Coastal Management

What you need to know
Traditional approaches to coastal flood & erosion risk: hard & soft engineering
Sustainable approaches to coastal flood & erosion risk with shoreline management
Sustainable approaches through integrated coastal zone management (ICZMs)

Introduction:

"Coastal protection measures have been put in place at various locations around Britain's coasts for over a century in an attempt to slow down and arrest coastal erosion. Many of the Victorian defences are now deteriorating and even for more recent defences, maintenance and repair costs are escalating. As traditional coastal protection methods present issues, then the more recent perspective of analysing coasts as systems in which sediment is recycled between various stores is shifting coastal management strategy towards more sustainable techniques that operate in co-ordination with natural systems rather than attempting to impede them."

Hard engineering coastal protection (erosion):

These traditional strategies aim to slow down or prevent further erosion of the coastline taking place, usually by placing an artificial, more resistant barrier between wave action and the coast.

Technique	Benefits	Issues
Concrete sea wall Solid facing to a coastal wall or cliff.	• Traditional, long used and with proven effectiveness. • Absorbs and deflects wave energy back to sea. • Recurved upper lip dampens down oncoming wave power	• Requires regular repair • Quarrying at base can undermine sea wall foundations. • Expensive to construct • Gives an artificial appearance to the coast
Revetment Open slanted concrete or wooden facing/fence offering partial resistance but letting some seawater to pass through	• Cheaper to construct than a sea wall • Along a beach they allow beach material to be deposited behind • Reduce power of oncoming waves	• Can restrict sea access from a beach • Unattractive along a length of beach • Can be damaged in high energy conditions • Require regular maintenance & repair
Rip rap / rock armour Massive blocks of natural rock placed in position and piled up at the base of a cliff	• Requires less maintenance than a sea wall • Granite often used that is barely eroded even under highest energy conditions • May look more natural than a concrete sea wall	• Expensive to extract, transport and place in position • Can impede access to a beach by visitors • Can lead to injuries climbing over • Rodents may inhabit spaces between rocks
Tetrapods	• Cheaper than rock armour but doing the same role by	• Less attractive than natural rock – look artificial

Moulded multi-angular concrete shapes formed on site and tipped onto beach to form interlocking components	being constructed on site from liquid concrete • Effective along long stretches of coastline requiring protection	• May protrude into sea and endanger swimmers/small craft • Almost impossible to climb over to get access to a beach
Gabions Rock-filled wire cages placed along a vulnerable coast	• Cheaper than tetrapods but doing the same role • May look more attractive than alternatives	• Wire containers may rust and be broken under high energy conditions • Require regular repair & replacement • Rodents may inhabit spaces between rocks
Groynes Wooden (or less often, boulder) 'breakwaters' at right angles to a beach extending into the sea designed to capture longshore drift sediments to build up beach width and height	• Effective at increasing a natural barrier of beach between sea and shore • Tourism amenity as wider beaches attract more visitors • Attractive • Groynes can act as 'wind breaks' for visitors • Calmer inshore water	• Traditionally constructed of hardwood – which is increasingly environmentally unsustainable • Require maintenance and repair • Speed up downcoast erosion by robbing adjacent beaches of sand
Offshore reefs Artificial sand/gravel offshore deposits designed to intercept destructive wave action	• The most 'natural' of hard engineering techniques • Create additional shore habitat • Create calmer water conditions between them and shore – benefits tourist use	• Vulnerable to storm conditions • Less reliable than 'concrete/rock' strategies • May be overwhelmed by rising sea levels

The concerns about using hard engineering techniques to protect the coast go beyond cost and extend to their interruption of natural systems at the coast. By slowing down or preventing coastal erosion the input of sediment into the system is reduced, which has implications for beach size, depositional features and transfers to neighbouring sub-systems. The protective benefit for some groups at a particular location on the coast is often at the expense of other groups further along the coast.

Hard engineering: protection from coastal flooding:

Preventing periodic inundation of low-lying coastal land from the sea invariably involves constructing high continuous barriers that block penetration of the land by the sea:

- *High concrete sea wall (Canvey Island)*
- *Barrier dams (Dutch constructions protecting low-lying polders of reclaimed land)*
- *Moveable estuary barriers (Thames barrier)*

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All are very expensive to construct and are vulnerable to

- Storm surges
- Tidal surges at spring tides with accompanying low pressure systems
- Rising sea levels

Soft engineering coastal protection (erosion):

The approach of soft engineering is to manipulate and modify natural systems to bring about desired consequences rather than trying to impede or interrupt them.

Technique	Benefits	Issues
Beach nourishment Replacing lost beach material from a natural store either offshore (beach rebuilding) or from downshore along a stretch of longshore drift (beach recycling)	• Reproduces what natural systems would do – but at a faster rate. • Sediment is not removed from the system – just redistributed. • Low cost intervention over short term • Maintains natural shoreline without artificial intrusions	• Requires repetition over the year (3x) and each year • Regular costs accumulate over the long-term • Can be disruptive to beaches (local amenity and tourist economy) while engineering takes place
Beach reprofiling Re-shaping the cross-sectional profile of a beach to ensure it offers maximum protective gradient and width against destructive wave action	• (as above)	• (as above)
Living shoreline barrier Planting shoreline vegetation (mangrove) or shellfish colonies (oyster reefs) to absorb wave energy between shore and sea	• Enhances shoreline habitats • Encourages wildlife • More attractive for locals and visitors • Can be modified with different species to adapt to rising sea level	• May be harmed by pollution events • May not adjust to rising ocean temperatures/acidity • Can be devastated by extreme storm events

Soft engineering: protection from coastal flooding:

Living shorelines offer some protection against storm/tidal surges by absorbing the forward movement of water, although extreme tidal heights will still make their way inland.

An increasingly favoured soft engineering strategy to cope with more extreme storm events and anticipated rising sea level is to redirect flooding from coastal areas that are valued (homes, industry and key infrastructure) onto areas that have less significance with correspondingly less damage. This is achieved through **'managed retreat'** (coastal realignment):

- New coastal embankments are constructed further inland on slightly higher land behind low-value shoreline
- Existing embankments are breached
- When higher sea levels are experienced the water floods onto the specified area
- New tidal saltmarsh/mudflats develop over time, absorbing flood water and providing essential wading-bird feeding habitat

Shoreline Management approaches:

Hold the line: intervene against coastal erosion with hard or soft engineering to prevent any further shoreline retreat.

Managed retreat: realignment of the coast to a pre-determined line some distance further inland from the current position of the coast *(see above)*

Advance the line: extend the coast into what is currently the sea. *(Very few examples around Britain, but the basis of Dutch polder reclamation and construction of man-made islands in Tokyo Bay).*

No active intervention: permit natural systems to modify the coastline as they are currently operating. It usually means allowing erosion and cliff retreat to continue.

The factors that determine which of the four options is designated for a section of coast depends on:

- The rate of coastal change (threatened loss of land as well as sea level rise)
- The economic value of land uses put at risk by coastal change (homes, businesses, infrastructure)
- The value of agricultural land at risk, along with habitats of value
- The cost of intervention strategies

Integrated Coastal Zone Management (ICZM):

A systems perspective recognises that an action in one location is likely to have an impact elsewhere. The development of ICZM plans takes this as a basis for holistic (all components taken into account) planning. monitoring, information-gathering and recording of what is taking place at the coast

- *Identifying and involving all stakeholders (who may change with time)*
- *Agreeing co-ordinated plans that allow key objectives for stakeholders to be met*
- *Following sustainable strategies*
- *Managing the natural and human systems responsibly*
- *Considering changes to coastal systems and anticipating likely impacts*
- *Adapting plans accordingly*

