



X826/75/11

Environmental Science Supplementary source booklet

This booklet contains sources for use with Section 2.

Supplementary sources of information

Source A is a sketch map showing the shingle banks and location of Settlement X.

Source B is an image showing forestry plantation on inland shingle banks, including gorse encroachment.

Source C is a table showing the SSSI designations in this area and reasons for their designation.

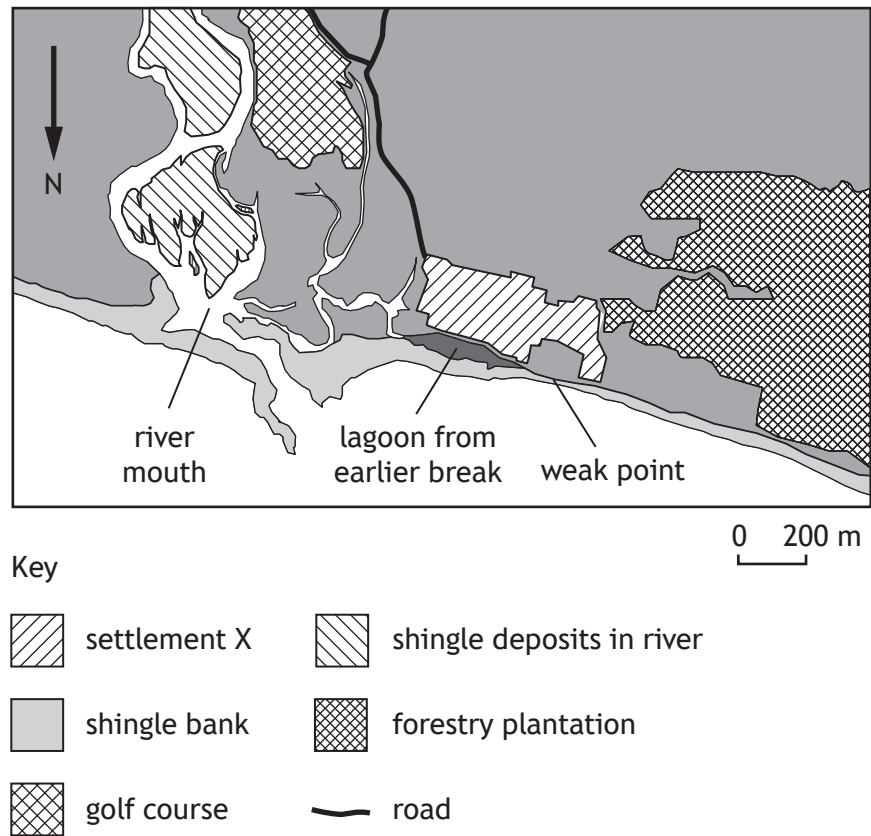
Source D is a list of particular risks to Scotland identified in the UK Climate Change Risk Assessment (2017).

Source E is a table showing the estimated costs of coastal engineering options at the estuary in 1996.

Source F is a graph showing the change in value of £100 between 1996 and 2020 when adjusted for inflation.

Source G is a table showing the advantages and disadvantages of coastal engineering approaches used to manage coastal erosion.

Source A Sketch map showing the shingle banks and location of Settlement X



Source B Image showing forestry plantation on inland shingle banks, including gorse encroachment



Source C SSSI designations in the area and reasons for their designation

Designation	Feature	Species
Estuary SSSI and river SSSI	<ul style="list-style-type: none"> coastal geomorphology river morphology saltmarsh shingle wet woodland 	<ul style="list-style-type: none"> plant communities Atlantic salmon, sea lamprey, freshwater pearl mussel, otter butterflies — small blue, dingy skipper

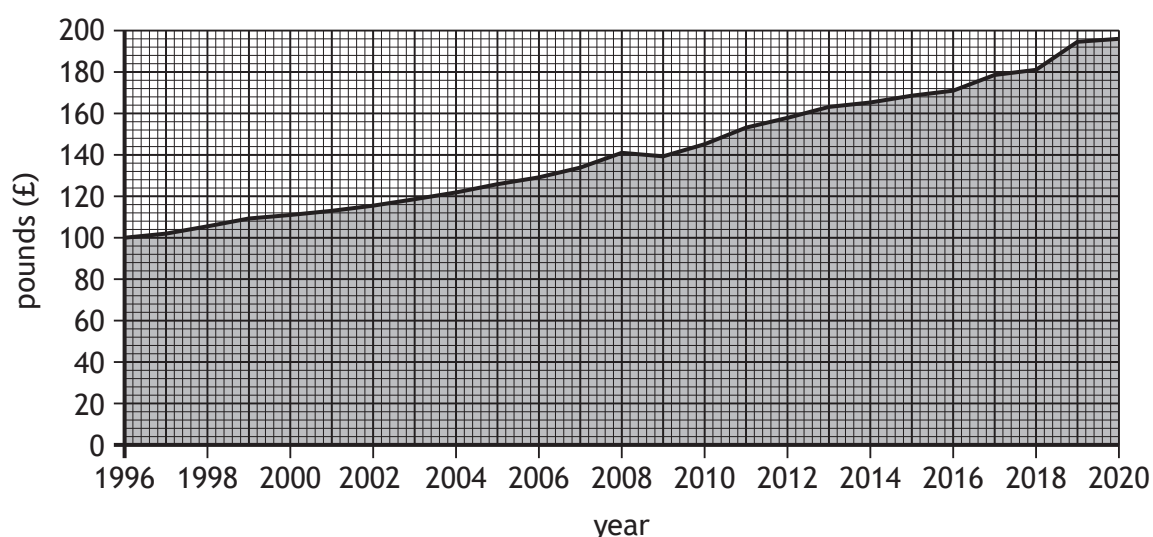
Source D Particular risks to Scotland identified in the UK Climate Change Risk Assessment (2017)

- Species and habitats, from the changing climate
- Soils and natural carbon stores
- People, communities, and buildings, from flooding
- Coastal areas, from sea level rise combined with extreme weather events
- Marine species, from coastal changes
- Health and wellbeing

Source E Estimated costs of coastal engineering options at the estuary in 1996

Offshore breakwater	Rock armour	Rock groynes	Beach nourishment (over 50 years)	Emergency work (over 50 years)
£1.85 million	£6.84 million	£1.94 million	£3.59 million	£776,554

Source F Change in value of £100 between 1996 and 2020 when adjusted for inflation



Source G Advantages and disadvantages of coastal engineering approaches used to manage coastal erosion

Approach	Advantages	Disadvantages
Breakwater — placed 200 m offshore, near weak point	<ul style="list-style-type: none"> • one-off construction • minimal maintenance once in place • will trap shingle coming downriver • will break the waves and absorb their energy • habitat potential for marine species eg lobsters, mussels 	<ul style="list-style-type: none"> • requires seabed survey and modelling • lengthy planning and construction processes • below-water construction, with disturbance of sea bed • may act as barrier to species such as sea lamprey and salmon
Rock armour — large boulders placed in front of shorefront shingle banks	<ul style="list-style-type: none"> • easy to maintain • will break the waves and absorb their energy 	<ul style="list-style-type: none"> • financial and environmental impacts of transporting rock • visual impact if imported rocks differ from local geology
Rock groynes — mesh cages containing rocks, placed at right angles to the coast	<ul style="list-style-type: none"> • will trap shingle carried westwards by coastal currents 	<ul style="list-style-type: none"> • minimum height of 6.5 m, plus extensive below-ground engineering • visual impact • reduces localised erosion but enhances it further along coast • disruption of coastal processes • disturbance of species could threaten SSSI status
Beach nourishment — local shingle deposits are moved back into place, or replacement of lost shingle	<ul style="list-style-type: none"> • not visually intrusive if the same materials are used • allows natural geomorphological processes to continue 	<ul style="list-style-type: none"> • impacts of transporting shingle • disturbance of shingle and species could impact SSSI status • requires constant monitoring and maintenance
Emergency work only		<ul style="list-style-type: none"> • would require planning to provide short-notice to Settlement X residents • could not be scheduled to protect species such as sea lamprey and salmon or nesting birds

[END OF SUPPLEMENTARY SOURCE BOOKLET]

Acknowledgement of copyright

Source B Image of shingle: © Copyright Anne Burgess and licensed for reuse under creativecommons.org/licenses/by-sa/2.0