East Lothian Council

Shoreline Management Plan

Summary Report

Observed Erosion and Damaged Gabion Defences at The Cast, Prestonpans.

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East Lothian Council
Shoreline Management Plan
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Executive Summary

This report is a summary document for the East Lothian Shoreline Management Plan (SMP) Project. This document is intended to provide a summary of the main conclusions regarding the coastal management units identified and analysed during the project.

The principal aim of the SMP is to provide a strategic framework for coastal defence in East Lothian.

This project involved the collation, interpretation and presentation of a diverse body of data describing the East Lothian shoreline. Based on these data the coastline has been split into management units and appropriate management options have been identified and assessed for each unit.

Other Outputs

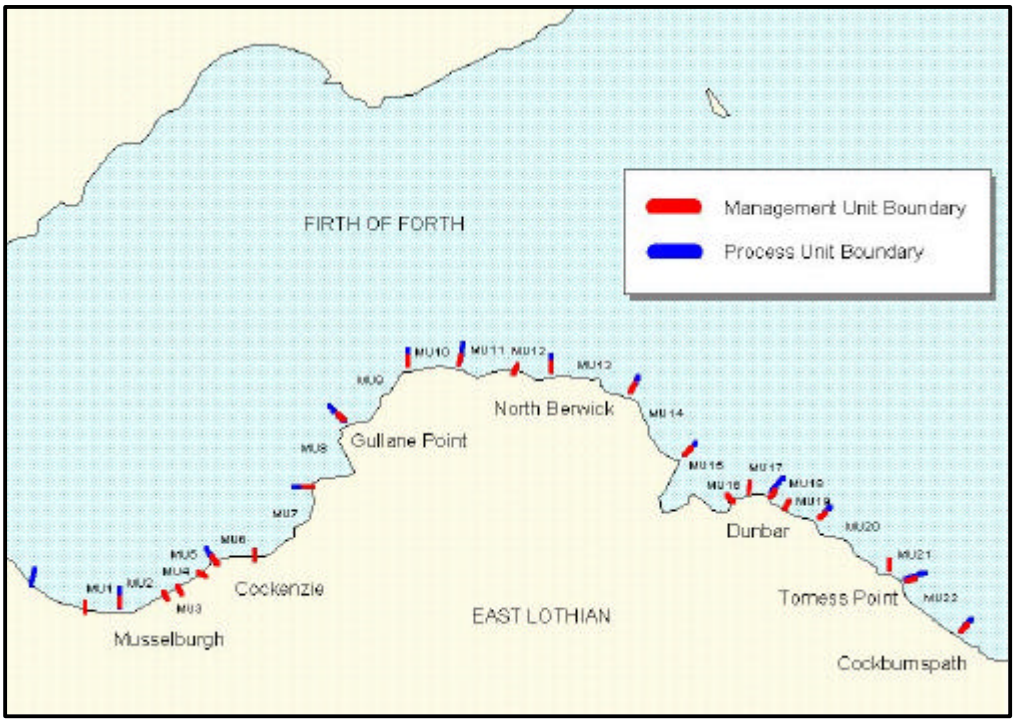
East Lothian Council, Shoreline Management Plan, Final Report, 4th July 2002, 455 Pages.

Much of the information presented in the full report and summarised here has been collated in a Geographical Information System (GIS). This GIS has been passed to East Lothian Council for ongoing use.

Further Information

Any requests for further information regarding this Shoreline Management Plan should be directed to East Lothian Council, Department of Education and Community Services.

Process and Management Units Identified along the ELC Coastline



The Preferred Option for Each Management Unit

The preferred coastal defence options for each management unit, are summarised in the following table.

Management Units 1 to 6

MU	MU Name	Approx Length (km)	Preferred Option	Capital Works	Estimated Costs (2001 rates)	Timescale for Works
1	Eastfield to River Esk	2	Selectively Hold the Line	Repairs to River Esk defences within 10 Years. Raising of Fisherrow Promenade and mouth of Fisherrow Harbour.	More detailed study required to determine capital costs Monitoring and maintenance £2,800pa	Detailed engineering appraisal of River Esk defences within 5 Years Repairs / Replacement within 10 years
2	Ash Lagoons	3	Hold the Line	Defences have estimated Residual Life of > 50 years	Monitoring and maintenance £2,700 pa.	ongoing
3	The Cast	1	Hold the Line	Existing gabion and rock armour: Estimated replacement within 5 years. However, it is also recommended that the Council investigate the possibility of Retreating the Line.	Monitoring and maintenance £850 pa Repair / Replace Gabions £380,000 Repair / Replace Rock Armour £205,000	ongoing During year 1 During year 5
4	Prestonpans	1.5	Selectively Hold the Line	Existing property walls observed to be in poor condition. ELC have estimated repair costs.	£395,000 Initial repair costs Monitoring and maintenance £1,250 pa	During year 1 ongoing
5	Humlocks & Cockenzie Power Station	1	Hold the Line	Defences at Power Station in good condition. Rock Armour at Sailing Club and Humlocks has residual life < 5years	Monitoring and maintenance £1,000 pa Rock armour replacement £415,000	ongoing During Year 4 / 5
6	Cockenzie and Port Seton	2	Hold the Line	Replacement of the rock armour east of Port Seton Promenade will be necessary in the next 15 years	Monitoring and maintenance £2,000 pa Rock Armour £170,000	ongoing During Year 14/15

Please see note on page iv

Management Units 7 to 18

MU	MU Name	Approx Length (km)	Preferred Option	Capital Works	Estimated Costs	Timescale for Works
7	Gosford Bay	6	Selectively Hold the Line	Rock Revetment required to protect coast road at Gosford House. Placement of toe protection at section of sloping masonry, which protects the coast road for a section of approximately 100m in Longniddry within 3 years	£475,000 £120,000 Monitoring and maintenance £650 pa	During year 1 During year 3 ongoing
8	Aberlady Bay	5	No Active Intervention		Monitoring and maintenance £200 pa	ongoing
9	Gullane Bay	5	Limited Intervention	Visitor management and management of sea buckthorn should be continued	Monitoring and maintenance £1,000 pa Dune Fencing, if necessary £21,000	ongoing During year 5,replacement assumed 10 year intervals
10	Archerfield and Yellowcraig	3	No Active Intervention		Monitoring £2,000 pa	ongoing
11	Broad Sands and West Links	3	Limited Intervention	Visitor management, such as dune fencing and signs to keep visitors off the eroding dunes, and relocation of tees/greens away from the eroding shore.	Monitoring and maintenance £1,000 pa Further studies and data collection may be required over time	ongoing
12	North Berwick	2.5	Selectively Hold the Line	Maintain existing defences.	Monitoring and maintenance £2,500 pa	ongoing
13	Tantallon	5.5	No Active Intervention		£500 pa	ongoing
14	Ravensheugh	4.5	Limited Intervention	Visitor management (e.g. dune fencing and signs)	Monitoring £500 pa	ongoing
15	Belhaven Bay	7	No Active Intervention		Monitoring & further studies required to develop strategy £1,000 pa	ongoing
16	Winterfield Golf Course	1.5	Selectively Hold the Line	Protect the clubhouse with the provision of rock armour along toe of slope.	Monitoring and maintenance £100 pa Rock armour £106,000	ongoing During year 2

Please see note on page iv

Management Units 17 to 22

MU	MU Name	Approx Length (km)	Preferred Option	Capital Works	Estimated Costs	Timescale for Works
17	Dunbar Cliffs	1.5	Selectively Hold the Line	Gabion toe protection at Bayeswell Hotel should be maintained	Monitoring and maintenance and further studies, £ 2,000 pa	ongoing if necessary
18	Dunbar	1.5	Hold the Line	Repairs to walls and Lamer Street Access Steps and Provision of Flood gate at cobbled access ramp	£ 50,000 £ 4,000 £10,000 Monitoring and maintenance £2,700 pa.	All during year 1 More detailed studies will be required to evaluate impacts and costs of these and other proposals related to the beach and groyne.
19	Dunbar Golf Course	2	No Active Intervention		Monitoring £1,000 pa	ongoing
20	Barns Ness	5.5	No Active Intervention		Monotoring £500 pa	ongoing
21	Torness Power Station	1.5	Hold the Line	Maintenance of defences at Nuclear Power Station will be required for the foreseeable future	Monitoring and maintenance £1600 pa	ongoing
22	Thorntonloch	4.5	Limited Intervention	Dune management and relocation of caravans, if necessary in the future	Monitoring and selective maintenance £ 300 pa	ongoing Dune planting / fencing if necessary

Total Estimated Expenditure at 2001 Prices	**£**
Annual Monitoring and Maintenance	**30,950**
Total Capital Expenditure	**2,351,000**

The identified capital expenditure ranges from works necessary within a year to works which may become necessary in 10, 15 or 20 years. The total figure given above covers estimated capital expenditure in this period and includes some allowance for engineering and environmental studies.

The estimated costs given above are based on broad brush appraisals and more detailed studies will be required to determine the exact extent of works necessary and to refine these estimates. For example it has not been possible to estimate costs for repairs to the River Esk defences in Musselburgh without further engineering studies.

The costs given above are sufficient to allow East Lothian Council to evaluate: the scope of work, which may be necessary and likely timescales within which this work may be required. This will allow a strategic programme of ongoing maintenance, further studies and necessary capital works to be developed for the whole coastline of East Lothian.

Contents

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1 Introduction

1.1 Aims of the SMP

The East Lothian Shoreline Management Plan (SMP) sets out a strategy for managing the East Lothian coast, taking account of natural processes and human and other environmental influences and needs. This document summarises the key issues and sets out the preferred strategy for managing the East Lothian coastline.

The principal aim of the SMP is to provide a strategic framework for managing the shoreline in East Lothian and the main reasons for developing the Plan are to:

- Help conserve the coastline and contribute towards the future development of a coastal management strategy;
- Co-ordinate and facilitate coastal defence action in East Lothian;
- Improve understanding of coastal processes operating within the sediment cell;
- Identify the need for site specific research and investigations;
- Facilitate consultation between those bodies with an interest in the coastline;
- Identify important activities and uses associated with the coast and its environs;
- Highlight opportunities for maintaining and enhancing the natural environment of the coast;
- Consider the importance of alternative means of dealing with coastal erosion.

1.2 The East Lothian Shoreline

The East Lothian coastline forms the southern shore of the Firth of Forth and extends for approximately 69km from Musselburgh in the west to just north of Cockburnspath in the east. The SMP considers a 1km strip of land inland from the East Lothian Shoreline and offshore to the 20m-depth contour.

The towns of Musselburgh, Prestonpans, Cockenzie and Port Seton, North Berwick and Dunbar are located along the coast, however it is more typically characterised by natural features such as raised beaches, saltmarshes, beaches and dune systems and rock outcrops.

2 Key Issues

In preparing the plan, four key issues were addressed as follows:

(i) Coastal Processes
(ii) Coastal Defences
(iii) Land Use and the Human and Built Environment
(iv) Natural Environment

Preliminary studies were undertaken on each of the above topics, firstly by collating all available relevant data and literature. As part of this stage, all relevant groups and organisations with an interest in the coastline were identified and contacted in order that their views, ideas and requirements may be taken into account. The data collected was reviewed and analysed and, if applicable, added to a Geographical Information System (GIS) that was created for the project. A summary of the key issues taken into account during the development of the East Lothian SMP follows.

2.1 Coastal Processes

Hydrodynamics

From west to east along the East Lothian coast there is a change in coastal environment from estuarine (Firth of Forth) to the open, more exposed coast from North Berwick to Cockburnspath. The hydrodynamic regime has a significant swell component and the shoreline outside the Firth of Forth is dominated by waves from the northern and eastern sectors. Inside the Firth of Forth waves from westerly sectors are important. The significant wave height exceeded for 10% of the time is 1.5-2.0 m on the open coast and 1.0-1.5 m in the Firth of Forth. The mean spring tidal range for the region exceeds 4 m and increases into the Forth Estuary. The 1 in 50 year storm surge height is 1.5 m and smaller surges of around 0.2 m occur several hundred times a year.

Sediment Transport

The embayed nature of the coastline and relatively low volume of beach sediments mean that, although wave energy is high, the actual longshore transport of material is relatively low. Hence many of the bays represent relatively closed littoral systems. Although previous workers have considered sediment transport to be generally from east to west, the variable wave direction can result in reversals and littoral divergences, especially at headlands. It is likely that under northerly wave conditions west to east transport can occur in a number of the bays on the open coast. Within the Firth of Forth reversals occur between Musselburgh and Eyebroughy, due to the existence of gyres between Port Seton and Gosford, Musselburgh to Prestonpans. Additionally, variation in wave direction can be important.

Morphology

The overall form of the East Lothian coast is dominated by a distinct underlying geology, which determines the coastal orientation and location of headlands. The geology is predominantly composed of Carboniferous sedimentary rocks and igneous intrusions. There are more recent Quaternary deposits of wind blown sand, till, raised beaches, fluvioglacial and alluvial material.

The coastal orientation and location of headlands controls the exposure to wave energy. Outside the Firth of Forth, the open coast is more exposed to wave action and is characterised by rock cut platforms and limited sediment volumes in the littoral zone. However, in the more sheltered areas within the Firth of Forth and within embayments between rocky headlands on the open coast, sandy beaches, marshes and dunes have accumulated.

Many of the morphological features of the present day coastline represent the reworking of features formed early in the Holocene under different sea levels. Thus, many of the coastal morphological features of the East Lothian Coast, such as the aeolian dunes, may be considered as being out of equilibrium with current hydrodynamic and sediment dynamic regimes.

Coastal Process Units

The coastline of East Lothian has been split into different sections representing headland-bay-headland units, which have coherent characteristics and to an extent behave independently from each other:

1. Edinburgh to Musselburgh
2. Musselburgh to Cockenzie
3. Cockenzie to Craigielaw Point
4. Craigielaw Point to Gullane Point
5. Gullane Point to Eyebroughy
6. Eyebroughy to Longskelly Point
7. Longskelly Point to North Berwick (Rugged Knowes)
8. North Berwick to St. Baldred's Boat
9. St. Baldred's Boat to St. Baldred's Cradle
10. St. Baldred's Cradle to Dunbar Harbour
11. Dunbar Harbour to Mill Stone Neuk
12. Mill Stone Neuk to Torness Point
13. Torness Point to Cockburnspath

The process units above were used as a basis to define management units for shoreline management, which also consider other factors such as land-use and natural environment.

Historical Evolution

It appears likely that the late Holocene has been characterised by falling sea level, coupled with minor transgressions or still-stands. Over the last 100 years the exact trend in sea level for the East Lothian coast is unclear, although the rate of global sea level rise has been increasing, whilst the rates of isostatic uplift in Scotland have been decreasing.

Over this time period some of the largest changes in coastal morphology have been the large-scale reclamations for power stations or industry, which have advanced the Mean High Water Spring (MHWS) contour seawards by several hundred metres (e.g. Cockenzie, Prestonpans, Torness Point).

Large lengths of the East Lothian coastline are characterised by rocky cliffs and these have undergone low or negligible rates of coastal erosion. Elsewhere accretion has been more common than erosion. The largest areas of coastal change have been associated with estuary or river mouths where spits have accumulated. These features have produced accretion rates of 2-4 m/yr at areas such as Belhaven Bay, and erosion rates of 0.7-1.0 m/yr at Peffer Sands, Belhaven Bay and Broad Sands. Elsewhere on the coast rates of change have been much lower, with accretion rates of 0.2-0.6 m/yr and erosion rates of 0.2-0.4 m/yr.

Future Coastal Evolution

Examination of literature and studies that have been carried out suggest the following responses for the East Lothian coastline in the future:

- By 2050 sea level rise is likely to be between 5-6 mm/yr (Hill et al., 1998).
- There is likely to be an increase in storminess in the future, which may influence incident wave heights, directions and frequencies.
- Many coastal responses are dependent on sediment supply, which is poorly understood at present and difficult to predict in the future.
- There is likely to be a reduction in width of saltmarshes coupled with a replacement by mudflats.
- On the North Berwick coast, the dune fields (Gullane Bay to St. Baldred's Cradle) may experience increased erosion from rising sea level and storms, with a possibility of onshore migration or barrier breakthrough. However this is heavily dependent on sediment supply.
- On the open coast (St. Baldred's Boat to Cockburnspath), there will be a general tendency for the landward movement of beaches coupled with a reorientation of bays in plan-shape. Unless supply increases, there is likely to be continued erosion of beaches such as East Dunbar.
- Spit features, such as those of Belhaven Bay, are likely to be more active showing migration onshore or extension alongshore.

2.2 Coastal Defences

A visual inspection of the coastal defences in East Lothian was undertaken during development of the SMP. The condition, estimated residual life, exposure and asset type of each identified coastal defence was recorded and added to the GIS.

There are about 17km of coastal defences in the area covered by the plan. Concrete / masonry seawalls are the most common type of coastal defence, covering a length of over 10km, while rock revetments extend over approximately 2km of shoreline.

The coastal defences of East Lothian are mainly located along the built-up areas of the shoreline, including Musselburgh, Prestonpans, Cockenzie, North Berwick and Dunbar. However, some short sections of defence were identified elsewhere along the East Lothian shoreline (e.g. Winterfield Golf Course, Torness Power Station).

Type of Coastal Defence	**Number**	**Total Length (m)**
Concrete / Masonry Wall	31	10,316
Concrete/Rock Revetment and Concrete/ Masonry Wall	1	1,493
Gabions	5	1,147
Geotextile	1	115
Groyne	1	49
Harbour	5	1,620
Rock Revetment	13	1,984
Timber Wall	3	433
Total	60	17,157

Although the defences are generally in reasonable condition and provide an adequate standard of defence, this is not the case everywhere. Repairs are needed and in some parts of the coastline, these are urgent. Twenty-five of the sixty coastal defence units identified are of unsatisfactory standard and works are required.

Condition of Defences in East Lothian	**Number**
1 Condition as built	8
2 Some signs of wear, needs to be kept under observation; returnable to condition as built with simple maintenance	27
3 Moderate works required; probably limited to a maintenance operation to return to satisfactory condition	14
4 Significant works needed; capital works probably required within 5 years	11

2.3 Land Use and the Human and Built Environment

Land Use

Land-use within 1km of the East Lothian coast	Area (ha)	Percentage
Arable	3032	43.8%
Factories & urban	1509	21.8%
Recreational land	627	9.0%
Improved grassland	398	5.7%
Mixed woodland	351	5.1%
Coniferous plantation	310	4.5%
Smooth grassland	271	3.9%
Duneland	189	2.7%
Quarries	100	1.4%
Coarse grassland	64	0.9%
Salt marsh	40	0.6%
Broadleaved woodland	16	0.2%
Maritime grasslands & heaths	14	0.2%
Water	5	0.1%
Total	6926	100%

Arable land is the principal land-use in the SMP area, covering 44% of land within 1km of the East Lothian shoreline. Factories and the urban area comprise only 22% of the hinterland, and are mainly located in the western part of study area (e.g. Musselburgh, Prestonpans, Cockenzie and Port Seton). The remaining land supports relatively low intensity land-uses, such as recreational land, grasslands, woodlands and dunes. Torness Nuclear Power Station and Cockenzie Power Station are located on the East Lothian coastline and will require specific management considerations.

The East Lothian coast is nationally important in terms of recreation and is a significant tourism asset, attracting more than 2.5 million visits annually. There are nine designated bathing waters in the area, at Seton Sands, Gullane, Yellowcraigs, North Berwick Bay, North Berwick Milsey Bay, Belhaven Bay, Dunbar East, White Sands and Throrntonloch.

Cultural Heritage

The East Lothian coastline is rich in archaeological and built heritage. There are 38 scheduled ancient monument within 1km of the East Lothian shoreline, some of which are very close to the shoreline, potentially at risk to erosion/flooding, including:

- Tantallon Castle (NT595850)
- Seacliff Tower (NT613841)
- Dunbar Castle and Fort (NT678793)

919 unscheduled monuments were identified within the SMP area. These include sites of both archaeological and architectural importance. A number of these sites lie close to the shoreline, buried under sand dune deposits or associated with the raised beach deposits. Several caves or rock-cut shelters were identified, often associated with midden material. These include:

- Kilspindie cave, post-medieval
- Archerfield, Iron Age
- Fidra, Medieval
- Yellow Man Cave
- Leckmoran Ness
- St Baldred's Cave, Early Iron Age

The archaeological record includes several sites where midden material has been exposed in the past, although during previous surveys no exposed or eroding middens were found. The following areas have been recognised as important sites, who suggest periodic monitoring in case further midden becomes exposed beneath slumped raised beach deposits or sand dunes:

- Gullane Links
- Fidra
- North Berwick Glen Golf Course
- Yellow Man Cave
- Tantallon Castle
- The Gegan, Seacliff
- Seacliff

There are 44 identified shipwrecks within in the nearshore of the East Lothian coast.

Cultural Heritage within 1km of the East Lothian Shoreline	**Number**
Scheduled Ancient Monuments	38
Unscheduled Monuments (archaeological and architectural)	919
Maritime Sites	44
Listed Buildings	1095
TOTAL	2096

A total of 1095 Listed Buildings lie within the 1km coastal zone of East Lothian. These are concentrated in the built-up areas of Musselburgh, Prestonpans, North Berwick, Belhaven and Dunbar. The majority of Listed buildings are domestic houses of the 18th and 19th century. Several churches are listed, including Prestonpans and North Berwick church. Listed harbours include Fisherrow Harbour, Cockenzie and Port Seton and Dunbar (including the Battery). The rich industrial heritage of East Lothian is preserved at Preston Grange (mining) and several listed maltings and warehouses at Dunbar Harbour. Listed buildings close to the coast may be affected by the salty environment, although they are not generally suffering from coastal erosion as defences generally protect the built-up areas.

2.4 Valuation of Assets and Losses

In a strategy study it is sufficient to calculate losses based on generic asset values. Detailed appraisal of the values of individual assets is not required. The loss of an asset due to coastal erosion is taken as the value of the asset or the replacement cost of the asset. The following asset types, based on land use, have been identified for the calculation of losses.

Estimated Asset Values (2001)

Asset Type	Value £ per Ha
Urban	1,400,000
Industrial	200,000
High Quality Agricultural	5,000
Open Areas	1,000

The value of the urban area is based on the Nationwide Building Society Housing Finance Review (3rd Quarter 2001) and the Halifax Bank Price Index (3rd Quarter 2001) for Scotland. The values assigned above are based on previous projects and advice received from the District Valuer South East Scotland. It should be noted that the unit values for each land use type are base estimates only. They are, however, useful for considering the relative values between Management Units.

2.5 Calculation of Losses

Information on coastal processes and change has been used to estimate the potential for erosion in each management unit. If an erosion rate is available, or can be estimated for a section of coast, it has been used to estimate the potential loss of land over the 50-year period of the Plan. An example of erosion rates and the associated loss of land are below.

Example Erosion Rates for Estimated Erosion Potential

Estimated Erosion Potential	Outline Erosion Rate	Distance over 50 years
High	1m/year	50m
Medium	0.5m/year	25m
Low	0.2m/year	10m

Once the erosion potential has been identified, the specified erosion rate was applied to frontages identified as being potential erosion sites. The potential losses were calculated based on the area of each asset type at risk. The present value of any losses was calculated assuming a uniform loss rate over 50 years.

2.6 Valuing Environmental and Heritage Losses

One of the difficulties in applying cost benefit analysis is in determining economic values appropriate for environmental and heritage assets, such as SSSI's, SPA's, Scheduled Ancient Monuments, Listed Buildings etc. This is discussed in the guidance produced by MAFF (MAFF 1999, 2000b). Estimation of economic values for such assets is difficult, time consuming and often contentious.

The general guidance available indicates that a lower bound economic value of an environmental or heritage asset can be taken as the lowest of:

- Cost of a similar site elsewhere of equivalent environmental value.
- Cost of relocating asset to another site.
- Cost of local protection.

Detailed investigations of these sorts are not appropriate in high level SMP studies. In carrying out the cost benefit analysis these type of assets at risk were highlighted in the overall discussion and option appraisal and the following values were applied for Sites of National and International Natural Heritage Interest:

SSSI's, SPA's, RAMSAR etc	High Quality Agricultural	£5,000 /ha
Local Wildlife Sites	Open Areas	£1,000 /ha

It should be noted that the value of some natural heritage sites is derived from the fact that they are examples of particular coastal processes. The introduction of defences could cause reduction in the environmental value of the site.

2.7 Natural Environment

The East Lothian coast is of outstanding natural heritage importance. Over 62km of the coast is designated as Site of Special Scientific Interest (SSSI) for biological, ornithological and geological interests and forms part of the newly designated Firth of Forth Special Protection Area (SPA) under the terms of the European Community Directive 79/409/EEC on the Conservation of Wild Birds. Much of the East Lothian shoreline has been recently designated as a Ramsar site (for Waterfowl Habitat) under the Ramsar Convention on Wetlands of International Importance.

The natural heritage designations confer additional levels of protection to the East Lothian shoreline. An Environmental Assessment is required for any proposed works or development, which may have significant environmental impacts on a "sensitive location" such as a SSSI or SPA. Implementation of the EC Habitats and Birds Directive places a requirement that an 'appropriate assessment' should be undertaken covering the implications of a development on the conservation interests for which the site has been designated, if it is concluded that the development is likely to have a significant effect. This may have implications for any proposed coastal protection works at or close to SPA sites.

Increased rates of erosion of intertidal sandflats and mudflats, saltmarshes, sand dunes and cliff-tops are likely to have adverse effects on the features of interest on which the SPA designation of the Firth of Forth is based. These features include populations of European importance of species of birds listed in Annex 1 of the EC Birds Directive and of migratory species, and the fact that the Firth regularly supports over 20,000 waterfowl. These species use the habitats listed for feeding, roosting, resting and, in some cases, breeding. The habitats, and the biological assemblages that they contain, also form part of the designations of SSSIs and Local Nature Reserves (LNRs) in the region. Protection of these features of interest in the face of future habitat loss may require a combination of measures. These measures may include:

- Allowing habitats to roll back as sea-level changes;
- The restoration of reclaimed or degraded areas;
- The creation of new habitats to compensate for loss elsewhere.

The precise extent of habitat creation required will depend on the extent of habitat loss, and predictions of this are currently very uncertain. To address this uncertainty will require more accurate estimates of the present extent of some critical habitats and monitoring to identify patterns and rates of future change. It will also require more detailed information on the features of interest in terms of their use of particular, critical habitats (specific sandflats, for example) and the likely future change in these. At present, guidance from Scottish Natural Heritage/English Nature on management of SPAs tends to be generic and to assume that loss of any habitat used by those species for which the SPA was designated is detrimental.

3 Consultation

Consultation is a key step in the formulation of the Shoreline Management Plan. In order to ensure that as wide an audience as possible could engage in the consultation process, we undertook a comprehensive written consultation stage and held 6 public meetings around the East Lothian coast. In addition, monthly progress meetings were held with the Steering Group, comprising representatives from Scottish Natural Heritage, Historic Scotland and East Lothian Council to ensure all interests were taken into account.

Response to the written consultation was relatively low (23%), although this was followed up by phone-calls and many of the consultees attended the public consultation meetings. Issues raised during the consultation were taken into account whilst assessing the strategic coastal defence option for a particular management unit.

Consultees	**No. of Letters Sent**	**No. of Written Reponses**
Steering Group	7	2
Local Authorities	6	2
Other Regulatory Consultees	11	6
Harbour Authorities & Committees	10	1
Community Councils	10	1
Commercial	19	1
Land-owners	5	0
Environmental	27	7
Recreation	24	7
Estuary/Coastal Organisations	3	1
Other Technical	4	1
Total	126	29
% Response		**23%**

Extensive public consultation exercises were also carried out in and around six areas of the East Lothian coast (Musselburgh, Prestonpans, Cockenzie & Port Seton, Longniddry, Gullane, North Berwick). Each area event included:

- An afternoon meeting for agency staff and the public;
- Getting out and about to meet users of the shoreline (for example: fishermen, bird watchers, ramblers, recreational users, youths, shore residents etc.) and
- An evening open meeting for the public.

Scottish Participatory Initiatives (SPI) carried out the public participation exercise and the results and raw data are reported in "SPI (2001) East Lothian Shoreline Consultation". A total of 382 people expressed their views to the team of SPI facilitators, split approximately evenly between areas. Public views were taken into account during development of the management options.

4 Options Considered

Six generic options for managing the East Lothian shoreline were considered for each management unit and are described below.

No Active Intervention
No actions are currently planned, although the situation is monitored so that should circumstances change the decision can be reviewed. Any defences will no longer be maintained and so will deteriorate and, in due course, fail.

Limited Intervention
Involves working with natural processes to reduce risks while allowing natural coastal change. This may range from measures which attempt to slow down rather than stop coastal erosion and cliff recession, to measures that address public safety (e.g. promoting the build-up of a beach in front of an unprotected cliff, dune management, visitor management)

Hold The Line
The defence line will remain where it is at present and will continue to be held there in the future. Existing defences will be maintained and the standard of protection may change by constructing new types of protection.

Selectively Hold The Line
For selected parts of the management unit, the defence line will remain where it is at present and will continue to be held there in the future. In general, the selected parts tend to be locations where there would be significant threat to life and property if the defences were not held. For the rest of the management unit *No Active intervention* is followed.

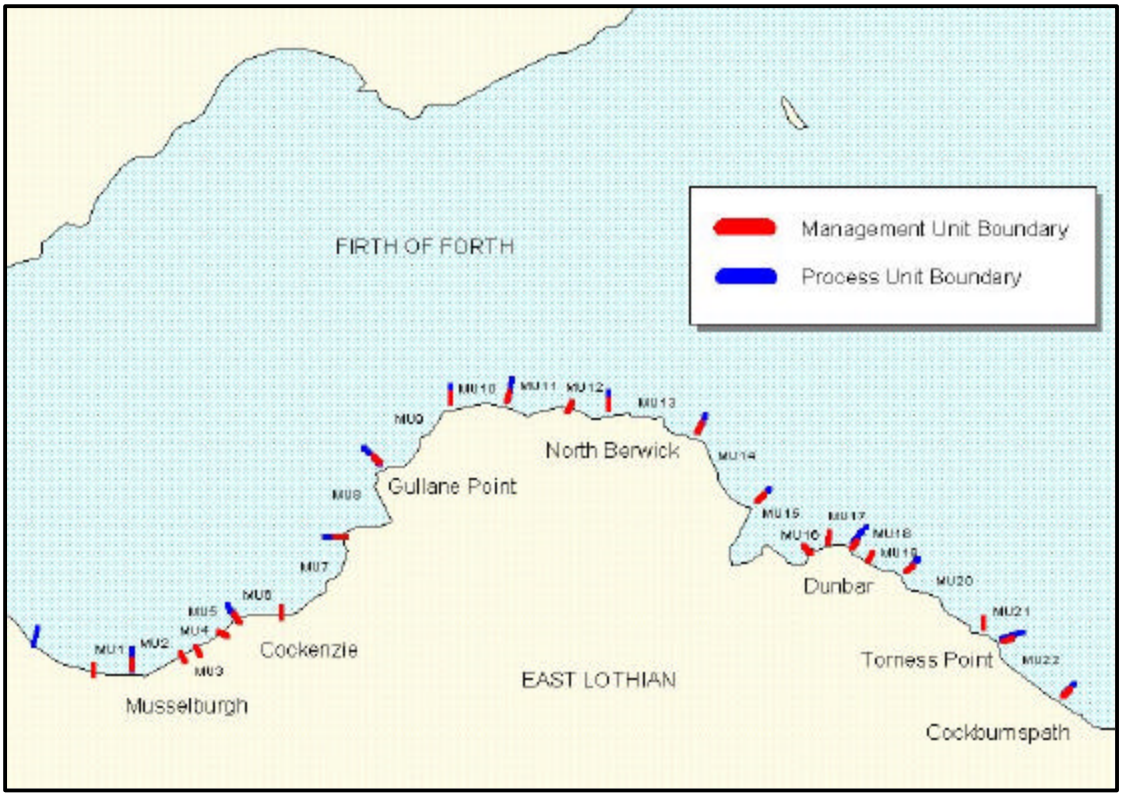
Advance The Line
The defence line is moved seawards to a new line of defences. The land between the new and old lines is protected against flooding and can be used for any function consistent with local planning policy.

Retreat The Line
The defence line is deliberately moved landwards, either to a new line of defences or to high ground further landward. The land between the old and new lines will no longer be protected against tidal inundation and may, though time, revert to mudflat or saltmarsh.

For each management unit a preferred coastal defence option is recommended. This option has been selected after a detailed assessment of the environmental, economic and engineering criteria, which involves, as far as possible, tying future generations into inflexible and expensive options for defence.

5 Management Units

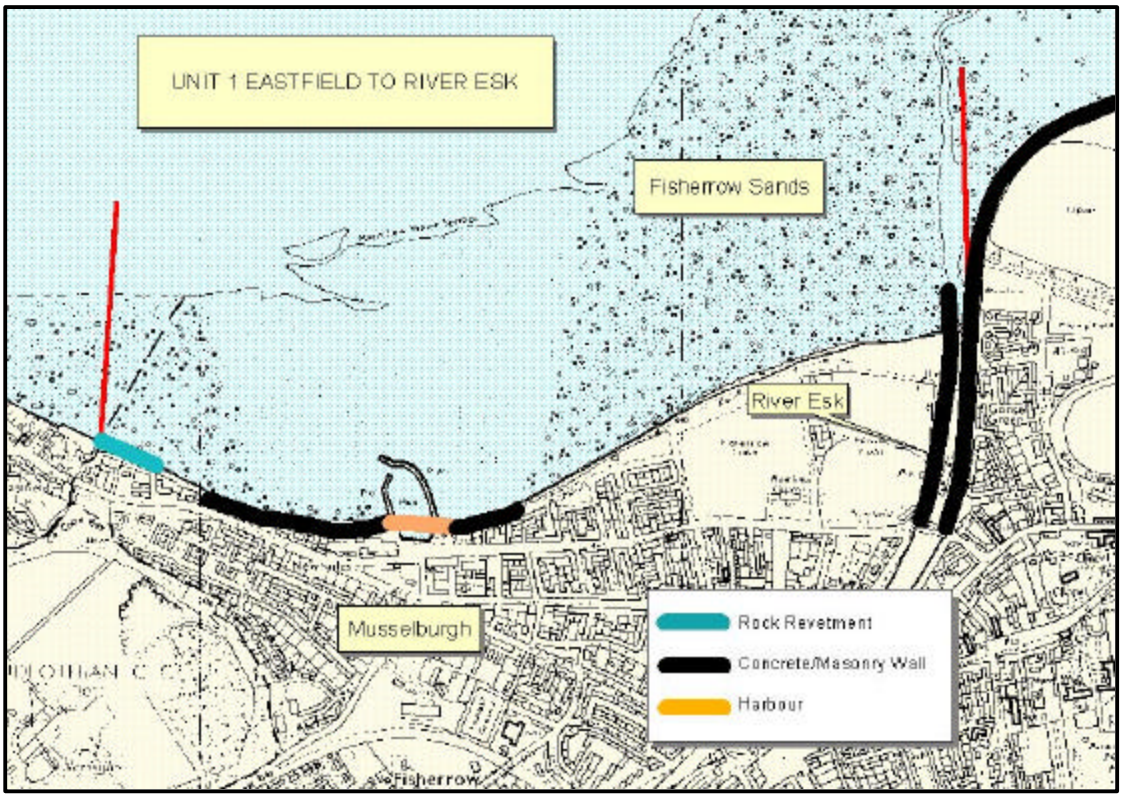
The East Lothian shoreline has been split into 22 management units based on the coastal process units, land-use, the human and built environment, natural environment and consultation. The management units form the basis for defining and assessing strategic coastal defence options.



The Executive Summary contains a table of the Preferred Options for each management unit. More detailed information describing each management unit follows. It should be noted that the Preferred Option for each management unit has been developed at a strategic level of planning and more detailed strategy studies, including modelling, detailed cost-benefit analysis and engineering design will have to be undertaken for proposals for site-specific capital works. All coastal development (and associated coastal defence proposals) will be expected to be in compliance with the Preferred Option for that particular management unit, otherwise it will be rejected unless the developer can demonstrate that their proposal meets management objectives.

6 Management Units and Preferred Options

6.1 UNIT 1 EASTFIELD TO RIVER ESK (MUSSELBURGH)



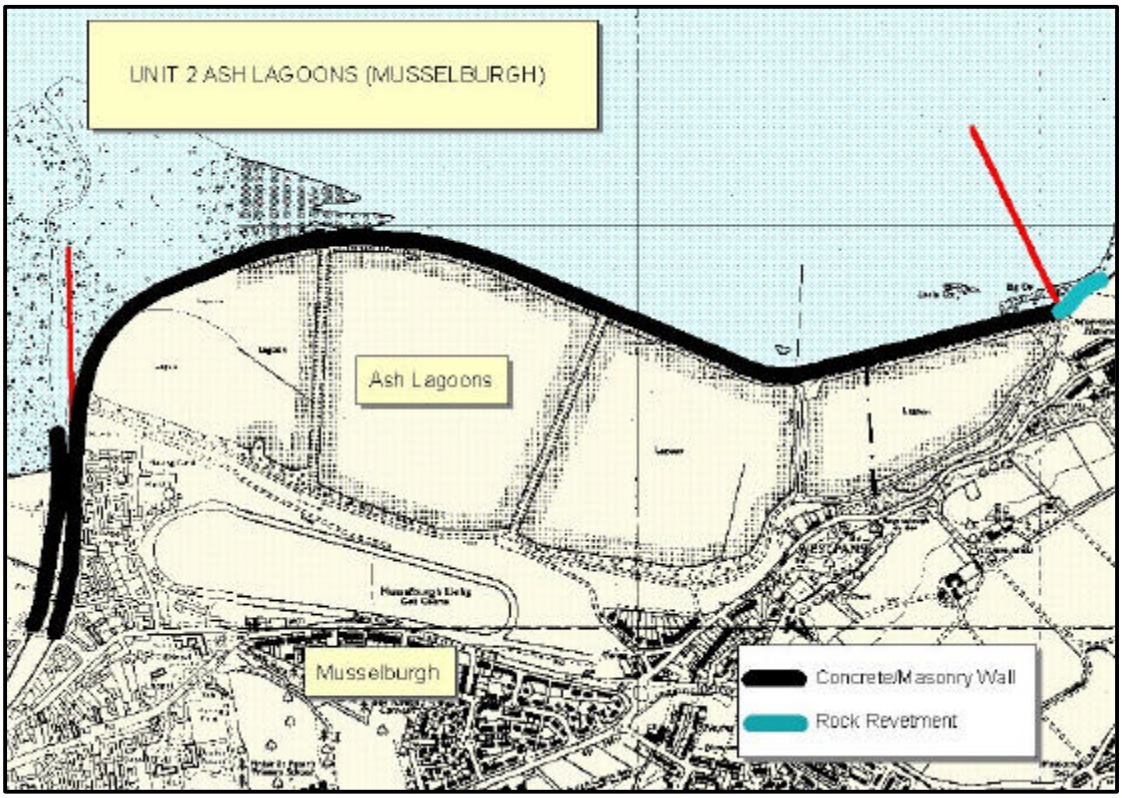
Selected strategy: A policy of **Selectively Hold the Line** is the preferred management option for Unit 1.

The shoreline is stable or accreting along Unit 1, thus the erosion risk is low and the main risk to defences is due to overtopping or structural failure during onerous tidal and storm conditions. Existing defences protect the urban area, including roads, from flooding. Therefore it is recommended that these defences be held for the duration of the SMP.

However, as part of the shoreline of Unit 1 is natural, with a low dune system in the east, it is likely that the dunes may undergo temporary phases of erosion during winter storms within a long-term cycle of accretion. This is a natural coastal process and short-lived phases of erosion should not be perceived as a problem. Allowing natural coastal processes to operate is beneficial to habitats and consequently natural heritage interests. Thus the Hold the Line option does not apply for the entire management unit.

Recommended Works: Capital works will be required within the next 10 years to improve the defences at the mouth of the River Esk. In addition, the level of the defences at the mouth of Fisherrow harbour and Fisherrow promenade is relatively low (approximately 4.3m OD) and may have to be raised over the next 50 years to cope with the predicted sea-level rise and increase in storminess. Routine maintenance and monitoring of the remaining defences in Unit 1 is recommended.

6.2 UNIT 2 ASH LAGOONS (MUSSELBURGH)



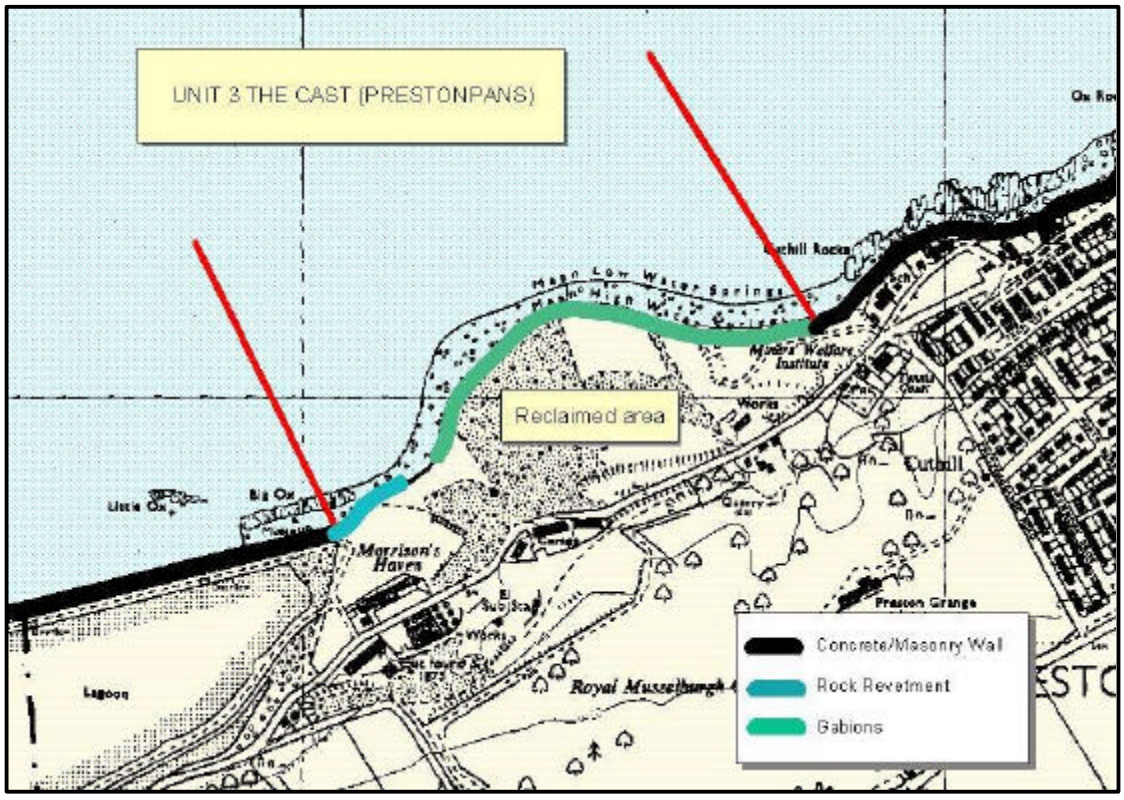
Selected strategy: The preferred option for Unit 2 is to **Hold the Line**.

The shoreline of Unit 2 is artificial in that it has been formed via the reclamation of intertidal land. As the MHWS contour is now further seaward than its natural position, some form of coastal defence is required to maintain this position.

Erosion of the reclaimed land (and thus the release of PFA to the environment) will have major environmental effects on the adjacent shoreline, water quality and wildlife of the surrounding area and would be unacceptable to SEPA, SNH and other environmental bodies. Thus the strategic options of No Active Intervention and Retreat the Line are considered not feasible for Unit 2. Given the predicted rise in sea level and increase in storminess in the future, it is realistic to expect that some maintenance of the current defence may be required in the next 50 years.

Recommended Works: The level of the defence is considered adequate for the wave and tidal conditions likely to be experienced in the next 50 years, however ongoing monitoring and maintenance of the defence should be carried out to ensure the structural condition of the defence is maintained.

6.3 UNIT 3 THE CAST (PRESTONPANS)

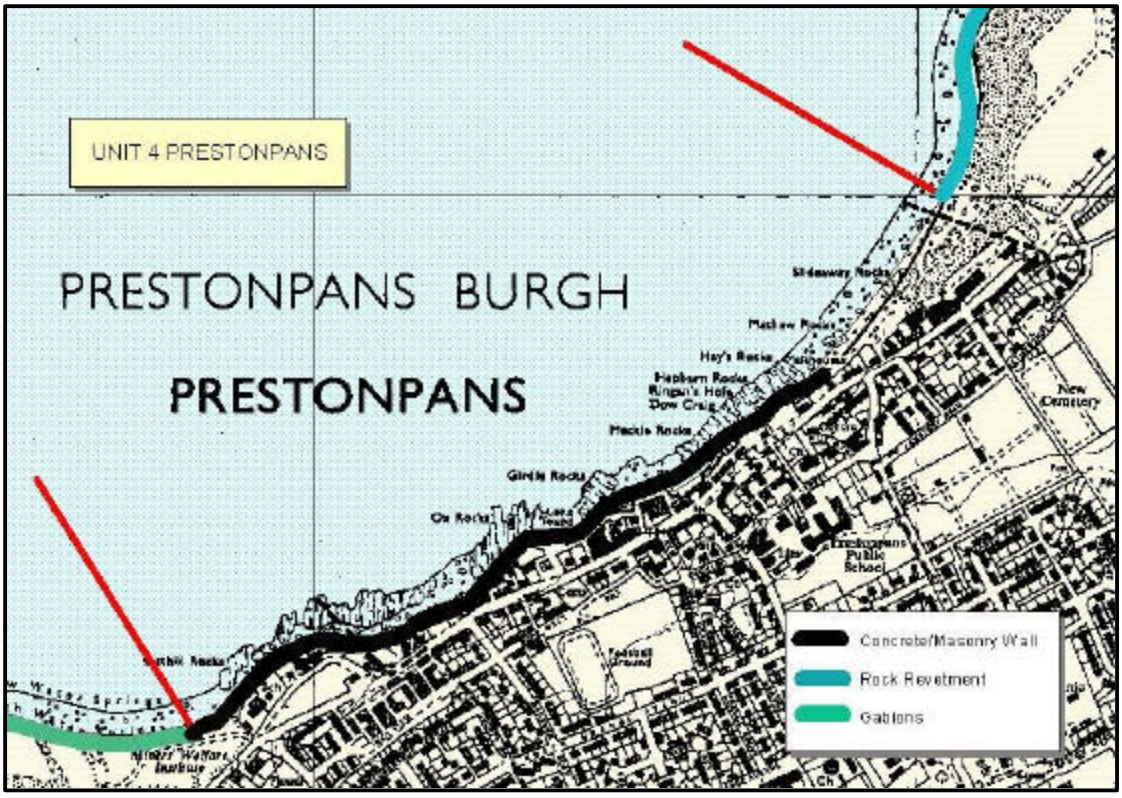


Selected strategy: The preferred option for Unit 3 is **Hold The Line**, although this is likely to be expensive. The shoreline of Unit 3 is artificial in that it has been formed via the reclamation of inter-tidal land. As the Mean High Water Spring (MHWS) contour is now further seaward than its natural position, some form of coastal defence is required to maintain this position. If this does not occur, erosion of the reclaimed land will create visual and environmental problems, as the disused mine workings become re-exposed. Such a scenario would be detrimental to the natural heritage interests of Unit 3 and would create visual amenity issues.

It is recommended that the feasibility of **Retreat The Line** be investigated as this may reduce the need for expensive coastal defences holding an artificial shoreline position and may also allow historic sites of archaeological heritage, such as Morrrison's Haven to be re-opened. If this strategy were followed, arrangements for off-site disposal of the disused working would have to be made.

Recommended Works: The **Hold The Line** option requires capital works to be undertaken to replace and/or upgrade the existing coastal defences in Unit 3. New coastal defences will have to be constructed to replace the existing gabions in year 1 of the Plan and the existing rock revetment will require replacement in year 5 of the Plan.

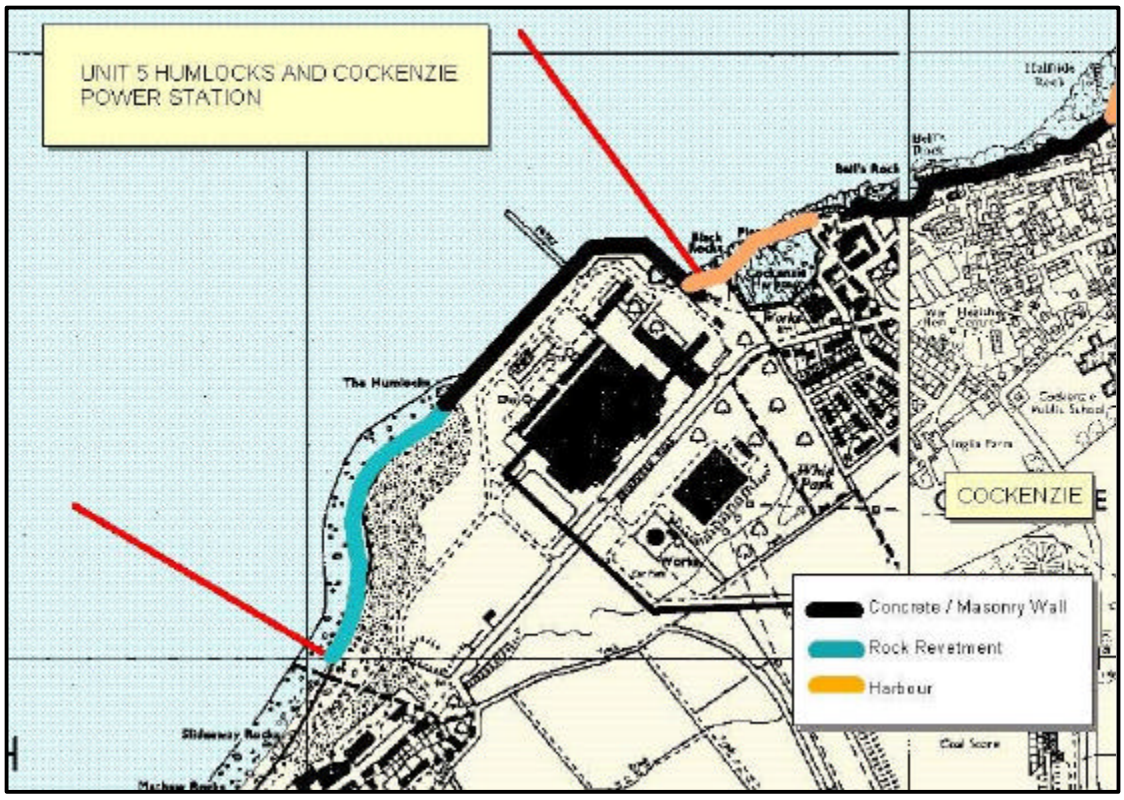
6.4 UNIT 4 PRESTONPANS



Selected strategy: **Selectively Hold the Line** is the preferred strategy for coastal defence in Unit 4, to protect the domestic and commercial property in Prestonpans from flooding and erosion.

Recommended Works: Repair works are required to improve the condition of the existing property walls. In addition, maintenance and monitoring should be continued for the remaining 50 years of the Plan.

6.5 UNIT 5 HUMLOCKS AND COCKENZIE POWER STATION

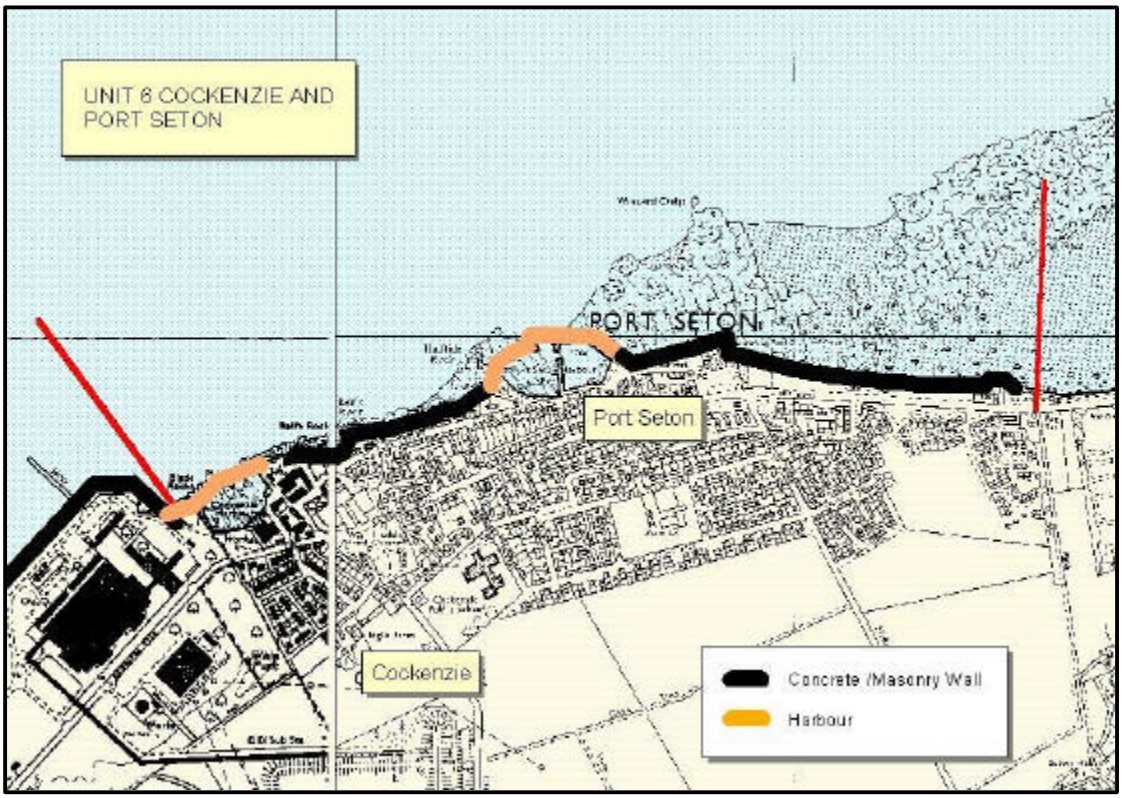


Selected strategy: The preferred strategic option for coastal defence in Unit 5 is **Hold The Line.**

Due to the exposed nature of Unit 5, if the defences are not maintained they will deteriorate and eventually fail, resulting in erosion and loss of land. This is not a feasible option, given the importance of protecting Cockenzie Power Station and the associated environmental impacts that would ensue if erosion of the disused workings occurred.

Recommended Works: In order to **Hold The Line** in Unit 5, it is envisaged that the western section of the rock revetment would have to be replaced in Year 5 of the Plan. Elsewhere within the unit the existing defences are in good condition, but will require ongoing monitoring and maintenance for the Plan period.

6.6 UNIT 6 COCKENZIE AND PORT SETON

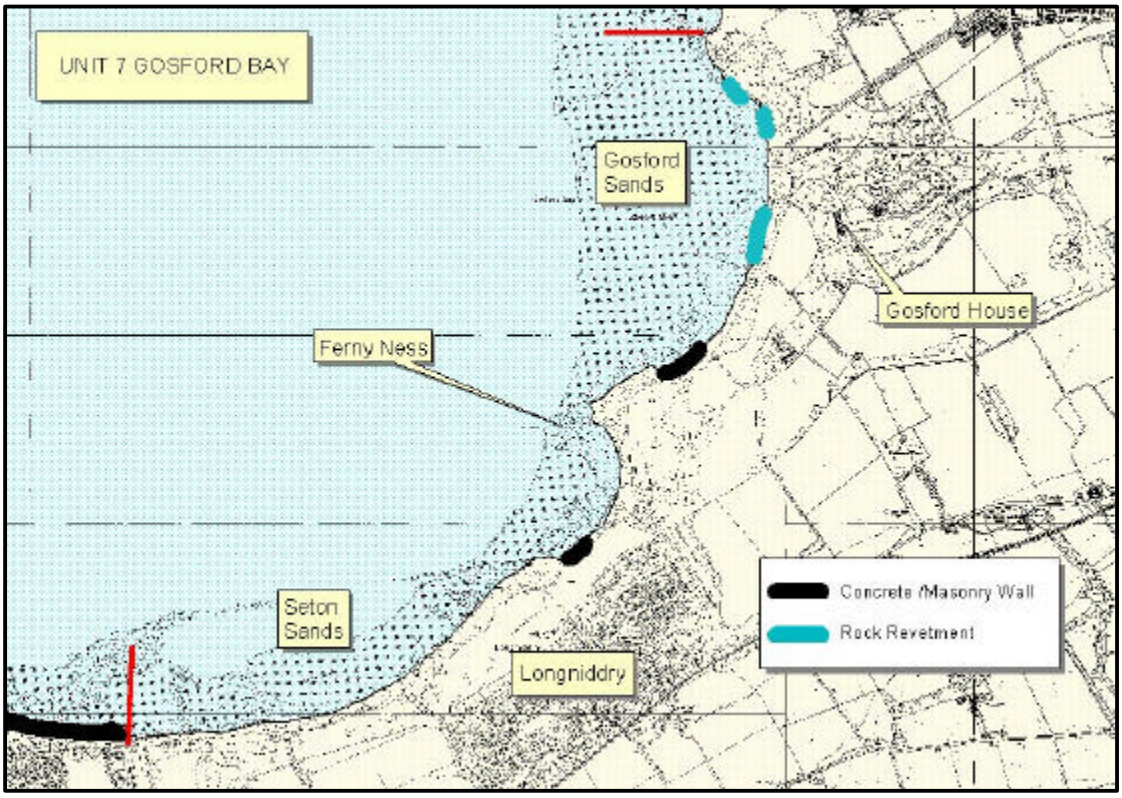


Selected strategy: **Hold the Line** is the preferred strategic coastal defence option.

In order to protect the urban area from flooding and erosion it will be necessary to adopt a polict to **Hold The Line**. Such a strategy is not likely to have any significant impact on the natural heritage interests of the inter-tidal area.

Recommended Works: General maintenance and monitoring of the existing defences is recommended, together with replacement of the rock armour, which is protecting property at the eastern limit of Unit 6, in year 15 of the Plan.

6.7 UNIT 7 GOSFORD BAY

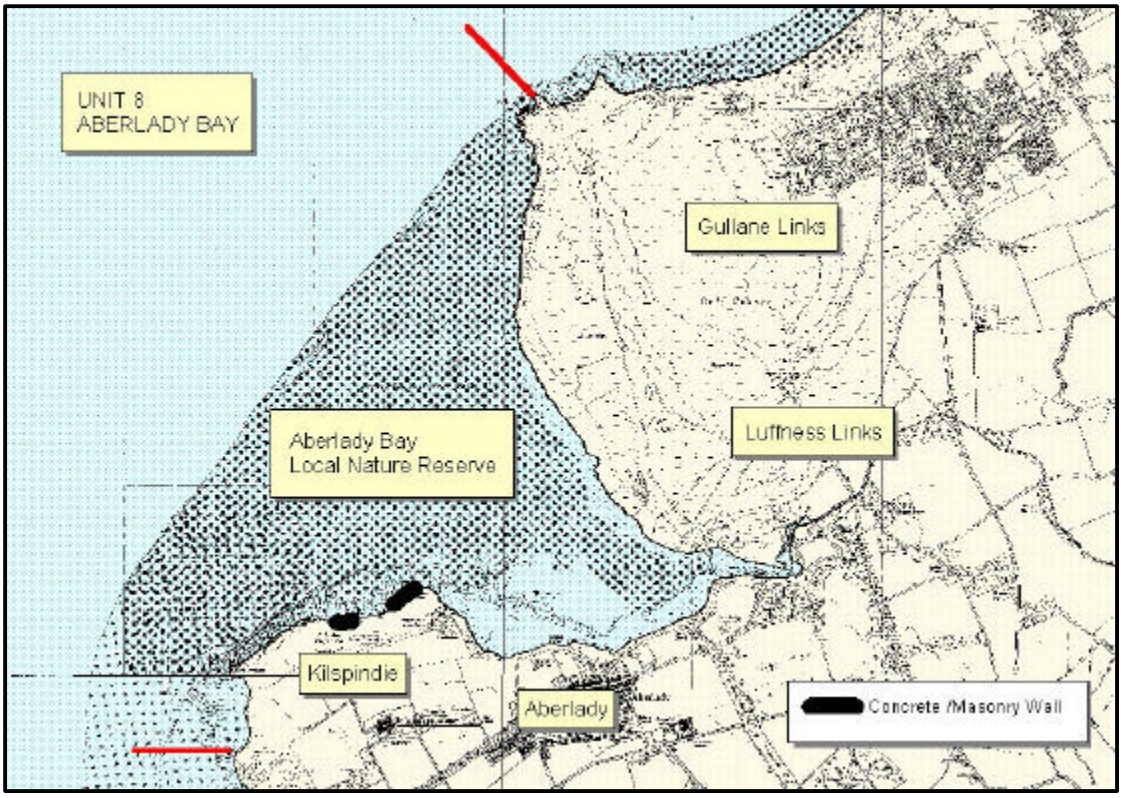


Selected strategy: **Selectively Hold the Line** is the preferred strategic coastal defence option for Unit 7.

Defences should be maintained to protect further erosion of the coast road. However, the remainder of the Unit should be allowed to function naturally and it is anticipated that phases of dune erosion will occur in the 50 years of the Plan period. As no assets are directly at risk, such erosion should be accepted.

Recommended Works: It is recommended that the existing defence at Gosford House be replaced with a more robust structure, such as an engineered rock revetment at the back of the beach. Further Strategy Studies will be required prior to any works being undertaken. In addition, the toe of seawall at Longniddry will need to be replaced in Year 5 of the plan.

6.8 UNIT 8 ABERLADY BAY



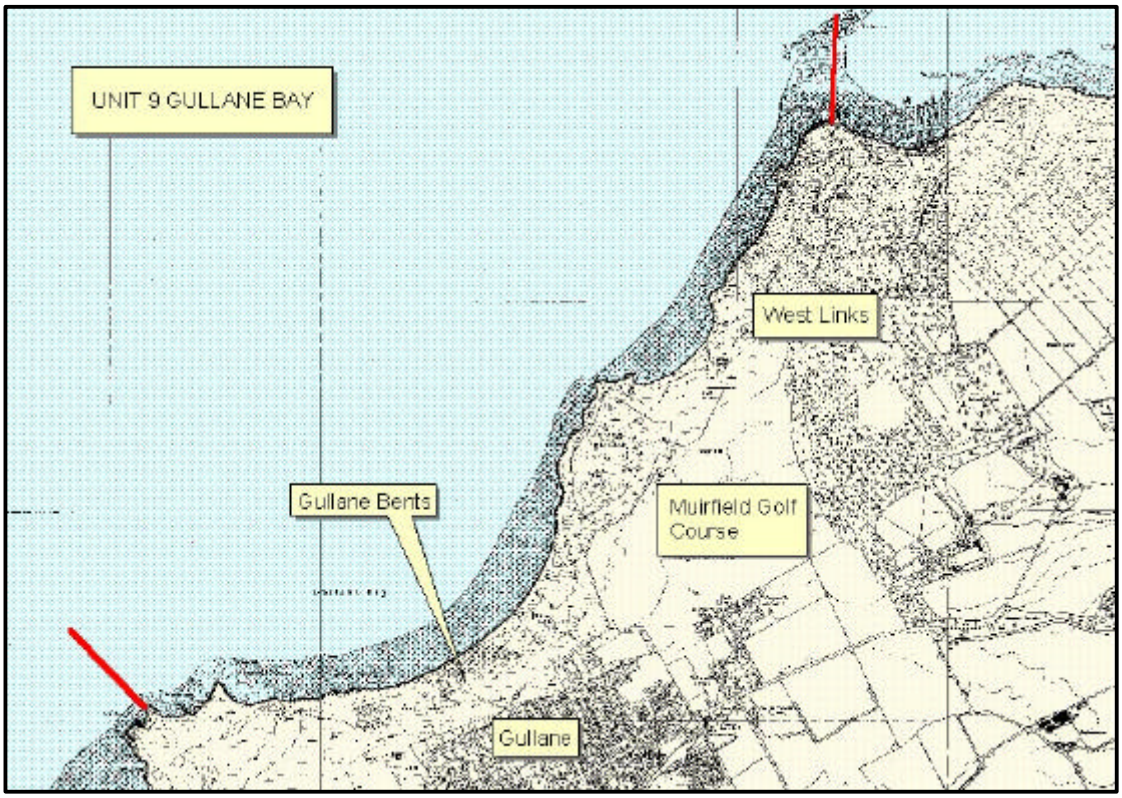
Selected strategy: **No Active Intervention** is the preferred option for Unit 8.

Erosion is not causing a significant threat to assets anywhere in the management unit. This strategy of management is consistent with that advocated by SNH and East Lothian Council, who state that natural changes in the dune system should be allowed to continue. Such a policy is not likely to be detrimental to the natural heritage interests of the coast. As the long-term trend in the dunes at Aberlady is one of accretion, the No Active Intervention approach is not likely to create significant problems in the long-term. However, adoption of this option should be consonant with a policy of monitoring the natural changes.

However, adoption of the No Active Intervention option would result in the eventual deterioration of the coastal defences at Kilspindie Golf Course. However, the potential loss of land is likely to be negligible given the low rates of erosion recorded on this stretch of coast.

Recommended Works: None

6.9 UNIT 9 GULLANE BAY

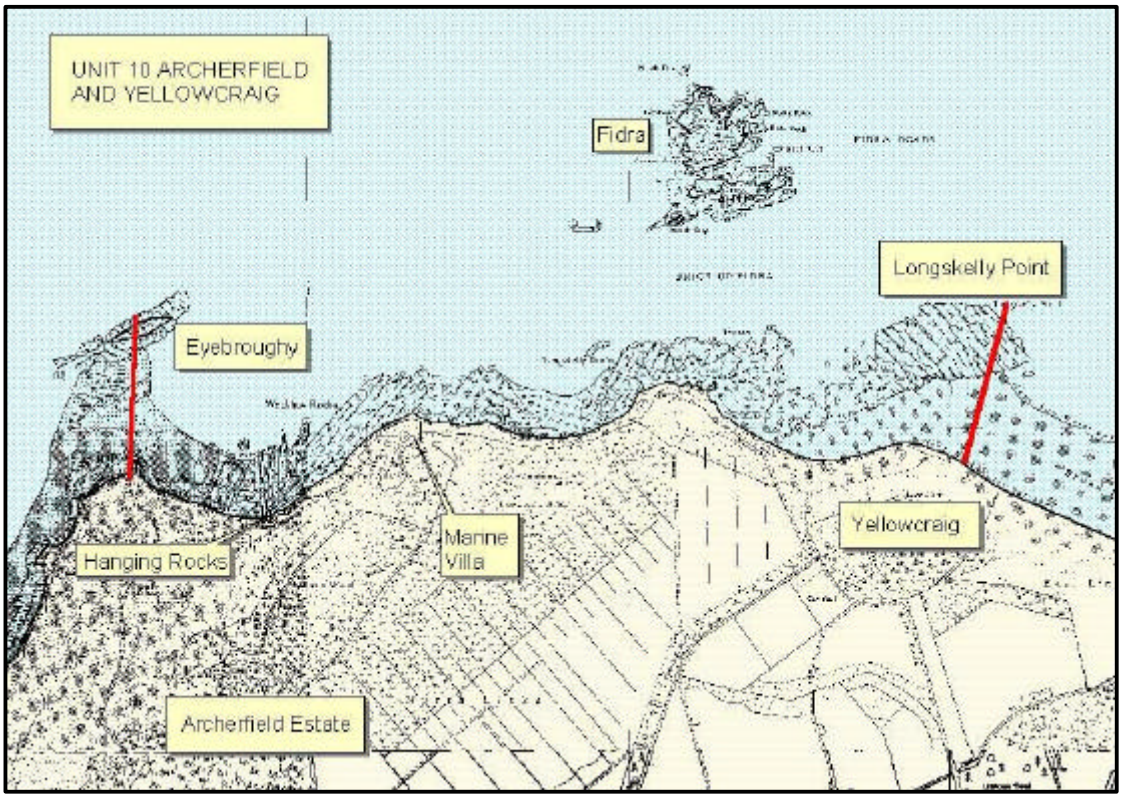


Selected strategy: **Limited Intervention** is the preferred strategic coastal defence option for Unit 9. This will permit the operation of natural processes, but will allow the continuation of natural erosion of the dune system, particularly at Gullane Bents. It is not economically feasible to prevent further erosion in the long term and it is recommended that Gullane Bents be managed with this in mind. However, natural rates of dune erosion may be reduced if visitors are kept off the eroding fore-dune, and East Lothian Council should continue to encourage this. Fixed photographs or surveys should be established to monitor the changes in the dune system.

Management of the spread of the Sea Buckthorn in the backdune area should be continued, and the correct levels of the species for optimum dune habitats should be defined and maintained, if possible.

Recommended Works: None.

6.10 UNIT 10 ARCHERFIELD AND YELLOWCRAIG

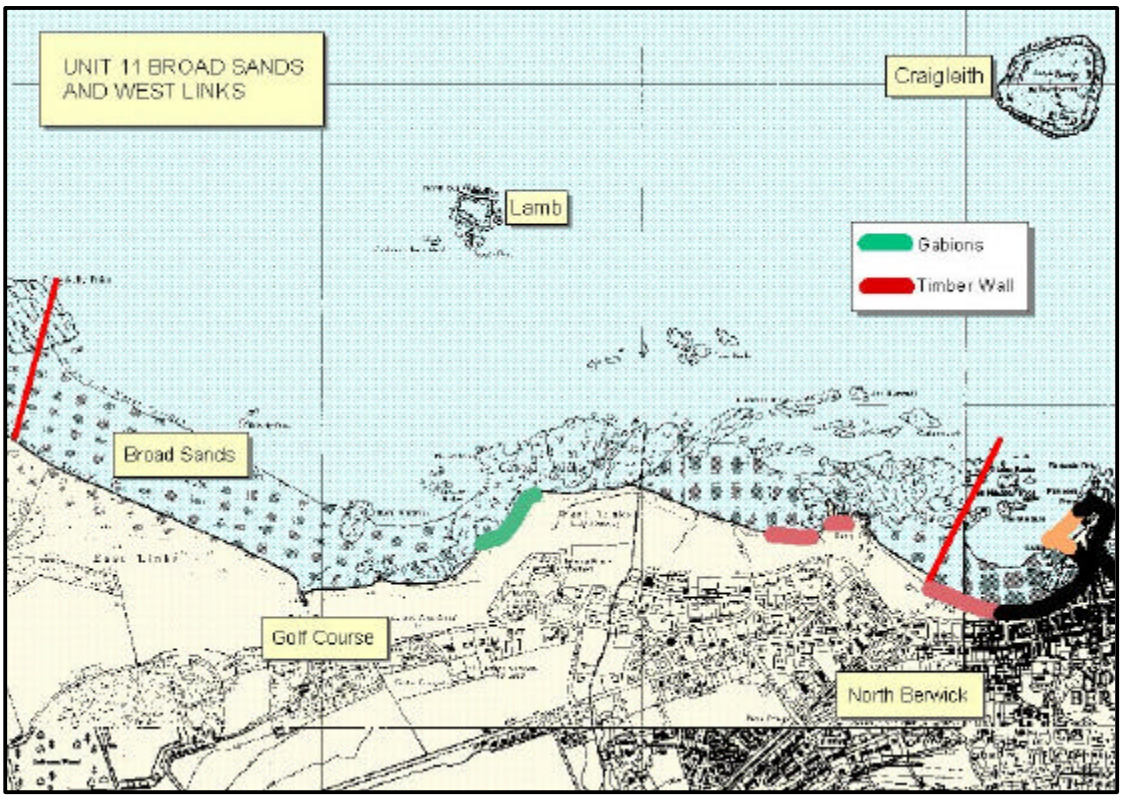


Selected strategy: The preferred option for Unit 10 is **No Active Intervention**.

Coastal erosion is not a risk to land or property in this area, thus there is no economic justification to protect this stretch of the coast. **No Active Intervention** will not interrupt the natural operation of coastal processes and is the preferred option in terms of minimal disruption to the natural environment. As erosion is not a problem, this strategy will not pose a threat to the rich archaeological and natural heritage of Unit 10. If the new Archerfield development goes ahead, it should be set back from the existing shoreline, by at least 50m. This will avoid tying future generations into the need for inflexible and expensive coastal defences, which will certainly be detrimental to the natural environment.

Recommended Works: None

6.11 UNIT 11 BROAD SANDS AND WEST LINKS



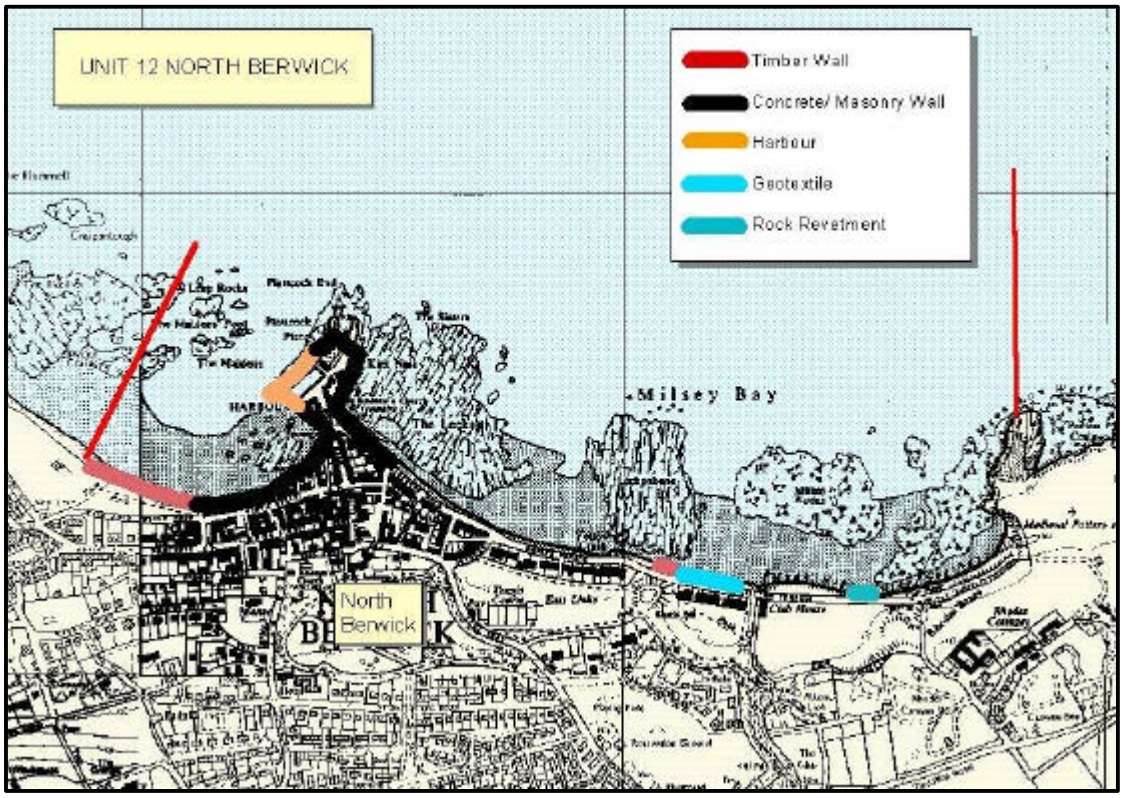
Selected strategy: **Limited Intervention** is the preferred management option for Unit 11.

Dune erosion of Links courses in Scotland is a common problem and the current thinking is that this erosion should be managed as an acceptable natural processes and coastal defence is not a long-term sustainable option. Consideration to the relocation of tees / greens away from the shoreline should be considered. Monitoring of coastal changes should be carried out. In terms of user management of Yellowcraig and the dunes at Broadsands, methods such as dune fencing and planting to keep visitors off the eroding dunes should be used with an aim to reduce the amount of human induced erosion.

Adoption of **Hold the Line** along a naturally adjusting shoreline, which appears to be undergoing cycles of short-lived phases of erosion and accretion, would result in a series of fixed stretches of the coast, which will effectively starve the adjacent shoreline of sediment, transferring the erosion problem elsewhere. Construction of defences would also be detrimental to the SSSI and SPA interests of the management unit. In terms of potential saving of land assets, Hold the Line is not economically feasible over the 50 years of the Plan.

Recommended Works: None.

6.12 UNIT 12 NORTH BERWICK



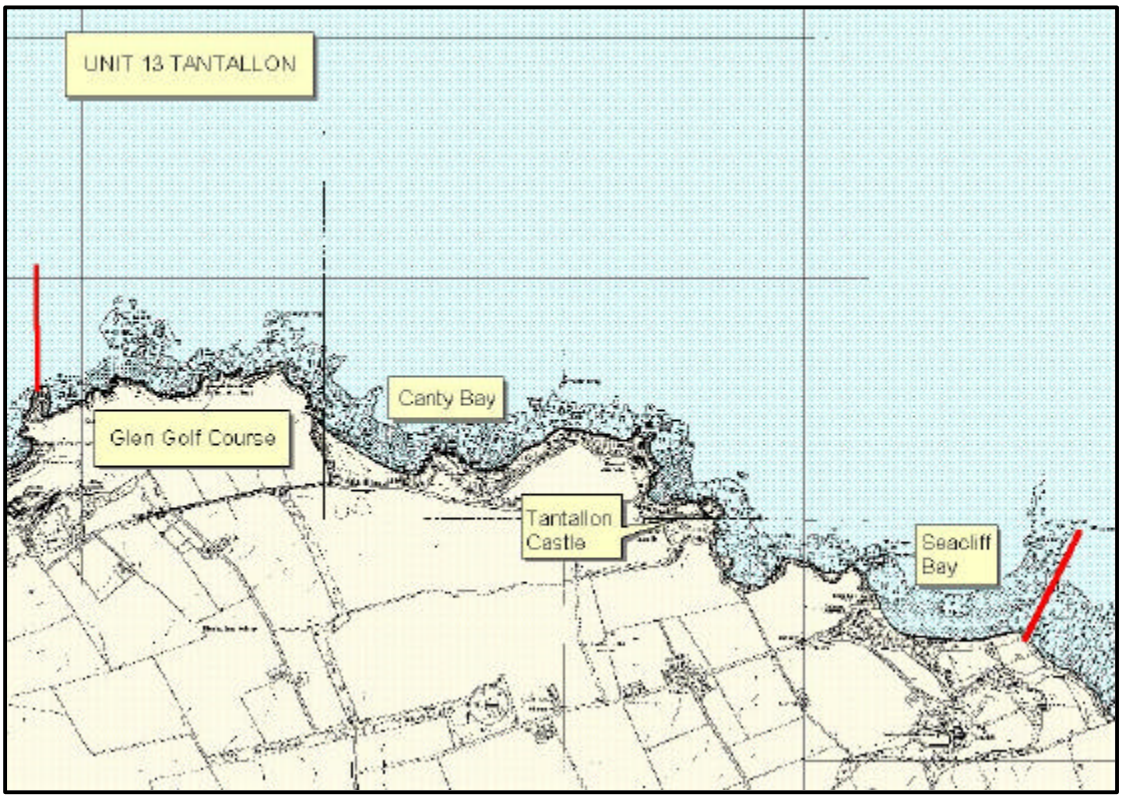
Selected strategy: The preferred option for Unit 12 is to **Selectively Hold the Line**.

As the beach changes identified in Unit 12 appear to be cyclical, it is recommended that a policy of minimal intervention to the natural shoreline be followed. Erosion of a stretch of beach/dune coastline may be short-lived and may be compensated by a subsequent period of accretion, such that the overall change is negligible. Thus, a **Hold the Line** option for the entire management unit is not feasible and natural coastal processes should be allowed to operate as far as is practicable. However, there are certain stretches of coastline where the defence line should be maintained to avoid risk of land and property.

The property walls backing the shoreline of North Berwick Bay, the headland defences and the promenade wall at East Links should be maintained. Monitoring of coastal change is recommended in Milsey Bay. Dune erosion that is not causing a threat to roads or property should be allowed to continue, as this is a natural process, which may be short-lived. However, if beach monitoring indicates that coastal erosion is threatening the integrity of the road, soft coastal defences, such as Geo-textile matting, should be considered to help stabilise the dunes and encourage vegetation.

Recommended Works: Ongoing maintenance of the existing defences and monitoring of Milsey Bay is recommended. In addition, it is recommended that the failed rock armour be removed from the toe of the dunes in Milsey Bay.

6.13 UNIT 13 TANTALLON

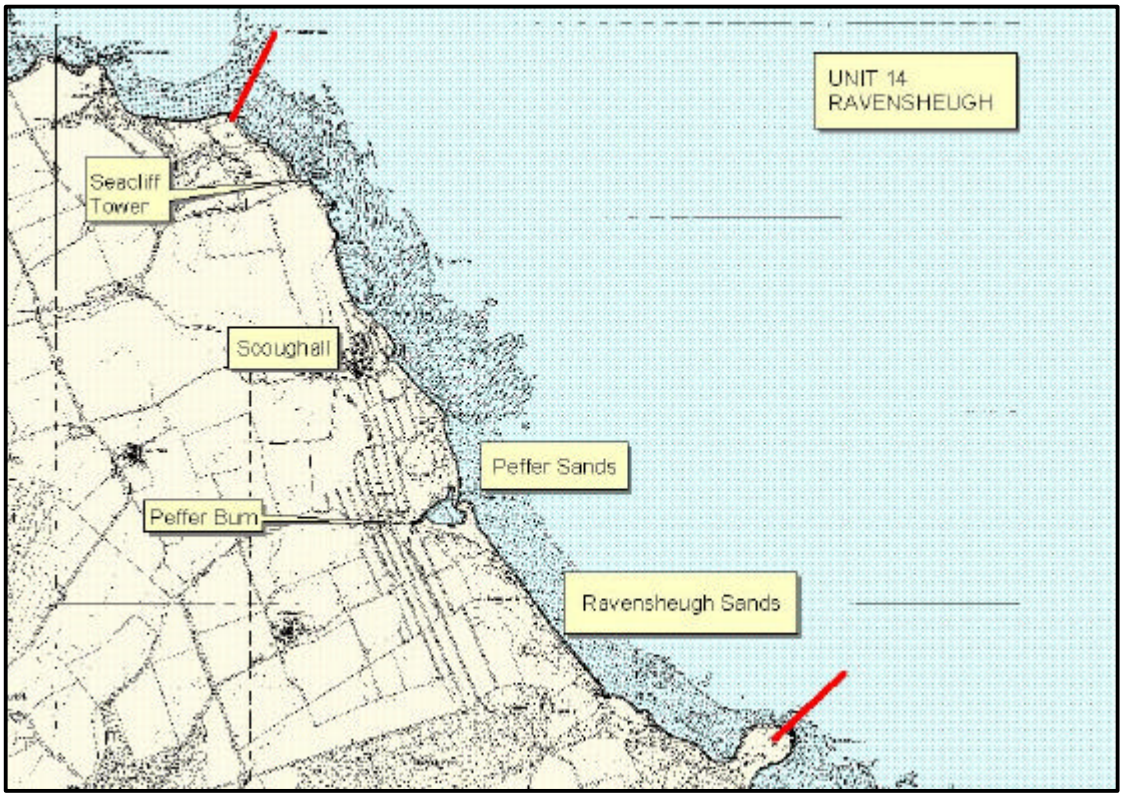


Selected strategy: **No Active Intervention** is the preferred option for unit 13.

Under **No Active Intervention** the potential loss of land due to erosion in the next 50 years is likely to be negligible, given the lack of past change along the shoreline. For this reason, there are no economic implications (in terms of loss of land) of the No Active Intervention option. No Active Intervention is also compatible with the nature conservation objectives of the management unit, as this will cause minimal disruption to the rare botanical interests and breeding bird population of the shoreline. However, it is recommended that fixed monitoring stations be set up at sensitive locations (e.g. Glen Golf course and potentially threatened sites of archaeological interest) in order to establish rates and trends of coastal erosion. This will enable future decisions to be made with a much better understanding of the problem.

Recommended Works: None, except for monitoring of sensitive locations.

6.14 UNIT 14 RAVENHEUGH

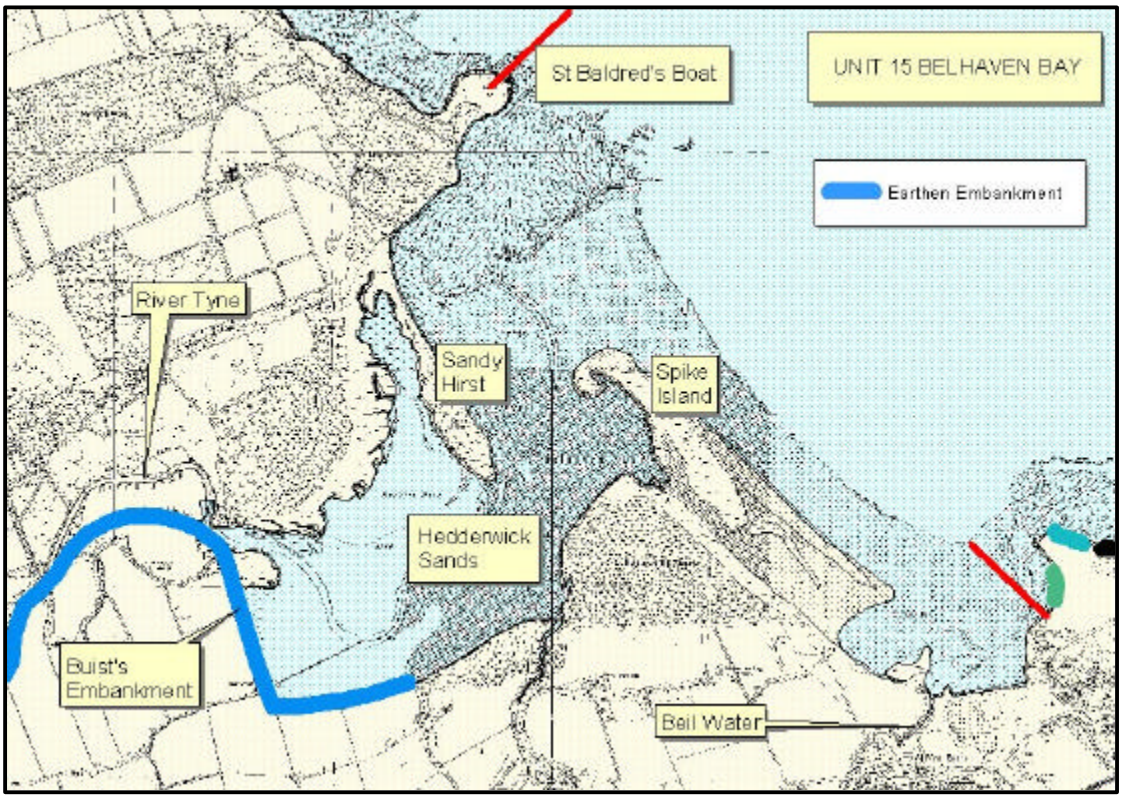


Selected strategy: **Limited Intervention** is the preferred option for Unit 14.

This would allow continuation of the natural processes and the outstanding landscape of the management unit would not be compromised. As there is no evidence of long-term erosion along Unit 14, the monetary value of land lost under this option is negligible. Future "ad-hoc" coastal protection, such as that put in place by the Scottish Scripture Union Summer Camp, should be discouraged in future. It is been suggested that localised dune erosion is caused by human pressure, thus management practices aimed to encourage visitors to stay off the dunes in sensitive areas should be considered. The rates of cliff erosion at Seacliff Tower should be monitored to determine the nature of the problem and to assess the need for future coastal defence, such as toe protection at the base of the cliff.

Recommended Works: None, although monitoring of sensitive areas should be undertaken.

6.15 UNIT 15 BELHAVEN BAY



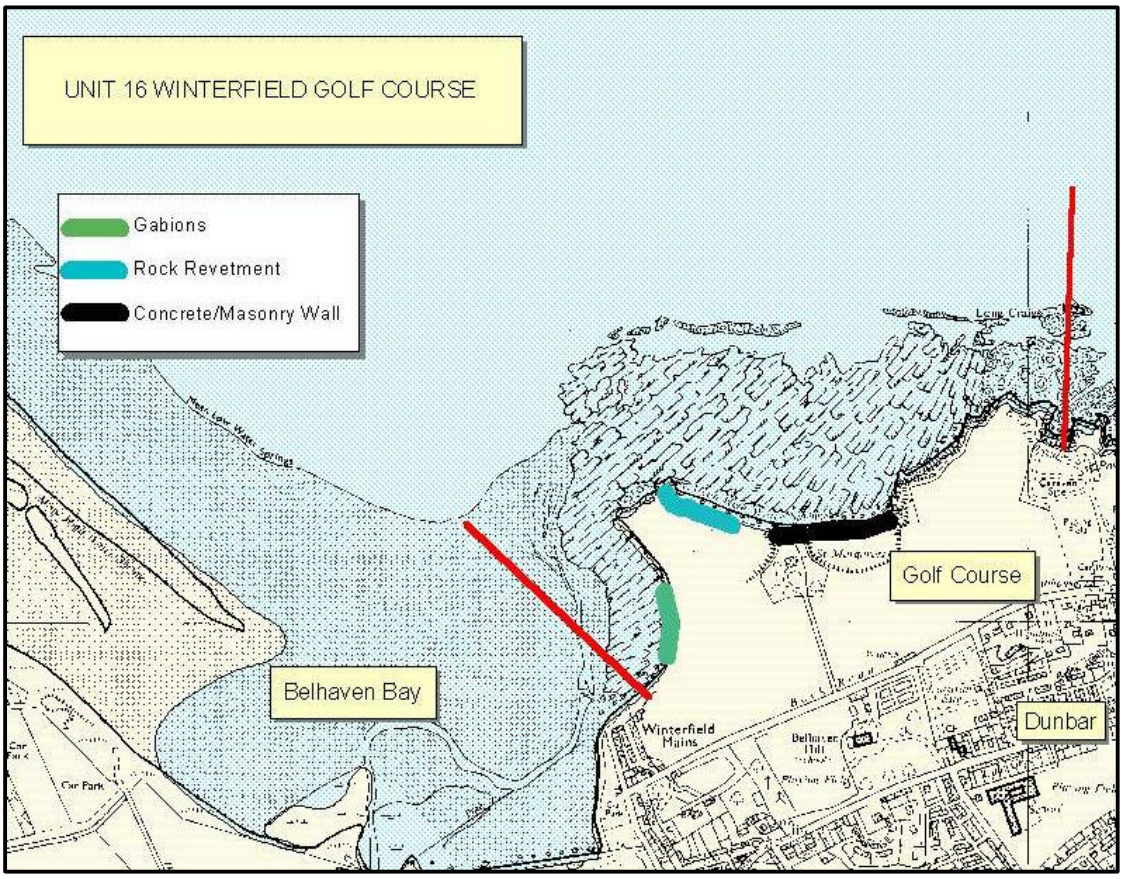
Selected strategy: **No Active Intervention** is the preferred option for Unit 15.

Any attempt to stabilise the dynamic, natural system by constructing coastal defences will be detrimental to the natural heritage interests, with knock-on effects on habitats and ornithological interests. In terms of management of JMCP, it is recommended that natural erosion should be accepted in most areas and coastal protection is only required where erosion leads to serious loss of amenity. Monitoring should be carried out to assess the rates of coastal change in the area. There is no evidence that erosion is causing any significant threat to amenity anywhere in Unit 15, therefore there is no justification to provide coastal defences.

An opportunity for realignment of the coastal defences has been identified to return reclaimed intertidal land to saltmarsh. Buist's embankment currently protects agricultural land south of the River Tyne from tidal inundation. Removal or set back of this defence would create additional important habitat within the Firth of Forth and could be used if habitat compensation were required for any other proposed schemes that result in habitat loss. If this option were to be pursued a detailed study would be required.

Recommended Works: None, although monitoring of coastal changes should be undertaken.

6.16 UNIT 16 WINTERFIELD GOLF COURSE

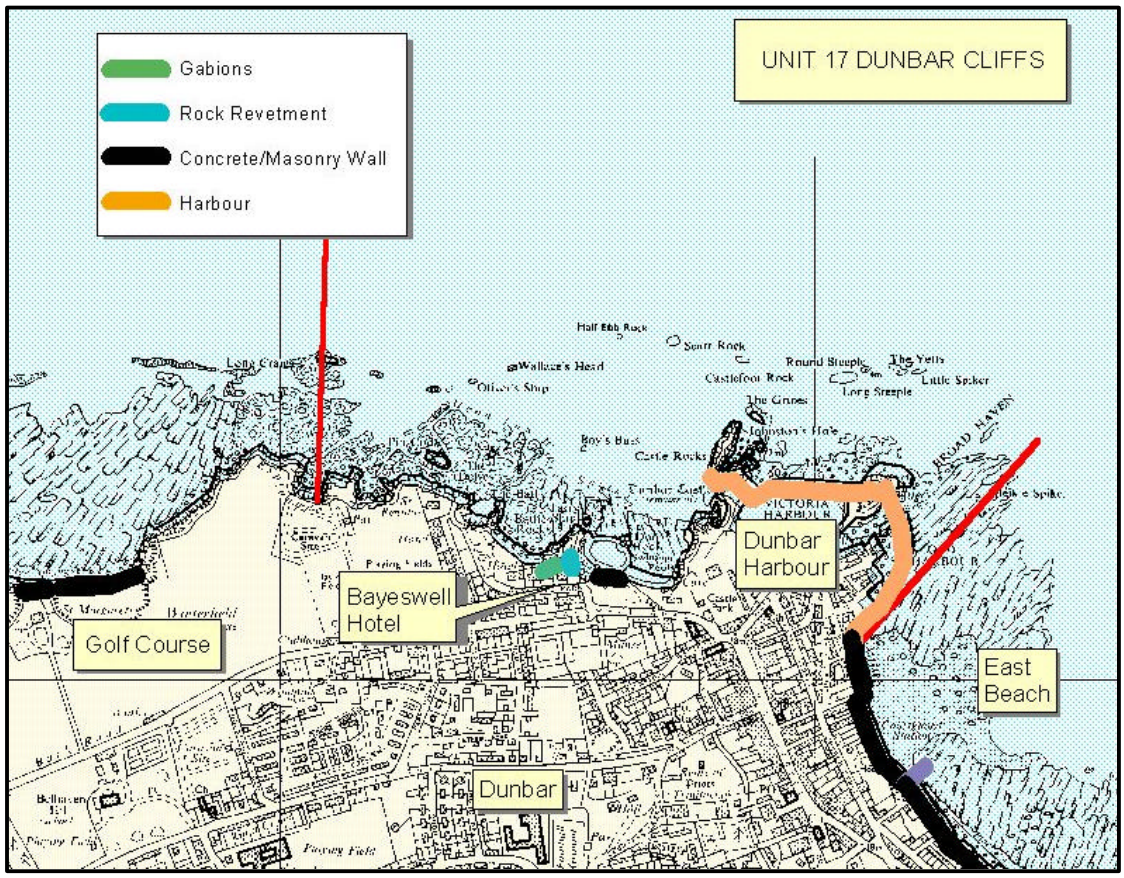


Selected strategy: **Selectively Hold the Line** is the preferred option for Unit 16.

The defence protecting the clubhouse should be maintained and repaired to prevent erosion of the base of the slope, which could lead to eventual slope failure and destabilisation of the clubhouse. The remaining defences are poorly designed and unsightly and appear to be enhancing erosion elsewhere in the management unit. It is recommended that their removal be considered. Although, removal of coastal defences may result in the continual erosion of Winterfield Golf Course, albeit at a relatively low rate, in the long-term relocation of tees and greens away from the eroding shore is a more sustainable approach to coastal defence in the area.

Recommended Works: Toe protection should be constructed at the base of the slope on which the clubhouse is located to replace the dilapidated seawall. It is also recommended that the other coastal defences in Unit 16 be removed.

6.17 UNIT 17 DUNBAR CLIFFS



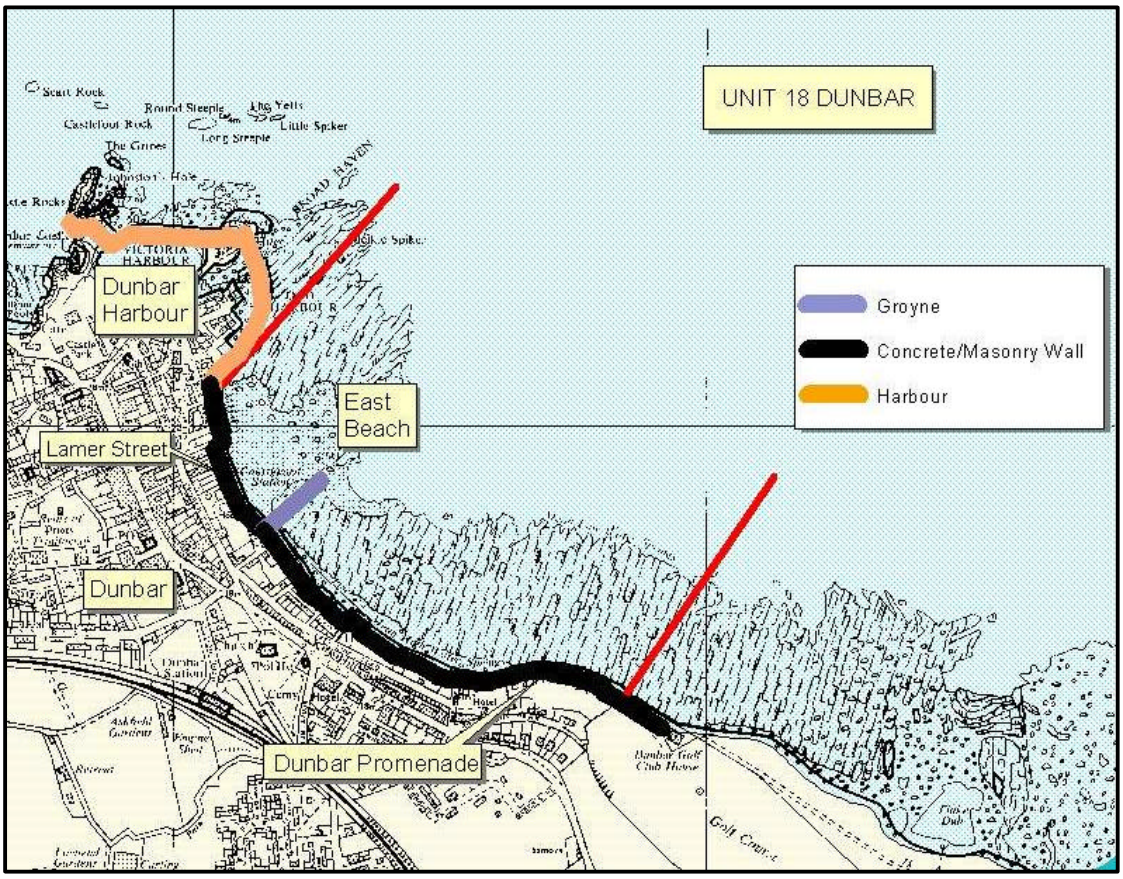
Selected strategy: **Selectively Hold the Line** is the preferred option.

The Dunbar cliffs are naturally eroding at a very slow rate. A policy of **Hold the Line** for the entire management unit is not feasible, as this would require extensive engineering works and would be detrimental to the natural heritage interests. Such as policy is not economically feasible, as threat to property/amenity along most of the shoreline under existing conditions is minimal. **Selectively Hold the Line** is the preferred option, whereby the coast protection (and/or cliff stabilisation) should be undertaken at critical locations. For example, the gabion baskets, which support the coastal path and stabilise the coastal slope should be maintained, as destabilisation could potentially result in further slips. It is also recommended that the harbour walls are inspected regularly and repaired.

As erosion is likely to continue in Unit 17, it is recommended that the coastal walkway be moved back from the cliff edge and relocated to a new route. This will reduce the need for increasingly robust coastal protection in the future and will minimise potential public safety issues. If the path is set back from the shoreline, this will reduce the need to maintain the old concrete retaining wall.

Recommended Works: The rock rubble that has been used to block off the old harbour entrance at Broad Haven will have to be upgraded in the future. Ongoing maintenance and repairs to the harbour and gabions. It is also recommended that, given the steepness of the coastline here and the role of any defences in maintaining the stability of the coastal slope, this area be monitored regularly and particularly following significant storms.

6.18 UNIT 18 DUNBAR

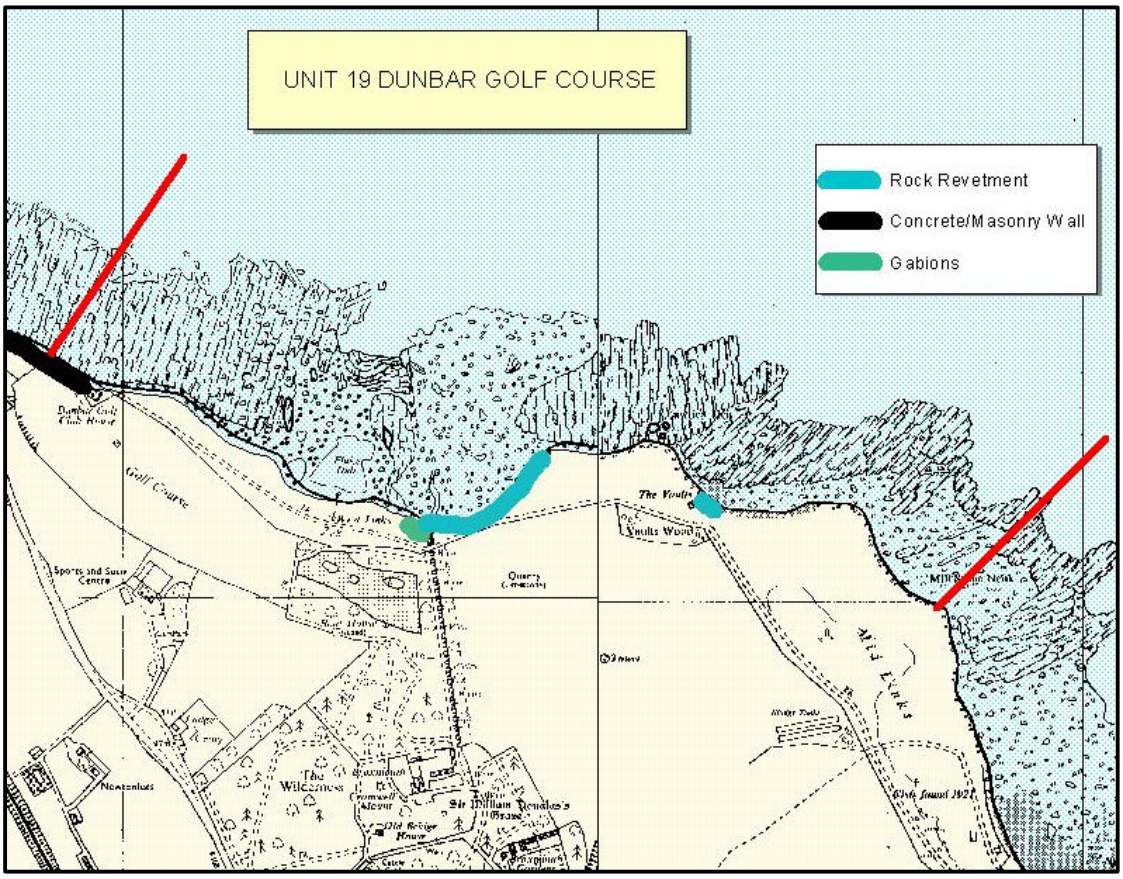


Selected strategy: **. Hold the Line** is the preferred option for coastal defence in Unit 18. If the coastal defences in Unit 18 are not maintained/repaired they would eventually deteriorate, which may result in considerable loss/damage to property and roads. Some sections of the seawall in Unit 18 have an estimated residual life of <10 years and thus require immediate attention in the near future. If such maintenance works are not carried out, damage costs to the hinterland are likely to be high

We understand that damage occurred to the Lamer Street Wall and that a section of the road subsided in late April of 2002. The damage was subsequently repaired by East Lothian Council. Ongoing monitoring and maintenance of the walls along Lamer Street will be necessary to maintain the current line. East Lothian Council have raised concerns related to Sand Loss, Building Erosion, Sewage Pipe; Seaweed and Kelp Flies; Litter; Sewage and Sewage Related Debris; Dog Fouling and Oil. These have been investigated in a separate commission (ABP 2001, Babtie Group 2001). This commission has identified the type of further studies necessary to confirm the findings and investigate sustainable solutions.

Recommended Works: The survey of existing structures identified several areas where attention is required in the short term, including maintenance and repairs to the seawall at East Beach, repairs to the access steps at Lamer Street and the provision of a new floodgate at the slipway. Further work is required to assess the need to replace/remove the groyne (see Babtie Group 2001, ABP Research 2001 for further details).

6.19 UNIT 19 DUNBAR GOLF COURSE



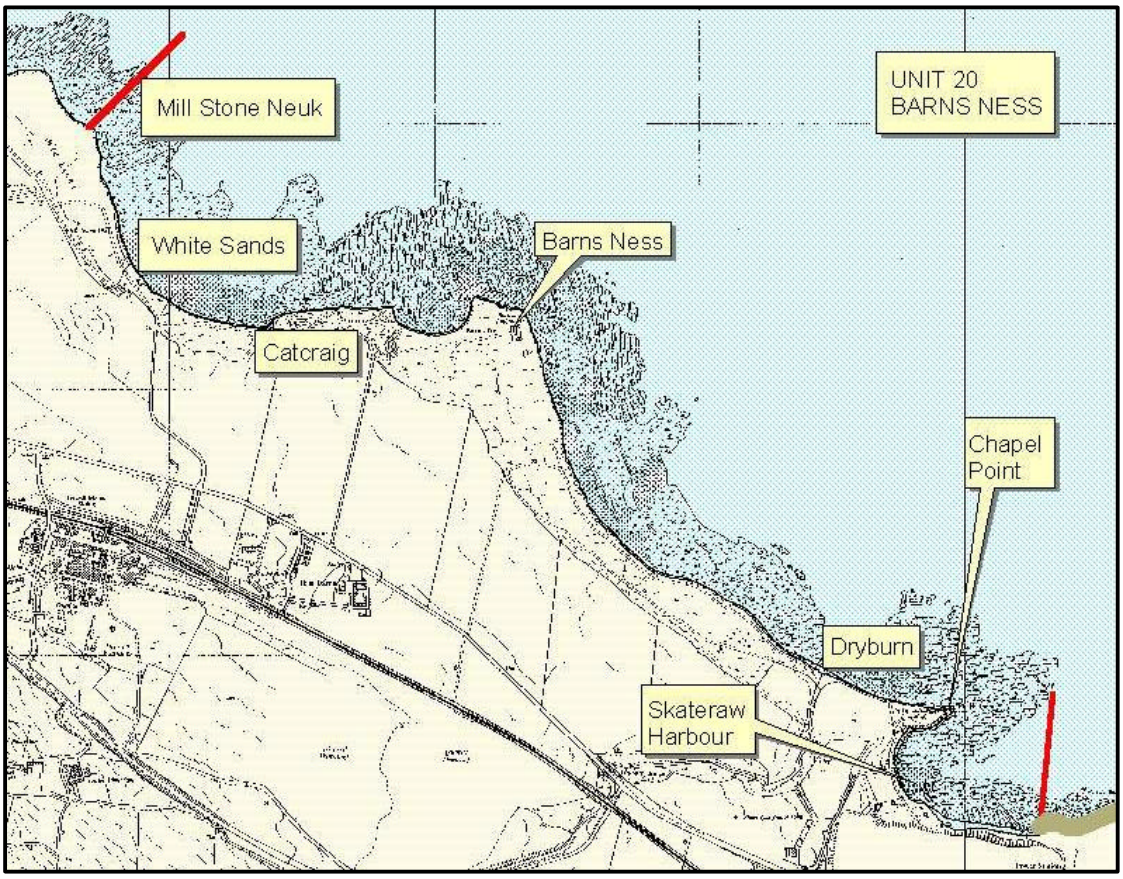
Selected strategy: **No Active Intervention** is the preferred option in terms of the aesthetic character and natural heritage interests of the management unit.

Map analysis indicates a stable or accreting shoreline, potential land losses under the No Active Intervention option are negligible Several of the existing defences are unsightly and unnatural, with rock and rubble placed on the upper beach and their removal should be considered. The Hold the Line option is not economically feasible as the estimated cost is likely to exceed the benefits, as erosion rates are negligible. It is recommended that short-term localised erosion along the shoreline should be accepted and "ad hoc" hard solutions should not be adopted to solve immediate concerns.

Recommended Works: Removal of the failed rock revetments should be considered, as they are unsightly and are having limited effect and may be transferring the erosion problem elsewhere.

Condition of Defences: The masonry wall is in reasonable condition and has an estimated residual life of 25-50 years. The gabions at the mouth of the Brox Burn are in good condition, with an estimated residual life of 10-25 years. However, the poorly engineered rock revetment further east is in poor condition and has failed in places. The rocks and rubble have been undermined and have slumped down at the back of the shingle beach.

6.20 UNIT 20 BARNS NESS

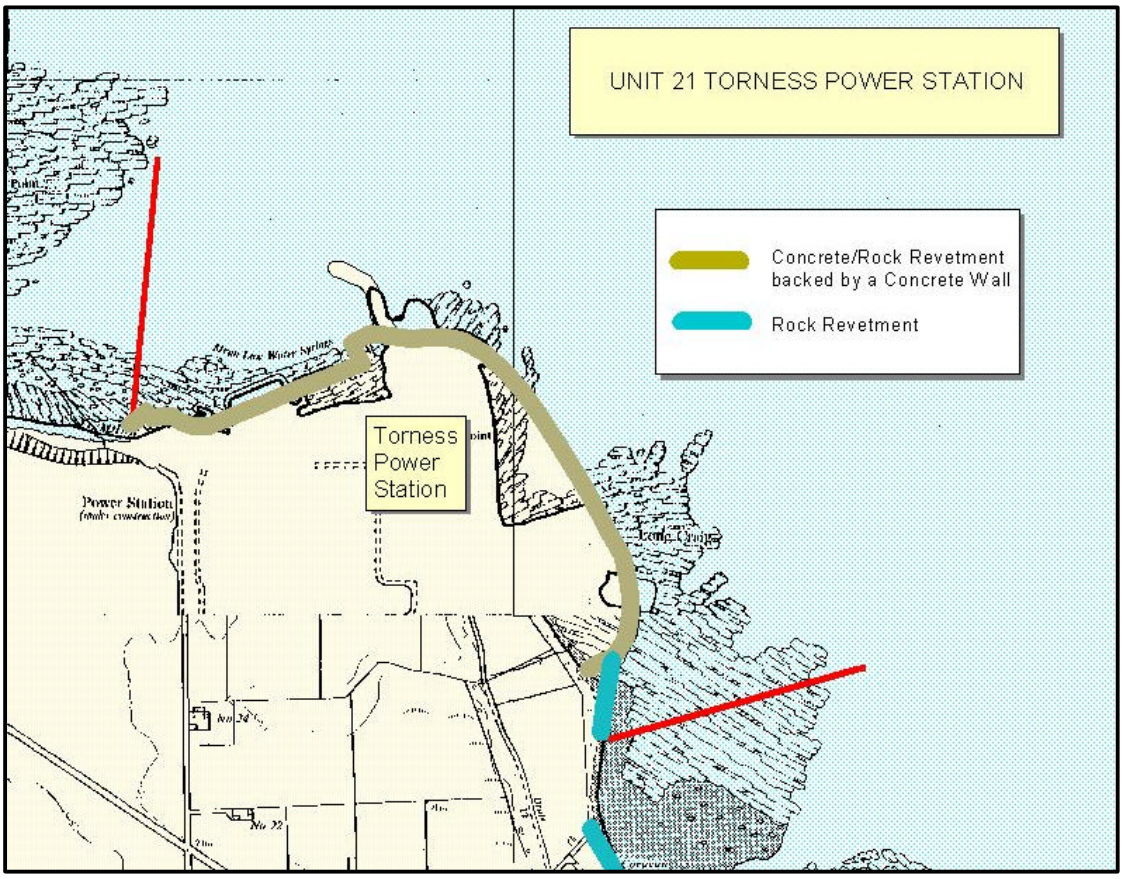


Selected strategy: **No Active Intervention** is the preferred option.

There is no significant risk to assets from coastal processes. Most of the shoreline has undergone accretion, although localised erosion is a natural and generally short-lived process. The monetary cost of the No Active Intervention option is negligible as there is limited loss of land and any erosion is likely to be compensated by accretion in the long-term. Hold the Line would be detrimental to the natural heritage interests of Unit 20m, as this would interrupt the operation of natural coastal processes, which are important in maintaining the diverse coastal habitats along this shoreline. Any attempt to stabilise these processes will impact the scientific interest of the site.

Recommended Works: None

6.21 UNIT 21 TORNESS POWER STATION



Selected strategy: **Hold the Line** is the preferred strategic management option for Unit 21. This will protect the Torness Nuclear Power Station and prevent the environmental disaster that would occur if the defences were breached.

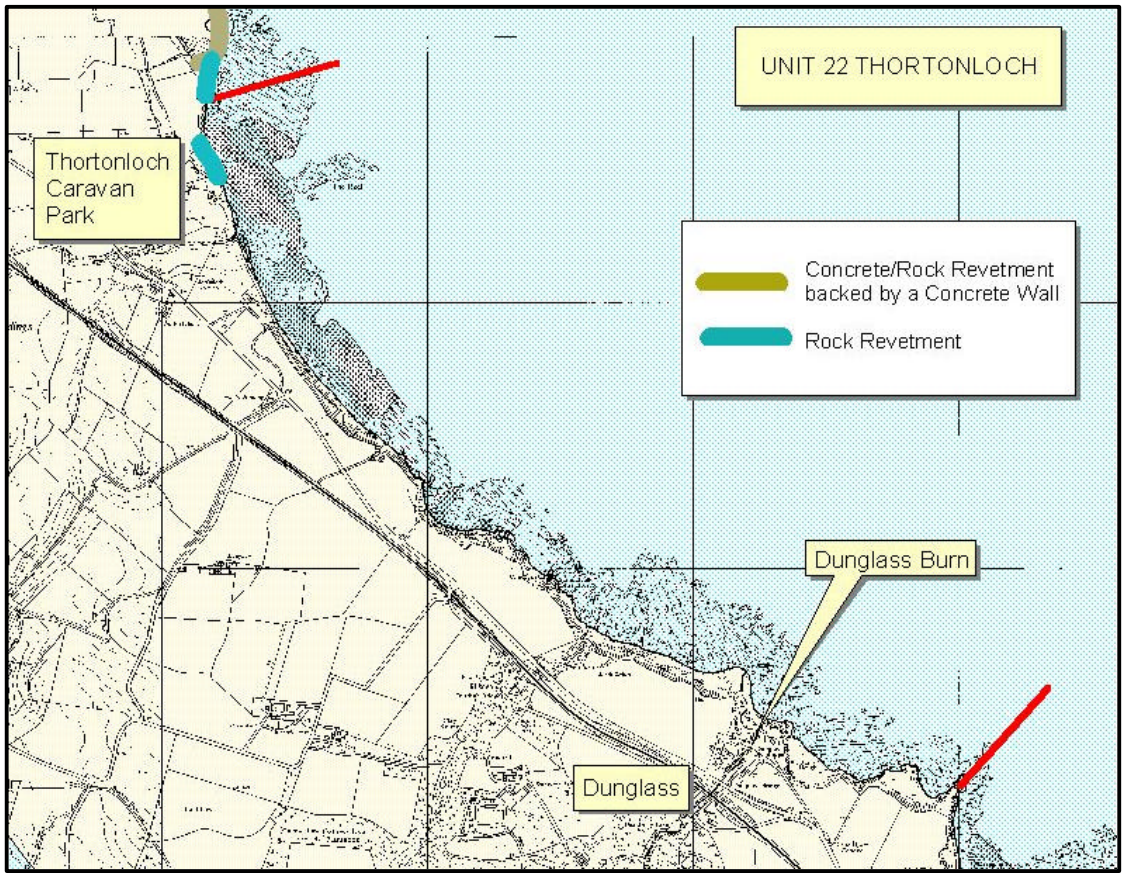
Recommended Works: No new construction is required, although ongoing maintenance and monitoring should be carried out for the Plan duration.

Land use: Unit 21 extends along 1.5km of the reclaimed shoreline of Torness Nuclear Power Station. The nuclear power station is the principal land-use within Unit 21, although arable land forms the landward part of the management unit.

Defences: Torness Nuclear Power Station is constructed on reclaimed land, which is protected along the whole frontage by a concrete revetment, backed by a concrete vertical embankment. The toe of the revetment is protected either by a wide expanse of rock armouring or by concrete tetrapods. The dunes south of Torness have rock armour toe protection, which extends along the base of the dunes for approximately 100m. The Torness defences have been designed to a standard of 1:10 000 years and are in very good condition.

Coastal Processes: The entire shoreline of Unit 21 has been reclaimed and the present shoreline lies up to 310m seaward of the 1907 shoreline. Reclamation will have substantially altered coastal processes. The dominant wave directions for this stretch of coast are from the sector between north and east and this headland is very exposed to waves.

6.22 UNIT 22 THORTONLOCH



Selected strategy: The preferred option for Unit 22 is **Limited Intervention**.
The economic case for maintaining the defences at Thortonloch is weak. In addition, artificially stabilising a short section of shoreline may result in enhanced erosion elsewhere in the process unit, either at the flanks of the defence unit or down beach. In the long-term a slow rate of coastal erosion may result in some loss of the frontage at the Caravan Park, however evidence suggests that the rate of loss is likely to be fairly low. Management techniques, such as relocating caravans back from the shoreline, if necessary in the future, discouraging users from accessing the beach over the dunes and dune planting and fencing solutions is a more sustainable approach to coastal defence in this management unit.

Recommended Works: None, although management techniques to encourage stabilisation of the dunes at Thortonloch should be investigated.

Land use: The main land use in Unit 22 is Arable land. Thortonloch beach is a popular tourist attraction. Visitor pressure is likely to be high around the dunes on the access routes between the Caravan Park and the beach, which may cause localised erosion.

Defences: Hard coastal defences protect approximately 150m of the shoreline of Unit 22, in the vicinity of Thortonloch Caravan Park. Tank traps have been laid in a vertical double layer at the base of the eroding dune face and a 50m section has been protected with smaller blocks of rock armour. In addition, the Council have planted sea-lyme grass to encourage dune stabilisation, which has been relatively successful.