4
This too is ongoing, but the initial part has been completed. This involved the construction of 390 metres of sea wall and stabilisation

Figure 5: New sea wall, new groynes and replenishment beach at Lyme

Source: http://geophotos.webs.com/METherington

of the soft cliffs and coastal slopes behind it at Church Cliff and East Cliff, to the east of the town.

This has been a very expensive scheme and it is likely to cost the government about £30 million. Figure 3 provides a useful overview of the works at Lyme Regis.

Pevensey Bay

Pevensey Bay is in East Sussex between Bexhill and Eastbourne (Figure 6). The bay is backed by a very long shingle beach and ridge, beyond which are the Pevensey Levels. This is an extensive area covering approximately 9000 ha of grazing marsh. The Pevensey Levels (Figure 7) are an area of great ecological importance. They attract wetland birds, and there are many types of flowering water plants, including some nationally rare species. It is also one of the top five locations in Britain for aquatic beetles. The area is a National Nature Reserve that is part run by Sussex Wildlife Trust and the rest is owned and managed by Natural England. The area also has Site of Social Scientific Interest status and Ramsar Convention status as a wetland of international importance.

The beach has high amenity value, lying as it does between two major coastal resorts, Eastbourne and Bexhill. The sea defences provide protection for an area of 50 sq km which includes Pevensey Bay, Normans Bay, Langney (part of east Eastbourne), Westham and Pevensey itself. Within the area there are more than 100,000 properties, some minor roads, one main road and a railway line. There are some recreational areas and a few commercial sites. If the sea defences were breached, then much of this would be flooded.

Historically, the area has been protected by the shingle beach and ridge, and about 150 groynes were present in 2000. The groynes were reaching the end of their life though and have gradually been removed. The plan was to leave about ten, to prevent major realignment of the beach. By 1997 it was believed that a storm with a return period of 1 in 20 years could breach the defences.

The Pevensey Bay Sea Defence system is unique – the first sea defence project of its kind in the world. Like all stretches of the British coastline, it is covered by an SMP, but responsibility for defence of the area is funded as a part private/public partnership. It involves the Environment Agency and Pevensey Coastal Defence Ltd (PCD Ltd) working together to develop 'best practice' in sea defences for this area.

Various methods are currently used to maintain the frontage and the overall strategy at present is to 'hold the line'. The shingle embankment has to be kept within certain width and height parameters to prevent the defences from being breached and to protect some properties behind the ridge. Bulldozers are used in the winter to reprofile the upper foreshore and to move sediments back up the beach that have been dragged down by storms. Large dump trucks also redistribute shingle from areas of accretion to areas that have been depleted. To supplement the beach material a dredger sometimes pours extra shingle onto the beach which it has dredged from the sea bed.

It might be asked why not build a sea wall to protect the Levels and the properties and infrastructure inland? This raises the issue of sustainability and also the pros and cons of hard and soft engineering. It is known from the experience of recent years that the soft sea defences can be maintained for about £1 million per year.

Any sea wall would need to be higher than the existing beach, because there would no longer be the same width of shingle to absorb wave energy. This would mean that most properties near the top

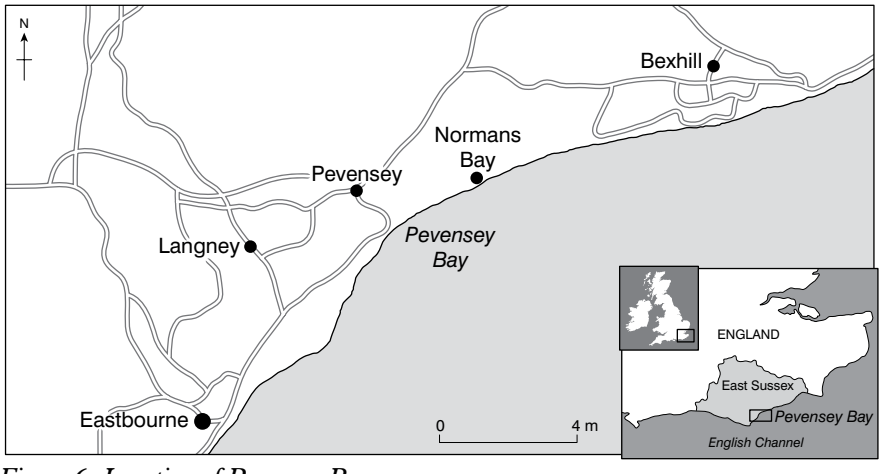

Figure 6: Location of Pevensey Bay

Figure 7: Pevensey Levels

Source: Julian P Guffogg/Wikipedia

of the beach would lose their sea view; it would also make it very difficult to launch boats from the beach. The cost of constructing a wall alone would be almost double the value of PCD Ltd's 25-year contract. This does not allow for maintenance of a wall either. A narrowing beach would result in waves reaching, and being deflected from, a wall; this could add to erosion of the beach and also lead to toe-scouring of the wall which would undermine the structure.

Replacing the groynes is also not a good option. Tropical hardwoods were used for groynes in the past, but this is not a sustainable option. They also do not last as long as many people think. The cost would be excessive, taking up most of PCD Ltd's budget due to last for about 25 years.

The environmental, social and economic costs of hard engineering approaches would be substantial and would not be sustainable. Hard engineering approaches would fundamentally change the nature of the frontage, from one with a beach and associated amenities, to one with extensive hard defences and little or no beach.

One problem however is that the sediment is from a relic supply – in other words, there are no contemporary sources that are replacing lost shingle. The beach replenishment is literally redistributing shingle within the system. In the future with rising sea levels it may not be possible to maintain the current level of protection using soft engineering practices alone.

Conclusion

This **Geofile** has covered some interesting issues. Much of the UK's coastline is eroding rapidly and sea levels are rising. The government's financial resources are not unlimited, and recent cutbacks means that less money is available to be spent. Money invested in coastal protection schemes mean less money can be spent elsewhere. Pevensey defences already offer protection for storms up to 1:400 years against breaching, which is much higher than is provided in most other places.

What would you do in Pevensey in the future? Would you adopt hard engineering practices to cope with sea level rise, or is there an alternative that does not involve fighting nature? What would be the consequences of your decision?

Useful websites

Lyme Regis

http://www.environment-agency.gov.uk/homeandleisure/134834.aspx

http://www.risknat.org/projets/riskydrogeo/docs/guide_pratique/Acivite1_Ateliers/Presentations%20Atelier1/A1P13-Coastal%20changes/vol2/g11.pdf

http://cliffs.lboro.ac.uk/downloads/workshop%204/Lyme%20Regis%20case%20study.pdf

Pevensey Bay

http://www.pevensey-bay.co.uk/ppp.html

http://www.pevensey-bay.co.uk/feature.html

Focus Questions

1. Summarise the main hard and soft engineering approaches used in Lyme and Pevensey.

2. There are some very useful and often spectacular photographs on the internet showing the location of Lyme Regis, landslides that have occurred and the works at Lyme; also photographs of Pevensey Levels and the works on the coast, particularly of the beach replenishment. Add these to your notes and include appropriate labelling.

3. Hold a discussion and make up two tables outlining the arguments for and against the management strategies that have been used in Lyme Regis and Pevensey. You could extend this if you wish and do the same for the four different management alternatives outlined in Figure 1.

4. Essay: Evaluate the economic and environmental effectiveness of hard and soft engineering approaches to coastal protection, referring to case studies in this Geofile and/or others you have studied.