
Sandsend Road Coast Protection Scheme PAR

Benefits Appraisal

1. Introduction

The economic damage assessment has been carried out as part of the 2011 review of the Whitby Coastal Strategy: Sandsend to Abbey Cliffs. The Strategic Appraisal Report (StAR) is due to be submitted to the Environment Agency's Large Project Review Group (LPRG) in Summer 2012. The relevant sections of the economic assessment from the StAR for the Sandsend Road area have been used in the Sandsend Road Coast Protection Scheme Project Appraisal Report (PAR).

Damages have been calculated using the Multi Coloured Manual (MCM) and the Green Book (HM Treasury, 2003). These documents have been used in combination with the Defra FCERM-AG series and Supplementary Guidance Notes. Figures in the Multi Coloured Manual have been updated to 2nd Quarter 2011 using the Consumer Price Index.

Damages have been calculated for the 100 year appraisal period and discount rates starting at 3.5% and reducing to 2.5% have been applied.

The damages that have been quantified fall into four categories, road traffic disruption, property, services and historic assets. Damages which have not been quantified include social, amenity and tourism. These damages have not been quantified as it would not be proportional to do so. Compared to the value of the damages derived from the road traffic disruption, the damages derived from social, amenity and tourism impacts would be relatively minor and would not change the magnitude of the total damages or the overall economic viability of a scheme.

2. Coastal Erosion

Sendsend is located along a highly active area of coastline, where processes of coastal erosion, cliff and slope instability and both alongshore and onshore-offshore sediment transport are considerable. As such, the risk from coastal erosion over the next 100 years is expected to be significant.

2.1 Property Damages

Values of damages caused by coastal erosion have been calculated using the Multi-Coloured Manual and guidance from Defra and the Environment Agency in order to establish Annual Average Damages (AAD).

The Shoreline Management Plan (SMP2) provides detailed information on the rates of coastal erosion and the projected shoreline position for the next 20, 50 and 100 years within the Study Area, both under a hypothetical No Active Intervention (NAI) policy and with the preferred SMP2 policies in place. The National Property Dataset has been overlain onto the NAI erosion lines from the SMP2 to determine which properties would be at risk in different future epochs.

The numbers of properties at risk over the 100 year appraisal period for each Management Unit are shown in Table 1. All of the properties at risk are within Management Unit 4CD at the eastern edge of the village. Of the 16 properties at risk, one would be lost by year 50 and the remaining by year 100.

Table 1 - Properties at risk of coastal erosion over the 100 year appraisal period

Management Unit	Properties at Risk (over 100 years)		
	Residential	Commercial	Total
4CD	10	6	16
5	0	0	0
6	0	0	0
7	0	0	0
Total	10	6	16

Damages have been calculated taking market value for the properties and discounting appropriately according to the period in which the property is lost, using the declining long term discount rate of 3.5% for years 0-30, 3.0% for years 31-75, and 2.5% for years 76-100 as recommended in the 'Green Book'.

Under the Do Minimum scenario the existing coastal defence assets will be maintained until the end of their residual lives, thereby delaying the onset of the erosion that will lead to the loss of properties. The damages for the Do Minimum have been derived by offsetting the Do Nothing damages by the difference between the residual life of the asset with and without maintenance.

Present Value (PV) damages over the 100 year appraisal period for the Do Nothing scenario are **£111k**, and for the Do Minimum scenario the PV damages are **£13k**.

2.2 Services Damages

There are services at risk from coastal erosion within the Study Area, located within the A174 Whitby to Sandsend road. The services information from the original 2002 Whitby Coastal Strategy: Sandsend to Abbey Cliff has been used to identify what services would be at risk within the SMP erosion zones. The following lengths of services have been identified as being at risk:

- British Telecom: 2,583m;
- Transco: 1,360m;
- Yorkshire Water: 1,503m; and
- Northern Electric: 493m.

The damages have been taken as a cost for relocating the services out of the 100 year erosion zone, based on a rate of £375/m, discounting appropriately according to the period in which the section of service is lost, using the declining long term discount rate of 3.5% for years 0-30, 3.0% for years 31-75, and 2.5% for years 76-100 as recommended in the 'Green Book'.

As for the coastal erosion property damages, the Do Minimum damages have been derived by offsetting the Do Nothing damages by the difference between the residual life of the asset with and without maintenance.

Present Value damages over the 100 year appraisal period for the Do Nothing scenario are **£828k**, and for the Do Minimum scenario the PV damages **£742k**.

3. Traffic Disruptions

The A174 is the main road between the village of Sandsend and Whitby town and harbour, covering a distance of 4km with an average journey time of 5 minutes. Sandsend relies on Whitby for the majority of its services such as emergency services, hospital, schools, recreational and amenity facilities, shopping, and employment. The A174 is at risk of coastal erosion; under Do Nothing scenario it can be expected to become unusable by year 20. Once this road is lost the alternative route on existing A-roads will be 26km with an average journey time of 30 minutes, an increase of 600%. This will result in major disruptions to traffic, with increased journey lengths and costs. This diversion would be permanent under Do Nothing.

The cost of the permanent traffic diversion has been calculated following the methodology set out in the Multi-Coloured Manual. Survey figures provided by North Yorkshire County Council give an Annual Average Daily Traffic figure of 5,209 vehicles between Sandsend and Whitby on the A174. The annual cost of the additional 22km journey length will be £9,681k.

For the first 20 years, up to the point that the road becomes unusable, damages have been allowed to account for works that would need to be carried out for health and safety reasons to clear cliff falls onto the road, to prevent road accidents. These damages have been based on 3 days of traffic diversions due to road closure every other year due to cliff falls, plus a £25k cost each event for clearing the road. This gives a cost per incident of £88k, which is applied every other year over the first 20 years.

The overall Do Nothing PV damage figure is **£158,542k**; this assumes that the road is lost in year 20. The A174 runs through Management Units (MU) 2 to 7 of the Whitby Coastal Strategy, therefore the overall PVD value has been split proportionally between the MUs according to length of road present, as shown in Table 2. The Sandsend Road Coast Protection Scheme PAR covers MUs 4CD to 7A, which includes 63.5% of the affected length of the A174 and therefore the corresponding factored PVD for the Do nothing scenario is **£100,731k**.

Table 2 Summary of Do Nothing PVD proportioned according to road length

Management Unit	Length of Affected Road (km)	% of Total Road Affected Length (%)	Do Nothing Damages (£k)
2	0.08km	4.4%	£7,007k
3	0.30km	16.6%	£26,278k
4AB	0.28km	15.5%	£24,526k
4CD	0.20km	11.0%	£17,518k
5	0.62km	34.3%	£54,307k
6	0.10km	5.5%	£8,759k
7A	0.23km	12.7%	£20,146k
TOTAL	1.81km	100%	£158,542k
TOTAL - PAR	1.15km	63.5%	£100,731k

Following the MCM methodology for infrastructure at risk of coastal erosion the least cost option needs to be considered from; abandoning the properties served by the affected infrastructure, diverting the infrastructure along a new route out of erosion zone, or the increased costs where disruption can be accommodated within the existing network. At strategy stage diverting the road out of the erosion zone was being considered as an option and therefore the damages were not capped and were taken as the costs of traffic using the 22km diversion. However at PAR stage the Do Nothing damages for the road traffic disruption have been capped at the cash cost of the road diversion (Option 3 from Whitby Coastal Strategy 2) which is £84,166k. As the road diversion falls entirely within the PAR study area of MU4CD to MU7A, this capping value does not need to be factored for length of road. Therefore the PVD for the Do Nothing scenario in the Sandsend Road Coast Protection Scheme PAR is **£84,166k**.

Although under the Do Minimum scenario the existing coastal defence assets in MU4CD and MU5 would have a slightly longer residual life (5 years more than Do Nothing), MU6 and MU7 are currently undefended sections and would therefore erode at the same rate as under Do Nothing and the road would still be lost in year 20. Therefore the Do Minimum damages are the same as for Do Nothing.

In addition, a sensitivity test was carried out on the impact of the additional vehicles on the diversion route, increasing congestion, reducing speeds and impeding traffic flow. The additional annual cost of this would be £20,034k, over the hundred year appraisal period this would result in a total combined PVD of **£178,576k**.

4. Loss of Historic Environment

The Study Area contains a large number of sites of historic significance, many of which will become at risk of coastal erosion within the appraisal period under the Do Nothing scenario. Table 3 summarises the heritage assets at risk of coastal erosion in each Management Unit.

In order to assign damage values for the loss of these historic assets specialists in archaeology have been consulted (Northern Archaeological Associates Ltd). The damages have been derived as the cost of surveying and recording the historic assets before they are lost to coastal erosion, as recommended in Environment Agency guidance (Flood and Coastal Erosion Risk Management Appraisal Guidance – Supporting Document for the Appraisal Summary Table, March 2010). The details of the works recommended for each management unit can be found in Appendix A, the cash costs of these works are shown in Table 3.

The costs for each management unit have been applied 5 years before the Do Nothing erosion of the frontage in that management unit is due to commence (taking into account existing coastal defence assets with no maintenance). The 5 years is to allow time for the surveying and recording to be carried out before the historic asset becomes directly at risk. The discounted PV damages for Do Nothing are therefore **£3.5k** over 100 years.

Under the Do minimum scenario the damages are delayed by the additional residual life of the existing coastal defence assets due to the maintenance that would be carried out for each management unit. Therefore the discounted PV damages for Do Minimum are **£2.9k** over 100 years.

Table 3 - Summary of Historic Environment Features that are at Risk from Coastal Erosion under the Do Nothing Scenario

MU	Listed Buildings	Cultural Heritage Sites	Archaeo-logical Events	Defence of Britain Site	Scheduled Monument	Conservation Area	Heritage Coast	Designed Landscape	Cost (£k)
4CD	3	10	3	3	N	N	Y	N	£0.3k
5	0	5	0	2	N	N	Y	N	£0.3k
6	0	5	0	2	N	N	Y	N	£2k
7	0	2	0	4	N	N	Y	N	£0.5k
TOTAL	3	22	3	11	0	0	1	0	£3.1k

5. Summary

A summary of the Do Nothing and Do Minimum scenarios is presented in Table 4. For a full breakdown according to Management Units please refer to the accompanying discounting spreadsheets.

Table 4 Summary of Do Nothing and Do Minimum Present Value Damages for Sandsend road Coast Protection Scheme Project Appraisal Report

Damage Category	Do Nothing PVd (£k)	Do Minimum PVd (£k)
1.1 Coastal Erosion - Property	£111k	£13k
1.2 Coastal Erosion - Services	£828k	£742k
3 Traffic Disruption	£84,166k	£84,166k
4 Loss of Historic Environment	£3.1k	£2.9k
TOTAL	£85,108k	£84,924k

Appendix A

Summary Spreadsheets

Project Summary Sheet					
Client/Authority North Yorkshire County Council			Prepared (date) 31/05/2012		
Project name Sandsend Road Coast Protection Scheme PAR - Strategic Options			Printed 31/05/2012		
Project reference 9W5572/Z3			Prepared by Emma Hick		
Base date for estimates (year 0) Q4 2011			Checked by		
Scaling factor (e.g. £m, £k, £) £			Checked date		
Year 0 30 75					
Discount Rate 3.5% 3.00% 2.50%					
Optimism bias adjustment factor 60%					
Costs and benefits of options					
Option number	Costs and benefits £				
	Option 1	Option 2	Option 3	Option 4	Option 5
Option name	Do-nothing	Do Minimum	Realign A174	Upgrade Minor Roads	Retain A174 on current alignment
AEP or SoP (where relevant)					
COSTS:					
PV capital costs	0	0	26,599,361	13,029,255	8,263,316
PV operation and maintenance costs	0	1,501,338	405,594	405,594	415,495
PV other	0	45,592	45,592	45,592	45,594
Optimism bias adjustment	0	928,158	16,230,328	8,088,264	5,234,643
PV negative costs (e.g. sales)	0	0	0	0	0
PV contributions					
Total PV Costs £ excluding contributions	0	2,475,087	43,280,875	21,568,705	13,959,047
Total PV Costs £ taking contributions into account	0	2,475,087	43,280,875	21,568,705	13,959,047
BENEFITS:					
PV monetised flood damages	0	0	0	0	0
PV monetised flood damages avoided		0	0	0	0
PV monetised erosion damages	101,673,563	101,488,374	2,113,385	63,247,507	298,140
PV monetised erosion damages avoided (protected)		185,189	99,560,178	38,426,056	101,375,422
Total monetised PV damages £	101,673,563	101,488,374	2,113,385	63,247,507	298,140
Total monetised PV benefits £		185,189	99,560,178	38,426,056	101,375,422
PV damages (from scoring and weighting)					
PV damages avoided/benefits (from scoring and weighting)					
PV benefits from ecosystem services					
Total PV damages £	101,673,563	101,488,374	2,113,385	63,247,507	298,140
Total PV benefits £		185,189	99,560,178	38,426,056	101,375,422
DECISION-MAKING CRITERIA:					
excluding contributions					
Based on total PV benefits (includes benefits from scoring and weighting and ecosystem services)					
Net Present Value NPV		-2,289,898	56,279,303	16,857,351	87,416,375
Average benefit/cost ratio BCR		0.1	2.3	1.8	7.3
Incremental benefit/cost ratio IBCR			2.4	2.8	-8.3
			IBCR>1	IBCR>1	Highest bcr
Based on monetised PV benefits (excludes benefits from scoring and weighting and ecosystem services)					
Net Present Value NPV		-2,289,898	56,279,303	16,857,351	87,416,375
Average benefit/cost ratio BCR		0.1	2.3	1.8	7.3
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			IBCR>1	IBCR>1	Highest bcr
Best practicable environmental option (WFD)					
Brief description of options:					
Option 1	Do-nothing				
Option 2	Do Minimum				
Option 3	Realign A174				
Option 4	Upgrade Minor Roads				
Option 5	Retain A174 on current alignment				
Comments and assumptions:					

Project Summary Sheet						
Client/Authority			Prepared (date) 31/05/2012			
North Yorkshire County Council			Printed 31/05/2012			
Project name			Prepared by Emma Hick			
Sandsend Road Coast Protection Scheme PAR			Checked by			
Project reference			Checked date			
Base date for estimates (year 0)			9W5572/Z3			
Scaling factor (e.g. £m, £k, £)			Q4 2011			
Year			£ (used for all costs, losses and benefits)			
Discount Rate			0 30 75			
Optimism bias adjustment factor			3.5% 3.00% 2.50%			
Costs and benefits of options			45%			
Costs and benefits £						
Option number	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6
Option name	Do-nothing	Do Minimum	Option 1B	Option 1C	Option 3B	Option 3C
AEP or SoP (where relevant)						
COSTS:						
PV capital costs	0	0	9,855,619	8,140,723	15,984,489	14,269,593
PV operation and maintenance costs	0	1,501,338	335,255	362,544	423,239	450,528
PV other	0	45,592	45,592	45,592	78,941	78,941
Optimism bias adjustment	0	696,118	4,606,410	3,846,987	7,419,001	6,659,578
PV negative costs (e.g. sales)	0	0	0	0	0	0
PV contributions						
Total PV Costs £ excluding contributions	0	2,243,048	14,842,875	12,395,846	23,905,669	21,458,639
Total PV Costs £ taking contributions into account	0	2,243,048	14,842,875	12,395,846	23,905,669	21,458,639
BENEFITS:						
PV monetised flood damages	0	0	0	0	0	0
PV monetised flood damages avoided		0	0	0	0	0
PV monetised erosion damages	85,108,373	84,923,184	298,140	298,140	298,140	298,140
PV monetised erosion damages avoided (protected)		185,189	84,810,233	84,810,233	84,810,233	84,810,233
Total monetised PV damages £	85,108,373	84,923,184	298,140	298,140	298,140	298,140
Total monetised PV benefits £		185,189	84,810,233	84,810,233	84,810,233	84,810,233
PV damages (from scoring and weighting)						
PV damages avoided/benefits (from scoring and weighting)						
PV benefits from ecosystem services						
Total PV damages £	85,108,373	84,923,184	298,140	298,140	298,140	298,140
Total PV benefits £		185,189	84,810,233	84,810,233	84,810,233	84,810,233
DECISION-MAKING CRITERIA:						
excluding contributions						
<i>Based on total PV benefits (includes benefits from scoring and weighting and ecosystem services)</i>						
Net Present Value NPV		-2,057,859	69,967,358	72,414,387	60,904,564	63,351,593
Average benefit/cost ratio BCR		0.1	5.7	6.8	3.5	4.0
Incremental benefit/cost ratio IBCR			6.7	8.3	3.9	4.4
			Highest bcr	IBCR>1	IBCR>1	IBCR>1
<i>Based on monetised PV benefits (excludes benefits from scoring and weighting and ecosystem services)</i>						
Net Present Value NPV		-2,057,859	69,967,358	72,414,387	60,904,564	63,351,593
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Incremental benefit/cost ratio IBCR			6.7	8.3	3.9	4.4
			Highest bcr	IBCR>1	IBCR>1	IBCR>1
Best practicable environmental option (WFD)						
Brief description of options:						
Option 1	Do-nothing					
Option 2	Do Minimum					
Option 3	Option 1B					
Option 4	Option 1C					
Option 5	Option 3B					
Option 6	Option 3C					
Comments and assumptions:						