

POLICY OPTION: No Active Intervention	
SCENARIO REF: No Active Intervention	
Scenario Summary	<p>Under this policy option, strategic monitoring of the Cuckmere Estuary will continue, ensuring that natural processes are not creating a risk to public Health and Safety. Maintenance and repair work to the existing defences will be stopped. No action is taken to intervene with the natural processes, allowing nature to take its course. This scenario could lead to one or more of the consequences listed below:</p> <ul style="list-style-type: none"> • Blockage of the mouth. • Erosion of the earth banks along the channel leading to a breach/failure. • Landward erosion of the beach or catastrophic failure of the beach. • Regular overtopping of the defences. <p>Any one of these consequences could occur first. However, on the basis of the assessments undertaken to date and historical information it is reasonable to assume that a blockage (most probably partial, but potentially a full blockage) of the mouth is the most likely (the likelihood being almost annually). A blockage of the mouth has the potential to cause an additional flood risk just upstream of Exceat Bridge.</p> <p>Landward erosion is occurring along sections of the east and west beach. The modelling work undertaken to date concluded that the west beach is very unstable and can be significantly shifted towards the land by moderate water levels and waves (including the 1 in 1 year wave). The estimated equilibrium position for the present (shingle ridge) crest is approximately 20m landwards of its current location. The stability of the east beach increases from west to east. The far east sections of the east beach can potentially withstand a combination of a 1 in 30 year water level and a 1 in 30 year wave.</p>

<p>The floodplains on the east and west side of the channel are currently protected to the level of the highest annual tide. Physical failure of the embankments or training walls is difficult to predict without detailed investigation. A visual engineering assessment carried out in 2004, has indicated that, under a 'No Active Intervention' policy the existing defences may have a life expectancy of up to 15 years. However, failure could occur at any time during an overtopping event through erosion of the crest. The likelihood of this is high given the nature of the material used for bank construction.</p> <p>In light of the above uncertainties there are a number of assumptions that have been made in the immediate term to predict the impacts for the medium (20 to 50 years) and long-term (50 to 100 years) time frames. Without these assumptions it is difficult to predict the natural processes that will occur and hence make any reasonable assessment of the long-term scenario implications.</p>			
<p>Location within Study Area</p>	<p>Predicted Change for</p>		
<p>The River Channel</p>	<p>Years 0 – 20</p> <p>Within this epoch the erosion of the river channel and flood banks will continue. The channel will seek to gradually increase in width and depth with the gradient of the river banks becoming steeper. It is likely that the flood banks will be subjected to a number of overtopping events. During an overtopping event the crest of the flood bank will be subject to erosion since there is currently no form of physical protection from scour. It is also likely the flood banks will fail at one or more locations between now and the end of</p>	<p>Years 20 – 50</p> <p>During this epoch it is assumed that the flood banks have failed at the susceptible points where erosion is prevalent. Initially the points where the tidal waters are entering the floodplain will increase in size as the flood banks erode. During this epoch the flood banks will become less defined and lost through erosion. The existing channel is likely to remain the main flow path for both fluvial and tidal flows. However, new limbs to the main channels will be created, as historic and new creeks are re/formed in the</p>	<p>Years 50 – 100</p> <p>There is a lot of uncertainty over the position and formation of the river channel through this epoch. The whole estuary (south of Exceat Bridge) will become a dynamic environment. Natural processes will dictate the changes to the channel. The channel will adjust naturally to the impacts of climate change including sea level rise.</p>

	<p>this time period through a combination of erosion and scour from an overtopping event.</p>	<p>floodplain. The channel will start to adapt to the new regime by becoming funnel shaped. During this epoch the channel will develop into a naturally functioning, self sustaining channel.</p>	
<p>Intervention</p>	<p>None proposed</p>	<p>None proposed</p>	<p>None proposed</p>

The Floodplain	<p>In the short term of this epoch the floodplain will continue to function in its current form. It is anticipated that there will be an increase in the number of overtopping events due to the impact of sea level rise. Once the banks start to fail the floodplain will become inundated at more regular intervals, eventually to a position where it is inundated during each tide cycle. Areas exposed to regular inundation will start to develop into inter tidal habitat. Salt marsh species may start to colonise the area</p>	<p>Regular inundation of the floodplain will lead to the creation of a new network of tidal creeks flowing into the main channel. Historic creeks are likely to be reactivated becoming more defined features within the floodplain. This is especially the case for the old meander. The meander is likely to become a tidal limb to the main channel. However, there is a possibility that a failure in the flood banks could occur just downstream of the bridge, adjacent to where the meanders join the eastern flood bank. This could lead to serious problems at the bridge as the banks erode.</p> <p>During the initial stages of this epoch inter tidal habitat will develop over much of the land surface. A more natural estuarine landscape will develop.</p>	<p>The floodplain will naturally adjust to the processes that are occurring as a result of climate change.</p>
Intervention	None proposed	None proposed	None proposed
The mouth of the Estuary	<p>It is anticipated that significant changes to the mouth will be connected with the failure of the channel banks. Currently the mouth is prone to sediment deposition and blocking</p>	<p>During this epoch the mouth of the estuary will become very dynamic as it adjusts to the new environment. The increase in volume of tidal water passing through the mouth should</p>	<p>The mouth will continue to widen as it naturally adjust to the processes that are occurring as a result of climate change moving towards a form in equilibrium with the</p>

	<p>with beach material this process will continue. From assessments made and using historic information it is likely that blockages will form (either partially or completely) on an annual basis. This will impact on the ability of the river to discharge fluvial water and has the potential to cause flooding upstream. It is considered highly unlikely the material build up at the mouth will lead to a complete blockage of fluvial flows. As the flood banks fail the mouth will start to adjust to the increased volume of water that is being exchanged during each tidal cycle. This will lead to the mouth becoming wider and/or deeper as a result. The mouth will move towards become self sustaining.</p>	<p>create a self cleansing system.</p> <p>In time the increased erosive forces at the mouth will undermine the training walls. It is likely both walls will be lost during the early stages of this epoch. Once this occurs the mouth will have more freedom to develop to an equilibrium form</p> <p>From the assessments undertaken the mouth will tend to migrate towards the east. However, the extent of migration cannot be accurately determined. It is considered unlikely the migration of the mouth will be as dramatic as in the past due to the present alignment of the waves (being different from that in the past) and the limited supply of sediment from the west.</p> <p>The fore bulge (ebb delta) should continue to increase in size as sediment is scoured from the channel.</p>	<p>local coastal processes.</p>	
<p>Intervention</p>	<p>None proposed</p>	<p>None proposed</p>	<p>None proposed</p>	

<p>The Beach</p>	<p>During this epoch the western beach will behave differently to the eastern beach due to their relative positions between the cliffs and being subject to differing coastal processes.</p> <p>The storm ridge on the western beach will continue to erode and migrate in a landward direction. This will lead to the profile of the beach becoming wider and flatter. A severe storm event in this period could lead to an increase in the rate of erosion. The beach may not be stable enough to prevent roll over of the ridge and which could lead to tidal inundation of the areas landward of the ridge.</p> <p>The east beach appears more stable than the west beach. The far eastern section of this beach is likely to remain in the existing position with a similar profile. The section of beach towards the mouth will be subject to higher levels of erosion and tend to migrate landwards.</p>	<p>The beach will continue to act as a pocket beach. Sediment is likely to be redistributed within the beach between the chalk cliffs.</p> <p>The development of the beach is uncertain during this epoch. Its behaviour being dependant on the frequency and intensity of storm events. The erosion of the cliff buttresses on either side of the valley will also affect its development.</p>	<p>It is difficult to predict the changes that will occur during this epoch. The behaviour of the beach will depend on the occurrence of storm events and the erosion rate of the Seven Sisters cliffs.</p>
<p>Intervention</p>	<p>None proposed</p>	<p>None proposed</p>	<p>None proposed</p>

POLICY OPTION: No Active Intervention with an EXIT STRATEGY	
SCENARIO REF: No Active Intervention with an EXIT STRATEGY	
Scenario Summary	<p>There are a number of uncertainties with the immediate implementation of a 'No Active Intervention' policy. The risks can be managed if an 'exit strategy' is commenced for a period of time prior to the 'No Active Intervention' policy being adopted. An 'exit strategy' would involve a limited amount of maintenance to minimise some of the main risks and a period of formal notification to the landowners and the affected parties. The maintenance work to manage these risks are detailed below:-</p> <ul style="list-style-type: none"> • Removing material from the mouth to prevent a partial or full blockage occurring; • Protecting the stability of the western beach to prevent catastrophic failure and migration of the channel in a westerly direction; • Close monitoring of the river channel adjacent to Exceat Bridge to ensure erosion does not affect the stability of the bridge abutments. <p>The above maintenance would need to be carried out until the flood embankments failed. Then the system would naturally start to adjust to the increased volume of water being exchanged during each tidal cycle. While the system is adjusting there would be a need to monitor the mouth during the neap tides (only) to check the system is self cleansing.</p>
Location within	Predicted Change for

Study Area	Years 0 – 20	Years 20 – 50	Years 50 – 100
The River Channel	<p>In the short term of this epoch the floodplain will continue to function in its current form. It is anticipated that there will be an increase in the number of overtopping events due to the impact of sea level rise. Once the banks start to fail the floodplain will become inundated at more regular intervals, eventually to a position where it is inundated during each tide cycle. Areas that are exposed to regular inundation will start to adjust towards becoming inter tidal habitat. Salt marsh species may start to colonise the area.</p>	<p>During this epoch it is assumed that the flood banks have failed at the susceptible points where erosion is prevalent. Initially the points where the tidal waters are entering the floodplain will increase in size as the flood banks erode. During this epoch the flood banks will become less defined and lost through erosion. The existing channel is likely to remain the main flow path for both fluvial and tidal flows. However, new limbs to the main channels will be created, as historic and new creeks are re/formed in the floodplain.</p> <p>The channel will start to adapt to the new regime by becoming funnel shaped. During this epoch the channel will develop into a naturally functioning, self sustaining channel.</p>	<p>There is a lot of uncertainty over the position and formation of the river channel through this epoch. The whole estuary (south of Exceat Bridge) will become a dynamic environment. Natural processes will dictate the changes to the channel. The channel will adjust naturally to the impacts of climate change including sea level rise.</p>
Intervention	<p>The bridge and the section of bank just downstream of the bridge abutments will be monitored for signs of possible failure, due to erosion. If the channel and banks demonstrate significant signs of erosion at</p>	<p>It is anticipated that no intervention will be required on the channel or flood banks during this epoch.</p>	<p>It is anticipated that no intervention will be required on the channel or flood banks during this epoch.</p>

	<p>this location there will be a need to provide protection. Failure at this location could threaten the bridge structure and access to the Golden Galleon Public House.</p>		
<p>The Floodplain</p>	<p>In the short term of this epoch the floodplain will continue to function in its current form. It is anticipated that there will be an increase in the number of overtopping events due to the impact of sea level rise. Once the banks start to fail the floodplain will become inundated at more regular intervals, eventually to a position where it is inundated during each tide cycle. Areas exposed to regular inundation will start to develop into inter tidal habitat. Salt marsh species may start to colonise the area</p>	<p>Regular inundation of the floodplain will lead to the creation of a new network of tidal creeks flowing into the main channel. Historic creeks will be reactivated becoming more defined features within the floodplain. This is especially the case for the old meander. The meander is likely to become a tidal limb to the main channel.</p> <p>During the initial stages of this epoch inter tidal habitat will develop over much of the land surface. A more natural estuarine landscape will develop.</p>	<p>The floodplain will naturally adjust to the processes that are occurring as a result of climate change.</p>
<p>Intervention</p>	<p>It is anticipated that no intervention will be required on the floodplain during this epoch.</p>	<p>It is anticipated that no intervention will be required on the floodplain during this epoch.</p>	<p>It is anticipated that no intervention will be required on the floodplain during this epoch.</p>
<p>The mouth of the Estuary</p>	<p>It is anticipated that significant changes to the mouth will be connected with the failure of the channel banks. Prior to their failure.</p>	<p>During this epoch the mouth of the estuary will become very dynamic as it adjusts to the new environment. The increase in volume of</p>	<p>The mouth will continue to widen as it naturally adjusts to the processes that are occurring as a result of climate change.</p>

<p>intervention at the mouth will be continued in terms of maintenance by the removal of material deposited within the mouth. This will prevent blockage of the mouth from causing problems upstream.</p> <p>As the flood banks fail the mouth will start to adjust to the new increased volume of water that is being exchanged during each tidal cycle. This will lead to the mouth wanting to become becoming wider and/or deeper as a result. From this point forth the mouth will move towards become self cleansing in terms of deposition.</p>	<p>tidal water passing through the mouth should lead to the development of a self cleansing mouth.</p> <p>In time the erosive forces at the mouth will undermine the training walls. Assessments have identified that the mouth will have a tendency to migrate towards the east. Due to this, the eastern training wall will fail during the early stages of this epoch. Once this occurs the mouth will begin to widen significantly in this direction. The western training wall will be maintained for as long as possible to provide support to the western beach and to prevent migration of the mouth in a westerly direction.</p> <p>The extent of migration cannot be accurately determined and it is unknown how far the mouth will migrate. It is considered unlikely the migration of the mouth will be as dramatic as in the past due to the present alignment of the waves (being different from that in the past) and the limited supply of sediment from the west</p>	<p>moving towards a form in equilibrium with the local coastal processes.</p>
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	<p>The fore bulge (ebb delta) will continue to increase in size as sediment is scoured from the channel.</p>		
<p>Intervention</p>	<p>At the start of this epoch the eastern training wall should be removed. This will reduce the H&S risk as the structure deteriorates and allows the mouth to adjust in an easterly location. The western training structure will initially be left in place to prevent the mouth migrating in a westerly direction. However, there will be a need to remove the structure at a later date for H&S reasons.</p>	<p>There will be annual monitoring of the mouth to ensure a build up of material does not impact on the ability of the mouth to convey flows. Material will be moved from the mouth and redistributed on to the western beach. The volume of material will be increased each year to stabilise the western beach. Removal of material at the mouth will be continued until the banks are naturally breached. Once this occurs the mouth will adjust and start to become self cleansing. Maintenance activities will be reduced over time, monitoring will be ongoing</p>	<p>No intervention will be required at the mouth during this epoch.</p>
<p>The Beach</p>	<p>The beach will continue to act as a pocket beach. Sediment is likely to be redistributed within the beach between the chalk cliffs. It is difficult to predict the changes that will occur during this epoch. The behaviour of the beach will depend on the occurrence of storm events and the erosion of the cliff</p>	<p>During this epoch the western beach will behave differently to the eastern beach due to their relative positions between the cliffs and being subject to differing coastal processes. The storm ridge on the western beach will continue to erode. Gradually the storm ridge will migrate in a landward direction. The profile of the beach will widen</p>	<p>Again, it is difficult to predict the changes that will occur during this epoch. The behaviour of the beach will depend on the occurrence of storm events and the erosion of the cliff buttresses on either side of the valley.</p>

	<p>and flatten. The rate of erosion will increase if the beach is subjected to severe storm events during this period. Under this scenario the western beach will be supplemented by material removed from the mouth. This will significantly help to prevent catastrophic failure of the beach.</p> <p>The east beach appears more stable than the west beach. The far eastern section of the beach is likely to remain in its existing position with a similar profile. The section of beach towards the mouth will be subject to higher levels of erosion and tend to migrate landwards.</p>	<p>buttresses on either side of the valley.</p>	
<p>Intervention</p>	<p>Material will be moved from the mouth and redistributed on to the western beach. The volume of material will be increased each year to stabilise the western beach. Material will be placed on the back face of the existing shingle ridge to prevent a storm event causing a catastrophic breach. This activity will be continued until the banks are naturally breached.</p>	<p>Erosion of the west beach will need to be monitored to prevent erosion of the cliff face below the coastguard cottages. The groyne south of the western beach will need to be removed if they become a H&S risk to the public.</p>	<p>No intervention will be required on the beach during this epoch.</p>

POLICY OPTION: Hold The Line

SCENARIO REF: Maintain the Existing Defences

<p>Under this scenario the Environment Agency would maintain the flood embankments along the present line. The training structures at the mouth and the field of groyne to the west of the existing mouth would also be maintained. Maintenance of privately owned defences will remain the responsibility of the respective owners.</p> <p>The embankments will be actively managed to prevent a breach failure of the defences. Rising water levels as a result of climate change will increase the chance of overtopping and hence there will be a need to reinforce the crest of the defences. In the long-term, (50 to 100 years) it is likely that there will be a need to replace much, if not all, of the existing earth embankments with hard defences.</p> <p>The integrity of the beaches (east and west) will need to be sustained against the threat of progressive wave attack. This is especially the case for the western beach. The western beach, if maintained at its present alignment, would be in an increasingly-aggressive (as a result of wave impact) environment as sea levels continue to rise. This could lead to a risk of catastrophic failure on an increasingly frequent basis and denude the sediment from the beach. As a result, sediment importation or more frequent sediment recycling would be required. It is likely that the western beach would need rock armour protection in the medium-term (20 to 50 years) as continued shingle re-nourishment would not be sustainable.</p> <p>To prevent the mouth from blocking the Environment Agency would continue to annually intervene. The rate of intervention is likely to increase with time leading to greater volumes being removed from the mouth or from the west beach by progressive wave attack.</p> <p>There will be the need to replace the timber training wall structures at the mouth and the timber groyne field. The replacement training structure will need to be much larger to function within the processes occurring at the mouth. The groyne will need to be regularly maintained and replaced after approximately a 30 year period.</p>	
<p>Location within Study Area</p>	<p>Predicted Change for</p>

	Years 0 – 20	Years 20 – 50	Years 50 – 100
<p>The River Channel</p>	<p>Under this scenario the river channel will be maintained in its current constrained form along the same alignment. The erosive pressures on the channel will increase as climate change forces more water through the channel. The area of salt marsh present in the channel will begin to erode as it is squeezed between the defences and the erosive channel. The bank crest level will be maintained at its current level. Rising water levels due to climate change will increase the number of overtopping events.</p>	<p>Under this epoch the processes mentioned in the first period are continued. There will be a continued loss of the salt marsh as the channel tries to widen. The erosive nature of the river will lead to a need for a greater level of protection on the channel banks using harder engineering solutions. This is especially the case through the seaward section of the channel. The channel will start to erode the bed creating a deeper channel.</p>	<p>During this epoch the channel, being constrained by hard engineering structures, will continue to erode vertically.</p>
<p>Intervention</p>	<p>There will be a need to protect the river channel and flood banks from the threat of erosion. There are a number of locations where the channel and flood banks are showing signs of severe erosion. These locations will be protected using stone or a concrete revetment system. The crest and back face of the flood bank will need to be protected against regular overtopping events during this epoch.</p>	<p>During this epoch the seaward section of the channel will need to be protected using hard engineering solution. Steel sheet piling or concrete walls are likely to be required to support the flood banks from the erosion of the channel sides and the bed.</p>	<p>During this epoch a programme of maintenance and replacement of the hard engineering structures will be required to sustain the channel in the present form.</p>

<p>The Floodplain</p>	<p>During this epoch the floodplain will continue to function in its current form. There is likely to be an increase in the number of overtopping events due to the impact of sea level rise. The meanders will continue to silt up and experience greater levels of saline intrusion from the tide. The meandering channel will become less of a defined feature and thinner in profile.</p>	<p>The processes described in the preceding epoch will continue to occur.</p> <p>An increase in the frequency of overtopping and greater levels of precipitation will lead to more water standing on the floodplain.</p>	<p>The processes described in the preceding epochs will continue to occur.</p>
<p>Intervention</p>	<p>Continued maintenance of the footpaths and access tracks would be required.</p>	<p>Continued maintenance of the footpaths and access tracks would be required.</p>	<p>Continued maintenance of the footpaths and access tracks would be required.</p>
<p>The mouth of the Estuary</p>	<p>The mouth of the estuary is a dynamic environment with material constantly adjusting to the flow regime. The impact of sea level rise will gradually lead to greater volumes of material being transported into the mouth. This will especially be the case following storm events.</p> <p>The delta formation that is evident at the bottom of the beach profile is likely to continue to extend seaward.</p>	<p>During this epoch the impact of climate change will start to threaten the stability of the training structures. The bed will adjust to the increase in flows by eroding vertically, undermining the timber training walls.</p> <p>The need to remove material from the mouth will become more frequent.</p>	<p>The processes that occur at the mouth will be closely related to the design of the new training structures.</p>

<p>Intervention</p>	<p>The practice of removing material from the mouth will continue. The volume of material is likely to increase during this period.</p>	<p>The practice of removing material from the mouth will continue. The frequency of intervention will increase.</p> <p>During this epoch both training structures will have to be replaced by more robust structures. The new structures will be constructed from concrete/steel as it is unlikely a timber structure will suffice in the aggressive environment.</p>	<p>The practice of removing material from the mouth will continue. The frequency of intervention will increase.</p>
<p>The Beach</p>	<p>The western beach is artificially maintained in the current position. This has been achieved over the years by the use of groynes and the annual recycling of material from the mouth. Under this scenario the beach will be maintained in its current position.</p> <p>During this epoch the shingle ridge on the western beach will continue to attempt to roll back to a landward position. The beach is unstable and will require maintenance of the groynes and the annual recycling to sustain the existing line. However, the beach is likely to remain susceptible to catastrophic failure.</p>	<p>The western beach will be subject to an increasingly aggressive environment through this epoch. The shingle ridge will be unsustainable in its current form and position, even with annual recycling. A more robust form of protection will be required to hold the existing line.</p> <p>During this epoch sea level rise will start to threaten the stability of the eastern end of the eastern beach. There will be a need to intervene on an annual basis to manage the movement of shingle and to prevent catastrophic failure.</p>	<p>It is difficult to predict the changes that will occur during this epoch. The behaviour of the beach will depend on the occurrence of storm events and the rate the cliffs of the Seven Sisters retreat.</p>

<p>Intervention</p>	<p>The east beach is more stable than the west beach. The far eastern section of the beach will remain in the existing position with a similar profile. Closer to the mouth the eastern beach is less stable; however, during this epoch it is unlikely there will be a need for intervention.</p> <p>Material will be moved from the mouth and redistributed on to the western beach. The frequency and volume of material will gradually increase. The groyne will be maintained and replaced during this epoch.</p> <p>Monitoring of the east beach will be required</p>	<p>During this epoch the recycling of shingle to stabilise the western beach will be replaced with a more robust solution. The western beach will be rebuilt using rock armour protection between the mouth and the cliff face.</p> <p>During this epoch the groyne will have to be replaced as the existing structures will come to the end of their design life.</p> <p>Shingle recycling will be necessary to stabilise the eastern end of the eastern beach.</p>	<p>During this epoch the groyne will have to be replaced as the existing structures will come to the end of their design life.</p> <p>There will be a continued need to manage or even re-nourish the eastern beach. It is assumed that the western beach will not need intervention due to the rock armour protection.</p>
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POLICY OPTION: Hold The Line	
SCENARIO REF: Sustain the Existing Defences	
Scenario Summary	Under this scenario the Environment Agency would need to undertake the same level of intervention as detailed in the 'Maintain' scenario. However, to cater for the impact of climate change the defences will need to be raised by approximately 600mm over the next 100 years (Defra, FCDPAG). This will sustain the existing standard of protection (SoP) for the Estuary south of Exceat Bridge. The existing defences only provide protection to approximately the level of the highest annual tide. To raise the banks by 600mm the existing earth banks will have to be built up on both the crest and the back face of the bank. This will maintain the crest width and hence the stability of the embankments.
Location within Study Area	Predicted Change for
	Years 0 – 20
The River Channel	Under this scenario the river channel will be maintained in its current constrained form along the same alignment. The erosive forces on the channel will increase as climate change forces more water through the channel. The area of salt marsh present in the channel will begin to erode as it is squeezed between the defences and the erosive channel. The bank crest level will be raised to maintain the standard of protection
	Years 20 – 50
	Under this epoch the processes mentioned during the first 20 years are continued. There will be a continued loss of the salt marsh as the channel tries to widen. The erosive nature of the river will lead to a need for a greater level of protection for the channel banks using harder engineering solutions. This is especially the case through the seaward section of the channel. The channel will start to erode the bed creating a
	Years 50 – 100
	During this epoch the channel, being constrained by hard engineering structures, will continue to erode vertically.

	<p>deeper channel.</p> <p>Towards the end of this time frame the impact of sea level rise will lead to a need for a second phase of bank raising to prevent regular overtopping of the defences.</p>	<p>provided.</p>	
<p>Intervention</p>	<p>During this epoch the seaward section of the channel will need to be protected using a hard engineering solution. Steel sheet piling or concrete walls will be required to support the flood banks from the erosion of the channel sides and the bed.</p> <p>The second phase of bank raising (approximately 300mm) will be completed to ensure flood protection is provided for the later part of the appraisal period.</p>	<p>There will be a need to protect the river channel and flood banks from the threat of erosion. There are a number of locations where the channel and flood banks are showing signs of erosion. These locations will be protected using stone or a concrete revetment system. The crest of the flood banks will be raised by approximately 300mm to cater for the impact of climate change over the first 50 year.</p>	
<p>The Floodplain</p>	<p>The processes described in the preceding epoch will continue to occur.</p> <p>Greater levels of precipitation will lead to more water standing on the floodplain.</p>	<p>During this epoch the floodplain will continue to function in its current form. The meanders will continue to silt up and experience greater levels of saline intrusion from the tide. The meandering channel will become less of a defined feature and thinner in profile.</p>	<p>The processes described in the preceding epochs will continue to occur.</p>

Intervention	Continued maintenance of the footpaths and access tracks would be required.	Continued maintenance of the footpaths and access tracks would be required.	Continued maintenance of the footpaths and access tracks would be required.
The mouth of the Estuary	<p>The processes that occur at the mouth will be closely related to the design of the new training structures.</p>	<p>During this epoch the impact of climate change will start to threaten the stability of the training structures. The bed will adjust to the increase in flows by eroding vertically, undermining the timber training walls.</p> <p>The need to remove material from the mouth will become more frequent as a result of storm events.</p>	<p>The mouth of the estuary is a dynamic environment with material constantly adjusting to the flow regime. The impact of sea level rise will gradually lead to greater volumes of material being transported into the mouth. This will especially be the case following storm events.</p> <p>The delta formation that is evident at the bottom of the beach profile is likely to continue to extend seaward.</p>
Intervention	<p>The practice of removing material from the mouth will continue. The frequency of intervention will increase.</p>	<p>The practice of removing material from the mouth will continue. The frequency of intervention will increase.</p> <p>During this epoch both training structures will have to be replaced by more robust structures. The new structures will be constructed from concrete/steel as it is unlikely a timber structure will suffice in the</p>	<p>The practice of removing material from the mouth will continue. The volume of material is likely to increase during this period.</p>

<p>The Beach</p>	<p>The western beach is maintained in the current position by intervention. This has been achieved over the years by the use of groynes and the annual recycling of material from the mouth. Under this scenario the beach will be maintained in its current position.</p> <p>During this epoch the shingle ridge on the western beach will continue to attempt to roll back to a landward position. The beach is unstable and will require maintenance of the groynes and the annual recycling to sustain the existing line. However, the beach is likely to remain susceptible to catastrophic failure.</p> <p>The east beach is more stable than the west beach. The far eastern section of the beach will remain in the existing position with a similar profile. Closer to the mouth the eastern beach is less stable; however, during this epoch it is unlikely there will be a need for intervention.</p>	<p>aggressive environment.</p> <p>The western beach will be subject to an increasingly aggressive environment through this epoch. The shingle ridge will be unsustainable in its current form and position, even with annual recycling. A more robust form of protection will be required to hold the existing line.</p> <p>During this epoch sea level rise will start to threaten the stability of the eastern end of the eastern beach. There will be a need to intervene on an annual basis to manage the movement of shingle and to prevent catastrophic failure.</p>	<p>It is difficult to predict the changes that will occur during this epoch. The behaviour of the beach will depend on the occurrence of storm events and the rate the Seven Sisters retreat.</p>
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<p>Intervention</p>	<p>Material will be moved from the mouth and redistributed on to the western beach. The frequency and volume of material will gradually increase. The groyne will be maintained and replaced during this epoch.</p> <p>The east beach will be monitored.</p>	<p>During this epoch the recycling of shingle to stabilise the western beach will be replaced with a more robust solution. The western beach will be rebuilt using rock armour protection between the mouth and the cliff face.</p> <p>During this epoch the groyne will have to be replaced, as the existing structures will come to the end of their design life.</p> <p>Shingle recycling will be necessary to stabilise the eastern end of the eastern beach.</p>	<p>During this epoch the groyne will have to be replaced, as the existing structures will come to the end of their design life.</p> <p>There will be a continued need to manage or even re-nourish the eastern beach. It is assumed that the western beach will not need intervention due to the rock armour protection.</p>
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POLICY OPTION: Managed Realignment		
SCENARIO REF: Partial Managed Realignment (Cells B & C)		
Scenario Summary	<p>This scenario considers a breach retreat of the defences to allow for tidal inundation of the western floodplain (cell B) and the southern floodplain on the eastern side of the channel (cell C). The embankments would be breached at a number of locations to provide a functioning system, this avoids the need to remove all the defences which reduces the environmental impact of construction work. The flood defences to the northern floodplain on the eastern side of the channel (cell A) would still need to be maintained and there would be a need to extend the defence line to isolate cell A from cell C. Maintenance of the earth embankments would be the same as for the hold the line scenarios. There would still be a need to maintain the western training wall at the mouth. Under this scenario, the likelihood of the estuary being able to sustain an open river mouth is significantly improved. However, there would be a need to monitor the mouth to ensure a blockage does not occur following an extreme event.</p>	
Location within Study Area	Predicted Change for	
	Years 0 – 20	Years 20 – 50
The River Channel	<p>The river channel will be maintained on the eastern side of the valley between Exceat Bridge and the southern tip of the meanders. This flood bank will be extended to isolate the north eastern part of the floodplain and the access route to the Foxhole Cottages. Other</p>	<p>Initially the points where the tidal waters are entering the floodplain will increase in size as the flood banks and channel erode. During this epoch the flood banks will become even less defined and lost through erosion. The existing channel is likely to remain the main</p>
	Years 50 – 100	<p>It is difficult to predict the position and formation of the river channel through this epoch. The whole estuary (south of Exceat Bridge) will be a dynamic environment. Natural processes will dictate the changes to the channel. The channel will adjust naturally</p>

	<p>sections of the channel and flood bank will be left to erode as the tide inundates the floodplain through the man made breaches. The newly unprotected sections of bank will rapidly become less defined as the new regime inundates the floodplain.</p> <p>Once the floodplains are inundated the precise alignment of the channel on the western side of the valley is difficult to predict. There is likely to be a significant change in the profile of the channel in the areas where new creeks are being formed. The areas of salt marsh that were present within the channel before the breaches were created are likely to be lost as the channel erodes.</p>	<p>flow path for both fluvial and tidal flows. However, new limbs to the main channels will be created, as historic and new creeks are re/formed in the floodplain.</p> <p>The channel will start to adapt to the new regime by becoming more funnel shaped. Having a wider profile towards the mouth of the estuary.</p>	<p>to the impacts of climate change and the availability of sediment supply.</p>
<p>Intervention</p>	<p>During this epoch maintenance of the section of the eastern flood bank and channel from Exceat Bridge to the southern tip of the meander will be continued. There will be an immediate need to reinforce this section of bank to strengthen the bank, prior to undertaking a managed breach of the opposite flood bank. The management regime of work associated with this section of</p>	<p>Continued monitoring will be required at Exceat Bridge and just downstream to ensure the bridge and channel remain in a stable condition.</p> <p>Annual maintenance work will continue along the eastern channel and flood bank to prevent erosion or overtopping events</p>	<p>Ongoing maintenance as detailed in the earlier timeframe will be required. There will be no need to raise the crest of the defences during this epoch.</p>

	<p>leading to a failure.</p> <p>The second phase of bank raising (approximately 300mm) will be completed to ensure flood protection is provided for cell A for the later part of the appraisal period.</p>	
<p>bank will be similar to that for the Hold The Line Sustain option. It is intended that the crest of the bank will be raised in two phases. The first phase will be immediately during this epoch.</p> <p>A closing bank will also be constructed to isolate the above section of the floodplain and the access route to the Foxhole Cottages. This bank will be approximately 2 metre above the existing ground level.</p> <p>The western flood bank and southern section of the eastern flood bank will be breached in a controlled manner to allow tidal inundation. The extent and layout of the breaches will need to be determined.</p> <p>The bridge and the section of bank just downstream of the bridge abutments will be monitored for signs of possible failure, due to erosion. If the channel and banks demonstrate significant signs of erosion at this location there will be a need to provide protection. Failure at this location could threaten the bridge structure and access to</p>		

	<p>the Golden Galleon Public House.</p> <p>There will be loss of pedestrian access along the crest of the flood banks that are no longer being maintained. Constructing new footpaths to maintain access to the beach will provide mitigation for this loss.</p>		
<p>The Floodplain</p>	<p>Following the creation of the controlled breaches, large sections of the floodplain will become inundated during each tide cycle. These areas will quickly start to adjust to the new regime. Regular inundation of the floodplain will lead to the creation of a new network of tidal creeks flowing into the main channel. Historic creeks may be reactivated and become more defined features within the floodplain. Salt marsh species will start to colonise on the floodplain.</p> <p>The north section of the eastern floodplain will continue to function in its current form. There is likely to be an increase in the number of overtopping events due to the impact of sea level rise. The meander will</p>	<p>During the initial stages of this epoch, inter tidal habitat will develop further over the land surface that is subject to tidal inundation.</p> <p>Channels within the floodplain will become more defined features within the landscape.</p> <p>The meander will become less of a defined feature and thinner in profile.</p>	<p>The areas of floodplain that have been subjected to tidal inundation will naturally adjust to the processes that are occurring as a result of climate change.</p>

	continue to silt up.		
Intervention	Footpaths and access tracks that have been lost through the breach retreat will be relocated on both sides of the valley to compensate for the loss of amenity and access (see figure 8). On the eastern side of the valley footpath access to the beach will be provided by constructing a new path on higher ground to connect the beach to the existing South Downs Way. On the western side of the valley the Vanguard Way will be relocated to provide the existing level of access to the beach. A circular route will be provided by developing further the network of paths on the western valley side.	Continued maintenance of the existing and proposed footpaths and access tracks will be required on either side of the valley.	Continued maintenance of the existing and proposed footpaths and access tracks will be required on either side of the valley.
The mouth of the Estuary	No significant changes are expected to occur at the mouth until the flood banks are breached. Prior to this point intervention at the mouth will be similar to the existing practise. This will assist in the prevention of a blockage at the mouth Once the flood banks are breached the mouth will start to adjust to the new volume	During this epoch the mouth of the estuary will continue to adjust to cater for the impacts of climate change. In time the erosive forces at the mouth will undermine the western training walls.	Through this epoch the mouth will naturally adjust to the processes that are occurring as a result of climate change and sediment supply.

		<p>of water that is being exchanged during each tidal cycle.</p> <p>From the analysis undertaken it is anticipated that the mouth will migrate towards the east. To allow this to happen the eastern training wall will be removed simultaneously with the active breaching of the flood banks. Once this occurs the mouth will begin to widen in this direction. The western training wall will be maintained for as long as possible to provide support to the maintenance of the western beach.</p> <p>It is not considered likely that the mouth will move fully to a self cleansing system during this epoch.</p>	
<p>Monitoring and removal of material at the mouth may still be required to prevent a blockage occurring.</p>	<p>The western training structure will initially be left in place to prevent the mouth migrating in a westerly direction. The evolution of the system is likely to make this structure redundant and as the structure deteriorates it should be removed for Health and Safety reasons.</p>	<p>Prior to the controlled breach of the defences there will be a need for annual monitoring of the mouth and intervention to prevent a build up of material, which would impact on the ability of the mouth to convey flows. Material will be moved from the mouth and redistributed on to the western beach.</p>	<p>Intervention</p>

	<p>Monitoring and removal of material at the mouth may still be required to prevent a blockage occurring.</p>	
<p>The Beach</p>	<p>The beach will continue to act as a pocket beach. Sediment is likely to be redistributed within the beach between the chalk cliffs.</p> <p>The development of the beach is complex and it is difficult to predict the changes that will occur during this epoch. With the behaviour of the beach being dependent upon the nature and occurrence of storm events. The extent of the erosion of the cliff buttresses on either side of the valley will also influence beach development.</p>	<p>Following the breach retreat of the defences the mouth will require less maintenance to clear the mouth. However, it is anticipated that there will still be a need to monitor the mouth as the system will not have reached a self cleansing equilibrium. Maintenance is still likely to be needed but under a less frequent regime.</p> <p>The eastern training wall will be removed at the same time as the defences are breached.</p> <p>The storm ridge on the western beach will continue to erode. Gradually the storm ridge will migrate in a landward direction. The profile of the beach will widen and flatten. The rate of erosion is likely to increase if the beach is subjected to a severe storm event(s) during this period. Under this scenario the western beach will be supplemented by the material removed from the mouth. This will significantly help to prevent catastrophic failure of the beach.</p> <p>The east beach is considered to be more stable than the west beach. The far eastern</p>

<p>Intervention</p>	<p>section of the beach is likely to remain in the existing position with a similar profile. The section of beach towards the mouth may be subject to greater erosion and migration landward.</p> <p>Prior to the controlled breaching of the flood banks there will still be a need to redistribute material on to the western beach from the mouth. Material will be placed on the back face of the existing shingle ridge to reduce the risk of a storm event causing a catastrophic breach.</p> <p>Once the banks have been breached the frequency of intervention at the mouth/beach should be reduced. However, there will still be a need to monitor both the beach and the mouth.</p>	<p>There may be a need to continue to remove material from the mouth and place it on the western beach.</p> <p>Erosion of the west beach will need to be monitored to prevent erosion of the cliff face below the coastguard cottages. The groyne south of the western beach will need to be removed if they become a H&S risk to the public.</p>	<p>Minimal intervention should be required on both the east and west beach during this epoch. There may still be a need to remove material from the mouth. This material can be distributed to appropriate locations on the east and west beach.</p>
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POLICY OPTION: Managed Realignment		
SCENARIO REF: Complete Managed Realignment (Cells A, B & C)		
Scenario Summary	<p>This scenario considers breaching of the existing bank defences to allow for tidal inundation of the western floodplain (cell B) and the majority of the eastern floodplain (cells A and C). A small section of the floodplain is excluded at the north of cell A, where a closing bank is proposed to protect the A259 road. The proposed closing bank should be constructed at a shallow gradient to limit the need for further maintenance. There would be a need to undertake some preliminary modification work to help the system to adjust. An area to the east of the existing channel would need to be excavated to assist conveyance of flows and to ensure there is no sediment build up in the mouth during a neap tide. This includes the section of existing beach material to the east of the existing mouth. Material removed from the beach could be used to supplement the western beach to prevent landward erosion from progressive wave attack. The eastern training structure would be removed to prevent a Health and Safety risk. The existing embankments would be breached at a number of strategic locations to avoid the need to remove all the defences. This also reduces the environmental impact of the bank removal process.</p>	
Location within Study Area	Predicted Change for	
	Years 0 – 20	Years 20 – 50
The River Channel	<p>Prior to breaching the defences the channel and flood banks will be left to erode naturally. There may be a need to intervene just downstream of the bridge on the eastern bank to prevent failure of the defences at this</p>	<p>Initially the points where the tidal waters are entering the floodplain will increase in size as the flood banks and channel erode. During this epoch the flood banks will become even less defined and lost through erosion. The</p>
		<p>Years 50 – 100</p> <p>It is difficult to predict the position and formation of the river channel through this epoch. The whole estuary (south of Exceat Bridge) will be a dynamic environment. Natural processes will dictate the changes to</p>

	<p>location.</p> <p>The banks will be actively breached at strategic locations to commence the managed realignment process. Once the floodplains are inundated the precise alignment of the channel is difficult to predict. There is likely to be a significant change in the profile of the channel in the areas where new creeks are being formed. This is especially the case at the southern end of the old meanders. The meander channel is likely to become a tidal limb to the main channel.</p> <p>The areas of salt marsh that were present within the channel before the breaches were created are likely to be lost as the channel erodes.</p>	<p>existing channel is likely to remain the main flow path for both fluvial and tidal flows. However, new limbs to the main channels will be created, as historic and new creeks are re/formed in the floodplain.</p> <p>The channel will start to adapt to the new regime by becoming more funnel shaped. Having a wider profile towards the mouth of the estuary.</p>	<p>the channel. The channel will adjust naturally to the impacts of climate change and the availability of sediment supply.</p>
<p>Intervention</p>	<p>The eastern and western flood banks will be breached in a controlled manner to allow tidal inundation. The extent and layout of the breaches will need to be determined.</p> <p>The bridge and the section of bank just downstream of the bridge abutments will be</p>	<p>Continued monitoring will be required at Exceat Bridge and just downstream to ensure the bridge and channel remain in a stable condition. Otherwise, it is anticipated that no intervention will be required on the channel or flood banks during this epoch.</p>	<p>It is anticipated that no intervention will be required on the channel or flood banks during this epoch.</p>

		<p>monitored for signs of possible failure, due to erosion. If the channel and banks demonstrate significant signs of erosion at this location there will be a need to provide protection. Failure at this location could threaten the bridge structure and access to the Golden Galleon Public House.</p> <p>There will be loss of pedestrian access along the crest of the flood banks that are no longer being maintained. Constructing new footpaths to maintain access to the beach will provide mitigation for this loss.</p>	
<p>The areas of floodplain that have been subjected to tidal inundation will naturally adjust to the processes that are occurring as a result of climate change.</p>	<p>During the initial stages of this epoch, inter tidal habitat will develop further over the land surface that is subject to tidal inundation.</p> <p>Channels within the floodplain will become more defined features within the landscape.</p>	<p>Following the creation of the controlled breaches, large sections of the floodplain will become inundated during each tide cycle. These areas will quickly start to adjust to the new regime. Regular inundation of the floodplain will lead to the creation of a new network of tidal creeks flowing into the main channel. Historic creeks may be reactivated and become more defined features within the floodplain. Salt marsh species will start to colonise on the floodplain.</p>	<p>The Floodplain</p>

<p>Intervention</p>	<p>Prior to the breaching, an area to the east of the existing channel would need to be excavated to assist conveyance of flows and to ensure there is no sediment build up in the mouth during a neap tide.</p> <p>A closing bank will also be constructed to isolate the most northern section of cell A. This bank will also provide protection to the A259 road. The closing bank will be gradually inclined and up to a maximum of 2 metres above the existing ground level.</p> <p>Footpaths and access tracks that will be lost through the inundation will be relocated on both sides of the valley to compensate for the loss of amenity and access (see figure 9). On the eastern side of the valley footpath access to the beach will be provided by constructing a new path on higher ground to connect the beach to the existing South Downs Way. On the western side of the valley the Vanguard Way will be relocated to provide the existing level of access to the</p>	<p>Continued maintenance of the existing and proposed footpaths and access tracks will be required on either side of the valley.</p>	<p>Continued maintenance of the existing and proposed footpaths and access tracks will be required on either side of the valley.</p>
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	<p>beach. Developing further the network of paths on the western valley side will provide a circular route.</p>	
<p>The mouth of the Estuary</p>	<p>No significant changes are expected to occur at the mouth until the flood banks are breached. Prior to this point intervention at the mouth will be similar to the existing practise. This will assist in the prevention of a blockage at the mouth</p> <p>Once the flood banks are breached the mouth will start to adjust to the new volume of water that is being exchanged during each tidal cycle.</p> <p>From the analysis undertaken it is anticipated that the mouth will migrate towards the east. To assist this process the eastern training wall and a large volume of beach material will be removed simultaneously with the active breaching of the flood banks. Once this occurs the mouth will begin to widen in this direction. The western training wall will be maintained for as long as possible to provide support to the maintenance of the western</p>	<p>During this epoch the mouth of the estuary will continue to adjust to cater for the impacts of climate change.</p> <p>In time the erosive forces at the mouth will undermine the western training walls.</p> <p>Through this epoch the mouth will naturally adjust to the processes that are occurring as a result of climate change and sediment supply.</p>

	<p>beach.</p> <p>The technical work undertaken to date have confirmed that, under this scenario, the mouth is likely to become self cleansing.</p>		
<p>Intervention</p>	<p>Prior to the controlled breach of the defences there will be a need for annual monitoring of the mouth and intervention to prevent a build up of material, which would impact on the ability of the mouth to convey flows. Material will be moved from the mouth and redistributed on to the western beach.</p> <p>Prior to the breach retreat a large volume of beach material will be removed from the western end of the eastern beach to aid the migration of the mouth. This material will be placed on the western beach to provide added stability. In addition the eastern training wall will be removed.</p>	<p>The western training structure will initially be left in place to prevent the mouth migrating in a westerly direction. The evolution of the system is likely to make this structure redundant and as the structure deteriorates it should be removed for Health and Safety reasons.</p>	<p>It is anticipated that no intervention will be required at the mouth during this epoch.</p>
<p>The Beach</p>	<p>The storm ridge on the western beach will continue to erode. Gradually the storm ridge will migrate in a landward direction. The profile of the beach will widen and flatten.</p>	<p>The beach will continue to act as a pocket beach. Sediment is likely to be redistributed within the beach between the chalk cliffs.</p>	<p>The beach will continue to evolve as identified within the previous epoch.</p>

