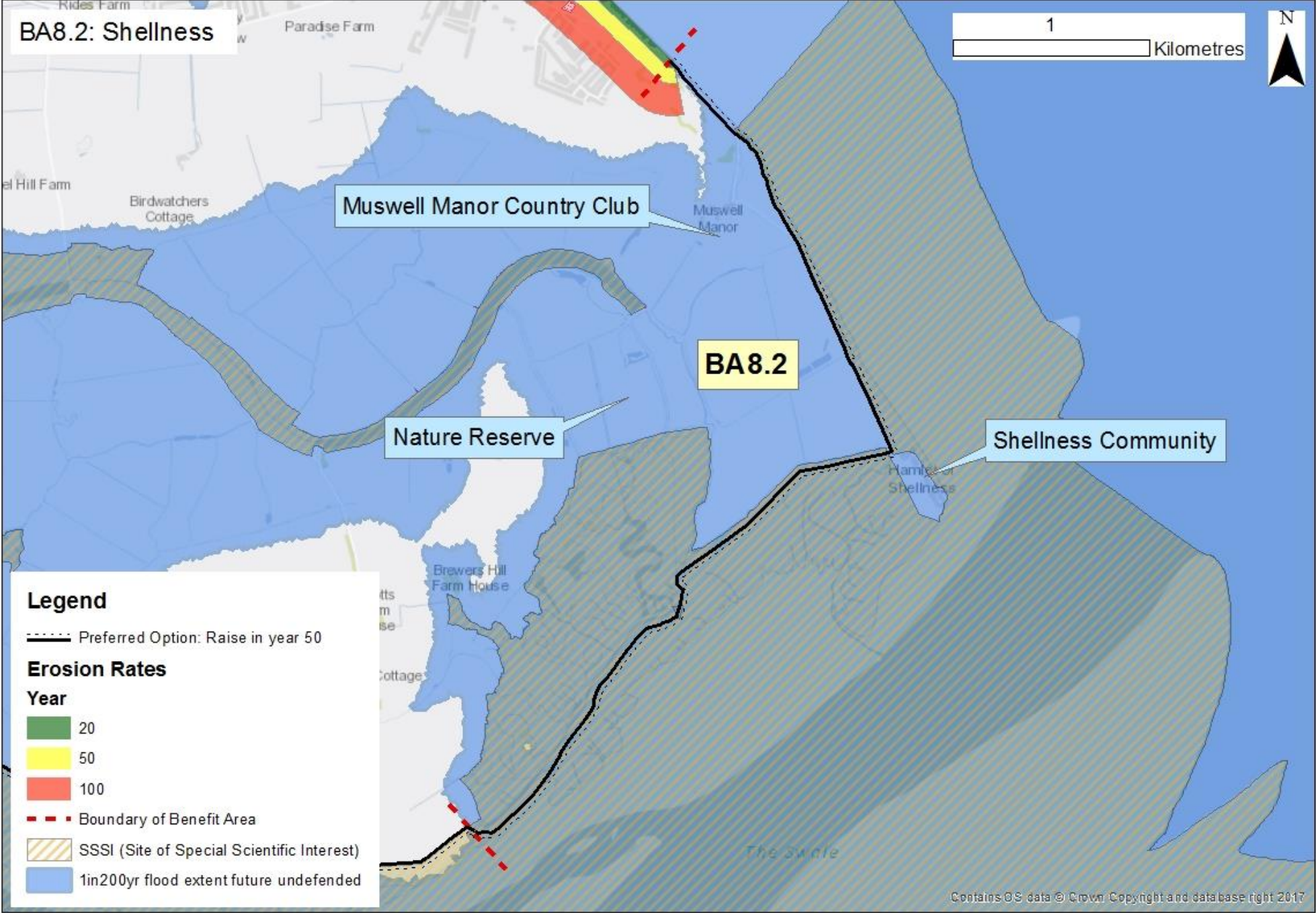


Benefit Area Name	8 - South Sheppey
Benefit Unit Name	(Site 30)
Frontage Length	6.9 km
Defence Structure Type	Embankments, walls, beach recharge, groynes
Min Standard of Protection (AEP%)	0.04
Residual Life (years)	25

	0-20 years	20-50 years	50-100 years
SMP Policy	MR	MR	MR
Aiming to comply with policy	No- suggest alternative considerations		
Comment	HTL around Shellness as there could be wider impacts on the mouth of the Estuary including increased wave exposure.		



Do Nothing Assets at Risk (Flooding)				
	50% AEP (undefended)		0.5% AEP (undefended)	
	Current Year	100 year	Current Year	100 Years
Residential	2	76	85	97
Commercial & Industrial	2	32	32	33
Agricultural (Ha)	584	636	645	682
Key Infrastructure	None	None	None	None
Social and Environmental Considerations	The Swale SPA, SSSI and Nature Reserve (seaward and landward), Muswell Manor Country Club, Nature Reserve	The Swale SPA, SSSI and Nature Reserve (seaward and landward), Muswell Manor Country Club, Nature Reserve, Shellness Community	The Swale SPA, SSSI and Nature Reserve (seaward and landward), Muswell Manor Country Club, Nature Reserve, Shellness Community	The Swale SPA, SSSI and Nature Reserve (seaward and landward), Muswell Manor Country Club, Nature Reserve, Shellness Community

Long List to Short List			
Potential Measures			
	Measures	Selected	Reasoning
Structural	Construct new embankment	Y	Take forward- embankments currently present
	Maintain embankment	Y	Take forward- embankments currently present
	Raise embankment (sustain)	Y	Take forward- embankments currently present
	Raise embankment (upgrade)	Y	Take forward- embankments currently present
	Construct new wall	Y	Take forward - walls currently present
	Maintain wall	Y	Take forward - walls currently present
	Raise wall (sustain)	Y	Take forward - walls currently present
	Raise wall (upgrade)	Y	Take forward - walls currently present
	Maintain rock revetment	N	Exclude - no rock revetment currently present
	Construct rock revetment	N	Exclude - limited benefits in constructing a revetment where existing defences are currently present and will not significantly reduce flood risk. Also potentially environmentally damaging in SPA habitat
	Install demountable defences	N	Exclude - relatively costly option which is not the most efficient use of FDGiA funding compared to sustaining existing defences. It would require significant man resources to implement during a flood event. This would need to be discussed with Asset Owners at OBC stage.
	Install temporary defences	N	Exclude - significant resources to implement and potentially not the most efficient use of FDGiA funding compared to sustaining existing defences. This would need to be discussed with asset owners at OBC stage.
	Beach recharge (sand or shingle)	Y	Take forward - beach currently present
	Construct rock groynes	N	Exclude - environmentally damaging to the SPA designated foreshore. Will have a significantly larger footprint than timber groynes.
	Maintain rock groynes	N	Exclude - no rock groynes currently present
	Construct timber structures	Y	Take forward - timber groynes currently present
	Maintain timber structures	Y	Take forward - timber groynes currently present
	Construct a tidal barrier	N	Exclude- likely to have significant environmental impacts, including on water quality (WFD), change in sedimentation in Estuary with wider impacts (environment, dredging, maintenance,
Non-Structural	Implement monitoring	N	Not suitable as a single measure to implement the SMP policy. May be combined with structural measures
	Implement flood warning system	N	Not suitable as a single measure to implement the SMP policy. May be combined with structural measures
	Land use planning	N	Not suitable as a single measure to implement the SMP policy. May be combined with structural measures
	Adaptation measures	N	Not suitable as a single measure to implement the SMP policy. May be combined with structural measures
	Development control	N	Not suitable as a single measure to implement the SMP policy. May be combined with structural measures
	Emergency response plans	N	Not suitable as a single measure to implement the SMP policy. May be combined with structural measures
	Monitoring for health and safety only	N	Not suitable as a single measure to implement the SMP policy.

Long List of Options					
	a) Do nothing	b) Ongoing maintenance of embankments	c) Maintain SOP (capital) embankments	d) Raise (sustain SOP) embankments	e) Raise (upgrade SOP) embankments
To what extent does the option meet the objectives?					
1- Reduce Flood Risk	N	Y	Y	Y	Y
2 - Natura 2000 sites	N	N	N	N	N
3- Reduce maintenance	N	N	N	N	N
4 - WFD	N	Y	Y	Y	Y
5 - Local Plans	-	-	-	-	-
Comment and decision on whether taken forward to shortlist	Y = baseline for economics.	Y= SOP and residual life good therefore maintenance could be considered.	N= SOP and residual life good therefore capital maintenance not required.	Y = SOP and residual life good but variable, therefore can increase SOP with sea level rise.	N - no significant assets to protect.

Long List of Options					
	f) Construct new setback embankments at identified managed realignment sites. Maintain SOP of existing embankments and walls along rest of frontage.	g) Construct new setback embankments at identified managed realignment sites. Raise (sustain SOP) existing embankments and walls along rest of frontage.	h) Construct new setback embankments at identified managed realignment sites. Raise (upgrade SOP) existing embankments and walls along rest of frontage.	i) Maintain embankments and walls until year 20. Then construct new setback embankments at identified managed realignment sites. Maintain SOP of existing embankments and walls along rest of frontage.	j) Maintain embankments and walls until year 20. The construct new setback embankments at identified managed realignment sites. Raise (sustain SOP) existing embankments and walls along rest of frontage.
To what extent does the option meet the objectives?					
1- Reduce Flood Risk	Y	Y	Y	Y	Y
2 - Natura 2000 sites	Y	Y	Y	Y	Y
3- Reduce maintenance	TBC*	TBC*	TBC*	TBC*	TBC*
4 - WFD	TBC	TBC	TBC	TBC	TBC
5 - Local Plans	-	-	-	-	-
Comment and decision on whether taken forward to shortlist	N = RL high therefore not economically viable to realign straight away.	N = RL high therefore not economically viable to realign straight away.	N = RL high therefore not economically viable to realign straight away.	N = RL high therefore not economically viable to realign straight away.	N = RL high therefore not economically viable to realign straight away.

Long List of Options				
	k) Maintain embankments and walls until year 20. Then construct new setback embankments at identified managed realignment sites. Raise (upgrade SOP) existing embankments and walls along rest of frontage.	l) Maintain embankments and walls until year 50. Then construct new setback embankments at identified managed realignment sites. Maintain SOP of existing embankments and walls along rest of frontage.	m) Maintain embankments and walls until year 50. The construct new setback embankments at identified managed realignment sites. Raise (sustain SOP) existing embankments and walls along rest of frontage.	n) Maintain embankments and walls until year 50. Then construct new setback embankments at identified managed realignment sites. Raise (upgrade SOP) existing embankments and walls along rest of frontage.
To what extent does the option meet the objectives?				
1- Reduce Flood Risk	Y	Y	Y	Y
2 - Natura 2000 sites	Y	Y	Y	Y
3- Reduce maintenance	TBC*	TBC*	TBC*	TBC*
4 - WFD	TBC	TBC	TBC	TBC
5 - Local Plans	-	-	-	-
Comment and decision on whether taken forward to shortlist	N= as above	N = with the maintain option there may still be overtopping of the defences after year 50, having an impact on the designated area.	Y = Take forwards sustain , and MR in 50 years to make aware the MR could be a possible option in the future. Compensatory habitat would need to be found for designated habitat.	N = No significant assets to warrant upgrade.

\* Maintenance requirements currently unknown, as will depend on the MR sites taken forwards



Short List of Options	
a)	Do nothing
b)	Ongoing maintenance of embankments
c)	Raise (sustain) embankments
d)	Raise (upgrade SOP) embankments
e)	Maintain embankments and walls until year 50. The construct new setback embankments at identified managed realignment sites. Raise (sustain SOP) existing embankments and walls along rest of frontage.

Assessment of Short List					
Option	a) Do nothing	b) Ongoing maintenance of embankments	c) Raise (sustain) embankments	d) Raise (upgrade SOP) embankments	e) Maintain embankments and walls until year 50. The construct new setback embankments at identified managed realignment sites. Raise (sustain SOP) existing embankments and walls along rest of frontage. MR site at Swale Nature Reserve (Site 30)
Description	Used as an economic baseline to compare the other options against.	Patch and repair of the current defences	Capital works are undertaken to improve the current defences	Capital works are undertaken to improve the current defences	Maintain defences for first 50 years and then develop MR site. Capital works undertaken to improve the remaining defences.
Technical Issue	Defences have 25 years residual life. The site is internationally designated (freshwater and intertidal) so compensatory habitat legally required.	Defences have 25 years residual life. The site is internationally designated (freshwater and intertidal) so compensatory habitat legally required.	Defences have 25 years residual life. The site is internationally designated (freshwater and intertidal) so compensatory habitat legally required.	Defences have 25 years residual life. The site is internationally designated (freshwater and intertidal) so compensatory habitat legally required.	Current defences have 25 years residual life. The site is internationally designated (freshwater and intertidal) so compensatory habitat legally required. Potentially increase in defence length due to development of new setback defences. Based on current sea levels the MR site would create 146ha of saltmarsh and 9ha of mudflat. With 100 years sea level rise there could be 26ha of saltmarsh and 142ha of mudflat.
Assumptions/ Uncertainties	Assumes that all management is ceased.	The crest height of the defences remains the same as currently in place i.e. is not increased. Over time this will lead to a reduction in the Standard of Protection (SOP) as the sea level rises.	The SOP provided by the defences is increased to the required standard over time. This option has a phased approach so the defences are raised in line with sea level rise at two phases i.e. capital works are undertaken in epoch 1 and again in year 50. This option will maintain the required SOP provided by the defences by keeping pace with sea level rise.	The crest height and SOP provided by the defences is increased. The crest heights will be raised to the level required to provide the SOP in 100 years time, i.e. the SOP will be greater than required during the first epoch, but this will decline over time with sea level rise but will still provide at least the SOP that the defence was upgraded to.	MR site to provide at least 1% AEP SOP to protect property etc. directly behind. The SOP provided by the remaining defences is increased to the required standard over time. This option has a phased approach so the defences are raised in line with sea level rise at two phases i.e. capital works are undertaken in epoch 1 and again in year 50. This will maintain the required SOP provided by the defences by keeping pace with sea level rise.
SOP Provided (% AEP)	>50%	4%	1%	1%	1%
Value of Economics					
PV Capital Costs	£ -	£ -	£ 5,698,040	£ 7,783,369	£ 6,844,166
PV Maintenance Costs	£ -	£ 284,475	£ 271,392	£ 277,104	£ 285,317
PV Other Costs	£ -	£ -	£ 474,611	£ 596,929	£ 542,182
Total Cost (including Optimism Bias) (PV)	£ -	£ 455,161	£ 10,310,469	£ 13,851,844	£ 12,274,663
Value of Benefits	£ -	£ 1,680,644	£ 1,966,065	£ 1,966,696	£ 1,863,371
Benefit Cost Ratio (BCR)	0.0	3.7	0.2	0.1	0.2
PF Score	0%	34%	2%	1%	73%
Further funding required to achieve 100% PF Score	£ -	£ 298,183	£ 10,139,401	£ 13,680,741	£ 3,322,095
Flood/ erosion impacts					

Number of Residential Properties at risk under 0.1% AEP	97	97	78	78	78
Number of Commercial properties at risk under 0.1% AEP	33	33	1	1	1
PV Value of Properties (Total including AAD, write-offs, vehicle damages and Emergency Services)	£13,821,554	£12,453,957	£12,196,619	£12,196,619.21	£12,196,619.21
Critical Infrastructure	No assets at risk	No assets at risk	No assets at risk	No assets at risk	No assets at risk
PV Value of Impacts on road and rail	-	-	-	-	-
PV Value of Tourism and Recreation Impacts	£16,251 Harty Marshes	£6,107 Harty Marshes	£51 Harty Marshes	-	£1,403 Harty Marshes
PV Value of Agriculture Impacts	£345,447 Worst case scenario 63ha Grade 3 agricultural land flooded and 564ha Grade 4 flooded 75ha Grade 5 flooded	£42,543 Worst case scenario 59ha Grade 3 agricultural land flooded and 563ha Grade 4 flooded 75ha Grade 5 flooded	£20,517 Worst case scenario 101ha Grade 4 agricultural land flooded and 72ha Grade 5 flooded	£19,937 Worst case scenario 1ha Grade 4 agricultural land flooded and 45ha Grade 5 flooded	£23,695 Worst case scenario 101ha Grade 4 agricultural land flooded and 72ha Grade 5 flooded
Stakeholders Feedback					
Statutory Stakeholders/ SEG	Would prefer maintenance/ improvement of the defences to protect against overtopping from sea level rise.	HTL is a preferred option to protect the important high quality designated habitat	HTL is a preferred option to protect the important high quality designated habitat	HTL is a preferred option to protect the important high quality designated habitat	The south of Sheppey is one of the best areas in the region for breeding waders. Therefore MR should be undertaken over designated sites.
Landowners	Landowners would prefer the defences to be raised to protect against sea level rise	Landowners in the area would like the defences to be continued to be maintained/ raised to allow the area to be farmed.	Landowners in the area would like the defences to be continued to be maintained/ raised to allow the area to be farmed.	Landowners in the area would like the defences to be continued to be maintained/ raised to allow the area to be farmed.	Landowners are not keen on MR in the area. Also the area proposed is already a freshwater compensation site for development in Rushenden
Technical Feasibility					
Site Specific	n/a	n/a	n/a	n/a	Site not flooded during the modelled Spring tide. Potentially 1,725m increase in defence length due to development of new setback defences. MR site would create 146ha of saltmarsh and 9ha of mudflat. With 100 years sea level rise there could be 26ha of saltmarsh and 142ha of mudflat.
Strategy Wide	n/a	n/a	n/a	n/a	Sites are completely flooded during extreme events. An increase in the flood risk in the central Swale during extreme events is however observed when this sites are breached. This effect is not desirable.

WFD (Water Framework Directive)					
Compliance assessment outcome	2 Some return to natural processes but uncontrolled	1 Heavily Modified Water Body (HMWB) maintained	1 Heavily Modified Water Body (HMWB) maintained	1 Heavily Modified Water Body (HMWB) maintained	4 Return to more natural processes
HRA (Habitats Regulation Assessment)					
Impact on SPA/ Ramsar qualifying features	1  There are potential significant effects on the Swale SPA and constituent qualifying features due to coastal squeeze until the defences fail in year 25. Coastal squeeze will lead to a loss of mudflat and small areas of saltmarsh habitat. When defences fail there is likely to be inundation of the designated freshwater habitats. However this may allow intertidal habitats to develop.	1  There are potential significant effects on the Swale SPA and constituent qualifying features due to coastal squeeze. Coastal squeeze will lead to a loss of mudflat and small areas of saltmarsh habitat. However with sea level rise the risk of overtopping will increase. This will significantly impact on the freshwater habitat, but may allow intertidal habitats to develop behind the defences.	1  There are potential significant effects on the intertidal Swale SPA and constituent qualifying features due to coastal squeeze. Coastal squeeze will lead to a loss of mudflat and small areas of saltmarsh habitat.	1  There are potential significant effects on the intertidal Swale SPA and constituent qualifying features due to coastal squeeze. Coastal squeeze will lead to a loss of mudflat and small areas of saltmarsh habitat.	2  There may be potential significant effects on the intertidal Swale SPA and its constituent qualifying features, due to coastal squeeze, especially until year 50. Following the creation of the MR site there will also be intrusion of works into Designated freshwater areas. Creation of the Managed Realignment site will impact on up to 163 ha of designated freshwater habitats, and those qualifying feature species that use them. These include good populations of breeding and overwintering avocet, lapwing, and overwintering bar-tailed godwit. It is likely that existing mudflat, and small areas of saltmarsh in front of the existing defences would still be lost despite the Managed Realignment. The newly created habitats within the MR site are not likely to develop to the same quality as those habitats lost.
Impacts on freshwater habitats	1  Yes. Compensatory habitat would be required in advance of failure of the defences to compensate for the loss of freshwater grazing marsh.	1  Yes. Compensatory habitat would be required in advance of regular overtopping of the defences to compensate for the gradual loss of freshwater grazing marsh.	3  No, defences improved so the risk of overtopping reduced.	3  No, defences improved so the risk of overtopping reduced.	1  Yes, compensatory freshwater habitat will be required to compensate for the loss of freshwater grazing marsh and associated habitats with the development of the MR site.
Impacts on intertidal habitats	2  Yes, until defences are predicted to fail (from year 25). Development of tidal habitats once defences fail will begin to mitigate for coastal squeeze, although this is uncontrolled and the quality of habitat that develops is unknown.	2  Yes, the maintenance of the defences will lead to coastal squeeze over time. However with the increased risk of overtopping intertidal habitat may start to develop behind the defences but this is uncontrolled.	1  Yes because the defences are improved there is the potential for coastal squeeze and the loss of designated intertidal habitat.	1  Yes because the defences are improved there is the potential for coastal squeeze and the loss of designated intertidal habitat.	5  Following the creation of the MR site intertidal habitat will be created, which will help mitigate against the effects of coastal squeeze.
Habitat Connectivity	2  Slight negative impact on connectivity of saltmarsh/mudflat habitats due to loss of habitat from coastal squeeze before defences fail. Loss of freshwater grazing marsh habitat along the Swale once defences fail, although estuarine habitat connectivity should begin to open up again.	2  Slight negative impact on connectivity of saltmarsh/mudflat habitats due to loss of habitat from coastal squeeze. However with increased risk of overtopping due to sea level rise there will also be a loss of freshwater grazing marsh habitat along the Swale.	2  Negative impact in connectivity due to loss of habitat from coastal squeeze.	2  Negative impact in connectivity due to loss of habitat from coastal squeeze.	4  Major benefits to habitat connectivity with the creation of new intertidal habitat, although compensatory habitat will be required for the loss of the designated freshwater habitat.

SEA (Strategic Environmental Assessment)					
Historic Environment	1 Muswell Manor at risk once the defences fail in year 25.	2 Muswell Manor at risk overtime due to increased risk of overtopping of the defences with sea level rise	4 Heritage assets at reduced risk from flooding	5 Heritage assets at reduced risk from flooding immediately	3 Muswell Manor at risk overtime due to increased risk of overtopping of the defences with sea level rise until year 50 when the defences will be improved.
Effects on population	1 Potential loss of homes, livelihoods and amenity once the defences fail in year 25	2 Potential gradual loss of homes, livelihoods and amenity overtime with sea level rise	5 Homes, livelihoods and amenity at reduced risk	5 Homes, livelihoods and amenity at reduced risk	5 Homes, livelihoods and amenity at risk overtime due to sea level rise. Until the defences are improved in year 50.
Impact on plans/ programmes	3 Benefit area does not coincide with proposed development sites	3 Benefit area does not coincide with proposed development sites	3 Benefit area does not coincide with proposed development sites	3 Benefit area does not coincide with proposed development sites	3 Benefit area does not coincide with proposed development sites
Freshwater Biodiversity	1 Loss of fresh water habitat SSSI and SPA and Ramsar once the defences fail in year 25. This is important overwintering habitat, therefore impact on freshwater species. Freshwater pools and some areas of woodland provide additional variety and complement the estuarine habitats.	2 Loss of fresh water habitat SSSI and SPA and Ramsar overtime due to sea level rise. This is important overwintering habitat, therefore impact on freshwater species. Freshwater pools and some areas of woodland provide additional variety and complement the estuarine habitats. However this gradual loss of habitat may allow the sustainable roll-back of the habitat.	4 Freshwater assets at reduced risk from saline intrusion	5 Freshwater assets at reduced risk from saline intrusion immediately	1 Loss of fresh water habitat SSSI, SPA and Ramsar through the development of the MR site. This is important overwintering habitat, and therefore impacts on freshwater species. Freshwater pools have GCN potential.
Saline Biodiversity	3 Impacts to SPA from coastal squeeze until the defences fail in year 25. After this there could be the uncontrolled development of intertidal habitat, but the extent and quality of this is unknown.	2 Impacts to SPA from coastal squeeze. Although with sea level rise there may be some overtopping of the defences, which could allow the development of intertidal habitats behind the defences, but this is uncontrolled.	1 Impacts to SPA from coastal squeeze	1 Impacts to SPA from coastal squeeze	4 Impacts to SPA from coastal squeeze over the next 50 years, until MR site is developed which will lead to the creation of mitigatory habitat.
Soil	2 Degradation of agricultural land following the failure of the defences in year 25.	3 Risk of saline intrusion overtime with sea level rise, which will degrade agricultural land	4 Reduced risk of degradation to agricultural land	5 Reduced risk of degradation to agricultural land immediately	1 Potential for saline intrusion, and resultant degradation of agricultural land overtime for the first 50 years. After year 50 there will be a loss of agricultural land to managed realignment, but in the areas where HTL the defences will be improved reducing the risk of overtopping.
Groundwater	3 No impact predicted	3 No impact predicted	3 No impact predicted	3 No impact predicted	3 No impact predicted
Landscape (visual impact)	4 Reverting to natural processes once the defences fail in year 25. Positive/negative effects depending on view and visual receptors	3 Gradual change but reverting to natural processes. Positive/negative effects depending on view and visual receptors	2 Impacts depending on height of defences	2 Impacts depending on height of defences	1 Significant landscape change from managed realignment. Positive/negative effects depending on view and visual receptors



Carbon Storage	2 Some loss of carbon storage from loss of saltmarsh until the defences fail. After this there may be creation of new intertidal habitat but the extent and quality of this is unknown.	1 Some loss of carbon storage from gradual loss of saltmarsh. Carbon cost from construction	1 Some loss of carbon storage from gradual loss of saltmarsh. Carbon cost from construction	1 Some loss of carbon storage from gradual loss of saltmarsh. Carbon cost from construction	2 Creation of new intertidal habitat from year 50 but increased carbon cost from construction
Ecosystem Services					
Qualitative Score from Ecosystem Services Assessment	-49	-33	-5	-8	32
Comments	Major degradation in many ES (e.g. food, water regulation, natural hazard regulation, erosion regulation, cultural heritage, recreation and tourism and conservation habitat) outweigh limited enhancement opportunities (e.g. aesthetic value and fishery habitat)	Moderate gradual degradation in many ES (e.g. food, water regulation, natural hazard regulation, erosion regulation and recreation and tourism) outweigh limited enhancement opportunities (e.g. aesthetic value and fishery habitat)	Balance of opportunities for enhancing some ES (e.g. natural hazard regulation and erosion regulation) with risks of degrading other ES (e.g. aesthetic value, conservation habitat and fisheries habitat)	Degradation in some ES (e.g. aesthetic value, conservation habitat and fishery habitat) outweigh the enhancement opportunities in some ES (e.g. natural hazard regulation and erosion regulation)	Enhancements in many ES (e.g. climate regulation, water regulation, natural hazard regulation, erosion regulation, aesthetic value and fishery habitat) outweigh the degradation risk in some ES (e.g. food and freshwater)
To what extent does the option meet the objectives?					
1- Reduce Flood Risk	N	Y	Y	Y	Y
2 - Natura 2000 sites	N	N	N	N	N
3- Reduce maintenance	Y	N	Y	Y	Y
4 - WFD	N	N	N	N	Y
5 - Local Plans	Y	Y	Y	Y	Y

Environmental Scores					
100 = best option, 0 = worst option					
Option	a) Do nothing	b) Ongoing maintenance of embankments	c) Raise (sustain) embankments	d) Raise (upgrade SOP) embankments	e) Maintain embankments and walls until year 50. The construct new setback embankments at identified managed realignment sites. Raise (sustain SOP) existing embankments and walls along rest of frontage. MR site at Swale Nature Reserve (Site 30)
WFD (Water Framework Directive)					
Compliance assessment outcome	25	0	0	0	75
HRA (Habitats Regulation Assessment)					
Impact on SPA/ Ramsar qualifying features	0	0	0	0	25
Impacts on freshwater habitats	0	0	50	50	0
Impacts on intertidal habitats	25	25	0	0	100
Habitat Connectivity	25	25	25	25	75
SEA (Strategic Environmental Assessment)					
Historic Environment	0	25	75	100	50
Effects on population	0	25	100	100	100
Impact on plans/ programmes	50	50	50	50	50
Freshwater Biodiversity	0	25	75	100	0
Saline Biodiversity	50	25	0	0	75
Soil	25	50	75	100	0
Groundwater	50	50	50	50	50
Landscape (visual impact)	75	50	25	25	0
Carbon Storage	25	0	0	0	25
Total	350	350	525	600	625

Summary of Results					
Option	a) Do nothing	b) Ongoing maintenance of embankments	c) Raise (sustain) embankments	d) Raise (upgrade SOP) embankments	e) Maintain embankments and walls until year 50. The construct new setback embankments at identified managed realignment sites. Raise (sustain SOP) existing embankments and walls along rest of frontage. MR site at Swale Nature Reserve (Site 30)
Costs	£ -	£ 455,161	£ 10,310,469	£ 13,851,844	£ 12,274,663
Benefits	£ -	£ 1,680,644	£ 1,966,065	£ 1,966,696	£ 1,863,371
NPV	£ -	£ 1,225,483	-£ 8,344,404	-£ 11,885,148	-£ 10,411,292
BCR	0.0	3.7	0.2	0.1	0.2
Environmental Scoring	350	350	525	600	625

Preferred Option Decision Making		
DLO	Leading Option at DLO Stage	Justification for Leading Option
DLO1 - Economic Assessment	b) Ongoing maintenance of embankments.	This option has the highest BCR (only option with BCR greater than one). However the option is the lowest ranked environmentally and further environmental mitigation would be required.
DLO2 - Economic Sensitivities		
DLO3 - Review of Compensatory Intertidal Habitat Requirements		
DLO4 - Review of Compensatory Freshwater Habitat Requirements	Maintain embankments and upgrade SoP with sea level rise in year 50.	The cost to compensate the freshwater habitat at risk of overtopping is greater than the cost to maintain the defences in line with sea level rise.
DLO5 - Modelling of Leading Options		
DLO6 - Consultation Phase		

Preferred Option Name
Maintain embankments and upgrade SOP with sea level rise in year 50.

Preferred Option
Maintenance (with capital works) of the current defences, and raise in year 50, to maintain a minimum SoP of 4%AEP with sea level rise.

Justification
<p>This option is the only option with BCR greater than one and a positive NPV score. However the option is the lowest ranked environmentally and further environmental mitigation would be required. The option is required as part of the legal obligations to cause no net loss of the designated freshwater habitat. The current defences have a 25-year residual life. Following this, the cost to compensate the large area of freshwater habitat is much greater than the cost to maintain the defences with sea level rise. Therefore, it is more cost-effective to maintain the defences and raise with sea level rise. The defences are required to be raised with sea level rise as otherwise the frequency of inundation to the freshwater habitat would increase with sea level rise and compensation for this would be required in year 50.</p>

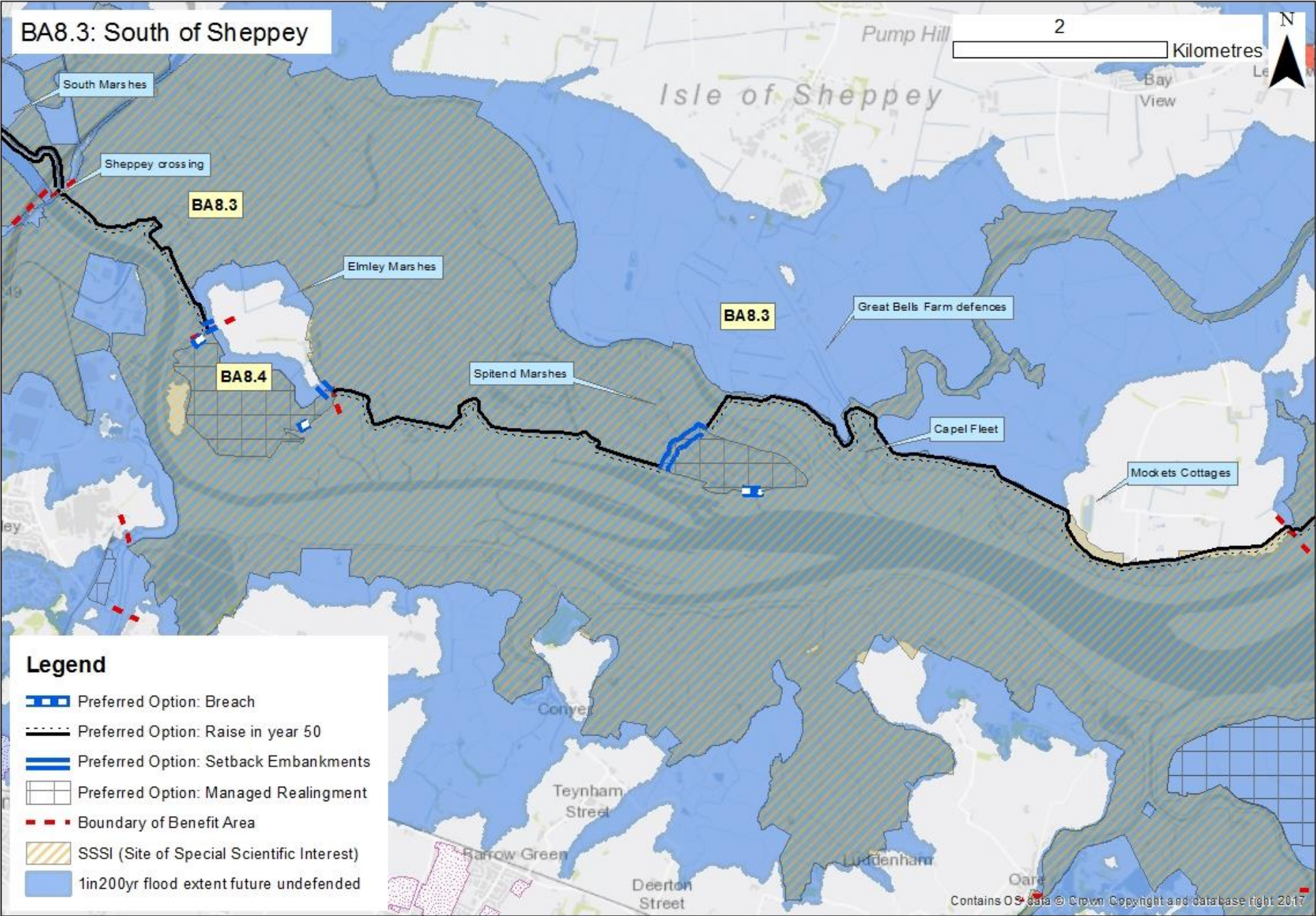
Preferred Option Costs											
<table><tr><th>Cost</th><th>Benefits</th><th>BCR</th><th>PF Score</th></tr><tr><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td></tr></table>				Cost	Benefits	BCR	PF Score	N/A	N/A	N/A	N/A
Cost	Benefits	BCR	PF Score								
N/A	N/A	N/A	N/A								

Impacts on freshwater designated habitat					
Ramsar and SPA habitat at risk from Year 24. Cost effectiveness analysis shows preferred management approach: Maintain defences and raise crest level in line with sea level rise to maintain current standard of protection.					
<table><tr><th>Cost of providing compensation for impacts</th><th>Cost of holding the line with SLR</th></tr><tr><td>£ 52,210,441</td><td>£ 28,048,344</td></tr></table>	Cost of providing compensation for impacts	Cost of holding the line with SLR	£ 52,210,441	£ 28,048,344	
Cost of providing compensation for impacts	Cost of holding the line with SLR				
£ 52,210,441	£ 28,048,344				



Benefit Area Name	8 - South Sheppey
Benefit Unit Name	8.3 - Sayes Court to Kingsferry Bridge (excluding Elmley Island) - MR site at Elmley Marshes (west) (Site 32)
Frontage Length	15.8 km
Defence Structure Type	Embankments
Min Standard of Protection (AEP%)	6%
Residual Life (years)	20

	0-20 years	20-50 years	50-100 years
SMP Policy (covers two SMP units)	MR	MR	MR
	HTL	MR with localised HTL	MR
Aiming to comply with policy	No- suggest alternative considerations		
Comment	MR/NAI for all epochs (rather than simply MR). MR may be difficult to achieve while complying with Habitats Directive so HTL should be considered.		



Do Nothing Assets at Risk (Flooding)				
	50% AEP (undefended)		0.5% AEP (undefended)	
	Current Year	100 year	Current Year	100 Years
Residential	3	3	3	3
Commercial & Industrial	10	10	10	11
Agricultural (Ha)	2741.7	2868	2891.8	2962.6
Key Infrastructure	Windmill Creek Historic Landfill (inert, industrial, household)	Windmill Creek Historic Landfill (inert, industrial, household)	Windmill Creek Historic Landfill (inert, industrial, household)	Windmill Creek Historic Landfill (inert, industrial, household)
Social and Environmental Considerations	The Swale SPA, SSSI, Elmley Nature Reserve (seaward and landward), Capel Fleet, Spitend Marshes, Great Bells Farm	The Swale SPA, SSSI, Elmley Nature Reserve (seaward and landward), Capel Fleet, Spitend Marshes, Great Bells Farm	The Swale SPA, SSSI, Elmley Nature Reserve (seaward and landward), Capel Fleet, Spitend Marshes, Great Bells Farm	The Swale SPA, SSSI, Elmley Nature Reserve (seaward and landward), Capel Fleet, Spitend Marshes, Great Bells Farm



Long List to Short List			
Potential Measures			
	Measures	Selected	Reasoning
Structural	Construct new embankment	Y	Take forward- embankments currently present
	Maintain embankment	Y	Take forward- embankments currently present
	Raise embankment (sustain)	Y	Take forward- embankments currently present
	Raise embankment (upgrade)	Y	Take forward- embankments currently present
	Construct new wall	N	potentially environmentally damaging in SPA habitat
	Maintain wall	N	Exclude - no walls currently present
	Raise wall (sustain)	N	Exclude - no walls currently present
	Raise wall (upgrade)	N	Exclude - no walls currently present
	Maintain rock revetment	N	Exclude - no rock revetment currently present
	Construct rock revetment	N	Exclude - limited benefits in constructing a revetment where embankments are currently present and will not significantly reduce flood risk. Also potentially environmentally damaging in
	Install demountable defences	N	Exclude - relatively costly option which is not the most efficient use of FDGiA funding compared to sustaining existing defences. It would require significant man resources to implement during
	Install temporary defences	N	Exclude - no significant assets at risk to warrant installation of temporary defences (significant resources to implement)
	Beach recharge (sand or shingle)	N	Exclude - not appropriate for this location
	Construct rock groynes	N	Exclude - not appropriate for this location
	Maintain rock groynes	N	Exclude - not appropriate for this location
	Construct timber structures	N	Exclude - not appropriate for this location
	Maintain timber structures	N	Exclude - not appropriate for this location
	Construct a tidal barrier	N	Exclude- likely to have significant environmental impacts, including on water quality (WFD), change in sedimentation in Estuary with wider impacts (environment, dredging, maintenance, navigation etc.). In addition likely to have significant costs.
Non-Structural	Implement monitoring	N	Not suitable as a single measure to implement the SMP policy. May be combined with structural measures
	Implement flood warning system	N	Not suitable as a single measure to implement the SMP policy. May be combined with structural measures
	Land use planning	N	Not suitable as a single measure to implement the SMP policy. May be combined with structural measures
	Adaptation measures	N	Not suitable as a single measure to implement the SMP policy. May be combined with structural measures
	Development control	N	Not suitable as a single measure to implement the SMP policy. May be combined with structural measures
	Emergency response plans	N	Not suitable as a single measure to implement the SMP policy. May be combined with structural measures
	Monitoring for health and safety	N	Not suitable as a single measure to implement the SMP policy.

Long List of Options					
	a) Do nothing	b) Ongoing maintenance of embankments and walls.	c) Maintain SOP (capital) embankments and walls. NAI at Isle of Harty.	d) Raise (sustain SOP) embankments and walls. NAI at Isle of Harty.	e) Raise (upgrade SOP) embankments and walls. NAI at Isle of Harty.
To what extent does the option meet the objectives?					
1- Reduce Flood Risk	N	N	Y	Y	Y
2 - Natura 2000 sites	N	N	N	N	N
3- Reduce maintenance	N	N	N	N	N
4 - WFD	N	Y	Y	Y	Y
5 - Local Plans	-	-	-	-	-
Comment and decision on whether taken forward to shortlist	Y = baseline for economics.	Y - as baseline. Following 30 years a Do nothing scenario would occur due to failure of the defences.	Y = low residual life of defences therefore capital maintenance required.	Y = SOP and residual life variable, therefore can increase SOP with sea level rise.	N = SOP is variable but there are limited assets currently at risk therefore no need to upgrade the defences now.

Long List of Options (continued)				
	f) Construct new setback embankments at identified managed realignment sites. Maintain SOP of existing embankments along the rest of the section. NAI at Isle of Harty.	g) Construct new setback embankments at identified managed realignment sites. Raise (sustain SOP) existing embankments along the rest of the section. NAI at Isle of Harty.	h) Construct new setback embankments at identified managed realignment sites. Raise (upgrade SOP) existing embankments along the rest of the sections. NAI at Isle of Harty.	i) Maintain embankments until year 20. Then construct new setback embankments at identified managed realignment sites. Maintain SOP of existing embankments along the rest of the section. NAI at Isle of Harty. NAI at Isle of Harty. Maintenance of the rest of the defences.
To what extent does the option meet the objectives?				
1- Reduce Flood Risk	Y	Y	Y	Y
2 - Natura 2000 sites	Y	Y	Y	Y
3- Reduce maintenance	TBC*	TBC*	TBC*	TBC*
4 - WFD	TBC	TBC	TBC	TBC
5 - Local Plans	-	-	-	-
Comment and decision on whether taken forward to shortlist	Y = some realignment sites are not environmentally designated therefore further consideration needed. Compensatory	Y = some realignment sites are not environmentally designated therefore further consideration needed. Compensatory habitat may be required.	N= no significant assets at risk therefore not consider upgrading defences.	N = current minimum residual life of defences is poor therefore unlikely to be economically viable to maintain and then realign later.

Long List of Options (continued)		
	j) Maintain embankments until year 20. Construct new setback embankments at identified managed realignment sites. Raise (sustain SOP) existing embankments along the rest of the section. NAI at Isle of Harty.. NAI at Isle of Harty. Sustain the	k) Maintain embankments and walls until year 20. Construct new setback embankments at identified managed realignment sites. Raise (sustain SOP) existing embankments along the rest of the section. NAI at Isle of Harty. NAI at Isle of Harty. Upgrade the rest of the defences.
To what extent does the option meet the objectives?		
1- Reduce Flood Risk	Y	Y
2 - Natura 2000 sites	Y	Y
3- Reduce maintenance	TBC*	TBC*
4 - WFD	TBC	TBC
5 - Local Plans	-	-
Comment and decision on whether taken forward to shortlist	N = current minimum residual life of defences is poor therefore unlikely to be economically viable to maintain and then realign later.	N = current minimum residual life of defences is poor therefore unlikely to be economically viable to maintain and then realign later.

Short List of Options	
a)	Do nothing
b)	Do minimum
c)	Maintain SOP (capital) embankments and walls. NAI at Isle of Harty.
d)	Raise (sustain) embankments and walls. NAI at Isle of Harty.
e)	Construct new setback embankments at identified managed realignment sites. Maintain embankments along the rest of the section. NAI at Isle of Harty
f)	Construct new setback embankments at identified managed realignment sites. Raise (sustain) embankments along the rest of the section. NAI at Isle of Harty.

Assessment of Short List				
Option	a) Do nothing	b) Do minimum	c) Maintain SOP (capital) embankments and walls. NAI at Isle of Harty.	d) Raise (sustain) embankments and walls. NAI at Isle of Harty.
Description	Used as an economic baseline to compare the other options against.	Used as an economic baseline to compare the other options against.	Capital works are undertaken to maintain the current defences	Capital works are undertaken to improve the current defences
Technical Issue	Defences have 20 years residual life. Potential for coastal squeeze, therefore compensatory intertidal habitat will need to be created elsewhere. Designated freshwater habitat at risk therefore compensatory habitat is required.	Defences have 25 years residual life. Potential for coastal squeeze, therefore compensatory intertidal habitat will need to be created elsewhere. Designated freshwater habitat at risk therefore compensatory habitat is required.	Defences have 20 years residual life. Potential for coastal squeeze, therefore compensatory intertidal habitat will need to be created elsewhere. Designated freshwater habitat at risk therefore compensatory habitat is required.	Defences have 20 years residual life. Potential for coastal squeeze, therefore compensatory intertidal habitat will need to be created elsewhere. Designated freshwater habitat at risk therefore compensatory habitat is required.
Assumptions/ Uncertainties	Assumes that all management is ceased.	Ongoing maintenance. Maintenance not sufficient to reduce risk of failure after year 25	The crest height of the defences remains the same as currently in place i.e. is not increased. Over time this will lead to a reduction in the SOP as the sea level rises.	The SOP provided by the defences is increased to the required standard over time. This option has a phased approach so the defences are raised in line with sea level rise at two phases i.e. capital works are undertaken in epoch 1 and again in year 50. This option will maintain the required SOP provided by the defences by keeping pace with sea level rise.
SOP Provided (% AEP)	>50%	>50%	6%	2.0%
Value of Economics				
PV Capital Costs	£-	£ -	£ 11,644,657	£ 14,495,105
PV Maintenance Costs	£-	£ 190,000	£ 869,095	£ 862,509
PV Other Costs	£-	£ -	£ 544,322	£ 674,519
Total Cost (including Optimism Bias) (PV)	£-	£ 304,000	£ 20,892,920	£ 25,651,413
Value of Benefits	£-	£ 4,359,000	£ 6,248,103	£ 6,653,938
Benefit Cost Ratio (BCR)	0	14.3	0.3	0.3
PF Score	0%	80%	2%	2%
Further funding required to achieve 100% PF Score	£-	£ 62,000	£ 20,498,096	£ 25,234,043



Assessment of Short List		
Option	e) Construct new setback embankments at identified managed realignment sites. Maintain embankments along the rest of the section. NAI at Isle of Harty. MR site at Elmley Marshes (west) (Site 32)	f) Construct new setback embankments at identified managed realignment sites. Raise (sustain) embankments along the rest of the section. NAI at Isle of Harty. MR site at Elmley Marshes (west) (Site 32)
Description	Development of MR site. Capital works undertaken on remaining defences to maintain the current defences	Development of MR site. Capital works undertaken to improve the remaining defences
Technical Issue	Current defences have 20 years residual life. Potentially increase in defence length due to development of new setback defences. The MR will lead to the loss of freshwater designated habitat and therefore compensatory habitat is required. Based on current sea levels the MR site would create 58ha of saltmarsh and 98ha of mudflat. With 100 years sea level rise there could be 5ha of saltmarsh and 153ha of mudflat.	Current defences have 20 years residual life. Potentially increase in defence length due to development of new setback defences. The MR will lead to the loss of freshwater designated habitat and therefore compensatory habitat is required. Based on current sea levels the MR site would create 58ha of saltmarsh and 98ha of mudflat. With 100 years sea level rise there could be 5ha of saltmarsh and 153ha of mudflat.
Assumptions/ Uncertainties	MR site to provide at least 2% AEP SOP to protect property etc. directly behind. The crest height of the remaining defences remains the same as currently in place i.e. is not increased. Over time this will lead to a reduction in SOP for these sections of defence as the sea level rises.	MR site to provide at least 2% AEP SOP to protect property etc. directly behind. The SOP provided by the remaining defences is increased to the required standard over time. This option has a phased approach so the defences are raised in line with sea level rise at two phases i.e. capital works are undertaken in epoch 1 and again in year 50. This will maintain the required SOP provided by the defences by keeping pace with sea level rise.
SOP Provided (% AEP)	6% and 2% at MR site	2%
Value of Economics		
PV Capital Costs	£ 16,912,663	£ 20,070,802
PV Maintenance Costs	£ 939,546	£ 936,456
PV Other Costs	£ 544,322	£ 670,346
Total Cost (including Optimism Bias) (PV)	£ 29,434,449	£ 34,684,167
Value of Benefits	£ 6,341,570	£ 6,710,079
Benefit Cost Ratio (BCR)	0.2	0.2
PF Score	27%	23%
Further funding required to achieve 100% PF Score	£ 21,465,023	£ 26,714,741

Flood/ erosion impacts				
Number of Residential Properties at risk under 0.1% AEP	4	4	3	0
Number of Commercial Properties at risk under 0.1% AEP	13	13	11	0
PV value of Properties (Total including AAD, write off, vehicle damages and Critical Infrastructure)	£ 2,827,011	£ 16,629	£ 196,954	£ 204.92
PV Value of Impacts on road and rail	No assets at risk	No assets at risk	No assets at risk	No assets at risk
PV Value of Tourism and Recreation Impacts	£138,371 Elmley Nature Reserve and Great Bells Farm	£ 93,526	£56,316 Elmley Nature Reserve and Great Bells Farm	£51 Great Bells Farm
PV Value of Agriculture Impacts	£2,474,361 Worst case scenario 198ha of Grade 3 agricultural land flooded, 2,502ha of Grade 4 flooded, and 299ha of Grade 5 flooded	£ 1,552,948	£266,756 Worst case scenario 167ha of Grade 3 agricultural land flooded, 2,498ha of Grade 4 flooded, and 298ha of Grade 5 flooded	£175,439 Worst case scenario 8ha of Grade 3 agricultural land flooded, 349ha of Grade 4 flooded, and 148ha of Grade 5 flooded
Stakeholders Feedback				
Statutory Stakeholders/ SEG	Would prefer maintenance/ improvement of the defences to protect against overtopping from sea level rise.	Would prefer maintenance/ improvement of the defences to protect against overtopping from sea level rise.	HTL is a preferred option to protect the important high quality designated habitat	HTL is a preferred option to protect the important high quality designated habitat
Landowners	Landowner would prefer maintenance/ improvement of the defences to protect against overtopping from sea level rise.	Landowner would prefer maintenance/ improvement of the defences to protect against overtopping from sea level rise.	Landowners would prefer HTL as the current defences are in a good condition, and the area is a important environmentally. Happy to undertake the maintenance of the defences.	Landowners would prefer HTL as the current defences are in a good condition, and the area is a important environmentally. Happy to undertake the maintenance of the defences.
Technical Feasibility				
Site Specific	n/a	n/a	n/a	n/a
Strategy Wide	n/a	n/a	n/a	n/a
WFD (Water Framework Directive)				
Compliance assessment outcome	2 Some return to natural processes but uncontrolled	2 Some return to natural processes but uncontrolled	1 Heavily Modified Water Body (HMWB) maintained	1 Heavily Modified Water Body (HMWB) maintained

Flood/ erosion impacts		
Number of Residential Properties at risk under 0.1% AEP	3	0
Number of Commercial properties at risk under 0.1% AEP	11	0
PV Value of Properties (Total including AAD, write-ons, vehicle damages and Emergency Services)	£ 196,953.95	£ -
Critical Infrastructure	No assets at risk	No assets at risk
PV Value of Impacts on road and rail	£01,505 A249 and the Isle of Sheppey rail line	No assets at risk
PV Value of Tourism and Recreation Impacts	£56,316 Elmley Nature Reserve and Great Bells Farm	£51 Great Bells Farm
PV Value of Agriculture Impacts	£173,289 Worst case scenario 154ha of Grade 3 agricultural land flooded, 2,298ha of Grade 4 flooded, and 274ha of Grade 5 flooded (note area within MR site not counted as compensation provided).	£119,298 Worst case scenario 154ha of Grade 3 agricultural land flooded, 2,298ha of Grade 4 flooded, and 274ha of Grade 5 flooded (note area within MR site not counted as compensation provided).
Stakeholders Feedback		
Statutory Stakeholders/ SEG	The south of Sheppey is one of the best areas in the region for breeding waders. Therefore MR should not be undertaken over designated sites.	The south of Sheppey is one of the best areas in the region for breeding waders. Therefore MR should not be undertaken over designated sites.
Landowners	Landowner would not like MR due to the environmental importance of the site. Also if MR were to be undertaken the backline defences would need to be upgraded to protect their property.	Landowner would not like MR due to the environmental importance of the site. Also if MR were to be undertaken the backline defences would need to be upgraded to protect their property.
Technical Feasibility		
Site Specific	Approx. 80% flooded on the modelled Spring tide. Potential 1,753m increase in defences due to construction of setback defences. MR site would create 58ha of saltmarsh and 98ha of mudflat. With 100 years sea level rise there could be 5ha of saltmarsh and 153ha of mudflat.	Approx. 80% flooded on the modelled Spring tide. Potential 1,753m increase in defences due to construction of setback defences. MR site would create 33ha of saltmarsh and 112ha of mudflat. With 100 years sea level rise there could be 4ha of saltmarsh and 143ha of mudflat.
Strategy Wide	Sites are completely flooded during extreme events. An increase in the flood risk in the central Swale during extreme events is however observed when this sites are breached. This effect is not desirable.	Sites are completely flooded during extreme events. An increase in the flood risk in the central Swale during extreme events is however observed when this sites are breached. This effect is not desirable.
WFD (Water Framework Directive)		
Compliance assessment outcome	4 Return to a more natural process	4 Return to a more natural process

HRA (Habitats Regulation Assessment)				
Impact on SPA/ Ramsar qualifying features	<p>1</p> <p>There are potential significant effects on the Swale SPA and constituent qualifying features due to coastal squeeze. Coastal squeeze will lead to a loss of saltmarsh and mudflat habitat, with potential impacts on a number of species including pintail and shoveller, that are known to use the small bay areas along this length.</p> <p>After year 20 the failing defences will allow saltmarsh and mudflat habitats to begin to form behind the existing defences. At this point, there will be impacts on the designated freshwater habitats and those qualifying feature species that use them. This includes breeding and overwintering avocet, lapwing, and overwintering bar-tailed godwit.</p>	<p>1</p> <p>There are potential significant effects on the Swale SPA and constituent qualifying features due to coastal squeeze. Coastal squeeze will lead to a loss of saltmarsh and mudflat habitat, with potential impacts on a number of species including pintail and shoveller, that are known to use the small bay areas along this length.</p> <p>After year 25 the failing defences will allow saltmarsh and mudflat habitats to begin to form behind the existing defences. At this point, there will be impacts on the designated freshwater habitats and those qualifying feature species that use them. This includes breeding and overwintering avocet, lapwing, and overwintering bar-tailed godwit.</p>	<p>1</p> <p>There are potential significant effects on the Swale SPA and constituent qualifying features due to coastal squeeze. Coastal squeeze will lead to a loss of saltmarsh and mudflat habitat, with potential impacts on a number of species including pintail and shoveller, that are known to use the small bay areas along this length.</p> <p>Eventually the overtopping of defences, due to sea level rise, will allow saltmarsh and mudflat habitats to begin to form behind the existing defences. At this point, there will be impacts on the designated freshwater habitats and those qualifying feature species that use them. This includes breeding and overwintering avocet, lapwing, and overwintering bar-tailed godwit.</p>	<p>1</p> <p>There are potential significant effects on the intertidal Swale SPA and constituent qualifying features due to coastal squeeze. Coastal squeeze will lead to a loss of saltmarsh and mudflat habitat, with potential impacts on a number of species including pintail and shoveller, that are known to use the small bay areas along this length.</p>
Impacts on freshwater habitats	<p>1</p> <p>Yes. Compensatory habitat would be required in advance of failure of the defences to compensate for the loss of freshwater grazing marsh.</p>	<p>1</p> <p>Yes. Compensatory habitat would be required in advance of failure of the defences to compensate for the loss of freshwater grazing marsh.</p>	<p>1</p> <p>Yes. Compensatory habitat would be required in advance of regular overtopping of the defences to compensate for the gradual loss of freshwater grazing marsh. Likely to be later than the Do Nothing Option</p>	<p>3</p> <p>No, defences improved so the risk of overtopping reduced.</p>
Impacts on intertidal habitats	<p>2</p> <p>Yes, until defences are predicted to fail (from year 20). Development of tidal habitats once defences fail will begin to mitigate for coastal squeeze, although this is uncontrolled and the quality of habitat that develops is unknown.</p>	<p>2</p> <p>Yes, until defences are predicted to fail (from year 20). Development of tidal habitats once defences fail will begin to mitigate for coastal squeeze, although this is uncontrolled and the quality of habitat that develops is unknown.</p>	<p>1</p> <p>Yes, the maintenance of the defences will lead to coastal squeeze over time. However with the increased risk of overtopping intertidal habitat may start to develop behind the defences but this is uncontrolled.</p>	<p>1</p> <p>Yes because the defences are improved there is the potential for coastal squeeze and the loss of designated intertidal habitat.</p>
Habitat Connectivity	<p>2</p> <p>Slight negative impact on connectivity of saltmarsh/mudflat habitats due to loss of habitat from coastal squeeze before defences fail. Loss of freshwater grazing marsh habitat along the Swale once defences fail, although estuarine habitat connectivity should begin to open up again.</p>	<p>2</p> <p>Slight negative impact on connectivity of saltmarsh/mudflat habitats due to loss of habitat from coastal squeeze before defences fail. Loss of freshwater grazing marsh habitat along the Swale once defences fail, although estuarine habitat connectivity should begin to open up again.</p>	<p>2</p> <p>Slight negative impact on connectivity of saltmarsh/mudflat habitats due to loss of habitat from coastal squeeze. However with increased risk of overtopping due to sea level rise there will also be a loss of freshwater grazing marsh habitat along the Swale.</p>	<p>2</p> <p>Negative impact in connectivity due to loss of habitat from coastal squeeze.</p>
SEA (Strategic Environmental Assessment)				



HRA (Habitats Regulation Assessment)		
Impact on SPA/ Ramsar qualifying features		<div>1</div> <p>There may be potential significant effects on the Swale SPA and its constituent qualifying features due to the intrusion of works into Designated areas.</p> <p>Creation of the Managed Realignment site will impact on up to 152 ha of designated freshwater habitats, and those qualifying feature species that use them. These include good populations of breeding and overwintering avocet, lapwing, and overwintering bar-tailed godwit. .</p> <p>It is likely that existing mudflat, and small areas of saltmarsh in front of the existing defences would still be lost despite the Managed Realignment. The newly created habitats within the MR site are not likely to develop to the same quality as those habitats lost.</p>
Impacts on freshwater habitats		<div>1</div> <p>Yes, compensatory freshwater habitat will be required to compensate for the loss of freshwater grazing marsh and associated habitats.</p>
Impacts on intertidal habitats		<div>5</div> <p>No, when saltmarsh and mudflat habitats begin to reform, once MR has taken place.</p>
Habitat Connectivity		<div>5</div> <p>This option would serve to maintain habitat connectivity by providing saltmarsh and mudflat habitats where otherwise it would be lost.</p>
SEA (Strategic Environmental Assessment)		

Historic Environment	1 Listed buildings at risk once the defences fail (year 20)	1 Listed buildings at risk once the defences fail (year 25)	2 Listed buildings may be at risk over time as the risk of overtopping increases.	5 Listed buildings at reduced risk from flooding due to improvement of defences.
Effects on population	1 Potential loss of homes, livelihoods and amenity once the defences fail in years 20.	1 Potential loss of homes, livelihoods and amenity once the defences fail in years 25.	2 Potential loss of homes, livelihoods and amenity overtime as the risk of overtopping increases.	4 Property and livelihoods at reduced risk from flooding as improvements made to the defences.
Impact on plans/ programmes	3 Benefit area does not coincide with proposed development sites	3 Benefit area does not coincide with proposed development sites	3 Benefit area does not coincide with proposed development sites	3 Benefit area does not coincide with proposed development sites
Freshwater Biodiversity	1 Loss of fresh water habitat SSSI and SPA and Ramsar once the defences fail in year 20. This is important overwintering habitat, therefore impact on freshwater species. Freshwater pools and some areas of woodland provide additional variety and complement the estuarine habitats.	1 Loss of fresh water habitat SSSI and SPA and Ramsar once the defences fail in year 25. This is important overwintering habitat, therefore impact on freshwater species. Freshwater pools and some areas of woodland provide additional variety and complement the estuarine habitats.	2 Loss of fresh water habitat SSSI and SPA and Ramsar overtime due to sea level rise. This is important overwintering habitat, therefore impact on freshwater species. Freshwater pools and some areas of woodland provide additional variety and complement the estuarine habitats. However this gradual loss of habitat may allow the sustainable roll-back of the habitat. Loss of freshwater habitat in the NAI area at the Isle of Harty	4 Freshwater assets at reduced risk from saline intrusion, apart from the area at the Isle of Harty where there is NAI
Saline Biodiversity	3 Impacts to SPA from coastal squeeze until the defences fail in year 20. After this there could be the uncontrolled development of intertidal habitat, but the extent and quality of this is unknown.	3 Impacts to SPA from coastal squeeze until the defences fail in year 25. After this there could be the uncontrolled development of intertidal habitat, but the extent and quality of this is unknown.	2 Impacts to SPA from coastal squeeze. Although with sea level rise there may be some overtopping of the defences, which could allow the development of intertidal habitats behind the defences, but this is uncontrolled.	1 Impacts to SPA from coastal squeeze
Soil	1 Degradation of agricultural land due to saline intrusion following the failure of the defences in year 20	1 Degradation of agricultural land due to saline intrusion following the failure of the defences in year 25	1 Gradual degradation of agricultural land as the risk of overtopping increases.	2 Agricultural land better protected against flooding, apart from the area of no active intervention (NAI)
Groundwater	3 No impacts predicted	3 No impacts predicted	3 No impacts predicted	3 No impacts predicted
Landscape (visual impact)	4 Significant change once the defences fail but reverting to natural processes. Positive/negative effects depending on view and visual receptors	4 Significant change once the defences fail but reverting to natural processes. Positive/negative effects depending on view and visual receptors	3 Gradual change as the risk of overtopping increases with sea level rise, but will revert to natural processes. Positive/negative effects depending on view and visual receptors	2 Impacts depending on height of defences

Historic Environment	2 Listed buildings may be at risk over time as the risk of overtopping increases.	5 Listed buildings at reduced risk from flooding due to improvement of defences.
Effects on population	2 Potential loss of homes, livelihoods and amenity overtime as the risk of overtopping increases.	4 Property and livelihoods at reduced risk from flooding as improvements made to the defences.
Impact on plans/ programmes	3 Benefit area does not coincide with proposed development sites	3 Benefit area does not coincide with proposed development sites
Freshwater Biodiversity	1 Loss of freshwater habitat in the areas of NAI The development of the MR site will result in the conversion of designated freshwater habitat to intertidal habitat which could have significant impacts for the species that use the freshwater habitat. Area provides important habitat for overwintering species. Reporting of nightingales on site further inland. Along the sections where the defences are held there will be a risk of increased overtopping with sea level rise, however this may allow the sustainable roll-back of natural habitat.	1 Loss of freshwater habitat in the areas of NAI The development of the MR site will result in the conversion of designated freshwater habitat to intertidal habitat which could have significant impacts for the species that use the freshwater habitat. Area provides important habitat for overwintering species. Reporting of nightingales on site further inland.
Saline Biodiversity	5 Development of the MR site will alleviate intertidal habitat losses arising from coastal squeeze. However compensatory habitat will be required for the freshwater species at risk	5 Development of the MR site will alleviate intertidal habitat losses arising from coastal squeeze. However compensatory habitat will be required for the freshwater species at risk
Soil	1 Conversion of areas of agricultural land to intertidal habitat with the development of the MR site. Also risk of overtopping of the defences which are held as the SOP is not increased with SLR	1 Conversion of areas of agricultural land to intertidal habitat with the development of the MR site.
Groundwater	3 No impacts predicted	3 No impacts predicted
Landscape (visual impact)	1 Significant landscape change from managed realignment. Positive/negative effects depending on view and visual receptors, but reverting to natural processes	1 Significant landscape change from managed realignment. Positive/negative effects depending on view and visual receptors, but reverting to natural processes

Carbon Storage	2 Some loss of carbon storage from loss of saltmarsh until the defences fail. After this there may be creation of new intertidal habitat but the extent and quality of this is unknown.	2 Some loss of carbon storage from loss of saltmarsh until the defences fail. After this there may be creation of new intertidal habitat but the extent and quality of this is unknown.	1 Some loss of carbon storage from gradual loss of saltmarsh. Carbon cost from construction	1 Some loss of carbon storage from gradual loss of saltmarsh. Carbon cost from construction
Ecosystem Services				
Qualitative Score from Ecosystem Services Assessment	-49	-49	-34	-5
Comments	Major degradation in many ES (e.g. food, water regulation, natural hazard regulation, erosion regulation, water purification, and recreation and tourism) outweigh limited enhancement opportunities (e.g. aesthetic value and fishery habitat)	Major degradation in many ES (e.g. food, water regulation, natural hazard regulation, erosion regulation, water purification, and recreation and tourism) outweigh limited enhancement opportunities (e.g. aesthetic value and fishery habitat)	Moderate gradual degradation in many ES (e.g. food, natural hazard regulation, erosion regulation, pollination and recreation and tourism) outweigh limited enhancement opportunities (e.g. aesthetic value and fishery habitat)	Balance of opportunities for enhancing some ES (e.g. water regulation, erosion regulation and aesthetic value) with risks of degrading many ES (e.g. genetic resources, air quality regulation, climate regulation, conservation habitat and fisheries habitat)
To what extent does the option meet the objectives?				
1- Reduce Flood Risk	N	N	Y	Y
2 - Natura 2000 sites	N	N	N	N
3- Reduce maintenance	Y	Y	Y	Y
4 - WFD	N	N	N	N
5 - Local Plans	Y	Y	Y	Y



Carbon Storage	2  Creation of new intertidal habitat which may provide some carbon storage but this is outweighed by the carbon cost gained from construction	2  Creation of new intertidal habitat which may provide some carbon storage but this is outweighed by the carbon cost gained from construction
Ecosystem Services		
Qualitative Score from Ecosystem Services Assessment	17	17
Comments	Enhancement for many ES (e.g. genetic resources, climate regulation, water regulation, natural hazard regulation, aesthetic value, conservation habitat and fishery habitat) outweigh the degradation in some ES (e.g. food and pollination)	Enhancement for many ES (e.g. genetic resources, climate regulation, water regulation, natural hazard regulation, aesthetic value, conservation habitat and fishery habitat) outweigh the degradation in some ES (e.g. food and pollination)
To what extent does the option meet the objectives?		
1- Reduce Flood Risk	Y	Y
2 - Natura 2000 sites	N	N
3- Reduce maintenance	Y	Y
4 - WFD	Y	Y
5 - Local Plans	Y	Y

Environmental Scores				
100 = best option, 0 = worst option				
Option	a) Do nothing	b) Do minimum	c) Maintain (capital) embankments, and walls (Do Minimum)	d) Raise (sustain) embankments and walls
WFD (Water Framework Directive)				
Compliance assessment outcome	25	25	0	0
HRA (Habitats Regulation Assessment)				
Impact on SPA/ Ramsar qualifying features	0	0	0	0
Impacts on freshwater habitats	0	0	0	50
Impacts on intertidal habitats	25	25	0	0
Habitat Connectivity	25	25	25	25
SEA (Strategic Environmental Assessment)				
Historic Environment	0	0	25	100
Effects on population	0	0	25	75
Impact on plans/ programmes	50	50	50	50
Freshwater Biodiversity	0	0	25	75
Saline Biodiversity	50	50	25	0
Soil	0	0	0	25
Groundwater	50	50	50	50
Landscape (visual impact)	75	75	50	25
Carbon Storage	25	25	0	0
Total	325	325	275	475

Environmental Scores (continued)		
100 = best option, 0 = worst option		
Option	e) Raise (upgrade) embankments and walls	f) Construct new setback embankments at identified managed realignment sites and maintain SOP(capital) of existing embankments and walls around other areas.
WFD (Water Framework Directive)		
Compliance assessment outcome	75	75
HRA (Habitats Regulation Assessment)		
Impact on SPA/ Ramsar qualifying	0	0
Impacts on freshwater habitats	0	25
Impacts on intertidal habitats	100	100
Habitat Connectivity	100	100
SEA (Strategic Environmental Assessment)		
Historic Environment	25	100
Effects on population	25	75
Impact on plans/ programmes	50	50
Freshwater Biodiversity	0	0
Saline Biodiversity	100	100
Soil	0	0
Groundwater	50	50
Landscape (visual impact)	0	0
Carbon Storage	25	25
Total	550	700

Summary of Results				
Option	a) Do nothing	b) Do minimum	c) Maintain (capital) embankments, and walls	d) Raise (sustain) embankments and walls
Costs	£ -	£ 304,000	£ 20,892,920	£ 25,651,413
Benefits	£ -	£ 4,359,000	£ 6,248,103	£ 6,653,938
NPV	£ -	£ 4,055,000	-£ 14,644,817	-£ 18,997,475
BCR	0.0	14.3	0.3	0.3
Environmental Scoring	325	325	275	475

Summary of Results		
Option	e) Raise (upgrade) embankments and walls	e) Construct new setback embankments at identified managed realignment sites and maintain SOP(capital) of existing embankments and walls around other areas.
Costs	£ 29,434,449	£ 34,684,167
Benefits	£ 6,341,570	£ 6,710,079
NPV	-£ 23,092,879	-£ 27,974,088
BCR	0.2	0.2
Environmental Scoring	550	700

Preferred Option Decision Making		
DLO	Leading Option at DLO Stage	Justification for Leading Option
DLO1 - Economic Assessment	Do minimum - ongoing maintenance until Year 25, followed by NAI.	The current defences have a 20 year median residual life if maintenance continues and have a positive BCR if maintained until residual life fails, enabling HTL policy in the short term.
DLO2 - Economic Sensitivities		
DLO3 - Review of Compensatory Intertidal Habitat Requirements		
DLO4 - Review of Compensatory Freshwater Habitat Requirements	Maintain embankments and upgrade SoP with sea level rise in year 50. NAI at Isle of Harty.	The current defences have a 25 year residual life. Following this, the cost to compensate the large area of freshwater habitat is much greater than the cost to maintain the defences with sea level rise.
DLO5 - Modelling of Leading Options		
DLO6 - Consultation Phase	Maintain embankments and upgrade SOP with sea level rise in year 50. No Active Intervention (NAI) at Isle of Harty and a Managed Realignment site in year 5 at the end of Spitend Marshes.	The current defences have a 25 year residual life. Following this, the cost to compensate the large area of freshwater habitat is much greater than the cost to maintain the defences with sea level rise. The justification for the MR site is related to the Strategy wide requirement for coastal squeeze compensation.

Preferred Option Name
Maintain embankments and upgrade SOP with sea level rise in year 50. No Active Intervention (NAI) at Isle of Harty and a Managed Realignment site in year 5 at the end of Spitend Marshes.

Preferred Option
Maintenance (with capital works) of the current defences, and raise in year 50, to maintain a minimum SoP of 4%AEP with sea level rise. A MR site to be developed at Spitend Marshes. Setback embankments will be constructed to manage tidal water and a breach in the current defences created.

Justification
<p>Due to the limited assets at risk in the area, options to Hold the Line in the long term do not provide a BCR above one. The current defences have a 25-year median residual life. If patch and repair maintenance continues, the overall BCR is above one and the NPV is positive, enabling HTL policy in the short term.</p> <p>The option is required as part of the legal obligations to cause no net loss of the designated freshwater habitat.</p> <p>The current defences have a 20 year residual life. Following this, the cost to compensate the large area of freshwater habitat is much greater than the cost to maintain the defences with sea level rise. Therefore, it is more cost-effective to maintain the defences and raise with sea level rise. The defences are required to be raised with sea level rise as otherwise the frequency of inundation to the freshwater habitat would increase with sea level rise and compensation for this would be required in year 50.</p> <p>The justification for the MR site is related to the Strategy wide requirement for coastal squeeze compensation.</p>

Preferred Option Costs											
<table><tr><th>Cost</th><th>Benefits</th><th>BCR</th><th>PF Score</th></tr><tr><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td></tr></table>				Cost	Benefits	BCR	PF Score	N/A	N/A	N/A	N/A
Cost	Benefits	BCR	PF Score								
N/A	N/A	N/A	N/A								

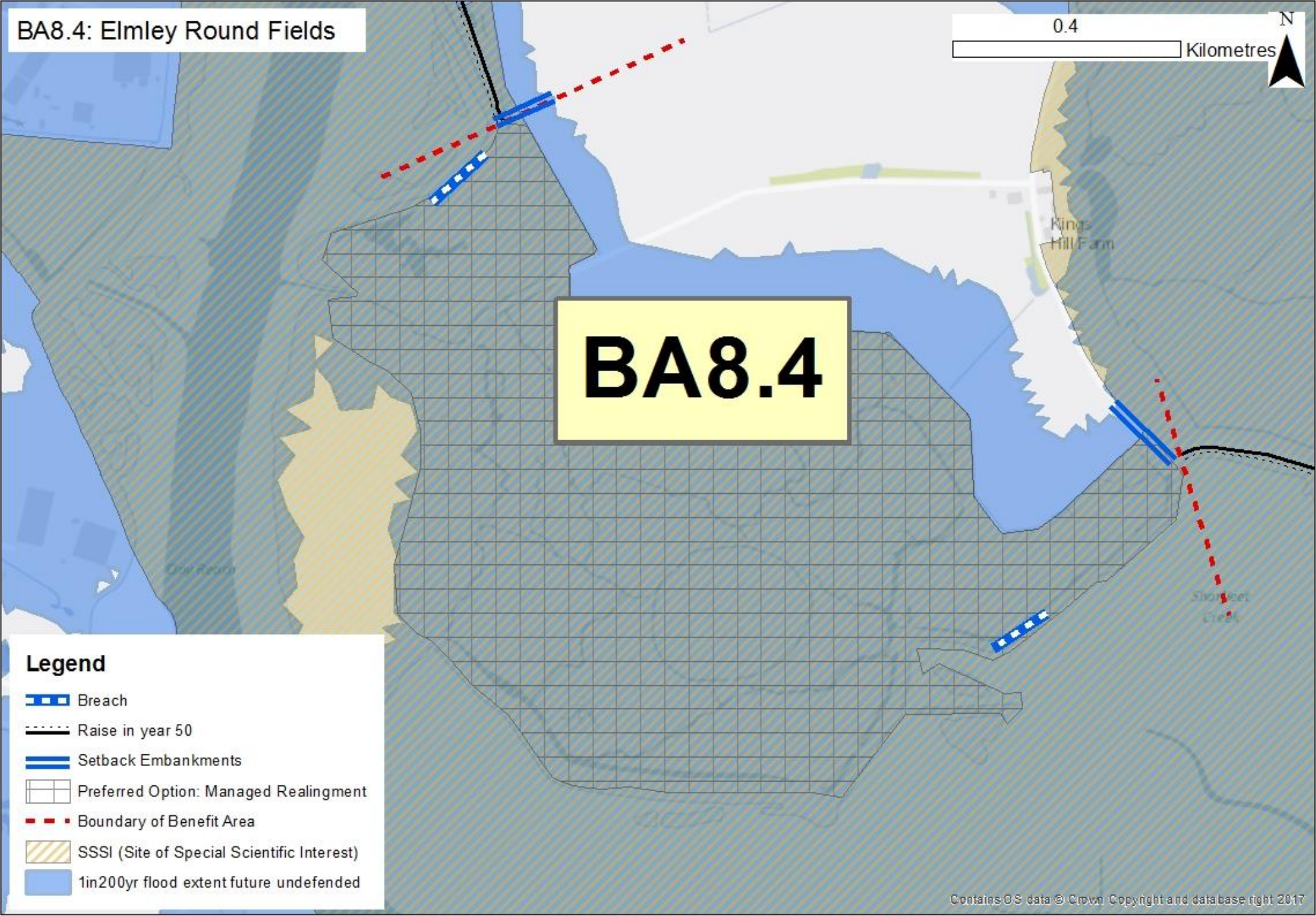
Managed Realignment					
Managed Realignment site proposed at Spitend Marsh in Year 5					
<table><tr><th>PV Cost</th><th>Hectares of saltmarsh created</th></tr><tr><td>£ 2,815,357</td><td>7.3 ha</td></tr></table>	PV Cost	Hectares of saltmarsh created	£ 2,815,357	7.3 ha	
PV Cost	Hectares of saltmarsh created				
£ 2,815,357	7.3 ha				

Impacts on freshwater designated habitat	
Ramsar and SPA habitat at risk from Year 9. Cost effectiveness analysis shows preferred management approach: Maintain defences and raise crest level in line with sea level rise to maintain current standard of protection.	
Cost of providing compensation for impacts	Cost of holding the line with SLR
£ 52,210,441	£ 28,048,344



Benefit Area Name	8 - South Sheppey
Benefit Unit Name	8.4 - North Emely Island
Frontage Length	3.8 km
Defence Structure Type	Embankments
Min Standard of Protection (AEP%)	0.09
Residual Life (years)	10

	0-20 years	20-50 years	50-100 years
SMP Policy	MR	MR	MR
	HTL	MR with localised HTL	MR
Aiming to comply with policy	No- suggest alternative considerations		
Comment	MR/NAI for all epochs (rather than simply MR). MR may be difficult to achieve while complying with Habitats Directive so HTL should be considered.		



Do Nothing Assets at Risk (Flooding)				
	50% AEP (undefended)		0.5% AEP (undefended)	
	Current Year	100 year	Current Year	100 Years
Residential	0	0	0	0
Commercial & Industrial	0	0	0	0
Agricultural (Ha)	216.7	120.9	123.2	131.1
Key Infrastructure	None	None	None	None
Social and Environmental Considerations	The Swale SPA, SSSI and Emely Nature Reserve (seaward and landward)	The Swale SPA, SSSI and Emely Nature Reserve (seaward and landward)	The Swale SPA, SSSI and Emely Nature Reserve (seaward and landward)	The Swale SPA, SSSI and Emely Nature Reserve (seaward and landward)

Long List to Short List			
Potential Measures			
	Measures	Selected	Reasoning
Structural	Construct new embankment	Y	Take forward- embankments currently present
	Maintain embankment	Y	Take forward- embankments currently present
	Raise embankment (sustain)	N	Exclude - will not reduce the erosion risk
	Raise embankment (upgrade)	N	Exclude - will not reduce the erosion risk
	Construct new wall	N	Exclude - limited benefits in constructing a wall where embankments are currently present. Also potentially environmentally damaging in SPA habitat
	Maintain wall	N	Exclude - no walls currently present
	Raise wall (sustain)	N	Exclude - no walls currently present
	Raise wall (upgrade)	N	Exclude - no walls currently present
	Maintain rock revetment	N	Exclude - no rock revetment currently present
	Construct rock revetment	N	Exclude - limited benefits in constructing a revetment where embankments are currently present and will not significantly reduce flood risk. Also potentially environmentally damaging in SPA habitat
	Install demountable defences	N	Exclude - relatively costly option which is not the most efficient use of FDGiA funding compared to sustaining existing defences. It would require significant man resources to implement during a flood event. This would need to be discussed with Asset Owners at OBC stage.
	Install temporary defences	N	Exclude - no significant assets at risk to warrant installation of temporary defences (significant resources to implement)
	Beach recharge (sand or shingle)	N	Exclude - not appropriate for this location
	Construct rock groynes	N	Exclude - not appropriate for this location
	Maintain rock groynes	N	Exclude - not appropriate for this location
	Construct timber structures	N	Exclude - not appropriate for this location
	Maintain timber structures	N	Exclude - not appropriate for this location
	Construct a tidal barrier	N	Exclude- likely to have significant environmental impacts, including on water quality (WFD), change in sedimentation in Estuary with wider impacts (environment, dredging, maintenance, navigation etc.). In addition likely to have significant costs.
Non-Structural	Implement monitoring	N	Not suitable as a single measure to implement the SMP policy. May be combined with
	Implement flood warning system	N	Not suitable as a single measure to implement the SMP policy. May be combined with structural measures
	Land use planning	N	Not suitable as a single measure to implement the SMP policy. May be combined with
	Adaptation measures	N	Not suitable as a single measure to implement the SMP policy. May be combined with
	Development control	N	Not suitable as a single measure to implement the SMP policy. May be combined with
	Emergency response plans	N	Not suitable as a single measure to implement the SMP policy. May be combined with structural measures
	Monitoring for health and safety only	N	Not suitable as a single measure to implement the SMP policy.



Long List of Options				
	a) Do nothing	b) Ongoing maintenance of embankments	c) Maintain (capital) embankments	d) Construct new setback embankments
To what extent does the option meet the objectives?				
1- Reduce Flood Risk	N	N	Y	Y
2 - Natura 2000 sites	N	N	N	Y
3- Reduce maintenance	N	N	N	Y*
4 - WFD	N	Y	Y	TBC
5 - Local Plans	-	-	-	-
Comment and decision on whether taken forward to shortlist	Y = baseline for economics	Y - as baseline. Following 30 years a Do nothing scenario would occur due to failure of the defences	Y = low residual life of defences therefore capital maintenance required	Y = realignment site environmentally designated but naturally constrained and therefore further consideration needed. May need to find compensatory habitat.

\* Assumed that the MR sites will have natural topography

Short List of Options				
a)	Do nothing			
b)	Do minimum			
c)	Ongoing Maintenance embankments			
d)	Maintain (capital) embankments			
e)	Construct new setback embankments			

Assessment of Short List				
Option	a) Do nothing	b) Do minimum	c) Maintain (capital) embankments	d) Construct new setback embankments at Elmley (Site 36)
Description	Used as an economic baseline to compare the other options against.	Used as an economic baseline to compare the other options against.	Capital works are undertaken to maintain the current defences	Development of MR site on whole of the site
Technical Issue	Defences have 10 years residual life. Potential for coastal squeeze, therefore compensatory intertidal habitat will need to be created elsewhere. Designated freshwater habitat and therefore compensatory habitat is required.	Defences have 15 years residual life. Potential for coastal squeeze, therefore compensatory intertidal habitat will need to be created elsewhere. Designated freshwater habitat and therefore compensatory habitat is required.	Defences have 10 years residual life. Potential for coastal squeeze, therefore compensatory intertidal habitat will need to be created elsewhere. Designated freshwater habitat and therefore compensatory habitat is required.	Current defences have 10 years residual life. The MR site ties back into high ground. The MR will be over designated freshwater habitat and therefore compensatory habitat is required. Based on current sea levels the MR site would create 66ha of saltmarsh and 15ha of mudflat. With 100 years sea level rise there could be 18.8ha of saltmarsh and 68ha of mudflat.
Assumptions/ Uncertainties	Assumes that all management is ceased.	Ongoing maintenance. Maintenance not sufficient to reduce risk of failure after year 15	The crest height of the defences remains the same as currently in place i.e. is not increased. Over time this will lead to a reduction in the SOP as the sea level rises.	MR site to provide at least a 5% AEP SOP to protect property etc. directly behind. Defences tied into high ground.
SOP Provided (% AEP)	>50%	>50%	9%	5%
Value of Economics				
PV Capital Costs	£ -	£ -	£ 1,976,745	£ 1,171,825
PV Maintenance Costs	£ -	£ 34,375	£ 194,926	£ 100,795
PV Other Costs	£ -	£ -	£ 184,534	£ 122,982
Total Cost (including Optimism Bias) (PV)	£ -	£ 55,000	£ 3,769,929	£ 2,232,963
Value of Benefits	£ -	£ -	£ 76,370	£ 133,884
Benefit Cost Ratio (BCR)	0.0	0.0	0.0	0.1
PF Score	0%	0%	0%	199%
Further funding required to achieve 100% PF Score	£ -	£ 55,000	£ 3,765,686	£ -
Flood/ erosion impacts				
Number of Residential Properties at risk under	0	0	0	0
Number of Commercial properties at risk under	1	1	0	0
PV Value of Properties (Total including AAD, write-offs, vehicle damages and Emergency Services)	£ 87	£ 87	£ -	£ -
Critical Infrastructure	No assets at risk	No assets at risk	No assets at risk	No assets at risk
PV Value of Impacts on road and rail	-	£ -	-	-
PV Value of Tourism and Recreation Impacts	£9,838 Elmley Nature Reserve	£ 9,838	£6,171 Elmley Nature Reserve	£6,171 Elmley Nature Reserve
PV Value of Agriculture Impacts	£146,085 Worst case scenario 28.35ha Grade 3 Agric land flooded and 106.63ha Grade 4 Agric land flooded	£ 146,085	£73,469 Worst case scenario 26.8ha Grade 3 Agric land flooded and 104.4ha Grade 4 Agric land flooded	0 Cost of agricultural land included in the option cost
Stakeholders Feedback				
Statutory Stakeholders/ SEG	Would prefer maintenance/ improvement of the defences to protect against overtopping from sea level rise.	Would prefer maintenance/ improvement of the defences to protect against overtopping from sea level rise.	HTL is a preferred option to protect the important high quality designated habitat	The south of Sheppey is one of the best areas in the region for breeding waders. Therefore MR should be undertaken over designated sites.
Landowners	Would like to be able to undertake repairs on the defences	Would like to be able to undertake repairs on the defences	Would prefer MR, but if the line should be held would like to be able to undertake repaired on the defences	Landowner keen for MR to take place. Believes would be a low cost option and help develop the only natural shoreline in Kent. Also believes could enhance the Swale NNR
Technical Feasibility				

Site Specific	n/a	n/a	n/a	Approx. 50% flooded on the modelled Spring tide. Potential 3,301m decrease in defence line as setback defences tied into high ground. MR site would create 66.2ha of saltmarsh and 15.2ha of mudflat. With 100 years sea level rise there could be 18.8ha of saltmarsh and 67.9ha of mudflat.
Strategy Wide	n/a	n/a	n/a	Sites are completely flooded during extreme events. An increase in the flood risk in the central Swale during extreme events is however observed when this sites are breached.
WFD (Water Framework Directive)				
Compliance assessment outcome	2 Some return to natural processes but uncontrolled	2 Some return to natural processes but uncontrolled	1 Heavily Modified Water Body (HMWB) maintained	4 Return to more natural processes
HRA (Habitats Regulation Assessment)				
Impact on SPA/ Ramsar qualifying features	1 There are potential significant effects on the Swale SPA and constituent qualifying features due to coastal squeeze until the defences fail in year 10. Coastal squeeze will lead to a loss of mudflat and small areas of saltmarsh habitat. When defences fail there is likely to be inundation of the designated freshwater habitats in Elmley. However this may allow intertidal habitats to develop.	1 There are potential significant effects on the Swale SPA and constituent qualifying features due to coastal squeeze until the defences fail in year 15. Coastal squeeze will lead to a loss of mudflat and small areas of saltmarsh habitat. When defences fail there is likely to be inundation of the designated freshwater habitats in Elmley. However this may allow intertidal habitats to develop.	1 There are potential significant effects on the Swale SPA and constituent qualifying features due to coastal squeeze. Coastal squeeze will lead to a loss of mudflat and small areas of saltmarsh habitat. However with sea level rise the risk of overtopping will increase. This will significantly impact on the freshwater habitat in Elmley, but may allow intertidal habitats to develop behind the defences.	1 Creation of the Managed Realignment site will impact on up to 89 ha of designated freshwater habitats, and those qualifying feature species that use them. This is likely to impact on species like avocet, ringed plover, lapwing that feed and breed in these habitats.  The newly created habitats within the MR site are not likely to develop to the same quality as those habitats lost within the Swale Estuary.
Impacts on freshwater habitats	1 Yes. Compensatory habitat would be required in advance of failure of the defences to compensate for the loss of freshwater grazing marsh on Elmley	1 Yes. Compensatory habitat would be required in advance of failure of the defences to compensate for the loss of freshwater grazing marsh on Elmley	1 Yes. Compensatory habitat would be required in advance of regular overtopping of the defences to compensate for the gradual loss of freshwater grazing marsh on Elmley.	1 Yes, compensatory freshwater habitat will be required to compensate for the loss of freshwater grazing marsh and associated habitats with the development of the MR site.
Impacts on intertidal habitats	2 Yes, until defences are predicted to fail (from year 10). Development of tidal habitats once defences fail will begin to mitigate for coastal squeeze, although this is uncontrolled and the quality of habitat that develops is unknown.	2 Yes, until defences are predicted to fail (from year 15). Development of tidal habitats once defences fail will begin to mitigate for coastal squeeze, although this is uncontrolled and the quality of habitat that develops is unknown.	1 Yes, the maintenance of the defences will lead to coastal squeeze over time. However with the increased risk of overtopping intertidal habitat may start to develop behind the defences but this is uncontrolled.	5 Following the creation of the MR site intertidal habitat will be created, which will help mitigate against the effects of coastal squeeze.
Habitat Connectivity	2 Slight negative impact on connectivity of saltmarsh/mudflat habitats due to loss of habitat from coastal squeeze before defences fail in year 10. Loss of freshwater grazing marsh habitat along the Swale once defences fail, although estuarine habitat connectivity should begin to open up again.	2 Slight negative impact on connectivity of saltmarsh/mudflat habitats due to loss of habitat from coastal squeeze before defences fail in year 15. Loss of freshwater grazing marsh habitat along the Swale once defences fail, although estuarine habitat connectivity should begin to open up again.	2 Slight negative impact on connectivity of saltmarsh/mudflat habitats due to loss of habitat from coastal squeeze. However with increased risk of overtopping due to sea level rise there will also be a loss of freshwater grazing marsh habitat along the Swale.	5 Major benefits to habitat connectivity with the creation of new intertidal habitat at a point where connectivity between the Swale and Medway SPA is thinner. compensatory habitat will be required for the loss of the designated freshwater habitat.
SEA (Strategic Environmental Assessment)				



Historic Environment	2 Some potential for loss of undesignated heritage assets once the defences fail	2 Some potential for loss of undesignated heritage assets once the defences fail	2 Increasing risk overtime to undesignated heritage assets	2 Potential for loss of undesignated heritage assets including Salt Box
Effects on population	3 Unpopulated area, limited impacts on the community	3 Unpopulated area, limited impacts on the community	3 Unpopulated area, limited impacts on the community	3 Unpopulated area, limited impacts on the community
Impact on plans/ programmes	3 Benefit area does not coincide with proposed development sites	3 Benefit area does not coincide with proposed development sites	3 Benefit area does not coincide with proposed development sites	3 Benefit area does not coincide with proposed development sites
Freshwater Biodiversity	1 Loss of freshwater habitat due to saline intrusion once the defences fail in year 10. The site is important for terrestrial species, there are nationally significant populations of water voles and the freshwater/saline ditches have an abundance of gammarid and palaemonid (probably as a result of intermittent overtopping) which provide foraging for SPA species. Area provides important habitat for overwintering species. Reporting of nightingales on site further inland.	1 Loss of freshwater habitat due to saline intrusion once the defences fail in year 15. The site is important for terrestrial species, there are nationally significant populations of water voles and the freshwater/saline ditches have an abundance of gammarid and palaemonid (probably as a result of intermittent overtopping) which provide foraging for SPA species. Area provides important habitat for overwintering species. Reporting of nightingales on site further inland.	2 Impacts on freshwater habitat overtime from increased risk of overtopping, however there may be the sustainable natural rollback of the freshwater habitat.	1 Loss of fresh water habitat SSSI and SPA and Ramsar. The site is important for terrestrial species, there are nationally significant populations of water voles and the freshwater/saline ditches have an abundance of gammarid and palaemonid (probably as a result of intermittent overtopping) which provide foraging for SPA species. Area provides important habitat for overwintering species. Reporting of nightingales on site further inland.
Saline Biodiversity	3 Potential for coastal squeeze until the defences fail in year 10. After this there could be the uncontrolled development of intertidal habitat, but the extent and quality of this is unknown.	3 Potential for coastal squeeze until the defences fail in year 15. After this there could be the uncontrolled development of intertidal habitat, but the extent and quality of this is unknown.	2 Impacts to SPA from coastal squeeze. Although with sea level rise there may be some overtopping of the defences, which could allow the development of intertidal habitats behind the defences, but this is uncontrolled.	5 MR site will create new intertidal habitats and provide compensatory habitat for the loss of SPA designated habitat elsewhere in the Swale estuary.
Soil	1 Degradation of agricultural land once the defences fail in year 10	1 Degradation of agricultural land once the defences fail in year 15	2 Gradual degradation of agricultural land as the risk of overtopping increase with sea level rise.	1 Loss of large amounts of agricultural land as the site is converted to intertidal habitat with the development of new intertidal habitat.
Groundwater	3 No impacts predicted	3 No impacts predicted	3 No impacts predicted	3 No impacts predicted
Landscape (visual impact)	2 Gradual change - but reverting to natural processes	2 Gradual change - but reverting to natural processes	3 Gradual changes to landscape but reverting to natural processes. Positive/negative effects depending on view and visual receptors,-	1 Significant landscape change from managed realignment. Positive/negative effects depending on view and visual receptors, but giving back to natural processes
Carbon Storage	2 Loss of intertidal carbon storage	2 Loss of intertidal carbon storage	1 Loss of intertidal carbon storage, carbon cost through construction	1 Carbon cost through construction
<b>Ecosystem Services</b>				
Qualitative Score from Ecosystem Services Assessment	-41	-41	-41	21
Comments	Major degradation in various ES (e.g. food, water regulation, natural hazard regulation and erosion regulation) outweigh limited enhancement opportunities (e.g. aesthetic value and fishery habitat)	Major degradation in various ES (e.g. food, water regulation, natural hazard regulation and erosion regulation) outweigh limited enhancement opportunities (e.g. aesthetic value and fishery habitat)	Moderate degradation in various ES (e.g. food, water regulation, natural hazard regulation and erosion regulation) outweigh limited enhancement opportunities (e.g. fishery habitat)	Enhancement in various ES (e.g. water regulation, natural hazard regulation, aesthetic value and fishery habitat) outweigh the degradation in some ES (e.g. food)

To what extent does the option meet the objectives?				
1- Reduce Flood Risk	N	N	Y	Y
2 - Natura 2000 sites	N	N	N	N
3- Reduce maintenance	Y	Y	Y	Y
4 - WFD	N	N	N	Y
5 - Local Plans	Y		Y	Y

Environmental Scores				
100 = best option, 0 = worst option				
Option	a) Do nothing	b) Do minimum	c) Maintain (capital) embankments	d) Construct new setback embankments at Elmley (Site 36)
WFD (Water Framework Directive)				
Compliance assessment outcome	25	25	0	75
HRA (Habitats Regulation Assessment)				
Impact on SPA/ Ramsar qualifying features	0	0	0	0
Impacts on freshwater habitats	0	0	0	0
Impacts on intertidal habitats	25	25	0	100
Habitat Connectivity	25	25	25	100
SEA (Strategic Environmental Assessment)				
Historic Environment	25	25	25	25
Effects on population	50	50	50	50
Impact on plans/ programmes	50	50	50	50
Freshwater Biodiversity	0	0	25	0
Saline Biodiversity	50	50	25	100
Soil	0	0	25	0
Groundwater	50	50	50	50
Landscape (visual impact)	25	25	50	0
Carbon Storage	25	25	0	0
Total	350	350	325	550

Summary of Results				
Option	a) Do nothing	b) Do minimum	c) Maintain (capital) embankments	d) Construct new setback embankments at Elmley (Site 36)
Costs	£ -	£ 55,000	£ 3,769,929	£ 2,232,963
Benefits	£ -	£ -	£ 76,370	£ 133,884
NPV	£ -	-£ 55,000	-£ 3,693,559	-£ 2,099,079
BCR	0.0	0.0	0.0	0.1
Environmental Scoring	350	350	325	550

Preferred Option Decision Making		
DLO	Leading Option at DLO Stage	Justification for Leading Option
DLO1 - Economic Assessment	No Active Intervention (NAI)	The BCR is less than one for all the options, so there is no economically viable option. However NAI is the current proposed management method so there is no deviation from the SMP.
DLO2 - Economic Sensitivities		
DLO3 - Review of Compensatory Intertidal Habitat Requirements	Construct setback defences to form Managed Realignment site in year 5 at Elmley Round Fields.	Managed realignment as although designated freshwater habitat is present, alternative is NAI which would be increased impacts over MR option. Required as part of coastal squeeze compensation across the Strategy in the first epoch.
DLO4 - Review of Compensatory Freshwater Habitat Requirements		
DLO5 - Modelling of Leading Options		
DLO6 - Consultation Phase		

Preferred Option Name
Construct setback defences to form Managed Realignment site in year 5 at Elmley Round Hills.

Preferred Option
Development of a MR site from year 5 to compensate against the strategy wide impacts of coastal squeeze. Most of the MR site will tie into high ground, but some new set-back embankments will need to be constructed near the shoreline to fully tie the site into high ground. These defences will provide a 5%AEP SoP.

Justification
No short listed options were identified which would provide increased protection and with BCRs above one/positive NPVs. Managed realignment is justified because although designated freshwater habitat is present, the alternative is NAI, which would have greater adverse impacts compared to the MR option which will contribute towards the strategy wide coastal squeeze compensation for the first epoch. The costs for compensating the freshwater SPA habitat has been added to the option costs.

Preferred Option Costs			
Cost	Benefits	BCR	PF Score
N/A	N/A	N/A	N/A

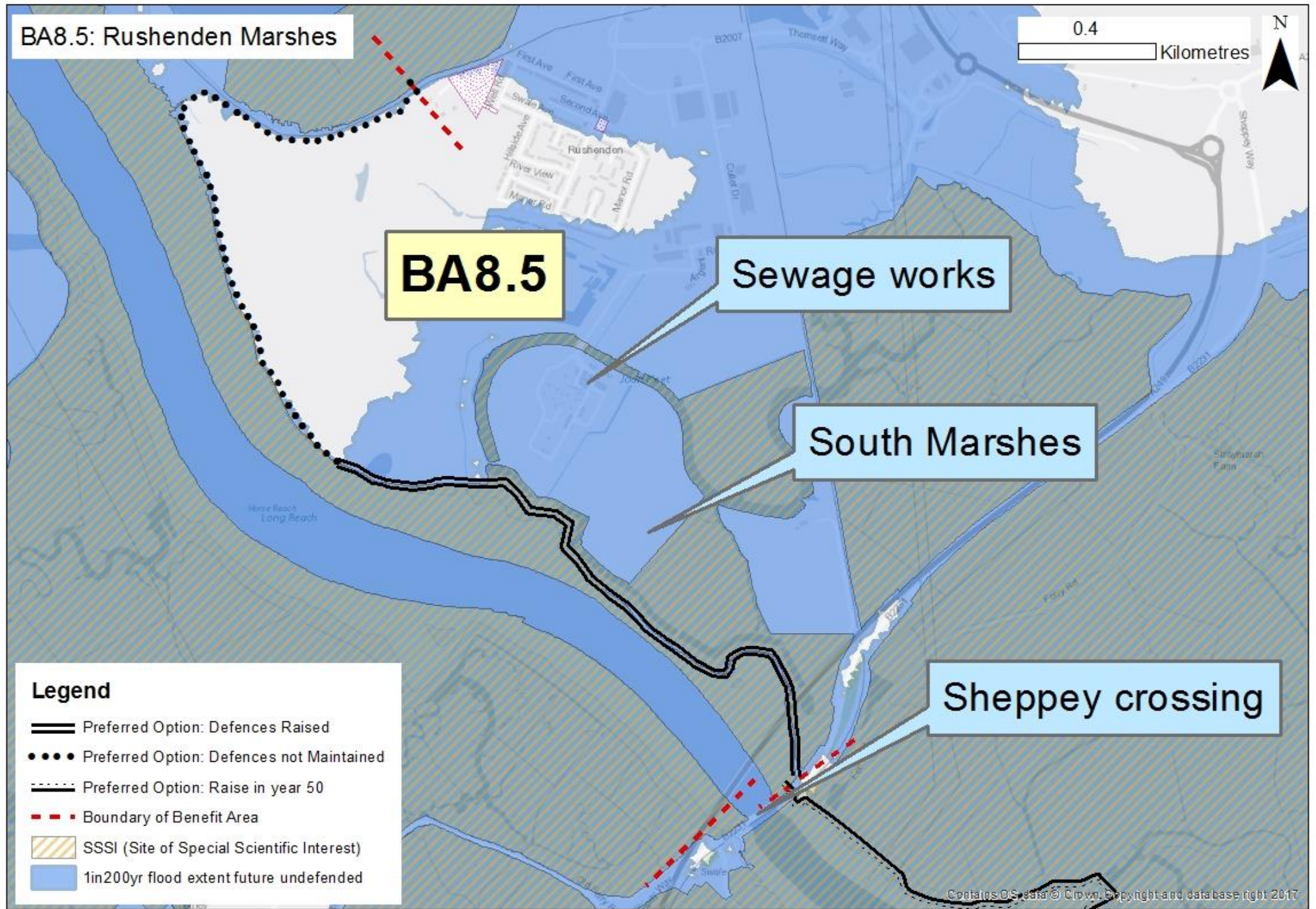
Managed Realignment	
Managed Realignment site proposed at Elmley in Year 5	
PV Cost	Hectares of saltmarsh created
£ 2,276,831	66.2 ha

Impacts on freshwater designated habitat
Ramsar and SPA habitat at risk from Year 5. Cost effectiveness analysis shows preferred management approach: Freshwater compensation required but costs considered within managed realignment site cost.



Benefit Area Name	8 - South Sheppey
Benefit Unit Name	8.5 - Kingsferry Bridge to Rushenden
Frontage Length	4.0 km
Defence Structure Type	Embankments
Min Standard of Protection (AEP%)	0.05
Residual Life (years)	25

	0-20 years	20-50 years	50-100 years
SMP Policy	HTL	MR	MR
Aiming to comply with policy	No- suggest alternative considerations		
Comment	There are some key features in the area which it is important to protect including sewage works, landfill sites and freshwater habitat. The Sheppey Crossing is also the only access route to the Island, so needs to be maintained. Additionally there is a large proposed development area in Rushenden. Therefore MR from year 20 may put these features at risk.		



Do Nothing Assets at Risk (Flooding)				
	50% AEP (undefended)		0.5% AEP (undefended)	
	Current Year	100 year	Current Year	100 Years
Residential	0	2	12	20
Commercial & Industrial	6	13	13	14
Agricultural (Ha)	165.4	172.8	175.1	193.1
Key Infrastructure	Sewage works, South Marshes, B2231, Sheppey Crossing, Rushenden Marshes Historic Landfill (inert)	Sewage works, Sheppey Crossing South Marshes, B2231, Rushenden Marshes Historic Landfill (inert)	Sewage works, Sheppey Crossing South Marshes, B2231, Rushenden Marshes Historic Landfill (inert)	Sewage works, Sheppey Crossing South Marshes, B2231, Rushenden Marshes Historic Landfill (inert)
Social and Environmental Considerations	Medway Estuary Marshes SPA and SSSI (seaward)	Medway Estuary Marshes SPA and SSSI (seaward)	Medway Estuary Marshes SPA and SSSI (seaward)	Medway Estuary Marshes SPA and SSSI (seaward)



Long List to Short List			
Potential Measures			
	Measures	Selected	Reasoning
Structural	Construct new embankment	Y	Take forward- embankments currently present
	Maintain embankment	Y	Take forward- embankments currently present
	Raise embankment (sustain)	Y	Take forward- embankments currently present
	Raise embankment (upgrade)	Y	Take forward- embankments currently present
	Construct new wall	N	Exclude - limited benefits in constructing a wall where embankments are currently present. Also potentially environmentally damaging in SPA habitat
	Maintain wall	N	Exclude - no walls currently present
	Raise wall (sustain)	N	Exclude - no walls currently present
	Raise wall (upgrade)	N	Exclude - no walls currently present
	Maintain rock revetment	N	Exclude - no rock revetment currently present
	Construct rock revetment	N	Exclude - limited benefits in constructing a revetment where embankments are currently present and will not significantly reduce flood risk. Also potentially environmentally damaging in SPA habitat
	Install demountable defences	N	Exclude - relatively costly option which is not the most efficient use of FDGiA funding compared to sustaining existing defences. It would require significant man resources to implement during a flood event. This would need to be discussed with Asset Owners at OBC stage.
	Install temporary defences	N	Exclude - no significant assets at risk to warrant installation of temporary defences (significant resources to implement)
	Beach recharge (sand or shingle)	N	Exclude - not appropriate for this location
	Construct rock groynes	N	Exclude - not appropriate for this location
	Maintain rock groynes	N	Exclude - not appropriate for this location
	Construct timber structures	N	Exclude - not appropriate for this location
	Maintain timber structures	N	Exclude - not appropriate for this location
	Construct a tidal barrier	N	Exclude- likely to have significant environmental impacts, including on water quality (WFD), change in sedimentation in Estuary with wider impacts (environment, dredging, maintenance, navigation etc.). In addition likely to have significant costs.
Non-Structural	Implement monitoring	N	Not suitable as a single measure to implement the SMP policy. May be combined with structural measures
	Implement flood warning system	N	Not suitable as a single measure to implement the SMP policy. May be combined with structural measures
	Land use planning	N	Not suitable as a single measure to implement the SMP policy. May be combined with structural measures
	Adaptation measures	N	Not suitable as a single measure to implement the SMP policy. May be combined with structural measures
	Development control	N	Not suitable as a single measure to implement the SMP policy. May be combined with structural measures
	Emergency response plans	N	Not suitable as a single measure to implement the SMP policy. May be combined with structural measures
	Monitoring for health and safety only	N	Not suitable as a single measure to implement the SMP policy.

Long List of Options					
	a) Do nothing	b) Ongoing maintenance of embankments	c) Maintain SOP (capital) embankments	d) Raise (sustain SOP) embankments	e) Raise (upgrade SOP) embankments
To what extent does the option meet the objectives?					
1- Reduce Flood Risk	N	N	Y	Y	Y
2 - Natura 2000 sites	N	N	N	N	N
3- Reduce maintenance	N	N	N	N	N
4 - WFD	N	Y	Y	Y	Y
5 - Local Plans	NA	NA	NA	NA	NA
Comment and decision on whether taken forward to shortlist	Y = baseline for economics.	Y - as baseline. Following 30 years a Do nothing scenario would occur due to failure of the defences	Y = low residual life of defences therefore capital maintenance may be required.	Y = SOP high but could increase SOP with sea level rise.	N = SOP of defences high and limited assets at risk therefore no need to upgrade defences.

Long List of Options (continued)				
	f) Construct new setback embankments at identified managed realignment sites. Maintain SOP of existing embankments along the rest of the section.	g) Construct new setback embankments at identified managed realignment sites. Raise (sustain SOP) existing embankments along the rest of the section.	h) Construct new setback embankments at identified managed realignment sites. Raise (upgrade SOP) existing embankments along the rest of the sections.	i) Maintain embankments until year 20. Then construct new setback embankments at identified managed realignment sites. Maintain SOP of existing embankments along the rest of the section. Maintenance of the rest of the defences.
To what extent does the option meet the objectives?				
1- Reduce Flood Risk	Y	Y	Y	Y
2 - Natura 2000 sites	Y	Y	Y	Y
3- Reduce maintenance	TBC*	TBC*	TBC*	TBC*
4 - WFD	TBC	TBC	TBC	TBC
5 - Local Plans	NA	NA	NA	NA
Comment and decision on whether taken forward to shortlist	N = realignment site is environmentally designated so consideration of compensatory habitat would be required. Due to high SOP of the defences MR will not be needed in the first epoch.	N = realignment site is environmentally designated so consideration of compensatory habitat would be required. Due to high SOP of the defences MR will not be needed in the first epoch.	N = realignment site is environmentally designated so consideration of compensatory habitat would be required. Due to high SOP of the defences MR will not be needed in the first epoch.	Y = due to high SOP MR will be delayed for 20 years. Compensatory habitat would need to be found for designated habitat.

Long List of Options (continued)		
	j) Maintain embankments until year 20. Construct new setback embankments at identified managed realignment sites. Raise (sustain SOP) existing embankments along the rest of the section. Sustain the rest of the defences.	k) Maintain embankments and walls until year 20. Construct new setback embankments at identified managed realignment sites. Raise (sustain SOP) existing embankments along the rest of the section. Upgrade the rest of the defences.
To what extent does the option meet the objectives?		
1- Reduce Flood Risk	Y	Y
2 - Natura 2000 sites	Y	Y
3- Reduce maintenance	TBC*	TBC*
4 - WFD	TBC	TBC
5 - Local Plans	NA	NA
Comment and decision on whether taken forward to shortlist	Y = due to high SOP MR will be delayed for 20 years. Compensatory habitat would need to be found for designated habitat.	N = SOP of defences high and limited assets at risk therefore no need to upgrade defences.

\*\* - Maintenance requirements currently unknown, as will depend on the MR sites taken forwards

Short List of Options
a) Do nothing
b) Do minimum
c) Maintain (capital) embankments
d) Raise (sustain) embankments
e) * Maintain embankments until year 20. Then construct new setback embankments at identified managed realignment sites. Maintain SOP of existing embankments along the rest of the section. Maintenance of the rest of the defences.
f) *Maintain embankments until year 20. Construct new setback embankments at identified managed realignment sites. Raise (sustain SOP) existing

\*This MR option was screened out following consultation with environmental stakeholders

Assessment of Short List				
Option	a) Do nothing	b) Do minimum	c) Maintain (capital) embankments	d) Raise (sustain) embankments
Description	Used as an economic baseline to compare the other options against.	Used as an economic baseline to compare the other options against.	Capital works are undertaken to maintain the current defences	Capital works are undertaken to improve the current defences
Technical Issue	Defences have 25 years residual life. Rushenden Marshes Historic Landfill (inert) potentially at risk.	Defences have 30 years residual life. Rushenden Marshes Historic Landfill (inert) potentially at risk.	Current defences have 25 years residual life. Rushenden Marshes Historic Landfill (inert) potentially at risk.	Current defences have 25 years residual life. Rushenden Marshes Historic Landfill (inert) potentially at risk.
Assumptions/ Uncertainties	Assumes that all management is ceased.	Ongoing maintenance. Maintenance not sufficient to reduce risk of failure after year 30	The crest height of the defences remains the same as currently in place i.e. is not increased. Over time this will lead to a reduction in the SOP as the sea level rises.	The SOP provided by the defences is increased to the required standard over time. This option has a phased approach so the defences are raised in line with sea level rise at two phases i.e. capital works are undertaken in epoch 1 and again in year 50. This option will maintain the required SOP provided by the defences by keeping pace with sea level rise.
SOP Provided (% AEP)	>50%	>50%	5%	0.1%
Value of Economics				
PV Capital Costs	£ -	£ -	£ 1,635,598	£ 3,375,862
PV Maintenance Costs	£ -	£ 135,625	£ 208,241	£ 203,900
PV Other Costs	£ -	£ -	£ 157,291	£ 317,672
Total Cost (including Optimism Bias) (PV)	£ -	£ 217,000	£ 3,201,809	£ 6,235,895
Value of Benefits	£ -	£ -	£ 2,410,411	£ 2,495,443
Benefit Cost Ratio (BCR)	0.0	1.5	0.8	0.4
PF Score	0%	8%	4%	2%
Further funding required to achieve 100% PF Score	£ -	£ 199,000	£ 3,059,063	£ 6,088,425
Flood/ erosion impacts				
Number of Residential Properties at risk under	26	26	17	0
Number of Commercial properties at risk under	14	14	14	0
PV Value of Properties (Total including AAD,	£ 1,655,320	£ 1,477,815.61	£ 45,461	£ -
Critical Infrastructure	Sewage works, Sheppey Crossing, South Marshes, and B2231 at risk	Sewage works, Sheppey Crossing, South Marshes, and B2231 at risk	Sewage works, Sheppey Crossing, South Marshes, and B2231 at risk over time	Infrastructure protected
PV Value of Impacts on road and rail	£782,681 Isle of Sheppey rail line	£ 639,379	£39,229 Isle of Sheppey rail line	-
PV Value of Tourism and Recreation Impacts	-	£ -	-	-
PV Value of Agriculture Impacts	£83,967 Worst case scenario 152ha of Grade 4 agricultural land flooded and 48ha Grade 5 flooded	£ 73,652	£26,866 Worst case scenario 149ha Grade 4 agricultural land flooded and 42ha Grade 5 flooded	£26,524 Worst case scenario 14ha Grade 4 agricultural land flooded and 32ha Grade 5 flooded
Stakeholders Feedback				
Statutory Stakeholders/ SEG	No specific comments	No specific comments	No specific comments	No specific comments
Landowners	No specific comments	No specific comments	No specific comments	No specific comments
Technical Feasibility				
Site Specific	n/a	n/a	n/a	n/a
Strategy Wide	n/a	n/a	n/a	n/a
WFD (Water Framework Directive)				
Compliance assessment outcome	2 Some return to natural processes but uncontrolled	2 Some return to natural processes but uncontrolled	1 Heavily Modified Water Body (HMWB) maintained	1 Heavily Modified Water Body (HMWB) maintained

HRA (Habitats Regulation Assessment)				
Impact on SPA/ Ramsar qualifying features	1 There are potential significant effects on the Swale SPA and constituent qualifying features due to coastal squeeze until the defences fail in year 25. Coastal squeeze will lead to a loss of mudflat and small areas of saltmarsh habitat. When defences fail there is likely to be inundation of the designated freshwater habitats. However this may allow intertidal habitats to develop.	1 There are potential significant effects on the Swale SPA and constituent qualifying features due to coastal squeeze until the defences fail in year 30. Coastal squeeze will lead to a loss of mudflat and small areas of saltmarsh habitat. When defences fail there is likely to be inundation of the designated freshwater habitats. However this may allow intertidal habitats to develop.	1 There are potential significant effects on the Swale SPA and constituent qualifying features due to coastal squeeze. Coastal squeeze will lead to a loss of mudflat and small areas of saltmarsh habitat. However with sea level rise the risk of overtopping will increase. This will significantly impact on the freshwater habitat, but may allow intertidal habitats to develop behind the defences.	2 There are potential significant effects on the intertidal Swale SPA and constituent qualifying features due to coastal squeeze. Coastal squeeze will lead to a loss of mudflat and small areas of saltmarsh habitat.
Impacts on freshwater habitats	1 Yes. Compensatory habitat would be required in advance of failure of the defences to compensate for the loss of freshwater grazing marsh at Neatscourt Marshes.	1 Yes. Compensatory habitat would be required in advance of failure of the defences to compensate for the loss of freshwater grazing marsh at Neatscourt Marshes.	1 Yes. Compensatory habitat would be required in advance of regular overtopping of the defences to compensate for the gradual loss of freshwater grazing marsh at Neatscourt Marshes.	3 No, defences improved so the risk of overtopping reduced.
Impacts on intertidal habitats	2 Yes, until defences are predicted to fail (from year 25). Development of tidal habitats once defences fail will begin to mitigate for coastal squeeze, although this is uncontrolled and the quality of habitat that develops is unknown.	2 Yes, until defences are predicted to fail (from year 30). Development of tidal habitats once defences fail will begin to mitigate for coastal squeeze, although this is uncontrolled and the quality of habitat that develops is unknown.	1 Yes, the maintenance of the defences will lead to coastal squeeze over time. However with the increased risk of overtopping intertidal habitat may start to develop behind the defences but this is uncontrolled.	1 Yes because the defences are improved there is the potential for coastal squeeze and the loss of designated intertidal habitat.
Habitat Connectivity	2 Slight negative impact on connectivity of saltmarsh/mudflat habitats due to loss of habitat from coastal squeeze before defences fail in year 25. Loss of freshwater grazing marsh habitat along the Swale once defences fail, although estuarine habitat connectivity should begin to open up again.	2 Slight negative impact on connectivity of saltmarsh/mudflat habitats due to loss of habitat from coastal squeeze before defences fail in year 30. Loss of freshwater grazing marsh habitat along the Swale once defences fail, although estuarine habitat connectivity should begin to open up again.	2 Slight negative impact on connectivity of saltmarsh/mudflat habitats due to loss of habitat from coastal squeeze. However with increased risk of overtopping due to sea level rise there will also be a loss of freshwater grazing marsh habitat along the Swale.	1 Negative impact in connectivity due to loss of habitat from coastal squeeze.
SEA (Strategic Environmental Assessment)				
Historic Environment	3 No historical assets at risk	3 No historical assets at risk	3 No historical assets at risk	3 No historical assets at risk
Effects on population	1 Potential impacts on agricultural livelihoods once the defences fail.	1 Potential impacts on agricultural livelihoods once the defences fail.	2 Possible risk to agricultural livelihoods overtime due to increased risk of overtopping.	5 Reduced risk of flooding so agricultural livelihoods protected.
Impact on plans/ programmes	3 Benefit area does not coincide with proposed development sites	3 Benefit area does not coincide with proposed development sites	3 Benefit area does not coincide with proposed development sites	3 Benefit area does not coincide with proposed development sites
Freshwater Biodiversity	1 Loss of freshwater habitat due to saline intrusion - relatively untouched rural freshwater marshland.	1 Loss of freshwater habitat due to saline intrusion - relatively untouched rural freshwater marshland.	2 Impacts on freshwater habitat from overtopping, however there may be the sustainable natural rollback of the freshwater habitat.	4 Freshwater habitat at reduced risk from flooding



Saline Biodiversity	3 Potential for coastal squeeze until the defences fail in year 25. after this there could be the uncontrolled development of intertidal habitat, but the extent and quality of this is unknown.	3 Potential for coastal squeeze until the defences fail in year 30. after this there could be the uncontrolled development of intertidal habitat, but the extent and quality of this is unknown.	2 Impacts to SPA from coastal squeeze. Although with sea level rise there may be some overtopping of the defences, which could allow the development of intertidal habitats behind the defences, but this is uncontrolled.	1 Impacts to SPA from coastal squeeze
Soil	1 Agricultural land at risk from degradation due to saline intrusion	1 Agricultural land at risk from degradation due to saline intrusion	2 Agricultural land at risk from degradation due to saline intrusion overtime as the risk of overtopping increases.	5 Soils at reduced risk of degradation as the defences are improved.
Groundwater	2 No impacts predicted on aquifers, but there is a risk of mobilisation of contaminants from the landfill site once the defences fail.	2 No impacts predicted on aquifers, but there is a risk of mobilisation of contaminants from the landfill site once the defences fail.	2 No impacts predicted on aquifers, but there is a risk of mobilisation of contaminants from the landfill sites over time as the risk of overtopping increases.	3 No impacts predicted on aquifers, or risk of mobilisation of contaminants from the landfill sites as the defences are improved.
Landscape (visual impact)	4 Gradual changes to landscape but reverting to natural processes. Positive/negative effects depending on view and visual receptors,- assumed a benefit	4 Gradual changes to landscape but reverting to natural processes. Positive/negative effects depending on view and visual receptors,- assumed a benefit	3 Gradual changes to landscape but reverting to natural processes. Positive/negative effects depending on view and visual receptors,-	2 Potential visual impact dependent on height of defences
Carbon Storage	3 Negligible - small loss of carbon storage through coastal squeeze	3 Negligible - small loss of carbon storage through coastal squeeze	2 Negligible - small loss of carbon storage through coastal squeeze over time. Some carbon cost in construction.	2 Some carbon cost through construction and loss of habitat storage through coastal squeeze.
Ecosystem Services				
Qualitative Score from Ecosystem Services	-44	-44	-27	-11
Comments	Major degradation in many ES (e.g. food, water regulation, natural hazard regulation, erosion regulation, water purification, pollination and conservation habitat) outweigh limited enhancement opportunities (e.g. aesthetic value and fishery habitat)	Major degradation in many ES (e.g. food, water regulation, natural hazard regulation, erosion regulation, water purification, pollination and conservation habitat) outweigh limited enhancement opportunities (e.g. aesthetic value and fishery habitat)	Moderate degradation in various ES (e.g. food, water regulation, natural hazard regulation and erosion regulation) outweigh limited enhancement opportunities (e.g. aesthetic value and fishery habitat)	Degradation in many ES (e.g. genetic resources, air quality regulation, climate regulation, aesthetic value, conservation habitat and fishery habitat) outweigh limited enhanced opportunities (e.g. natural hazard regulation and erosion regulation)
To what extent does the option meet the objectives?				
1- Reduce Flood Risk	N	N	Y	Y
2 - Natura 2000 sites	N	N	N	N
3- Reduce maintenance	Y	Y	Y	Y
4 - WFD	N	N	N	N
5 - Local Plans	Y	Y	Y	Y

Environmental Scores				
100 = best option, 0 = worst option				
Option	a) Do nothing	b) Do minimum	c) Maintain (capital) embankments	d) Raise (sustain) embankments
WFD (Water Framework Directive)				
Compliance assessment outcome	25	25	0	0
HRA (Habitats Regulation Assessment)				
Impact on SPA/ Ramsar qualifying features	0	0	0	25
Impacts on freshwater habitats	0	0	0	50
Impacts on intertidal habitats	25	25	0	0
Habitat Connectivity	25	25	25	0
SEA (Strategic Environmental Assessment)				
Historic Environment	50	50	50	50
Effects on population	0	0	25	100
Impact on plans/ programmes	50	50	50	50
Freshwater Biodiversity	0	0	25	75
Saline Biodiversity	50	50	25	0
Soil	0	0	25	100
Groundwater	25	25	25	50
Landscape (visual impact)	75	75	50	25
Carbon Storage	50	50	25	25
Total	375	375	325	550

Summary of Results				
Option	a) Do nothing	b) Do minimum	c) Maintain (capital) embankments	d) Raise (sustain) embankments
Costs	£ -	£ 217,000	£ 3,201,809	£ 6,235,895
Benefits	£ -	£ 331,000	£ 2,410,411	£ 2,495,443
NPV	£ -	£ 114	-£ 791,398	-£ 3,740,452
BCR	0.0	1.5	0.8	0.4
Environmental Scoring	375	375	325	550

Preferred Option Costs			
Cost	Benefits	BCR	PF Score
N/A	N/A	N/A	N/A