EXECUTIVE SUMMARY

- The aim of the study was to develop a long-term strategy (50 years) for the management of the coastline and adjacent land within Durlston Bay (Management Units DUR 1 to DUR 3).

- The strategy study comprised a number of elements including:
  - Review of planning and environmental policy in the area;
  - Description of the environmental baseline (ecology, historic heritage, geology, etc);
  - Definition of Management Sub-Units (MSU's);
  - Consequences of the 'do nothing' policy option and its effect on the environment;
  - Development of a range of management and outline scheme options for each MSU, based on assessment of risk to persons and property, engineering assessment and economic evaluation;
  - Recommendation for a preferred management and/or scheme option for each MSU;
  - Identification of cost, benefits and consequences of the preferred options; and
  - An implementation programme for the preferred strategy elements.

- The strategy coastline is almost entirely undefended, characterised by cliffs and steep, largely vegetated, coastal slopes where the toes are subject to frequent aggressive wave action.

- The formation of the cliffs is the product of marine action. The creation of oversteep and near vertical slopes by marine erosion has triggered other slope processes that have resulted in significant landslide events. These landslide events are intermittent, resulting in often dramatic large-scale movements punctuated by long periods of stasis. That the slope processes are on-going is the result of the continued marine action at the cliff toe removing landslide debris from the foreshore, thus reactivating the near-shore ground movements. Recession of the cliff is, therefore, the result of marine action as the principal genesis of the cliffs, which has triggered inherent instability of the coastal cliffs and slopes leading to the development and propagation of terrestrial landslide systems. The Pinecliff Walk landslide in the winter of 2000/2001 was the result of a combination of these processes with the high groundwater levels resulting from the wettest winter on record probably acting as a trigger mechanism.

- The area is of considerable environmental and conservation value, which is recognised by Site of Special Scientific Interest and Special Area of Conservation designations and its partial inclusion in the Purbeck Heritage Coast. A substantial portion of the foreshore, cliffline and adjacent land is owned by Dorset County Council and managed by Durlston Country Park. Durlston Bay lies within a World Heritage Site.

- Coastal recession and landslide activity are active in most portions of the Bay. The consequences of this instability are generally of minor concern, anticipated to affect cliff top paths and fences only within the timeframe of the strategy.

- The locations and issues which are exceptions and of principal concern were:

  - **Pinecliff Walk Landslide –** An historic landslide system that was recently reactivated following the high rainfall in 2000/2001.

  - **Durlston Cliffs Flats –** Extensive remediation was undertaken for a full height cliff landslide in 1989. Some distress remains evident in the grounds of the flats. Anecdotal evidence suggests that this is long standing however the evidence indicates the presence of movement and monitoring is required to determine if this is ongoing.

  - **Zig-Zag Path Woods –** A spur between the Pinecliff Walk Landslide and Durlston Cliff Flats where incipient ground movements have been recognised.

  - **Durlston Wall -** The proximity to the clifftop and geological setting indicate the property to be at risk.

- The recommended management strategies and outline preferred option for engineering intervention (where necessary) were:

  - **Pinecliff Walk Landslide**

Principle Elements	Description	Comment
Diversion of stream to the south of the landslide	The stream discharges storm water runoff from Durlston Road and upper areas of catchment directly into the landslide system. Diversion and training works to re-direct stream flow in new channel away from landslide system.	Completed under an emergency works package in Autumn 2002.
Prevention of Clifftop Regression by Bored Shear Piles	Construction of bored shear piles behind Upper Escarpment to prevent further inland regression of the landslide.	Shear piles will provide effectively full protection to upper escarpment with minimal visual impact. Natural colonisation of the existing escarpment with vegetation would occur, but spalling of the oversteep face is inevitable without some reprofiling.
Prevention of Regression of the	Construction of bored shear piles behind Mid Escarpment	Similar to above, but construction on mid escarpment.

Mid Escarpments by Bored Shear Piles	to prevent further regression.	Minimal visual impact, no loss of exposure, and no loss of habitat. Some spalling of escarpment face would occur unless rock stabilisation measures taken.
Clifftop drainage	To include gullies to collect stormwater from existing buildings, and forecourts; new road drainage and discharge into existing stream channel or surface water drainage system.	Existing stormwater drainage is relatively uncontrolled, including soakaway drains to buildings and gravity drainage along existing road and track surfaces. Improvements are required in order to collect and dispose of storm water away from the landslide system, and control infiltration into the ground. Whilst drainage improvements to the entire catchment that feeds into the landslide system would be impracticable, local improvements to clifftop properties and Durlston Road are recommended.

- **Zig-Zag Path Woods** – Install monitoring systems including inclinometers, remote monitoring devices and early warning system. The system would provide data on which the risk to adjacent property may be better quantified. Further assessment of the requirement for engineering intervention may be made based on the data retrieved. The alarm system would be set to alert officials of the onset of ground movement beyond pre-set limits, thus providing a maximum opportunity to enact rapid remediation, or evacuate affected properties if required.

- **Durlston Cliff Flats –** Install monitoring systems including inclinometers, remote monitoring devices and early warning system. The system would provide data on which the risk to adjacent property may be better quantified. Further assessment of the requirement for engineering intervention may be made based on the data retrieved. The alarm system would be set to alert officials of the onset of ground movement beyond pre-set limits, thus providing a maximum opportunity to enact rapid remediation, or evacuate affected properties if required.

- **Durlston Wall –** Will benefit from the remote monitoring systems installed in Durlston Cliff Flats, otherwise routine inspection.

- **Other areas –** Routine inspection.

- The estimated cost of implementing the above scheme is as follows (note that emergency works undertaken in 2002 are excluded from the cost assessments for future works):

Location	Emergency Works Undertaken in 2002 (i.e. Year 1)		Immediate Works (i.e. Year 2 & 3)		Annual Repeat Activities	
	Capital Cost	Activities	Capital Cost	Activities	Cost per year	Activities
Pinecliff Walk Landslide	£94k	Diversion of stream that previously discharged into the landslide system.	£329k	Stabilisation of active landslide elements (i.e. upper and mid escarpments) with shear piles, drainage of upper landslide system.		Routine inspection included in 'other areas'
Clifftop in vicinity of Pinecliff Walk Landslide			£223k	Improved drainage to properties and highways		
Zig-Zag Path Woods & Durlston Cliff Flats			£86k	Monitoring system and alarm.	£26k for initial monitoring 2 yr. period, reducing to £6k for yrs. 3-5	Interrogation and interpretation of monitoring system; Maintenance of monitoring system; Routine inspection included in *'other areas'*
Other areas			nil		£5.3k	Biannual inspection of all strategy area.

- Estimated strategy implementation costs for the Preferred Option (i.e. Option 3) are (including for 3.5%/year discount factor):

Year	Total Costs	
	Cash (£k)	**Present Value (£k)**
0	86.0	86.0
1	360.3	348.1
2-4	276.9	247.6
5-9	32.5	25.9
10-19	63.0	39.4
20-29	63.0	28.0
30-39	63.0	20.2
40-49	63.0	15.0
TOTAL	**1007.7**	**820.0**

- The DEFRA Prioritisation Score for the strategy schemes is as follows:

Score Element	Scheme Option	
	Preferred	**Highest Scoring**
	Option 3	**Option 5**
Economic Element		
Benefit Cost Ratio	3.02	3.68
Score	5.04	6.35
People Element		
Present Value Cost of works	£871k	£778k
Nr. of properties benefiting from scheme	53	53
Base Score	4.56	5.11
Risk Score	1	1
Vulnerability	0	0
Score	5.56	6.11
Environmental Element		
Area	15ha.	15ha.
Score	0.65	0.72
DEFRA Prioritisation Score	**11.25**	**13.18**

The proposed monitoring strategy for the remaining MSU's achieves a Prioritisation Score of 10 by default.

- Whilst the Preferred Option (Option 3) does not score sufficiently high to warrant immediate consideration for grant aid, there are exceptional circumstances surrounding this area that do not conform to the normal rules of the economic assessment. These factors are summarised as follows:

- There is uncertainty around the actual probabilities of loss, which are based on a subjective assessment of loss of value in affected properties. This uncertainty is greater were minimal intervention to occur;
- The loss will be borne directly by local residents in terms of loss of property value rather than tangible structural damage.
- The diminishing value is likely to be marked in the short term due to the risk (perceived and real) posed by the recent landslide activity;
- The cost of short-term engineering intervention can be more readily calculated than that of future intervention where circumstances become less readily definable. In this respect the optimism bias factor (60% in all cases) is likely to lead to an overestimate in short-term costs, and underestimate of long-term costs. Notwithstanding the details of the economic assessment that are based on the best cost forecast possible, given current knowledge, comprehensive short-term intervention should be considered more favourably than arises from the economic appraisal;
- The engineering and economic appraisals are based ultimately on historical precedent, including large-scale landslide activity recurring on a 20-30year return period. Changes in circumstances especially arising from the altered stress regime within the coastal slopes, but also arising from increased precipitation rates, lead to particular difficulties in accurately predicting risk and the future pattern of landslide movements. Whilst monitoring is proposed to assist in quantification of the future risk, a comprehensive intervention at this stage must assist in controlling unprecedented and unpredictable future ground movements.

Considering all of the data for the site and arising from this assessment, the Preferred Engineered Solution, Option 3 is proposed for consideration as the most favourable intervention into the landslide hazard in MSU1/5. This should be undertaken in conjunction with comprehensive and detailed monitoring of the adjacent areas on MSU1/6 and MSU2/1.