

Sidmouth & East Beach Management Plan (BMP)

Introduction

East Devon District Council, working in partnership with the Environment Agency, Sidmouth Town Council, local community representatives including CRAG, the South West Strategic Regional Coastal Monitoring Programme and our consultants CH2M (formerly Halcrow), are developing a Beach Management Plan (BMP) for Sidmouth Beach, East Beach and the River Sid up to the Weir.

This exhibition aims to provide you, as a member of the local community, with information about the purpose of this project, proposals for the future management of coastal flood and erosion risk at Sidmouth, and how you can influence the choice of preferred option.

What is the purpose of the project?

The purpose of this project is to review and update the existing Sidmouth BMP and develop it to include the beach to the east of the River Sid, 'East Beach', where significant cliff erosion is taking place, to produce a Sidmouth and East Beach Management Plan that achieves the following aims:

1. Maintain the 1990's Sidmouth Coastal Defence Scheme's Standard of Service (Sidmouth Beach).
2. Reduce the rate of beach and cliff erosion to the east of the River Sid (East Beach).
3. Carry out (1) and (2) in an integrated, justifiable and sustainable way.

What is a Beach Management Plan?

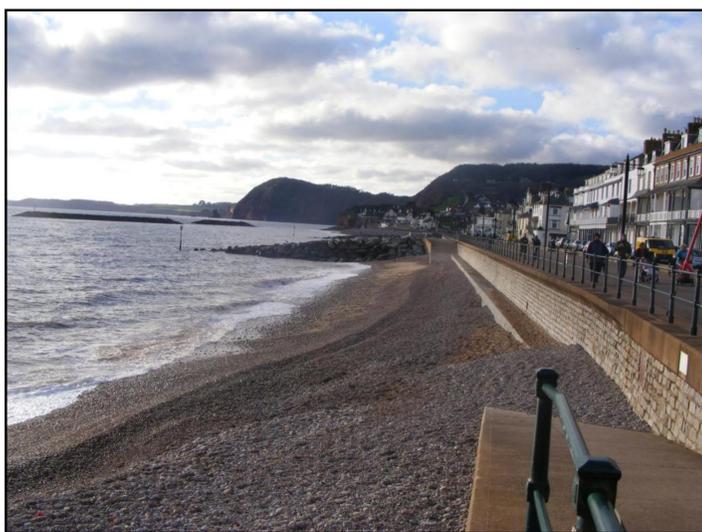
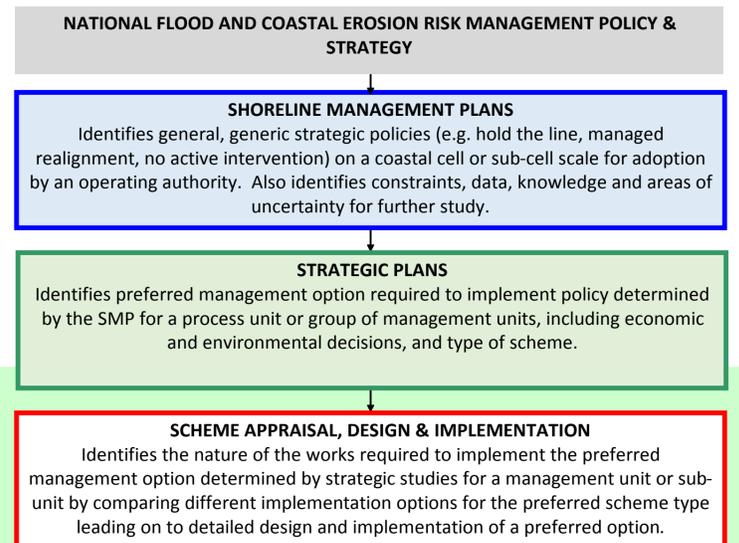
Beaches have many uses and functions. These include amenity, recreation, commercial and community uses, and coast defence, habitat and earth science functions; all of which have social, environmental and economic value.

BMPs are a non-statutory method of providing a coastal defence plan for managing a beach at a local level that takes into account and, where possible, promotes or enhances the other uses and functions of a beach.

BMPs provide a framework for more cohesive management of a beach that may be regulated and used by different parties, all with their own agendas. They establish a means to control the physical form of beaches and the general beach environment, and to promote good practice within the environment.

A BMP should provide a detailed plan for the short (c.10 years), medium (c.50 years) and long (c.100 years) term management of a beach to achieve an agreed aim and objectives.

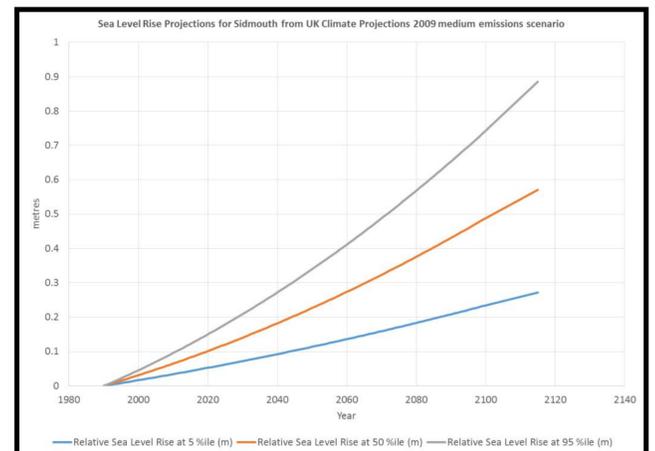
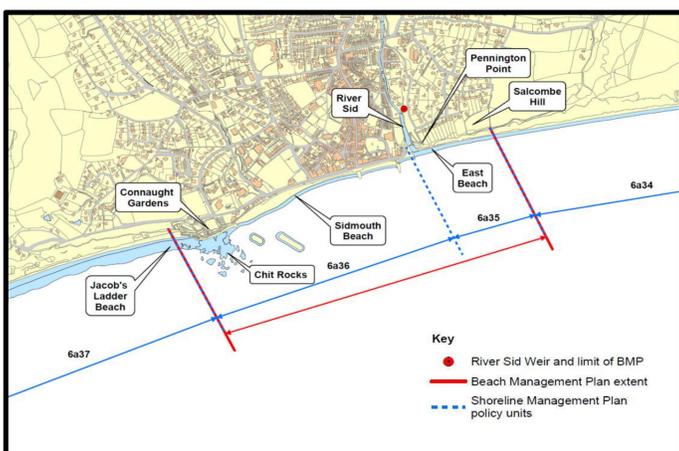
In this context, beach management is defined as a process for physically managing the beach by such things as simple interventions, nourishment and recycling of beach material, the construction and maintenance of beach control structures (e.g. groynes and breakwaters) and monitoring.



How does this relate to other recent coastal management projects?

The Sidmouth coast has been subject to human intervention to manage the risk of coastal flooding and erosion since the 19th century. In the past 26 years there have been a number of significant projects looking at the future management of coastal flood and erosion risk at Sidmouth, as follows:

- **1990: Report on Coast Protection at Sidmouth** – this led to the implementation of **Phase I** of the Sidmouth coastal defences we see today, involving repairs to the seawall which was severely damaged in 1990. It also paved the way for subsequent phases of coast protection works during the 1990s.
- **1992: Coast Protection at Sidmouth (Phase II) Engineers Report** – this developed the design and business case for constructing the two offshore breakwaters, the two easternmost rock groynes and beach recharge along the Sidmouth town frontage as **Phase II** of coastal defence works at Sidmouth.
- **1994: Coast Protection Connaught Gardens Revised Engineers Report** – this developed the design and business case for construction of the rock revetment constructed in the 1990s in front of the promenade and seawall that extends around the base of Chit Rocks.
- **1998: Sidmouth Phase II Coast Protection Scheme: Revised Beach Management Plan** – This BMP included assessment of the **Phase II** scheme performance, and developed the design and business case both for ongoing maintenance works and construction of a third rock groyne adjacent to the Bedford Hotel.
- **2001: Pennington Point Coastal Study** – This study undertook assessment of risk posed to the western wall of the River Sid and cliff top properties along Cliff Road above Pennington Point. The findings of this report provided the basis for development of a coast protection scheme proposal in 2003 by EDDC to construct a 200m long rock revetment along the base of the cliff at East Beach to reduce coastal erosion. This scheme was withdrawn by EDDC at planning.
- **2011: South Devon & Dorset Shoreline Management Plan Review (SMP2)** – With reference to the map to the right, the preferred option defined in the Sidmouth and East Beach Management Plan will contribute to the implementation of SMP2 policies of 'Hold the Line' along the Sidmouth part of the frontage (6a36), and 'Managed Realignment' along the East Beach part of the frontage (6a35), including inter-relationships with and impact upon the adjacent undefended coasts where the policy is for 'No Active Intervention' (6a34 and 6a37).
- **2011: Dorset and East Devon Jurassic Coast Coastal Change Pathfinder Project** – The Pathfinder Project was funded by Defra to investigate ways in which coastal communities that are at risk of future coastal change due to climate change and associated sea level rise can be engaged. This enabled communities to contribute to the development of 'adaptation measures' for their communities in response to coastal change (*see adjacent boards*).



The graph above shows the sea level rise guidance that has to be assumed for appraising coastal flood and erosion risk management measures in England.

Sidmouth & East Beach Management Plan (BMP)

Images produced as part of the Jurassic Coast Pathfinder Project (courtesy of Dorset County Council). Please note, the 2050 and 2100 cases are based upon data in the National Coastal Erosion Risk Map. These images are provided to illustrate how the future coast may look, not exactly how it will look in the future as a result of ongoing coastal change, if no further intervention occurs along the coast.



Mouth of the River Sid – 2010



Mouth of the River Sid – 2050



Mouth of the River Sid – 2100

Without intervention, East Cliff / Pennington Point will continue to erode. Over time, this will expose the western wall of the River Sid to direct wave attack from South-Easterly storms. This River Sid wall is not designed to withstand such forces so the risk of flooding to Sidmouth town centre by wave action along the River Sid will increase. This poses a risk to property valued at £85m as well as the towns' infrastructure.



Sidmouth seafront looking east – 2010



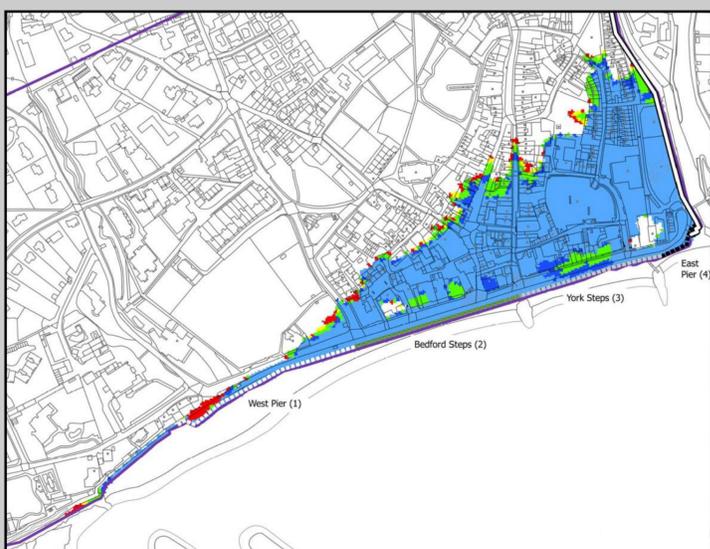
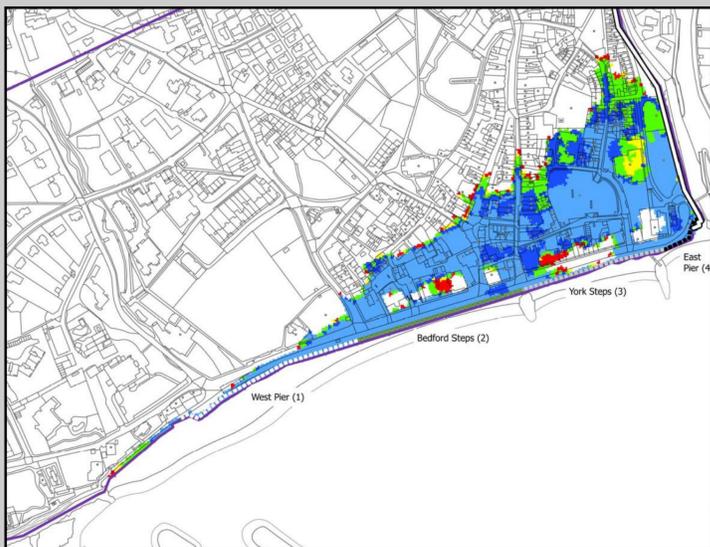
Sidmouth seafront looking east – 2050



Sidmouth seafront looking east – 2100

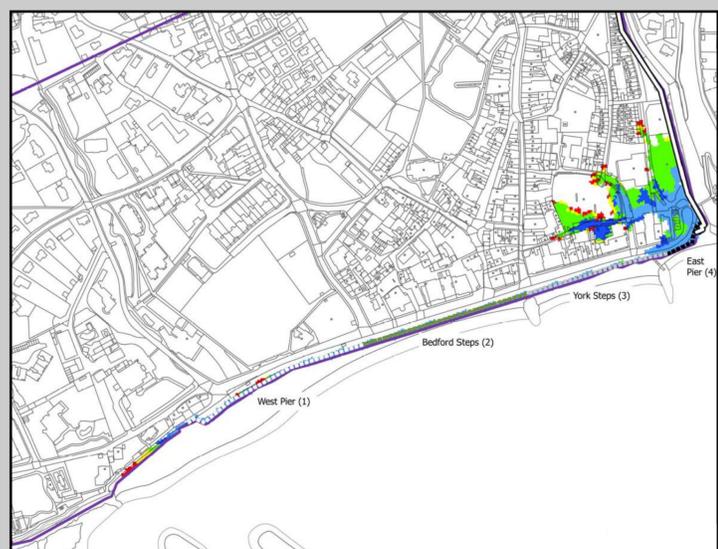
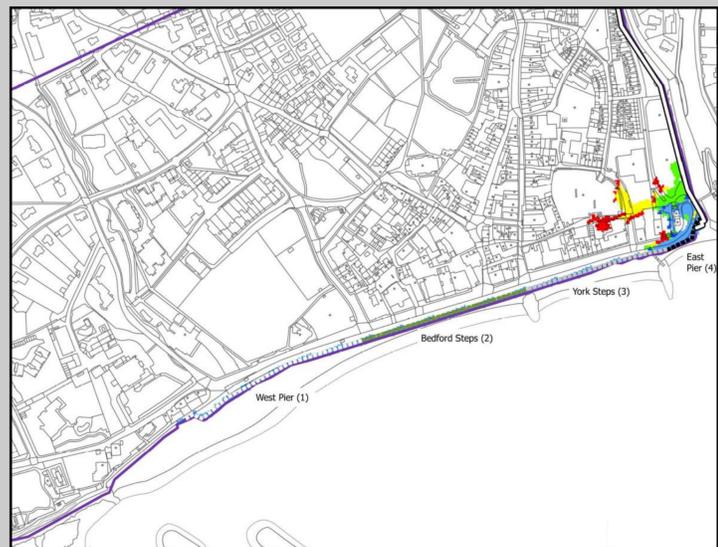
Without intervention, as sea levels rise the beaches along Sidmouth will narrow and lower as they are squeezed against the seawall. This will reduce the amount of beach for recreation use and increase wave action on the seawall, increasing its susceptibility to failure during storms and also allowing greater wave overtopping to occur, which leads to increased flood risk to property valued at £85m.

Flood risk, present day
(assuming lowered beach levels)



Flood risk, 100 years with sea level rise
(assuming lowered beach levels)

Flood risk, present day
(assuming 1990's scheme design beach levels)



Flood risk, 100 years with sea level rise
(assuming 1990's scheme design beach levels)



Sidmouth & East Beach Management Plan (BMP)

How is the beach management plan being developed?

Development of the beach management plan involves a number of stages. These are shown in the flow diagram adjacent along with identifying when community involvement is planned.

Involving the community!

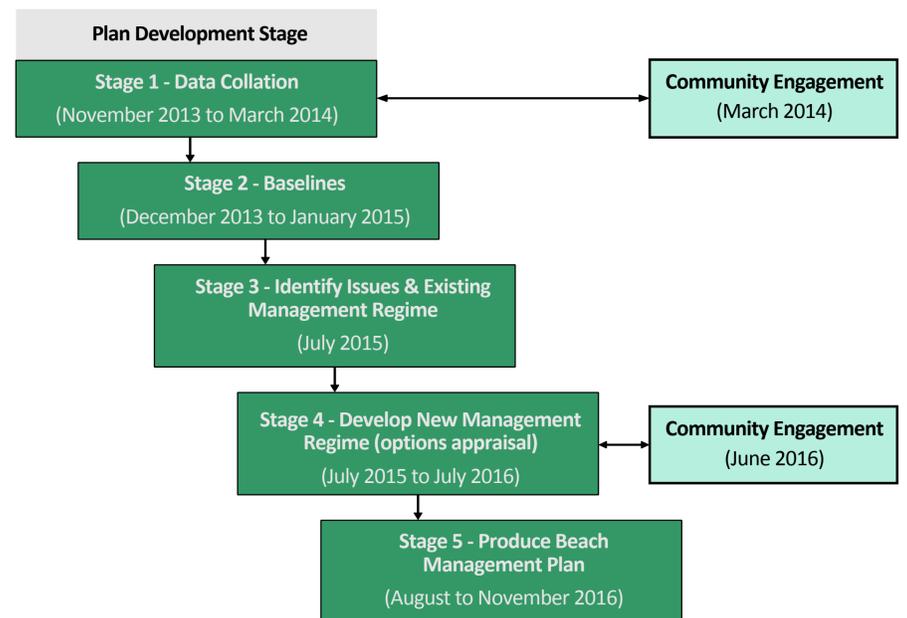
This is the **second community engagement event** held during the project. The purpose of this event is to allow the local community to give their views on a short-list of potential future management options that have been identified by the project team and project steering group. Please let us have your comments by **4th July 2016**.

After the 4th July 2016, the project team will consider all comments and make recommendation as to what should be the preferred option. This will be presented to the project steering group (which includes members of the community) in early August 2016, after which time the final options appraisal report and beach management plan will be prepared.

Once approved, the beach management plan will drive further investigations and scheme development to implement the preferred option.

How you can get involved at this stage?

This is your opportunity to provide your views on the potential future management of coastal flood and erosion risk at Sidmouth, and identify to the project team your preference in this regards along with any specific local issues, opportunities or hurdles that you think should be considered in the delivering a new management approach to the beaches and coastal defences along the Sidmouth coast.



Fixed Requirements (your views are welcome but we need to follow national guidance on the assessment of options)
Cost-benefit of the preferred option: We must subject any proposals to a cost-benefit analysis and this will influence the choice of the preferred option.
Funding: Funding to implement the preferred option cannot be guaranteed as it will be assess amongst national priorities. However, the greater the amount of partnership funding contributions that can be secured, the greater the chance of implementing the preferred option will be.
Detailed design and investigation: The preferred option identified in the BMP will need to be subjected to further more detailed design and investigation to refine and optimise the scheme. This will take about 1-2 years following approval of the BMP, depending upon exactly what option is chosen and so the amount of work required. East Devon District Council is already planning for this work.
Consents and Planning: As part of detailed design and investigation, the final scheme will need Planning Permission, a Marine Licence and various environmental consents.
Negotiable (the views of residents and professional partners will guide the preferred option selection process as part of this BMP project)
Scale and form of defences: We will listen to your views on the scale and form of each option, and the acceptability of each option on access, visual impact, use of the beach and promenade etc.
Alignment/position of defences: There are technical constraints that influence the alignment and position of proposed defences, and whilst these are subject to refinement in detailed design, we welcome views on how these may impact use of the frontage and where we can seek to minimise any such impacts through detailed design.
Other potential benefits: We are already considering potential for each option to incorporate broader benefits to the area as part of the measures to reduce the risk of coastal flooding and erosion, such as access to the shoreline and regeneration of the Port Royal area, but we would welcome your views on any particular broader benefits that could be considered for incorporating into any of the options.

What happens next?

After the 4th July 2016, the project team will consider all comments and make recommendation as to what should be the preferred option. This will be presented to the project steering group in early August 2016, after which time the final options appraisal report and beach management plan will be prepared.

Once approved, the beach management plan will drive further investigations and scheme development to implement the preferred option.

Contacting us –

If you have any questions following this event, please contact sidmoutheastbmp@eastdevon.gov.uk

or visit the project website at <http://eastdevon.gov.uk/coastal-protection/beach-management-plans/sidmouth-and-east-beach-management-plan>



Options Appraisal – A Brief Overview

The options appraisal process comprises the following steps:

1. Identify a long-list of potentially viable and appropriate options for managing coastal flood and erosion risk along different parts of the BMP area.
2. Appraise the long-list against technical, economic and environmental criteria.
3. Consult the project steering group.
4. Confirm a short-list of options that will work in combination across the BMP area.
5. Appraise the short-list against technical, economic and environmental criteria.
6. **Consult the steering group and the public (current step).**
7. Select and confirm the preferred option.

In identifying the long-list of options, the BMP frontage was sub-divided into four frontage units:

- A. Jacob's Ladder Beach and Connaught Gardens (Chit Rocks)
- B. Sidmouth Town (Chit Rocks to the River Sid, including the training wall seawards of Alma Bridge)
- C. East Beach (River Sid eastwards to BMP boundary)
- D. River Sid Western Wall (upstream of the training wall / Alma Bridge).



The short-list is derived of combinations of options for each of these four frontages which are: (i) considered appropriate for that frontage following the long-list appraisal; and (ii) complimentary with options in the adjacent frontages.

Technical Appraisal

Each short-list option has been appraised for how well it would be anticipated to perform and achieve the aims and objectives of this project. This appraisal has been based upon the evidence and understanding of the coastal defences and coastal processes developed as part of this project.

Environmental Appraisal

The environmental implications of each option have been appraised against the understanding of the environmental characteristics of the area developed as part of this project.

Economic Appraisal

The economic appraisal is based on assessment of the costs and benefits of each option. This is expressed as the benefit:cost ratio (BCR) for each option. The BCR then forms part of the Partnership Funding calculation to determine how much of the required costs can be claimed from central Government via the FCERM-GIA, and how much of the costs will have to be found from other sources of funding. This partnership funding calculation also takes into account the numbers of properties protected against the risk of flooding and erosion, the level of social deprivation of the areas at risk, and legal environmental requirements.

Sidmouth & East Beach Management Plan (BMP)

Short-List Option #S1

A: Jacob's Ladder Beach and Connaught Gardens	B: Sidmouth Town	C: East Beach	D: River Sid Western Wall
<p>Undertake maintenance of seawall, promenade and rock revetment including re-packing of rock, guided by regular inspection.</p> <p>Periodic removal of shingle from Jacob's Ladder Beach promenade area, with sediment placed to the west of the wall within this sediment cell.</p> <p>This is the same as in Options S2, S3 and S4.</p>	<p>Maintain existing defence configuration. Repair and shorten length of both the current freestanding section of training wall and East Pier. Undertake periodic beach recharge to maintain volume to level of design beach, supported by ongoing beach recycling.</p>	<p>Construct 1 short/low level rock groyne to the east of the River Sid to aid beach levels control as it transitions eastwards; supported by periodic beach recycling within Frontage B.</p> <p>This is the same as in Options S2 and S3.</p> <p>Note, a sensitivity test will be done on the implications of constructing 2 groynes instead of 1.</p>	<p>Undertake maintenance of the existing River Sid western wall for as long as is economically viable then replace with a coastal standard wall as it becomes at risk of being exposed by erosion at East Beach.</p> <p>This is the same as in Options S2, S3 and S4.</p>

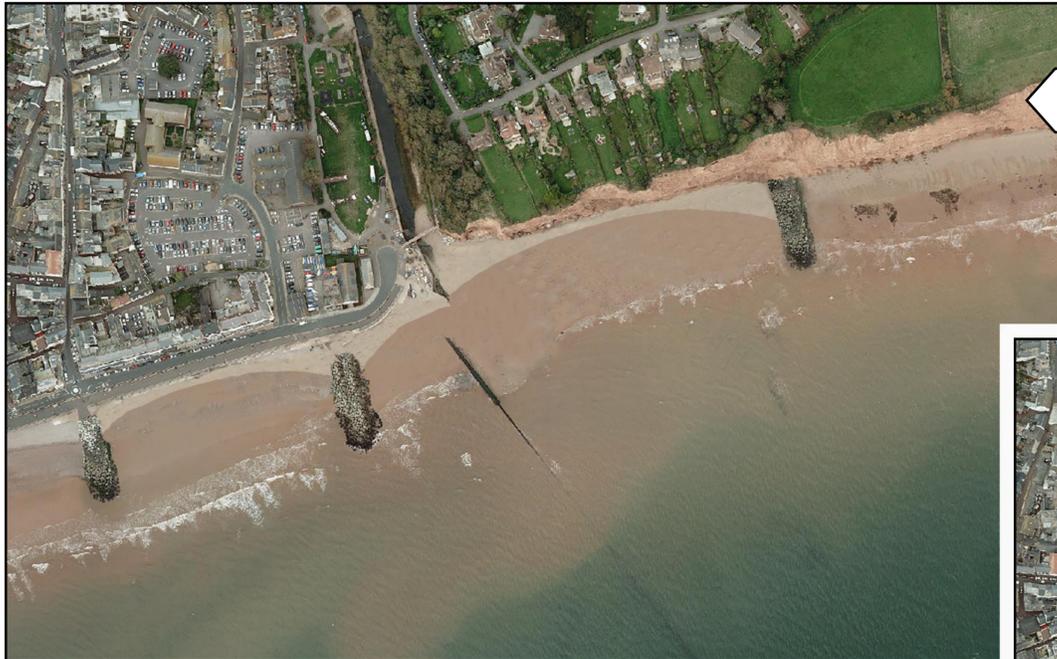
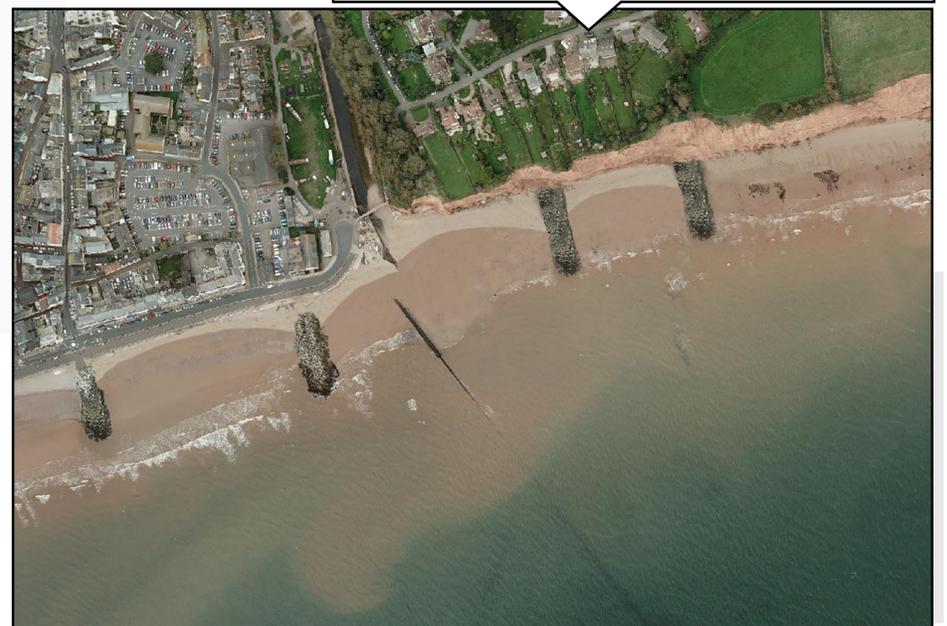


Illustration of how 1 groyne along East Beach could look

Please note, that these are provided for illustration of the option only and are subject to change and refinement as part of further detailed investigations to develop the final design should this be taken forward as the preferred option.

Illustration of how 2 groynes along East Beach could look



Key points from Technical Appraisal

- Provides required standard of flood risk protection, increasing potential for future development within the Sidmouth frontage.
- No residential or commercial properties would be lost to erosion within 100 years.
- Option protects tourism and amenity interests including SW Coast Path National Trail, beach huts and Connaught Gardens from erosion.
- Delays and reduces impact of erosion of East Cliff on Alma Bridge and River Sid western wall, but does not prevent it.
- Assumes commitment to regular beach recycling and recharge as beach levels will still be quite variable.
- Reduction in length of training wall along River Sid improves connectivity to East Beach.
- Two groyne option likely to perform better than one groyne option along East Beach.

Key points from Economic Appraisal

- **Estimated Cost:** £11,004,000
- **Benefit:Cost Ratio:** 7.8
- **Amount of Partnership Funding Contribution required:** £5,997,000

Key points from Environmental Appraisal

Receptor	Potential impacts of option
Geology Geomorphology	Changes to coastal processes by the implementation of the scheme within all but East Beach sections will promote natural coastal processes rather than inhibit. No in-combination effects to UNESCO World Heritage Site and nationally designated geological are envisaged..
Water quality	Increased threat of greater chemical pollution (chemical composition unknown) by increased volume of sediment
Ecology	Potential increased impact on nationally and internationally designated ecological features including SAC features and BAP Habitats.
Fisheries	Temporary effects to launch/landing access from construction and maintenance works if undertaken across all four frontage sections at a similar time
Navigation	Temporary in-combination effects to launch/landing access from construction and maintenance works if undertaken across all four frontage sections at a similar time.
Landscape	Short term visual impact during construction. Long term, a greater visual impact from changes at Sidmouth Town and East Beach on setting of designated and non-designated features including Sidmouth Town Centre Conservation Area, listed buildings, WHS, East Devon AONB, East Devon Heritage Coast and the Blackdowns NCA.
Archaeology and Cultural Heritage	Potential long term effect on the setting of cultural heritage asset.
Air quality	Any effects are considered negligible.
Noise	Increased noise and vibration impacts during construction works.
Amenity value	Potential temporary, negative effect on amenity value during construction periods. Positive impact of ensuring beach is provided for amenity benefit through ongoing regular beach recharge and recycling.

Sidmouth & East Beach Management Plan (BMP)

Short-List Option #S2

A: Jacob's Ladder Beach and Connaught Gardens	B: Sidmouth Town	C: East Beach	D: River Sid Western Wall
Undertake maintenance of seawall, promenade and rock revetment including re-packing of rock, guided by regular inspection. Periodic removal of shingle from Jacob's Ladder Beach promenade area, with sediment placed to the west of the wall within this sediment cell. This is the same as in Options S1, S3 and S4.	Modify existing Bedford Steps, York Steps and East Pier rock groynes to make 'T-head' type groynes to retain sediment in small stable bays between each groyne bay and shortening East Pier groyne in the process. Support with periodic beach recycling and/or recharge to retain volume to give required design beach. Repair/replace training wall and shorten its length.	Construct 1 short/low level rock groyne to the east of the River Sid to aid beach levels control as it transitions eastwards; supported by periodic beach recycling within Frontage B. This is the same as in Options S1 and S3. Note, a sensitivity test will be done on the implications of constructing 2 groynes instead of 1.	Undertake maintenance of the existing River Sid western wall for as long as is economically viable then replace with a coastal standard wall as it becomes at risk of being exposed by erosion at East Beach. This is the same as in Options S1, S3 and S4.

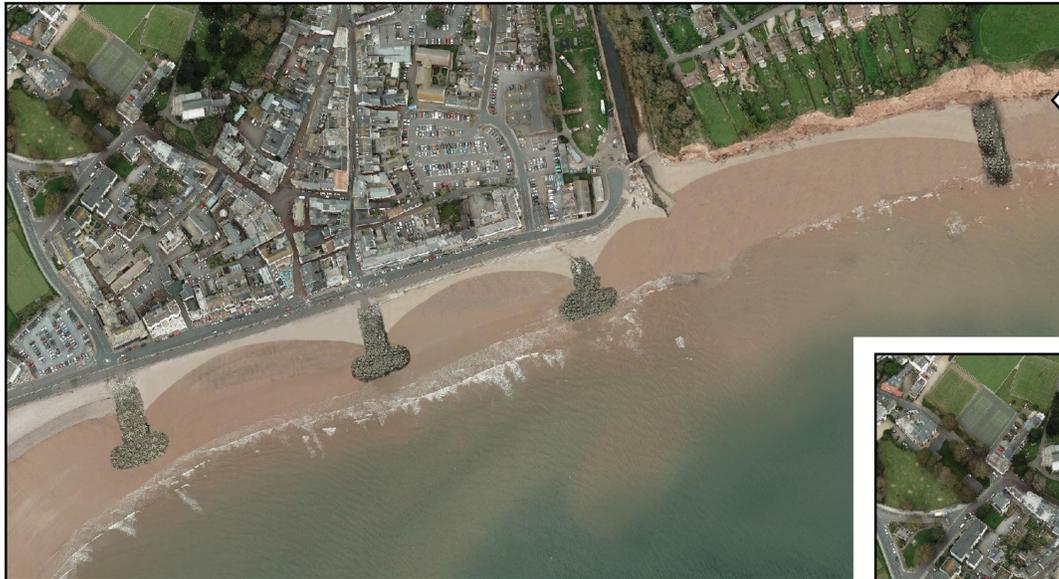


Illustration of how 1 groyne along East Beach could look with modified groynes along Sidmouth Town

Please note, that these are provided for illustration of the option only and are subject to change and refinement as part of further detailed investigations to develop the final design should this be taken forward as the preferred option.

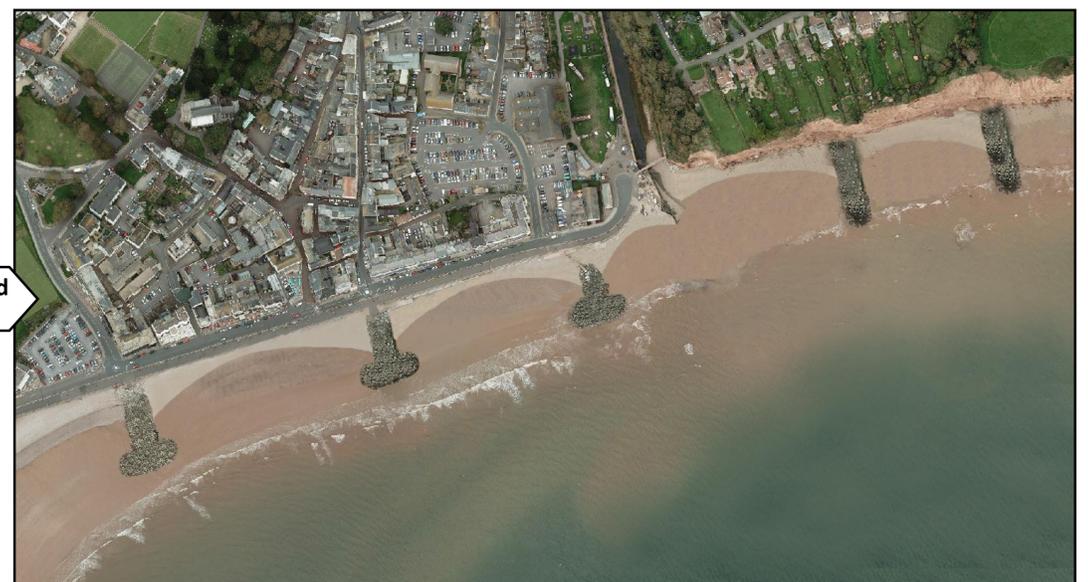


Illustration of how 2 groynes along East Beach could look with modified groynes along Sidmouth Town

Key points from Technical Appraisal

- Provides required standard of flood risk protection, increasing potential for future development within the Sidmouth frontage.
- No residential or commercial properties would be lost to erosion within 100 years.
- Option protects tourism and amenity interests including SW Coast Path National Trail, beach huts and Connaught Gardens from erosion.
- Delays and reduces impact of erosion of East Cliff on Alma Bridge and River Sid western wall, but does not prevent it.
- Assumes commitment to regular beach recycling and recharge as beach levels will still be quite variable, though beach will be more stable along Sidmouth frontage with T-Head groynes compared to current groynes.
- Reduction in length of training wall along River Sid improves connectivity to East Beach.
- Two groyne option likely to perform better than one groyne option along East Beach.

Key points from Economic Appraisal

- **Estimated Cost:** £16,410,000
- **Benefit:Cost Ratio:** 5.2
- **Amount of Partnership Funding Contribution required:** £11,402,000

Key points from Environmental Appraisal

Receptor	Potential impacts of option
Geology Geomorphology	Implementation of the scheme is likely to inhibit natural coastal processes rather than promote, affecting UNESCO World Heritage Site and nationally designated geological sites.
Water quality	Increased threat of greater chemical pollution (chemical composition unknown) by increased volume of sediment
Ecology	Potential increased impact on nationally and internationally designated ecological features including SAC features, BAP Habitats and nursery and spawning grounds of fish species.
Fisheries	Temporary effects to launch/landing access from construction and maintenance works if undertaken across all four frontage sections at a similar time
Navigation	Temporary in-combination effects to launch/landing access from construction and maintenance works if undertaken across all four frontage sections at a similar time.
Landscape	Short term visual impact during construction. Long term, a greater visual impact from changes at Sidmouth Town and East Beach on setting of designated and non-designated features including Sidmouth Town Centre Conservation Area, listed buildings, WHS, East Devon AONB, East Devon Heritage Coast and the Blackdowns NCA.
Archaeology and Cultural Heritage	Potential long term effect on the setting of cultural heritage asset.
Air quality	Any effects are considered negligible.
Noise	Increased noise and vibration impacts during construction works.
Amenity value	Potential temporary, negative effect on amenity value during construction periods. Positive impact of ensuring beach is provided for amenity benefit through ongoing regular beach recharge and recycling.

Sidmouth & East Beach Management Plan (BMP)

Short-List Option #S3

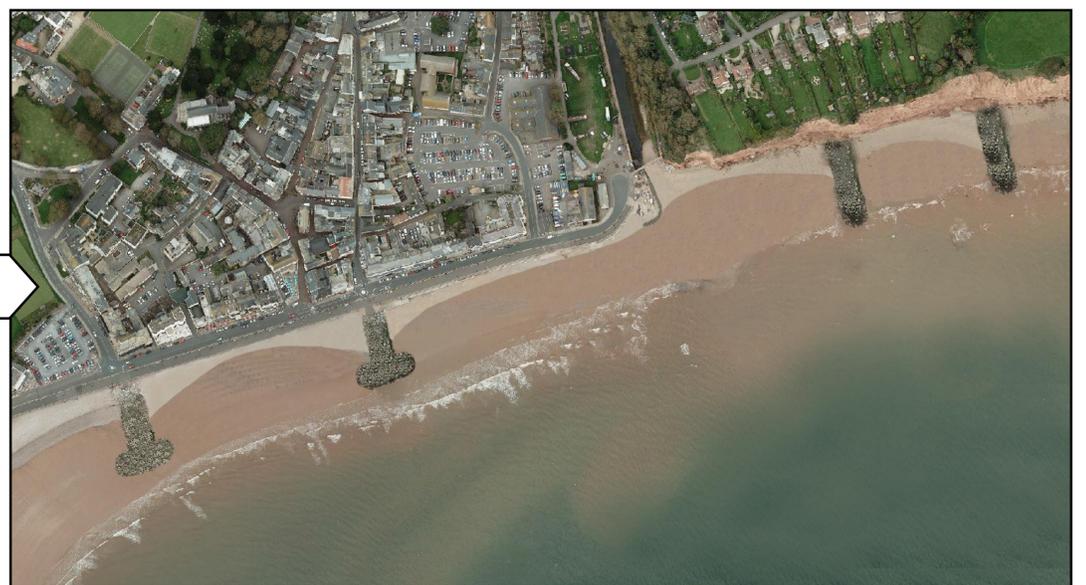
A: Jacob's Ladder Beach and Connaught Gardens	B: Sidmouth Town	C: East Beach	D: River Sid Western Wall
Undertake maintenance of seawall, promenade and rock revetment including re-packing of rock, guided by regular inspection. Periodic removal of shingle from Jacob's Ladder Beach promenade area, with sediment placed to the west of the wall within this sediment cell. This is the same as in Options S1, S2 and S4.	Modify existing Bedford Steps and York Steps rock groynes to make 'T-head' type groynes to retain sediment in small stable bays between each groyne bay. Support with periodic beach recycling and/or recharge to retain volume to give required design beach. Remove East Pier rock groyne and free-standing length of the training wall and place rock-armour around seawall where it curves into the River Sid.	Construct 1 short/low level rock groyne to the east of the River Sid to aid beach levels control as it transitions eastwards; supported by periodic beach recycling within Frontage B. This is the same as in Options S1 and S2. Note, a sensitivity test will be done on the implications of constructing 2 groynes instead of 1.	Undertake maintenance of the existing River Sid western wall for as long as is economically viable then replace with a coastal standard wall as it becomes at risk of being exposed by erosion at East Beach. This is the same as in Options S1, S2 and S4.



Illustration of how 2 groynes along East Beach could look with modified and reduced number of groynes along Sidmouth Town

Illustration of how 1 groyne along East Beach could look with modified and reduced number of groynes along Sidmouth Town

Please note, that these are provided for illustration of the option only and are subject to change and refinement as part of further detailed investigations to develop the final design should this be taken forward as the preferred option.



Key points from Technical Appraisal

- Provides required standard of flood risk protection, increasing potential for future development within the Sidmouth frontage.
- No residential or commercial properties would be lost to erosion within 100 years.
- Option protects tourism and amenity interests including SW Coast Path National Trail, beach huts and Connaught Gardens from erosion.
- Delays and reduces impact of erosion of East Cliff on Alma Bridge and River Sid western wall, but does not prevent it.
- Assumes commitment to regular beach recycling and recharge as beach levels will still be quite variable at eastern end, though beach will be more stable along parts of frontage with T-Head groynes.
- Greater reduction in length of training wall (compared to Options S1 and S2) along River Sid further improves connectivity to East Beach.
- Two groyne option likely to perform better than one groyne option along East Beach.

Key points from Economic Appraisal

- **Estimated Cost:** £14,566,000
- **Benefit:Cost Ratio:** 5.9
- **Amount of Partnership Funding Contribution required:** £9,558,000

Key points from Environmental Appraisal

Receptor	Potential impacts of option
Geology Geomorphology	Implementation of the scheme is likely to inhibit natural coastal processes rather than promote, affecting UNESCO World Heritage Site and nationally designated geological sites. Impacts likely to be less than other options.
Water quality	Increased threat of greater chemical pollution (chemical composition unknown) by increased volume of sediment.
Ecology	Potential increased impact on nationally and internationally designated ecological features including SAC features, BAP Habitats and nursery and spawning grounds of fish species.
Fisheries	Temporary effects to launch/landing access from construction and maintenance works if undertaken across all four frontage sections at a similar time
Navigation	Temporary in-combination effects to launch/landing access from construction and maintenance works if undertaken across all four frontage sections at a similar time.
Landscape	Short term visual impact during construction. Long term, a greater visual impact from changes at Sidmouth Town and East Beach on setting of designated and non-designated features including Sidmouth Town Centre Conservation Area, listed buildings, WHS, East Devon AONB, East Devon Heritage Coast and the Blackdowns NCA.
Archaeology and Cultural Heritage	Potential long term effect on the setting of cultural heritage asset.
Air quality	Any effects are considered negligible.
Noise	Increased noise and vibration impacts during construction works.
Amenity value	Potential temporary, negative effect on amenity value during construction periods. Positive impact of ensuring beach is provided for amenity benefit through ongoing regular beach recharge and recycling.

Sidmouth & East Beach Management Plan (BMP)

Short-List Option #S4

A: Jacob's Ladder Beach and Connaught Gardens	B: Sidmouth Town	C: East Beach	D: River Sid Western Wall
Undertake maintenance of seawall, promenade and rock revetment including re-packing of rock, guided by regular inspection. Periodic removal of shingle from Jacob's Ladder Beach promenade area, with sediment placed to the west of the wall within this sediment cell. This is the same as in Options S1, S2 and S3.	Remove existing beach structures and construct new offshore breakwaters.* * The number, position, size and height of structures to deliver option would only be known after modelling of the structures was undertaken as part of detailed design.	Construction offshore breakwaters tapering towards the eastern end of the study areas.*	Undertake maintenance of the existing River Sid western wall for as long as is economically viable then replace with a coastal standard wall as it becomes at risk of being exposed by erosion at East Beach. This is the same as in Options S1, S2 and S3.



Illustration of how replacing the groynes with additional oblique offshore breakwaters could look (basis of sensitivity test)

Please note, that these are provided for illustration of the option only and are subject to change and refinement as part of further detailed investigations to develop the final design should this be taken forward as the preferred option.

Illustration of how replacing the groynes with additional shore-parallel offshore breakwaters could look (basis of core appraisal)



Key points from Technical Appraisal

- Provides required standard of flood risk protection, increasing potential for future development within the Sidmouth frontage.
- No residential or commercial properties would be lost to erosion within 100 years.
- Option protects tourism and amenity interests including SW Coast Path National Trail, beach huts and Connaught Gardens from erosion.
- Delays and reduces impact of erosion of East Cliff on Alma Bridge and River Sid western wall to greater amount than Options S1, S2 and S3.
- Assumes commitment to regular beach recycling and recharge as beach levels, though commitment likely to be less than other options as beach will be more stable behind the reefs.
- Greater reduction in length of training wall and removal of groynes improves connectivity along length of shoreline.

Key points from Economic Appraisal

- **Estimated Cost:** £19,894,000
- **Benefit:Cost Ratio:** 4.3
- **Amount of Partnership Funding Contribution required:** £14,886,000

Key points from Environmental Appraisal

Receptor	Potential impacts of option
Geology Geomorphology	Implementation of the scheme is likely to inhibit natural coastal processes rather than promote, affecting UNESCO World Heritage Site and nationally designated geological sites. Impacts likely to be greater than other options.
Water quality	Increased threat of greater chemical pollution (chemical composition unknown) by increased volume of sediment. Timing may be key to reducing impacts.
Ecology	Potential increased impact on nationally and internationally designated ecological features including SAC features, BAP Habitats and nursery and spawning grounds of fish species. Breakwater construction would be at the detriment of loss of habitat to benthic species associated with soft sediment. However, construction could be of benefit to other species, which may also benefit if rock-pool type features are included in the reef construction. Long term altered changes to ecology
Fisheries	Temporary effects during works as per Options S1, S2 and S3. The reef structures themselves may provide increased fishing ground (reef) for pelagic species, however breakwater construction may impact benthic species (loss of sediment habitat) changing fishing potential
Navigation	Temporary effects during works as per Options S1, S2 and S3. Dangers to safe navigation of structures lying just below the water surface, although these will be charted. Wave induced currents may develop
Landscape	Potentially greater negative impact on landscape features compared to other options. Impact depends upon scale, height and number of reefs.
Archaeology and Cultural Heritage	Potential long term effect on the setting of cultural heritage asset.
Air quality	Any effects are considered negligible.
Noise	Increased noise and vibration impacts during construction works.
Amenity value	Potential temporary, negative effect on amenity value during construction periods. Positive impact of ensuring beach is provided for amenity benefit through ongoing regular beach recharge and recycling. Potential long term effect on swimmer safety from wave induced currents.