

Appraisal Summary Table – Strategic Options					
Project Name	Sandsend Coast Protection Scheme – Strategic Options				
Management Unit Description	<p>MU4CD: Sloping concrete revetment between beach and main coast road (~8m OD) protecting low fill/glacial till slope below road. Toe protection and slope stabilisation was contemporary with former railway.</p> <p>MU5: Sloping concrete revetment at the base of low-lying glacial till/fill slope below the A174 coast road, that were constructed at the time of the former railway. Short length of remnant timber revetment at eastern limit of unit, concrete surface now removed by marine erosion. Coastal slopes rise to an elevation of 30-40m OD to the east of East Row valley. Slopes traversed by A174 coast road. Steep coastal slopes formed in glacial till which were engineered at the time of the former railway, but have locally been subsequently modified for current road alignment. Slopes unstable and various drainage measures have been undertaken, although these are largely unsuccessful. Major slope stabilisation and drainage works undertaken over one section near Raithwaite Ravine after major deep-seated failure in the 1960's.</p> <p>MU6: Unprotected glacial till/fill embankment which carries A174 coast road over valley of Raithwaite Ravine. Coastal slopes modified by embankment construction at base of Raithwaite Ravine valley. Inland forms the steep-sided valley which bifurcates inland into valleys of Dunsley Beck and Newholm Beck. Road level above embankment ~ 25m OD, embankment thought to be constructed in 1923 using glacial till deposits. Becks are culverted through the base of the embankment.</p> <p>MU7A: no coastal defences (former coast protection contemporary with former railway, now removed by instability and marine erosion). Glacial till slopes increasing in elevation eastwards. Toe of coastal slopes are eroded at each high tide. Instability evident particularly in the east of the unit, west of unit marginally stable. Some remnant drainage (stone drains) from disused railway, partially removed by erosion on lower slopes. 'Pinch point' where A174 coast road is within few metres of unstable coastal slopes lies within this unit. Whitby Golf course located above coastal slopes.</p> <p>Key Problems:</p> <ul style="list-style-type: none"> • Instability of cut slopes inland of A174 coast road. • Outflanking of eastern end of concrete revetment. • Instability/erosion of slope directly above revetment. • Variable beach levels. • Residual life of revetment and gabion baskets. • Currently the embankment holds the A174 alignment to this point (MU6). Loss of embankment would result in major realignment or alternative structure across ravine (bridge/embankment) if road is to be maintained along this coastline. Location of a section of A174 coast road within a few metres of unstable slopes (MU7A). • Marine erosion at toe of coastal slopes promoting slope instability. • Health and safety issues related to cliff top and unstable slopes. 				
SMP2 Policy	<p>MU4CD: Policy Unit 22.2 Sandsend Village: Hold the Line Maintain both the assets associated with the village of Sandsend but also the overall important character of the area.</p> <p>MU5 & 6: Policy Unit 22.3 Coastal Road: Hold the Line (Short Term), Retreat or Realignment (Medium & Long Term) Unit needs to be treated as transition zone between hard defence of the village and the NAI of the cliffs along Uppgang Beach. Consideration must be given to re-routing the road.</p> <p>MU7A: Policy Unit 22.4 Uppgang Beach: No Active Intervention</p>				
Option	Option 1: Baseline (Do Nothing)	Option 2 (Do Minimum)	Option 3 (New Road)	Option 4 (Upgrade Minor Roads)	Option 5 (Retain A174 in current location)
Overview Description	Do Nothing: no further maintenance or capital works are carried out. Coastal slope will fail and collapse on to road, and continue to add to deterioration of revetment. Existing concrete revetment fails leading to erosion and loss of A174 road.	Revetment continues to be patched up on an annual basis at increasing expense, to prolong its residual life. Coastal slope will continue to undergo minor failures requiring clear up and temporary piecemeal stabilisation works.	A174 realigned between Dunsley Lane and Cliff Lane out of the 100 year erosion zone on to the top of the coastal slope requiring 1.2km section of new road. 200m section of revetment between Meadowfield and Dunsley Lane (East Row) would also require replacing. Patch repairs to the existing revetment would cease in Year 0, resulting in failure and onset of erosion to the highway.	The minor roads (farm roads) between Lythe and the A171 would be upgraded to 'A' class standard to provide an alternative route. 6.2km of roads would need to be upgraded.	Works would be carried out to the revetment and the coastal slope above the road in order to retain the road on its current alignment and reduce the maintenance burden. Works would also include extending the revetment eastwards across Raithwaite Ravine area and part of Golf Course to prevent outflanking of existing defences.
Technical Issues	Until road is lost there will be considerable H&S risks to the public using the road from minor failures of the coastal slope onto the road. Therefore Do Nothing includes for the costs of clearing the road after slips until the road is no longer passable.	The condition of the revetments is such that routine maintenance consists of emergency repairs to the revetment in response to partial collapses to the toe and upper slopes of the revetment. The frequency and extent of these patch repairs are increasing and so to the costs.	Significant changes in level along the proposed length, with a height difference between peaks and troughs in the region of 30m over relatively short distances. This would result in severe gradients of approximately 1:3 (33%) which would be inappropriate for the type of road required. Therefore major works such as cuttings and infill's through the existing ground will be required to provide suitable gradients.	Technically difficult – would basically require construction of a new A road on the alignment of the existing single track minor roads. Many issues including gradient, proximity of properties, overhead services.	The works would include the stabilisation of the upper coastal slope to reduce the risk of deep rooted slip failures, to improve safety for road users and to better manage slope drainage and discharge. The works to the revetment need to take account of ongoing fluctuations in beach level and also rate of erosion of soft bedrock which can become exposed. The works would include providing additional protection to MU6 and a designed end detail to prevent outflanking in MU7A.
Assumptions/Uncertainties	Road will be lost in Year 20.	It has been assumed that the revetment can only be patched up for another 5 years due to the increasing degradation of the assets and extent of emergency works required. The patch up works for the revetment will not delay the loss of the Road, as erosion in MU's 6 & 7 where the defences are virtually obsolete will	New road constructed in Year 19 – year prior to estimated year of road loss under Do Nothing	Road upgrade constructed in Year 19 – year prior to estimated year of road loss under Do Nothing	Works carried out in Year 1. Upper slope material removed in MU5 can be used to protect exposed embankment in MU6 (Raithwaite Ravine).

		result in the loss of the Road (at the pinch point and Raithwaite Ravine) in Year 20.															
Approaches to adaptation	None	None – effects of SLR may result in more frequent maintenance of the revetment being required.					Road will be outside of erosion zones			Road will be outside of erosion zones			Works designed to accommodate sea level rise				
Present Value Costs (£k)	£0					£2,480k			£43,280k			£21,568k			£13,960k		
Present Value Benefits (£k)	(Present Value Damages = £101,673k)					£184k (Present Value Damages = £101,489k)			£99,559k (Present Value Damages = £2,114k)			£38,425k (Present Value Damages = £63,248k)			£101,376k (Present Value Damages = £298k)		
Benefit-Cost Ratios						0.07			2.30			1.78			7.26		
Category	Description and Quantification of Impacts	Value of Impacts	Assumptions & Uncertainties	Description and Quantification of Impacts	Value of Impacts	Assumptions & Uncertainties	Description and Quantification of Impacts	Value of Impacts	Assumptions & Uncertainties	Description and Quantification of Impacts	Value of Impacts	Assumptions & Uncertainties	Description and Quantification of Impacts	Value of Impacts	Assumptions & Uncertainties		
Economic Impacts																	
Properties	1 property would be lost by Year 50, and additional 15 by year 100. In total 10 residential and 6 commercial properties would be at risk.	£111k	Based on SMP2 erosion lines	Property would become at risk after assets have failed, however the losses would be delayed by ~5 years compared to the Do Nothing.	£13k	Therefore some properties would no longer be at risk until after the end of the 100 year appraisal period.	Properties would continue to be protected as now.	£0k	200m section of revetment between Meadowfield and Dunsley Lane would need to be replaced to prevent loss of properties and protect tie in of new road at Dunsley Lane.	Properties would be at risk as under Do Nothing, however the loss of the properties would be delayed whilst the revetment was maintained until the upgrade of the minor roads was carried out.	£13k	Delay of 5 years on Do Nothing	Properties would continue to be protected as now.	£0k			
Emergency Costs	Emergency services (police and ambulance) will be forced to use longer route (22km diversion), resulting in longer response times. Therefore increased risk to life for patients.		Emergency services based in Whitby	Do Nothing impacts would be delayed by ~5 years.		However, A174 would still be lost as under the Do Nothing scenario in MUs 6 & 7 where the defences are virtually obsolete and therefore damages across the full A174 length (MUs 2-7) would occur as under Do Nothing.	Realigned route is 0.1km longer than existing A174 therefore no impact.			As Do Nothing, however slightly shorter diversion route of 13km.			No diversions required therefore no impact.				
Infrastructure	2583m BT, 1360m Transco services, 1503m Yorkshire Water, and 493m of Northern Electric services.	£828k		Do Nothing impacts would be delayed by ~5 years.	£742k		Existing road will be lost however a replacement route will be created. Services would need to be relocated into new section of road.	£687k		Existing road will be lost however a replacement route will be created. Services would need to be relocated.	£742k	Unlikely to use the road upgrade route, more likely to create new route across the agricultural land at top of coastal slope.	No impacts as existing road will be retained.	£205k			
Transport	1150m of A174 main road would be lost, resulting in major traffic diversions of 22km.	£100,731k	Based on permanent 22km diversion.	As Do Nothing	£100,731k	A174 would be lost as under the Do Nothing scenario in MUs 6 & 7 where the defences are virtually obsolete and therefore damages across the full A174 length (MUs 2-7) would occur as under Do Nothing.	Limited permanent impacts due to minor difference in length of new road. However periodic temporary road closures to deal with minor failures of the coastal slope	£1,424k		Upgrade route is shorter than the existing A road diversion route (13km rather than 22km), however it is still a significant increase in distance compared to the current A174. Additional traffic diverted onto other roads would increase congestion on	£62,491k		No permanent impacts as existing road will be retained. However periodic temporary road closures to deal with minor failures of the coastal slope until new scheme is complete.	£92k	Assumes disruption in first year until scheme is complete		

