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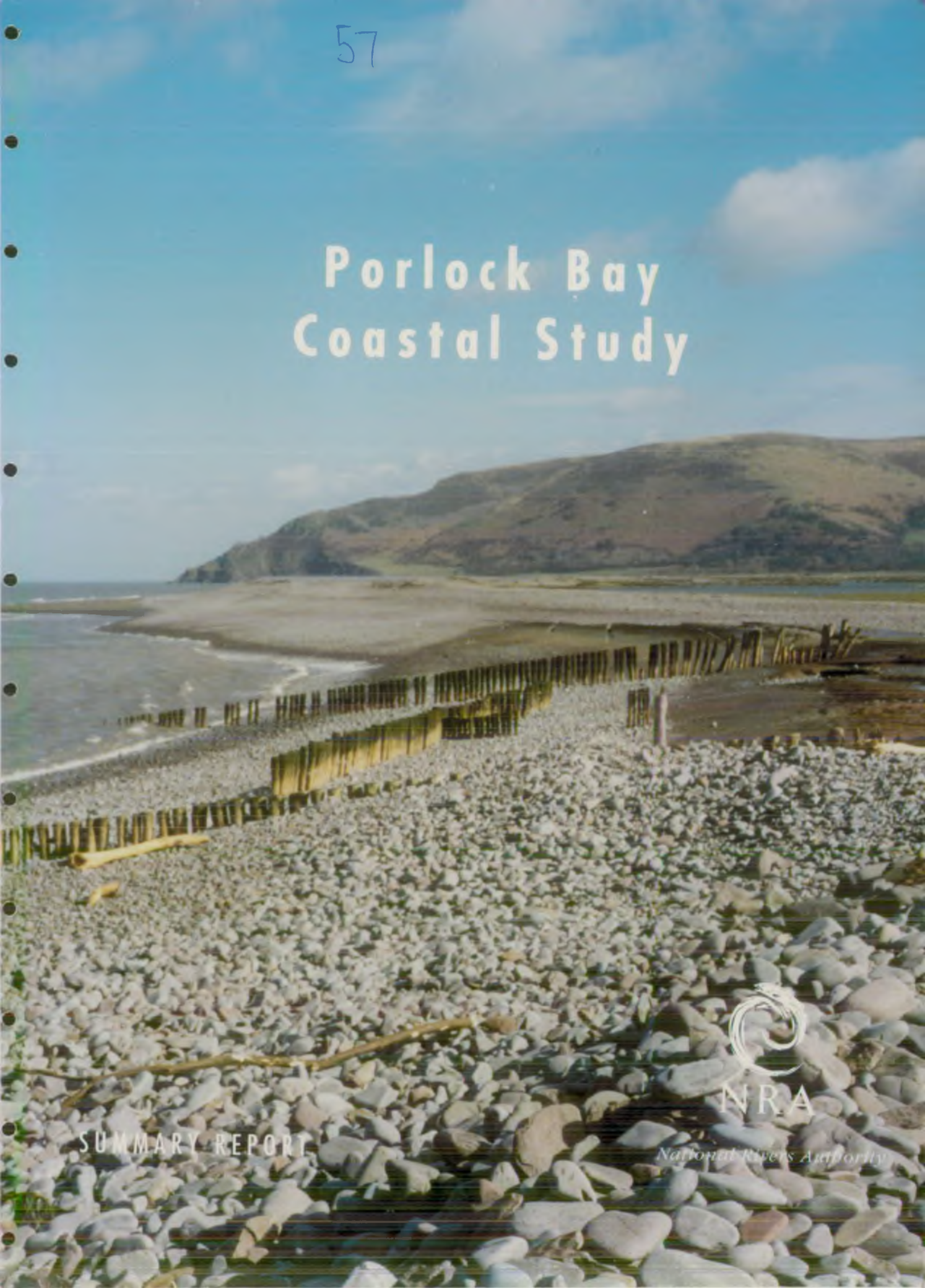
Porlock Bay Coastal Study



SUMMARY REPORT

NRA

National Rivers Authority

NATIONAL RIVERS AUTHORITY - WESSEX REGION
MINISTRY OF AGRICULTURE FISHERIES AND FOOD
WEST SOMERSET DISTRICT COUNCIL
EXMOOR NATIONAL PARK

PORLOCK BAY COASTAL MANAGEMENT STUDY

SUMMARY REPORT

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SUMMARY REPORT

1.0 INTRODUCTION

1.1 Background

Porlock Bay extends some four kilometres between Gore Point and Hurlstone Point (*Figure 1*). The hinterland includes Porlock Weir village and harbour, and Porlock Marsh, an area of low lying land protected from flooding by Porlock Ridge.

Despite the use of groynes and shingle replenishment, the ridge has a history of breaching, notably during 1981 and 1990. The problem was examined by consulting engineers Sir William Halcrow and Partners in 1985 who recommended restoration of the ridge using shingle from the part of Bossington Beach owned by the National Trust. Implementation was, however, prevented by objections to the removal of shingle from Bossington Beach. This prompted calls for "bay wide" coastal management.

1.2 The Present Study

The first stage of this study, finished in March 1991, dealt with the economic benefits of flood defence. The second stage commissioned in November 1991, has examined the coastal processes in Porlock Bay and the reasons for breaching of the shingle ridge. Various options for the future coastal management of the bay, including their likely environmental implications, have been assessed.

2.0 SHINGLE MOVEMENT IN PORLOCK BAY

2.1 Shingle Entering Porlock Bay

Shingle entering Porlock Bay comes from cliff falls between Foreland Point and Gore Point.

The volume depends upon the proportion of shingle forming the cliffs and the frequency of cliff falls. This, in turn, depends upon the rate at which waves can transport material along the shore.The cliffs are soft and if transport rates were higher then cliff falls would occur more frequently.

The shingle input to Porlock Bay is estimated to be in the range 250 to 2000 cubic metres per year. This shingle is transported around Gore Point and into Porlock Bay.

2.2 Shingle Loss from Porlock Bay

At Gore Point the hills are fronted by low lying land which in turn is fronted by a continuous shingle beach, thus facilitating shingle transport into the bay. At Hurlstone Point, however, the steep cliff protrudes beyond the coastal plain, interrupting the drift of shingle. The loss of shingle to the east by normal transport around the headland is therefore small.

There is, however, a potential loss of sediment resulting from breaching of the shingle ridge at Horner Water at times of high fluvial flow about once per year. At these times sediment is flushed onto the foreshore. The shingle tends to move back onshore but finer sediment tends to move offshore from where it can be transported eastwards and around Hurlstone Point. This represents a loss of sediment from Porlock Bay.

2.3 Shoreline Development within Porlock Bay

The characteristics of shingle transport along the shore within Porlock Bay were examined with the aid of mathematical modelling and by reference to historic data. Shingle transport is illustrated by *Figure 2*.

Generally, the transport is from west to east except between Porlock Weir and the point denoted X7 (*see Figure 1*). Between these points the drift, averaged over a year, reverses. This means that at these two points the transport is theoretically zero, ie. at Porlock Weir and at point X7. The reducing transport rate between Gore Point and Porlockford Cliff suggests a tendency for shingle accumulation - a feature which is borne out by observation. Conversely, the increasing transport to the east of Porlockford Cliff is indicative of erosion.

Zero transport at Porlock Weir would also suggest that there is no shingle supply to the east. It is possible, though not proven, that there is an alternative sediment path which cuts across Porlock Beach (*see Figure 1*) below the low water mark, linking the shingle at Porlock Weir with that at New Works. Overall, however, the sediment supply to the ridge is very poor, especially to the east of Porlockford Cliff.

2.4 Strength of the Shingle Ridge

Mathematical modelling was used to assess the strength of the shingle ridge. Twelve cross-sections through the shingle ridge were surveyed in January 1992 and six of these were used in the model. Each of the six cross-sections was tested against increasingly severe storm conditions to determine the level of failure and hence the strength of the section.

Two parts of the ridge are markedly weaker than the rest. These are at New Works and at the end of the groyned section close to Sparkhayes Lane, where failure is likely within a year. Such an event could of course happen at any time, given the correct tidal and meteorological conditions. The standard of the shingle ridge at Porlockford Cliff is rather better. This is attributed partly to the sheltering brought about by the accumulation of shingle at Gibraltar Cottages, and partly due to groyning and some beach replenishment having been carried out in 1969. Generally, failure of the shingle ridge between Porlockford Cliff and Horner Water is likely to happen every one to five years.

In two areas (at Bossington Beach and Gibraltar Cottages) the shingle ridge is notably stronger and here a breach is likely to happen less often than once every 100 years.

2.5 Findings

By combining the findings of the modelling with those of the historic research, a comprehensive assessment of shoreline processes was obtained:

- Shingle has accumulated between Gore Point and the harbour since the initial groyne construction in the nineteenth century. Accumulation in this area stopped as the groyne became "saturated" with shingle.

- Shingle has accumulated in front of the Anchor car park and Gibraltar Cottages and this accretion continues. There is however, insufficient shingle in this area to restore the endangered part of the ridge

- Porlockford Cliff was eroding but this has stopped in recent years, possibly as a result of protection by the shingle accumulation at Gibraltar Cottages.

- There is a marked absence of shingle supply to the east of Porlockford Cliff but the potential longshore transport to the east of New Works is significant. The consequence is a long term erosion and hence weakening of the shingle ridge from Porlockford Cliff to beyond New Works.

3.0 EXISTING ENVIRONMENT

3.1 Porlock Marsh

The low lying land behind the shingle ridge is characterised by low intensity agricultural regimes, primarily the grazing of stock with limited areas of arable cropping (barley and wheat), a managed reedbed and a small plot of Christmas trees. Much of the flood risk area has recently been designated as a Site of Special Scientific Interest. It is a diverse and regionally important site comprising strandline vegetation, shingle, maritime grassland, saltmarsh, swamp and brackish water habitats.

The Somerset and North Devon Coast Path, part of the Countryside Commission's South West Peninsula Coast Path, runs along the line of the shingle ridge. A number of local footpaths from the villages also cross the marsh, providing access to the ridge. The whole of the study area lies within the Exmoor National Park and, as such, is of significant landscape value.

There are also features of considerable archaeological interest in the vicinity of the shingle ridge. These include peat deposits and a submarine forest, flint scatters, fish weirs, lime kilns, pill boxes, and a duck decoy.

Finally, two sewage outfalls cross the marsh area, one from Bossington village and a second from Porlock village.

3.2 Porlock Weir

The harbour at Porlock Weir is a significant tourist attraction which regularly attracts a large number of visitors mainly by car but also by boat. The village developed around the harbour which is thought to be of Medieval origin. Low lying land is largely well protected against flooding, by a significant shingle bank in front of the car park and Gibraltar Cottages. Turkey Cottages are more exposed and do suffer flooding from time to time.

4.0 OPTIONS FOR SHORELINE MANAGEMENT

Four fundamental options have been examined:

- Do Nothing
- Managed Retreat
- Sustain Existing Standard of Defence
- Improve Standard of Defence to 20 years

4.1 Do Nothing

4.1.1 The true do nothing option means that no works to the defences are undertaken by the NRA, District Council, Porlock Manor Estate or others. It is expected that within five years there will be a number of breaches in the ridge and consequently much of the low-lying land behind the ridge will be regularly inundated by salt water. This option assumes that having made a decision to do nothing, the responsible authorities take no further interest in the site. This includes monitoring or management as well as engineering works.

4.1.2 Environmental Implications

The most significant potential adverse impacts associated with the true do nothing option as described above, are:

- the uncertain ecological and landscape development of the marsh following the failure of the ridge because such development will depend on the extent and frequency of flooding which will, in turn, depend on the precise nature and location of the breaches
- loss of the specific ecology protected by the Site of Special Scientific Interest
- possible pollution associated with the disruption of the sewage outfall due to submersion or regular inundation
- accumulation of litter around high water mark
- disruption or loss of parts of the footpath network

Other locally important adverse impacts include:

- the partial or total loss of agricultural and reedbed production, notably in the low lying area behind the new works outfall.
- the degradation of the duck decoy.

4.2 Managed Retreat

4.2.1 Managed retreat is based on the assumption that the potential adverse impacts of the do nothing option (outlined in Section 4.1.2) might be reduced through careful management of the response to the ridge failure. Due to the uncertainties in respect of the precise nature, location and timing of breaches, such management will necessarily be largely reactive. Careful monitoring of key physical and biological parameters will be required, both prior to and following any breach(es). This monitoring may demonstrate that the habitat which develops naturally is considered to be of nature conservation value, or it may show that some form of intervention would be beneficial in order to improve the nature conservation value of the site. Intervention, in turn, could range from general site management (eg. undertaking litter clearance, controlling visitor access and providing interpretation facilities) to the provision of basic structures to control water levels or retain a required water level across part of the marsh. In the event that such structures are required, it is conceivable that each could cost several thousands of pounds.

4.2.2 Environmental Implications

Managed retreat offers a number of significant advantages over the do nothing option in that it:

- offers an opportunity for regular monitoring and, if necessary, intervention to ensure that degradation of the nature conservation and landscape resource is prevented and that enhancement is promoted
- enables measures to be taken to mitigate against disruption of the sewage outfall.
- could provide for the re-routing of the footpath

Managed retreat does not, however, avoid the locally important adverse impacts described in 4.1.2 above.

4.3 Sustain Existing Standard of Defence

"Sustain" means that works are undertaken but only sufficient to ensure that the present standard of defence is retained.

The sustain option differs from the current practice of transporting shingle from the Harbour Gut to the western end of the ridge. It is a planned programme which counteracts the long term weakening of the shingle ridge together with rising sea level.

Rising sea levels and the larger inshore waves that will accompany them, will put increasing demands on sea defences in the future. This will require just over 1000 cubic metres more shingle per year to provide the same standard of defence. A further 2000 to 4000 cubic metres of shingle would be required annually to counter the drift of shingle from the problem area.

There are considerable risks involved in adopting such a low standard of defence, ie. where breaching could occur every year. Apart from the inevitable breaching which would continue to be a feature of the area, it is possible that abnormal weather could result in severe and extensive breaching in any one year, thus incurring expensive breach repair costs and negating previous investment in beach replenishment work. **For this reason the sustain option is not recommended.**

4.4 Improve Standard of Defence to 20 years

Improving the standard of defence to 20 years means that a breach is likely to occur only once in 20 years on average. The following measures for improving the standard of defence have been examined.

4.4.1 Groynes

Groynes trap a proportion of the shingle moved by longshore transport. Where the transport rate is high for example between New Works and the most easterly groyne at Sparkhayes Lane, then the build-up of shingle on the west side of each groyne is very apparent. However, there is a corresponding loss of shingle on the east side. Thus, whilst the groynes are advantageous by helping to hold back some of the shingle which would otherwise be moved along, they also lead to weak spots in the ridge. It is the weak spots that dictate the strength of the ridge and its capacity to resist breaching during storms.

One of the weaker spots on the ridge is at the end of the groyne system at Sparkhayes Lane. More Groynes to the east of Sparkhayes Lane would simply move this problem along the coast. **The construction of further groynes is therefore not recommended.**

4.4.2 Revetment and Offshore Breakwaters

The ridge could be protected by constructing a revetment (or seawall) or by constructing offshore breakwaters parallel to the shore. The costs, estimated to be £12 million and £14 million respectively would be high in relation to the benefits. **Such schemes could not be economically justified and are therefore not recommended.**

4.4.3 Beach Replenishment

Various alternatives for beach replenishment were examined during the present study, viz.

- use of "imported" shingle
- removal of harbour groyne
- installation of drainage at Horner Water

Given the location of Porlock in relation to potential supplies, imported shingle would come from land based quarries. The unit costs for shingle supply would be about eight times that of local material. Costs would be in excess of the value of benefits and hence the **use of imported shingle is not economically viable and is not recommended.**

Removing the harbour groyne would release a proportion of the shingle accumulated adjacent to Turkey Cottages. However, the longshore drift onto the ridge is so small that this measure would not remedy the weakness of the ridge. There is a finite volume of shingle accumulated behind the harbour groyne. Once this material was released then the sediment input to the problem area would revert to the norm. Moreover, the loss of shingle from adjacent to Turkey Cottages would make them more vulnerable to flooding and land erosion. **This situation would be unacceptable and this option is therefore not recommended.**

Shingle loss from Porlock Bay could be reduced by preventing breaching of the shingle ridge at Horner Water (see section 2.2). This might be achieved by improving the drainage at Horner Water to maintain the water at a lower level. The potential advantages of this are: improvement in the long term sustainability of the beach replenishment programme; possible reduction in the amount of shingle required periodically to restore the ridge. There is, however, considerable uncertainty regarding the actual volume of sediment that is lost from the bay due to breaching at Horner Water, and hence the actual advantages. **Hence, this option is not recommended**, but could be given further consideration following several years' monitoring of the ridge.

Of the above three variants on a basic beach management scheme, only the last offers a potentially viable advantage, and then not for at least five years say. In the meantime therefore, **the only viable option is that of beach management using shingle available from within Porlock Bay.**

It is recommended that shingle is not taken from the Gibraltar Cottages area as this would increase flooding risk in that area. Moreover, it is not proven that the removal of shingle from in front of Gibraltar Cottages would actually improve the natural drift of shingle eastwards.

The only alternative area where the beach is sufficiently healthy to become a borrow area is Bossington Beach. At Bossington Beach, shingle would be removed from the seaward face, thus avoiding damage to the ecological interests on the back face of the ridge. The volume of shingle required to provide a minimum flood defence standard of 1 in 20 years is calculated to be 67000 cubic metres distributed between Porlockford and the Lime Kilns east of Horner Water. *Figure 3* shows a cross-section of the nourished ridge at Sparkhayes and also shows the increased extent of the shingle ridge in 50 years time when more shingle would be required to off-set sea level rise. The seaward face of the nourished ridge would quickly respond to the action of the sea to form a natural profile.

There are alternative strategies for placing the shingle to achieve the 20 year standard of defence and subsequently to sustain it. Assuming a programme which entails an initial major replenishment together with five years replenishment work and annual maintenance the estimated present day cost, calculated (and discounted) over a scheme life of 50 years is between £334,514 and £429,546. The same scheme costed for a 30 year scheme life is between £311,355 and £393,579

4.5 Environmental Implications of Sustaining or Improving Standard of Defence

Local Beneficial Impacts

Works to improve or sustain the standard of defence of the shingle ridge would result in the following locally beneficial impacts.

- retention of the traditional system of agricultural land management including the existing Site of Special Scientific Interest in its current state
- retention of existing landscape value
- retention of the existing footpath network
- continued protection for the duck decoy
- opportunities, under the improvement scenario only, for intensifying the agricultural regime (although this is likely to be opposed by English Nature on the grounds of potential damage to nature conservation interest).

Long Term Adverse Impacts

Long term adverse impacts of these options are likely to include:

- Any significant improvement in the standard of flood defence, particularly if salt water seepage/overtopping were to be reduced, could detrimentally affect the interests of the SSSI, notably the salt marsh and brackish water habitats landward of the ridge.
- Depending on the type of structure used, a possible reduction in local aquatic and wetland habitats due to any artificial drainage of Horner Water to prevent regular breaching.

Short Term Adverse Impacts

In addition to the adverse impacts identified above which may occur as a result of the adoption of a sustain or improve policy, there will be short term impacts, depending on the extent of works. These are likely to include:

- Visual intrusion associated with plant movement and construction affecting the important National Park landscape.
- Damage to ecological features associated with plant movement
- Disturbance to both local residents and visitors should shingle be removed from sites at Porlock Weir

Finally, it should be noted that any option which depends upon the continued artificial replenishment of the shingle ridge may not be supported by National Trust or English Nature, both of whom would prefer to see a minimum level of intervention to the natural/semi-natural processes currently operating.

5.0 SCHEME JUSTIFICATION

5.1 Benefits

To obtain grant-aid from the Ministry of Agriculture Fisheries and Food for flood defence works, the economic benefits likely to accrue as a result of a scheme must be greater than the total costs of implementing the action. A large proportion of the benefits identified in the 1991 Report were, however, specifically and unavoidably related to works around Porlock Weir and the assessment revealed only limited benefits directly associated with maintaining or improving the shingle ridge (ie. continued agricultural land use and preservation of the footpath).

The benefits of protecting the agricultural land in this particular case can only apply to maintaining the existing, low intensity agricultural regime which, in turn, reflects the relatively low current standard of flood defence. The benefit area has been defined as being equivalent to the 1990 flood level, and all agricultural production in this area is assumed to be lost. However, the 1990 flood levels were equivalent to those associated with a storm event with a return period in excess of 1 in 20 years. Therefore it is likely that upland edges of the benefit area will, in fact, be available for agricultural use in some years. Within this area the existing agricultural regime consists primarily of land rented out for livestock grazing.

Unlike other areas where an improvement in the standard of flood defence might lead to the intensification of agricultural practices and hence an economic benefit associated with increased production, the designation of the SSSI over much of the flood risk area precludes such intensification. The maximum benefit that can be realised within the area flooded is therefore the maintenance of current levels of production (total economic net margin £7361 per annum). Alternatively the capital value of the land (£239,370) could be used but this may not be acceptable to MAFF.

The cost of reinstating or re-routing the footpath under the do nothing option could vary considerably depending on the magnitude of any claims for compensation. Values of £10,000 and £70,000 have therefore been used as alternatives in the benefits assessment.

A further damage cost, avoided by undertaking works to sustain or improve the defences is the cost of works to maintain the sewage outfall from Porlock village (£25,000) and hence prevent pollution.

No measure of recreation or amenity values has been used in the benefits assessment because this would mean assuming that those visitors who use Porlock Weir car park and walk along the ridge cannot derive an equal level of enjoyment elsewhere locally. It is considered that this assumption could not be substantiated.

Sensitivity analysis on the above was used to determine a range of total damage costs avoided (ie. benefits) by undertaking works to improve the shingle ridge to a 1:20 year standard. These values range from £158,205 to £334,370 for a 50 year scheme, and from £142,520 to £334,370 for a 30 year scheme.

5.2 Benefit/Cost Ratio and Net Present Value

The economic justification of a scheme can be measured in terms of its benefit/cost ratio, (ie. the ratio of the value of the benefits to the cost of the scheme). It can also be measured in terms of the net present value, which is the difference between the value of benefits and the cost. The scheme is economically justified if b/c is greater than unity, and NPV is greater than zero.

For the improvement scheme providing a twenty year standard of defence by beach management, the benefit/cost ratio and net present values corresponding to scheme lives of 30 years and 50 years are as follows:

Scheme Life:	30 years	30 years	50 years	50 years
Benefits:	Upper Limit	Lower Limit	Upper Limit	Lower Limit
b/c ratio	1.07	0.36	1.00	0.37
NPV	+£23,015	-£251,059	-£144	-£271,341

6.0 CONCLUSIONS

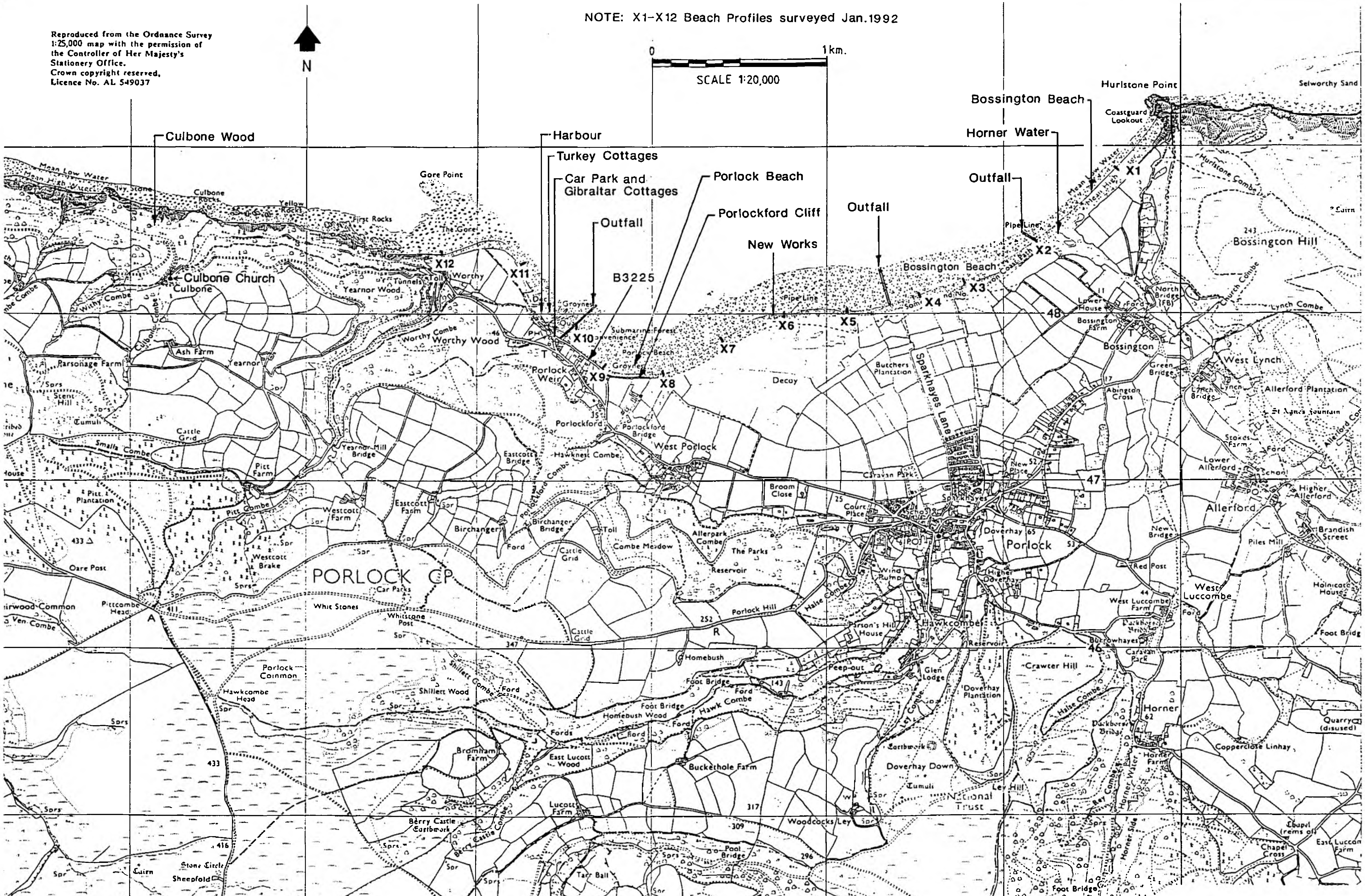
- The lack of natural supply of material onto the ridge at Porlockford and the much higher eastwards drift to the east of New Works causes a long term weakening of the ridge

- Because of this situation, works at the harbour entrance to allow shingle past the weir, would not significantly improve the situation on the ridge.

- If the ridge is to be preserved, the cheapest technically viable solution is to improve it to a twenty year standard. This would involve beach management, taking shingle from Bossington Beach, and would cost between £311,355 and £393,579 for a thirty year scheme life. Its economic justification is questionable with benefit/cost ratios ranging from 1.07 to 0.36.

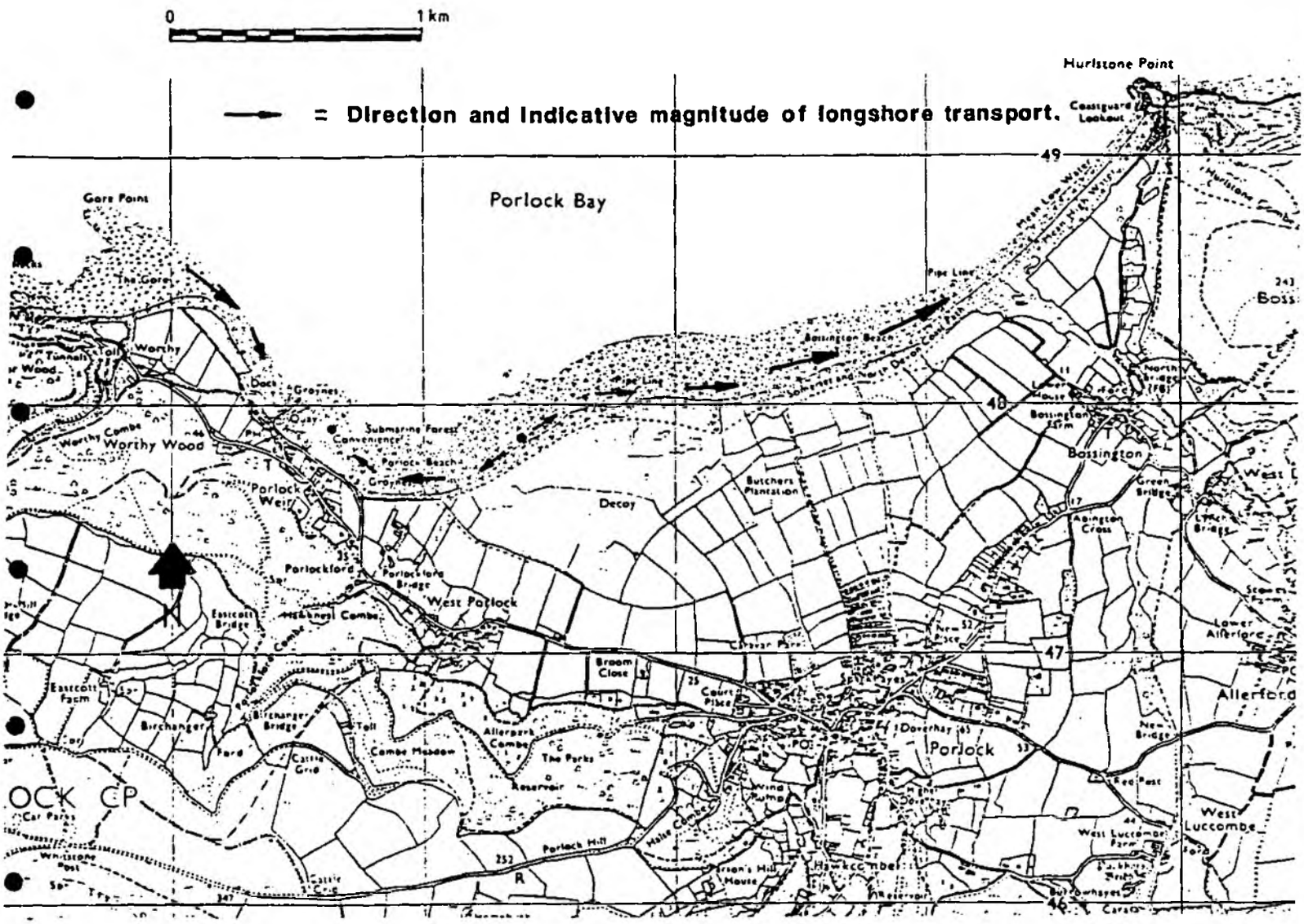
- With the exception of the existing nature conservation interest, the environmental appraisal failed to identify any assets in the area of marsh likely to be affected by flooding which are of more than local value. It is therefore difficult to justify maintaining or improving the standard of defence for environmental reasons.

- If the improvement to a 20 year standard is not pursued, there could be advantages, from an environmental point of view, in a managed retreat rather than a "do nothing" option. This is because of the uncertainties of the ecological and landscape consequences of the do nothing option .



LOCATION PLAN

Figure 1.



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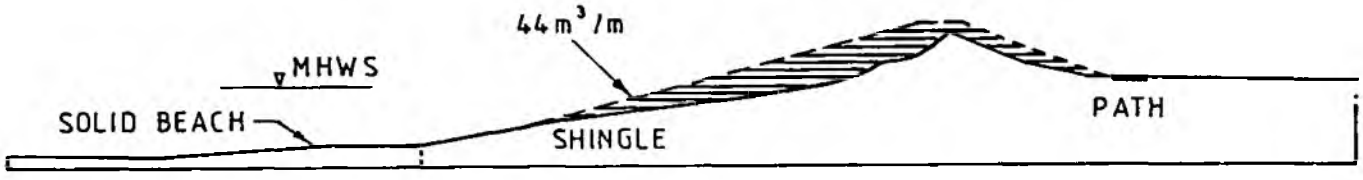
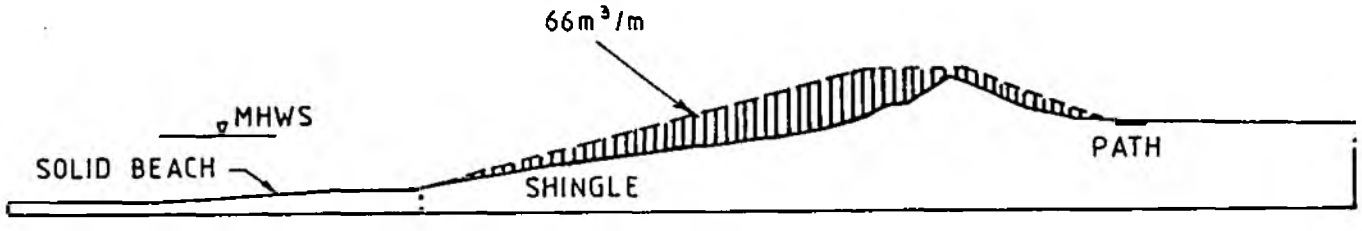
LONGSHORE TRANSPORT

Figure 2





PROFILE X4

SCALE 1:500

KEY

20 YR. STANDARD OF DEFENCE NOW

20 YR. STANDARD OF DEFENCE IN 50 YRS. TIME

RESTORED SHINGLE RIDGE

Figure 3